

BY THE SAME AUTHOR

Northward: On the New Frontier
Canada's Century
Nation of the North
Sudbury Basin

METALS AND MEN

THE STORY OF CANADIAN MINING

by

D. M. LEBOURDAIS

McCLELLAND & STEWART LIMITED

1957

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by

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PRINTED AND BOUND IN CANADA

T. H. Best Printing Co., Limited, Toronto

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: Foreword :
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TO WRITE ON SUCH A DYNAMIC SUBJECT AS CANADIAN MINING HAS not been easy. Fresh mining regions are constantly being opened up, and new mines have been coming into production so fast that one section of a chapter could easily be out of date before the next one was complete. My deadline, originally set for the end of 1955, has from time to time moved along, the temptation being always to hold up the work until one further adjustment could be made, one more trip taken to see some new thing—in Algoma, perhaps, or Ungava. But because the earlier writing was done with a 1955 deadline in view, 1956 and then the first part of 1957 have been treated as a sort of continuous present; selections were made from new material as it became available and were incorporated at many points throughout the book, although such additions had to be relatively brief and, in some cases, tentative.

Canadian mining has advanced across the continent against the sun in a series of booms. The West was the scene of the first important activities, and this book therefore begins with the Cariboo gold rush in the middle of the last century. The geographical scheme of presentation is generally from West to East, and the book does on the whole move forward in time through the hundred years with which it deals, but I have tried to arrange matters in such a way that the influence of events upon each other can be clearly shown, and to do this it was often necessary to complete the story of one locality and then go back to deal with developments in other regions over a corresponding period. Furthermore, there was an advantage in writing about certain products of mining as a class rather than in the order of

time or of place, and accordingly I have devoted a chapter apiece to iron ore, to asbestos, and to uranium and other rare metals. A glance at the Index will, I trust, suffice to guide the reader if my admittedly rather complex ordering of events should at any point fail to do so.

A word of explanation should be given regarding the exclusion of aluminum and the inclusion of asbestos, in a book whose title contains the word "Metals." Asbestos is included because, although it is not a metal, it is a peculiarly and typically Canadian mining product and is economically of great importance. On the other hand the aluminum industry which is now so prominent a feature of economic development in British Columbia and the Saguenay has had to be omitted because this book deals with metallurgy only in so far as the treatment of Canadian raw material is concerned.

I have chosen to write principally about the discovery and development of mines because that aspect of mining is most typical of Canada as a pioneer country. No other form of economic activity could have contributed so much to the opening up of a country with a large proportion of relatively inaccessible and agriculturally worthless territory. It is usual to speak of mining as an industry, but to a great extent each mine is actually a world in itself. While the problems of each are similar to those of some others, they are at the same time intensely individual. About the only thing common to all mines is that they are subject to a price structure, covering the sale of their products, over which they can have no control.

The book tells of the prospectors who have searched for mines, of the long waits that have faced mine-finders while money was being raised to bring their prospects to production, and of the further delays while metallurgists worked to evolve methods whereby reluctant ores were induced to give up their riches. The repetition of familiar situations in mine after mine may sometimes seem monotonous, but I felt that these individual records and histories had a value that mere generalizations have not. They show, as no general treatment can, that mines were not made in a day, and they show also how far the skill and experience of

Canadian mining men and geologists has now gone to eliminate the uncertainty of mining.

An interesting book could be written about the people who work in mines, but to write of them here would have extended a book that is already beyond its projected length. From the smallest mine to the largest the processes are the same, but a great difference exists between the lives of people who depend upon mines for a living in such places as Pickle Crow, Discovery Yellowknife or Galena Hill, for example, and those who, while they may work in mines, live in communities such as Trail and Sudbury which differ little from most other industrial cities or towns.

Furthermore, despite the wide extent of mining, those who make it their sole occupation constitute a small percentage of workers in the mines at any one time. Most mines experience a high labour turnover; men on the job today may be prospecting tomorrow, or returning to their homesteads for seeding or harvesting, or off to work in the woods or on some construction project. Those who most closely associate themselves with mining are mainly the engineers, the geologists and metallurgists, and the various types of technicians whose work is now essential. Having seen them on the job in out-of-the-way places, in laboratories, in mines big and small across the face of Canada, I can say that, while most unassuming, no group of people I have ever come in contact with is performing its tasks with greater competence and devotion.

It goes without saying that the writing of such a book as this could not have been done without the co-operation of the men who direct and operate the mines. In the past four years I have visited almost every mining region and the greater number of the principal mines in Canada and have been hospitably received everywhere. For all of this I wish to express my grateful appreciation.

D. M. LeBOURDAIS

Summer, 1957.

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I

The Cariboo

THE CANADA WE KNOW TODAY COULD NEVER HAVE EXISTED HAD IT not been for the discovery of gold in the Cariboo a hundred years ago. When the rush began, the region then known as New Caledonia was administered by the Hudson's Bay Company as part of its fur preserve. Within ten years it had passed through its colonial period and had become the Province of British Columbia in the newly-formed Dominion of Canada. As part of the contract, Sir John Macdonald, the Prime Minister of Canada, had pledged his government to build a transcontinental railway. He was moved by more than the lure of gold; ever present in his mind was the fear that without intervention by Canada the Northwest and Pacific territories must inevitably go the way of Oregon, which had already slipped from the fur-traders' slackening grasp. The Cariboo gold-seekers were mostly disappointed California miners who had crossed the continent in 1849 and the years immediately following, and whose compatriots had raised their flag over the one-time Mexican province of California. Failing the extension of Canadian hegemony, they might easily have done likewise in British Columbia.

Since Canada's mining history goes back to the California gold rush, that stirring event may well mark the beginning of our story. In January 1848, James Marshall, a carpenter who was helping to build a sawmill at Coloma in California, found flakes of gold in the tail-race of the dam which was to be used for power. This discovery started the famous rush and set the stage for the public participation in mining which is now so characteristic of the industry.

Although Sutter's mill has become an historic spot, neither Marshall, the discoverer, nor Sutter, on whose land the discovery

was made, derived any benefit from the millions that were shortly to be sifted from the sands of nearby streams. John A. Sutter was an enterprising Swiss who had a ranch, a tannery, and a trading-post at New Helvetia, as he called the place, at the junction of the Sacramento and American rivers where the City of Sacramento now stands. The American flows southwesterly in three principal branches from the western flank of the Sierra Nevada. Coloma was on the south fork, some forty miles upstream from New Helvetia.

Despite Sutter's efforts to hold back the news, word of the discovery reached San Francisco, at first causing little excitement because, although none had yet been found, the belief was general that gold might exist almost anywhere in California. But gradually, as word spread throughout the countryside that men with simple rockers were getting two or three ounces of gold a day, others joined the diggers. Soon a stream of gold began to reach San Francisco, and this caused a general exodus of footloose men. By the time word reached the East, people were willing to believe that the rays of the setting sun were made of gold.

These reports from California had an extraordinary power to stir people. They gave the signal to the adventurous, of course; but others living hitherto humdrum lives were also stirred. They were induced to drop what they were doing, to give up their jobs, even to desert their families, and head for California. Hundreds went by ship, either round the Horn or by Panama. Thousands crossed the continent in prairie schooners, and even on foot. Many never reached the Promised Land: some found the going too hard and lingered in frontier communities along the way; others died in fights with Indians, from drowning in attempts to ford rivers at the flood, from exposure, from starvation. Nevertheless, scores of thousands did get through.

The year 1849 is associated in most people's minds with the California gold rush, and undoubtedly the fever reached its climax in that year; but even earlier most of the ground on the likely-looking creeks was being worked. By 1850, about ten thousand men swarmed the diggings, the greater number doomed to eventual disappointment.

The mines were of the type known as "placer," in which the metal is found loose in gravel or on bedrock, in the form of fine or coarse dust or in nuggets that are sometimes as large as beans and even larger. Since gold is much heavier than sand or gravel, it can be separated from the latter simply by washing in a sheet-iron pan, with a "rocker," or by the use of easily constructed sluice-boxes. In 1849, the goldfields produced \$10,000,000; the following year the golden harvest amounted to more than \$40,000,000.

Placer diggings—so far as the most productive ground is concerned—are notoriously short-lived; and in that respect California was typical. Naturally, the first to arrive got the most promising claims, and in a short while the creek beds for miles in all directions were solidly staked. Newcomers eagerly panned every bar of sand or gravel in the hope of striking a paystreak, but the gold-bearing area was limited. Those with money were able to buy shares in claims already staked; but disappointment was the lot of most.

Others, quickly realizing the situation, began that search for the "mother lode" which always accompanies a placer boom. It is generally believed that the gold has been liberated by glacial action from quartz or other gold-bearing ores, and that some of the original ore may still be in place. In this case, whether the relationship could be traced or not, rich gold ore was discovered in the famous Comstock Lode, which in the end yielded much more wealth than the placer diggings. Here, too, the available ground was far less than enough to go round, and again there was disappointment. The Comstock Lode, however, produced a number of great fortunes, helped to finance the first transcontinental railway, and provided the endowment for one of California's leading universities. In 1849, Edward Hargraves arrived from Australia and spent a year in California. He returned to discover rich goldfields in New South Wales and Victoria; and new names, such as Ballarat and Bendigo, were soon heard around the world.

The unprecedented new wealth that flowed from the goldfields of California and Australia had a profound effect upon the world's economy. In the decade 1848-58 their combined yield

was \$1,200,000,000, almost half as much as the previously estimated gold supply for the whole world. Economists hold that California gold was of great assistance to the Union side in the Civil War. The discovery of gold came at the beginning of the railway-building era, when immense sums were needed; and while the new money caused some fluctuation in existing values and prices, greater dislocation in other directions was prevented. Nevertheless, most of the orthodox economists were fearful of the consequences.* The situation was similar to that which might have developed in the medical sphere if, at a time when blood-letting was general, some audacious surgeon should have proposed to subject his patients to blood transfusions.

As for the unsuccessful gold-seekers, most of them found other consolations. The lush valleys of California and Oregon lay open to settlement. Railways were being built, new towns were springing up, and the foundations of a great city were being laid on the shores of San Francisco Bay. Even so, not all were able to find land or a job that suited them, and these made up a considerable floating population which tended to gather in San Francisco.

This was the situation when, in February 1858, the Hudson's Bay Company's steamer *Otter* sailed through the Golden Gate into San Francisco Bay carrying eight hundred ounces of gold, and word leaked out that placer gold had been discovered on gravel bars along the lower Fraser River in British Columbia. The rush was on again. The footloose, and some not so footloose, headed for the new diggings. Once more the adventurous from all over the world were attracted by the lure of gold. Every sort of craft that could float, and some that could not, were pressed into service, loaded to the gunwales with eager, excited gold-seekers headed for the new El Dorado.

The territory now known as British Columbia was at that time held under lease by the Hudson's Bay Company, although not part of its original grant. In 1849 the British government had ceded the territory of Vancouver Island to the Company, creating an anomalous sort of colony. The Company's Chief Factor, James Douglas, became the governor of the colony, with wide but largely undefined powers. The mainland was administered by

*See T. A. Rickard's *Man and Metals*, 1932.

the Company for a short while longer as part of its domain, with trading-posts, generally referred to as forts, at strategic points. Extremely jealous of its exclusive right to trade with the Indians, it sternly discouraged any attempt at settlement within its realm. The fates could not therefore have dealt the Company a harder blow than that gold should have been discovered on the Fraser River, for inevitably its days of placid rule were at an end.

The Fraser is one of the great rivers of Canada. Like the Kootenay and the Columbia it rises in the Rocky Mountain Trench, that remarkable depression flanking the western slope of the Rocky Mountains from south of the Boundary almost to the Liard. Also like the Kootenay and Columbia, the Fraser flows first northwestward and then, in spite of the northwesterly trend of the country, almost due south until it cuts through the Cascade range (Hell's Gate), turning abruptly to the westward for the final hundred miles of its course. For the greater part of its length it is deep, swift and turbid, in high water carrying a continuous procession of driftwood and in every season great quantities of silt. From Hell's Gate to Pacific tidewater, the river, in places a mile wide, bears little resemblance (except in colour) to the treacherous stream that has cut through all obstructions in its headlong rush across the face of British Columbia.

Victoria, headquarters of the Hudson's Bay Company on Vancouver Island, and capital of the new colony, was the gathering point of the gold-seekers from San Francisco and the nearer ports in Puget Sound. Since the Company's boats were not suited to river navigation, Douglas allowed American steamers to continue to Yale, head of navigation on the Fraser, but would not permit them to transport goods other than those belonging to the Company. He also extracted a tribute of two dollars a head for each passenger carried.

Despite the high water that covered many of the bars, and limited the size of others, the first arrivals, after outfitting at the Company's posts, began working their way upstream, testing every bar in the main stream and its tributaries. On most of the bars some gold was found, but no fortunes were made. Disappointed, many returned to Victoria and San Francisco, but

others, possessors of that spark which marks the true prospector, pressed onward, through canyons and along interminable stretches of cutbank, like the salmon in the same stream seeking spawning-grounds in the far reaches of the river. The prospectors' lure was the mother lode from which they believed the great river had ground the fine gold on the bars, and they struggled on with visions of rocky ledges seamed with veins of gold, or studded with nuggets like currants in a bun.

By the end of 1858, the forerunners had reached the mouth of the Chilcotin River, about 350 river-miles inland. There the orderly advance from bar to bar gave place to a foray into territory far from the main stream that would lead, if not to the mother lode, at least to diggings rich beyond the wildest dreams. Among those who had reached the Chilcotin was a young man of twenty-five, Peter C. Dunlevy, who had come from Pittsburgh by way of California. In the spring of 1859, he and his four partners were working a bar with rockers when an Indian runner for the Hudson's Bay Company told them of a "clear-water" stream off to the northeast in which golden nuggets the size of a bean could be seen. Dunlevy and his partners arranged for an Indian guide to take them to the creek, which they reached early in June. As the Indians had promised, on a bench along what became known as the Horsefly River, they found heavy gold. This was the first discovery of gold within the region known as the Cariboo.*

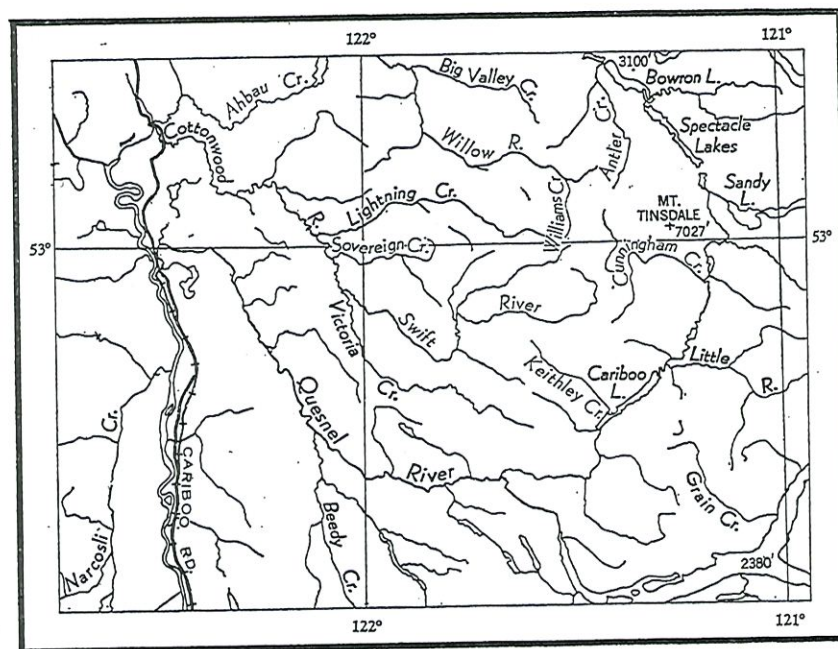
Prospectors who had tracked Dunlevy's party, and others who had poled the Quesnel River upward from the Fraser, found varying amounts of gold on the bars along the Quesnel's two forks and their tributaries. Among those who came up the Quesnel River was Doc Keithley, after whom one of the gold-producing streams has been named. Always the number of prospectors outran the extent of the paystreak; those whose gold-pans failed to reflect the golden glitter crossed the watershed at the head of Keithley Creek to test the gravels of northward-flowing streams, and thus the wealth of Antler, Grouse and other creeks was discovered. Continuing a few miles to the west, "Dutch" Bill Dietz, early in 1861, found heavy gold at the headwaters of

*See Alex P. McInnes's *Chronicles of the Cariboo*, 1938.

a creek, the famous Williams (after Dietz's first name), which was to prove the richest in all Cariboo. Others, in spots, did almost as well, but Williams Creek was to take its place as one of the greatest placer streams ever found.

Williams Creek and Antler Creek may be seen in the upper right portion of the inset map, above the fifty-third parallel, with Keithley Creek and Cariboo Lake to the south of them across the watershed.

CARIBOO GOLDFIELDS



Virtually all the streams within a radius of twenty miles from Williams Creek were gold-bearing. Lightning, to the north, one of the richest, was discovered in July 1861 by Ned Campbell, and Lowhee, to the west, by Richard Willoughby in 1862. The region reached its peak in 1863, when about four thousand men delved on Williams Creek alone, the workable length of which

was about seven miles. (Beyond this the overburden was too heavy for profitable operations.)

In the upper reaches of Williams Creek, where the amount of gravel over the bedrock was slight, the coarse gold could be secured by diverting a portion of the stream through a few lengths of sluice-boxes, the gravel being shovelled into the running water. Sluices were sometimes paved with wood blocks to prevent the sand and gravel from wearing through the bottom, and also to provide riffles against which the gold might lodge. Not far below its source, the stream passed through a short canyon (which the paystreak by-passed), and beyond this its nature changed, the depth to bedrock becoming much greater. The procedure then was to sink a shaft in the rock (rim-rock) to the gutter level of the ancient creek-bed, running a crosscut out to the channel. The shaft, of course, would be at the downstream boundary of the claim, and when the crosscut had reached the gutter, a drive at right angles, upstream, would be run. In most cases the gravel on and immediately above the bedrock would contain variable quantities of gold, and heavier pieces would be found embedded in the soft bedrock itself.

The gravel was then shovelled into buckets, taken to the foot of the shaft, and hoisted by windlass to the surface. There it was dumped into a sluice-box and the gold separated from the sand and gravel in the usual manner. Since the greater part of the crosscut and all of the upstream drive would be in gravel, it was necessary to timber the workings very heavily. Fortunately, timber was close at hand; the country round about was thickly covered with pine, spruce and fir. Because water goes through gravel as through a sieve, pumping was constantly necessary. Pumps, usually made of wood and leather, were geared to water-wheels and the stream itself harnessed to the task of freeing the diggings of water.

When the ground became deeper and the flow of water consequently greater, a number of mining companies co-operated in a drainage tunnel running beneath their claims, and the pumping was done from one location. After the shallower ground was exhausted, the problem of water disposal became of paramount importance, eventually requiring the use of steam pumping-

plants. The final anomaly occurred (many years later) when the sole activity of some companies was the pumping of water, with sporadic but unsuccessful attempts—working from the security of the rim-rock—to reach the gold strung along the bottom of the channel.

Billy Barker, who was to give his name to Williams Creek's principal settlement, was the first to sink a shaft to reach gold on bedrock. His claim produced a fortune which quickly passed through his hands, and although he lived to be an old man he was never again in the money. He died in a home for destitute men maintained by the British Columbia government. On the other hand, Bill Dietz, who presumably had his pick of the claims, drew one of the few blanks on the creek, and departed from the Cariboo as poor as when he arrived. Although the experience of Barker and Dietz was not exceptional, this was not because gold could not be picked up by the bucketful along the productive part of Williams Creek. Writing presumably from official records, Dr. G. M. Dawson, one-time director of the Geological Survey of Canada, had this to say:

Williams Creek has yielded more gold than any other stream in British Columbia. As examples of its yield in early years, Steele's claim gave a maximum yield of 409 oz., or \$6,544* a day. More than \$100,000 in all was taken from this claim of 80 ft. by 25 ft. In 1862, Cunningham's claim produced gold to the value of nearly \$2,000 a day for the season, while on several days as much as 52 lbs. weight of gold was taken out. The Adams claim yielded to each of its three partners \$40,000 clear. These claims were above the canyon in shallow ground. The deep ground below the canyon was first bottomed toward the end of 1861 by the Barker Company (whence the name of the town of Barkerville). The Diller Company was the next successful in this, and it is credibly stated that here, on one occasion, 200 lbs. of gold worth \$38,400, was obtained in one day. In 1863, three claims below the canyon yielded \$300,000 and 20 claims were steadily producing from 70 to 400 ozs. a day†

Meanwhile, word of the fabulous fortunes to be made had

*Value of gold in Cariboo creeks varied from \$16.25 to \$19.85 an ounce; Williams Creek gold was valued at 17.05.

†In *Canada and Its Provinces*, Vol. 22, p. 561.

spread abroad, kindling a spirit of adventure in the breasts of men who soon were crossing the oceans and continents to get to the Cariboo. Among these were several groups of Welsh and Cornish miners, many of whom were to find in Cariboo the land of their hearts' desire and live there the rest of their days. A writer has described the effect of the news from British Columbia on such a staid journal as *The Times*:

As the golden harvest began to reach the coast, word of these diggings that exceeded in richness anything that had ever been discovered, spread throughout the world. One of the chief disseminators was Donald Fraser, correspondent of the London Times at Victoria, whose dispatches were prominently displayed by his newspaper and later printed in a pamphlet which received wide circulation, in the North American colonies as well as in Great Britain. Their correspondent's enthusiasm was transmitted to the leader writers of that august journal, who declared: "In the letters of our correspondent this dull and heavy region stands out as a land of promise, an El Dorado, a Canaan, the glowing west, over which the golden sun ever travelling westward, sinks at last into the sea . . . According to our correspondent, the gold digging of British Columbia is a lottery in which there are no blanks; and the prizes are indeed splendid."*

Three principal communities were established along the creek: Richfield, above the canyon, Barkerville, the chief centre, immediately below, and Camerontown, about a mile below that. Williams Creek, most of the year a slight, meandering stream, shifting from side to side of a wide flood-plain, became a raging torrent when the freshet was on. Since the settlements straggled along the west bank, an attempt had been made to confine the flow to the opposite side by means of a log bulkhead. But tailings from claims above soon filled the space behind the bulkhead, allowing the stream to follow its own inclinations—down the communities' one and only street—until the bulkhead could be raised and the turbulent waters were once more restrained.

In order to avoid some of the consequences of this periodic inundation, the houses had been hoisted and set on posts; but because the owners varied in initiative and optimism, no two buildings—particularly if adjacent—were ever raised to the same

*Victor Ross, *The History of the Canadian Bank of Commerce*, Vol. I, p. 253.

level, and consequently the rickety board sidewalks presented a roller-coaster effect. Furthermore, although the street level also rose as a result of frequent deposits of tailings, it usually failed to keep pace with the sidewalk, and thus each principal establishment found it necessary to provide a set of steps (often comprising eight or nine) by which the street might be reached.

British Columbia in the sixties was one of the most inaccessible portions of North America. Victoria, its one seaport, was on an island; its few settlements consisted of remote posts established by the Hudson's Bay Company for its trade with the natives. Outside of the fur trade, now rapidly losing its primacy, placer mining and the activities connected with it were the principal occupations of its people. The Cariboo diggings were five hundred miles inland; from the head of navigation, at Yale, stretched four hundred miles of mountain wilderness, traversed at first by men on foot carrying packs, and, after some sort of trail had been cut through, by trains of horses, mules and, for a short while, a few camels.

To serve miners working along the southern part of the Fraser, and also to provide the beginnings of a trail to the Cariboo, Governor Douglas initiated a unique co-operative trail-building scheme. A force of five hundred miners was recruited, comprising twenty companies of twenty-five men, each under the command of a captain, who received free transportation (where walking was not the means of locomotion), food and lodging, but no wages. The trail, about a hundred miles in length, did not attempt to ascend the canyons of the Fraser, but followed an easier route by way of Harrison, Lillooet, Anderson and Seaton lakes with their connecting streams, reaching the river at Lillooet.

A trail would do for miners washing the sands on bars along the lower reaches of the river, but as tales of fabulous strikes continued to come from Cariboo, followed soon by consignments of gold, Douglas arrived at a momentous decision. This fur-trader upon whom chance had thrust rare responsibility was a man of heroic mould, whose stature increases as his part in the formation of the country we know as Canada comes to be understood more fully. With an empty treasury, and lacking specific authority, he proposed to build a highway from Yale to Cariboo through a

country that would have daunted any but the most audacious. Fortunately, in 1858, the Colonial Office had sent a detachment of Royal Engineers to survey roads and trails and to assist with other public works. Little did the Colonial Secretary, Sir Edward Bulwer Lytton, suspect how useful they would be.

In this bulldozer age, it is not easy to imagine the task of men who would set out to cut a road through such a country with little more than their bare hands. At the outset, the builders had to conquer the gorges of the Fraser Canyon, where the river bursts through the ramparts of the Cascades, thundering past the precipitous walls of rock that compress it to but a fraction of its normal width. To find a footing for a road along the face of such cliffs was almost a superhuman task, yet the Royal Engineers marked out a track that even a goat might have hesitated to follow, and along it an eighteen-foot passage was constructed. In places, timber cribbing or masonry had to be built up laboriously from some lower ledge or vantage-place to carry the road past stretches where no other support was possible, and deep cuts made through outlying buttresses of rock.

The road followed the Fraser to Lytton, and then the Thompson to Ashcroft, there beginning the climb to the heavily timbered interior plateau to which it kept, more or less, until the Fraser was again reached at Soda Creek. From Soda Creek to the mouth of the Quesnel (where the steamer *Enterprise* helped out in summer) the road followed the river and then turned eastward to Barkerville, climbing in the sixty miles from an elevation of about 1,700 feet to over 4,000 feet.

Almost four hundred miles in length, the Cariboo Road, begun in 1862, was completed in three years—a feat, considering the time and circumstances, rarely if ever surpassed. The British colonies in the eastern part of the continent were still two years away from Confederation, and their efforts might ultimately have failed had it not been for the gold of Cariboo. The cost was about \$1,250,000, which could have been an intolerable load of debt for a fledgling colony, but Douglas, to whom the monetary unit had previously consisted of a beaver pelt, seems to have had a full appreciation of the role of gold. By 1862, millions of dollars were coming out of Cariboo and of this there seemed

no end. The road was essential to the gold-miners, and Douglas was determined that they should pay for it, which they were quite satisfied to do. Consequently he instituted a system of tolls and, unlike many modern highways which are worn out before the underlying bond issues mature, the Cariboo Road was paid for almost before it was finished.

Pending completion of the sections along the Fraser and Thompson valleys, where a partially constructed road could not be used, a 47-mile road was built from Lillooet to Clinton, thirty-five miles north of Ashcroft, enabling pack-trains coming over the Harrison-Lillooet trail to continue northward. The steamer between Soda Creek and Quesnel allowed that stretch of road also to await the completion of more pressing portions.

As soon, therefore, as a track was provided to allow a mule to put one foot before another, an interminable procession of pack-trains began, each consisting of anything from a dozen to fifty or more animals bearing precious loads of supplies to meet the insistent demand along the creeks of Cariboo. When the road became passable for wagons, some of the pack-trains gave place to canvas-covered wagons, hauled by six to sixteen head of horses or mules, or twelve to sixteen yoke of oxen. Until much later, these animals "lived off the country"; their days were spent staggering under packs or straining in harness, and their nights foraging in the bush. The packers and teamsters were a motley crew—Indians, Chinese, Mexicans, and men from every section of the U.S.A. as well as from most of the countries of Europe.

As compared with men on foot, carrying packs, this was fast service, but there was still need for some quicker way to get in the mail and special supplies. The man for the job was at hand in the person of F. J. Barnard. In 1862, the condition of the trail made possible a "pony express"—not such as Hollywood might have portrayed it, however, with riders dashing up to road-houses and exchanging jaded mounts for fresh ones. Barnard's outfit consisted of himself, tramping the trail and leading a cayuse to whose back was strapped a load of mail and express.

In 1863, Barnard placed a number of two-horse wagons on the completed portions of the road, carrying passengers in addi-

tion to mail and express, with saddle and pack horses for the unfinished sections. By the following year, his British Columbia Express Company, or B.X., as it was popularly called, had established a line of four- or six-horse stage coaches, running on regular schedules with frequent changes of horses from Yale to Soda Creek, and later through to Barkerville. Although long stretches of the road were either hub-deep in mud or enveloped in clouds of dust that rarely settled, this was travel de luxe. In its first year of operation, the B.X. carried, besides mail and express, fifteen hundred passengers and over \$4,500,000 in gold.* Until superseded by motor vehicles in the first decade of the twentieth century, the B.C. Express Co. continued to provide regular and reliable stage service over the Cariboo Road.

Meanwhile, the Cariboo diggings had become one of the liveliest spots north of the American border. (The fratricidal war raging south of that line caused scarcely a flutter of interest among the eager gold-seekers.) Long before the road was finished thousands of men had tramped its length, most with packs on their backs. Barkerville, in 1864, was the largest place west of Toronto and north of San Francisco. A few women camp-followers had braved the hardships of the trail soon after the rush began, and their numbers increased as travel became easier, but it was almost entirely a male community. A group of German girls were brought in to supply partners for miners in the dance-halls, and some remained to become mothers of the next generation of Caribooites.

One of the few to bring a wife was John A. "Cariboo" Cameron, probably the best known and most successful miner on Williams Creek, after whom Camerontown was named. His young and charming wife died shortly after her arrival and Cameron had her body hauled out to the coast on a hand-sled for shipment to her former home in Ontario. After amassing a fortune Cameron left for Ontario, where in a few years, through unwise investment, he lost his money. Returning to the Cariboo in a futile effort to make another fortune, he died in 1888, and was buried in the cemetery overlooking the site of his previous success.

Almost every second shack along the straggling street housed

*See Winnifred M. Fitcher's *The Great North Road*, 1938.

a saloon or gambling joint, all wide open both day and night, seven days a week. Money, mostly gold dust, changed hands rapidly—thousands of dollars on the turn of a card, or on the ownership of a claim or interest. Men would work for a few days or weeks on one of the creeks near Barkerville, become dissatisfied and go off to try their luck in the Lightning Creek area, fifteen or twenty miles away, only to move on again a few weeks later. As in all placer camps, the number of possible claims in areas believed to be gold-bearing was always much less than the number of men looking for a chance to mine. "Twelve-foot" Davis, who became a famous western character, arrived late and looked harder than most. Discovering that a claim on Williams Creek was too long by twelve feet, he went out at night and by the light of a lantern staked the fraction for himself. He sold his interest for \$4,000 and it yielded \$10,000 for the purchaser.

Considering the absence of local government, the diggings were remarkably orderly. In the same year as the Royal Engineers arrived, the Colonial Office sent out Matthew (later Sir Matthew) Baillie Begbie, no legal luminary at home, but destined to become a legendary character in the colony. Although, presumably, English law prevailed in the new land, Begbie was continually confronted by situations beyond his experience; but since he preferred to create precedents rather than follow them, this bothered him very little. He stood in no danger of reversal in a higher court. Punishment, in his view, was the best deterrent of crime, and he was not very often troubled with doubt as to the guilt of the accused. To the tough characters inured to the arbitrary acts of Judge Lynch on the western frontier, this implacable, bewigged embodiment of terror was more terrifying than any posse with ready rope. And whether owing to Begbie's influence or not, the Cariboo diggings were strangely free from those acts of violence common to mining camps elsewhere.

In accordance with California custom, the first prospectors on the Fraser had set up miners' councils, and this practice was followed in the Cariboo. In his first proclamation dealing with mineral rights, issued in 1859, Douglas gave legal sanction to these councils, referring to them as "mining boards." They were given power from time to time to make, alter or repeal by-laws

for the regulation and size of claims and the manner in which they might be worked, held and forfeited. These boards were to consist of not less than six nor more than twelve members, formed upon petition signed by not less than a hundred and one registered "free miners" in the district. Douglas had originally issued miners' licences at a fee of ten shillings a month, and this was later increased to twenty-one shillings, but owing to difficulty of collection the fee had finally been set at a pound a year. The term "free miner," since then generally in use, appeared first in the proclamation of 1859 and is said to have had its origin in medieval England when a serf who discovered lead ore was granted his freedom and was known thereafter as a free miner. The regulations defined the sizes of claims (when not otherwise established by by-law) as, for bar diggings, a strip of land twenty-five feet wide at high watermark, extending into the water indefinitely; for dry diggings, a space twenty-five feet wide by thirty feet; for ravine diggings, a space of twenty-five feet along the bank of the ravine, extending to the top of each bank.

The number of men working on the creeks of the Cariboo declined as rapidly as it had grown; disappointed miners backtracked the weary miles, not much better off than when, filled with hope and expectation, they had trudged up the trail. Others, still hopeful, pushed further into the wilderness, eventually finding new goldfields in the Omineca and Cassiar districts where some fairly rich ground was discovered. (On McDame Creek, a tributary of the Dease, which in turn flows into the Liard, a slug of gold worth \$1,300 was found.)* These new fields followed the familiar pattern of flush production and quick decline, although, as in Cariboo, gold is still being produced both in Omineca and in the Cassiar.

In placer mining, after the richest sections have been drifted, a great deal of untouched ground remains—above the level of the drifts, on the sides, or left inadvertently by the miners. Since such gold as there may be in this ground cannot be recovered by drifting, hydraulic operations become necessary. In this form of mining the object is to wash everything in the channel, from surface to bedrock, through sluice-boxes. The

*F. W. Howay, *British Columbia: The Making of a Province*, 1928; p. 173.

hydraulic miner must therefore acquire the mining rights covering the full length of a stream, or at least the greater part of it. He must also control sufficient water rights for his purpose. In fact, the operation depends mainly upon the availability of a sufficient water supply, at the proper elevation above the ground to be hydraulicked. The snowfall on the western slope of the Cariboo Mountains is generally heavy, thus providing, during the run-off period at any rate, an ample supply of water. In order to get an effective "head," streams are tapped as high up as possible, and the water is brought by ditch to the nearest point above where it is to be used. From a penstock, it descends through a large steel pipe to pit-level. The lead-in pipe ends in a monitor, or tapering nozzle, attached by a universal joint which allows the monitor to move as flexibly as a hose in the hands of a fireman. A variety of outlets, graduated in size, can be fitted to the monitor, depending upon the amount of water available and the force and volume required. A stream under a 320-foot head, shot through a six- or eight-inch outlet, such as at John Hopp's claim on Stout's Gulch in the early years of the present century, could demolish a thirty-foot bank of solid gravel in a very short time.

After the gravel has thus been torn down and flushed to the head of the sluice-boxes, it is swept along to the dump by the swift current continually flowing through the flume. The gold will fall to the bottom and catch on the riffles, very little going below the first few boxes. If the flume has not sufficient grade, gravel and sand will tend to clog, and there must be sufficient fall at the lower end to prevent the tailings from piling up. As the operation advances up-channel, additional lengths of sluice-boxes are added at the head of the flume.

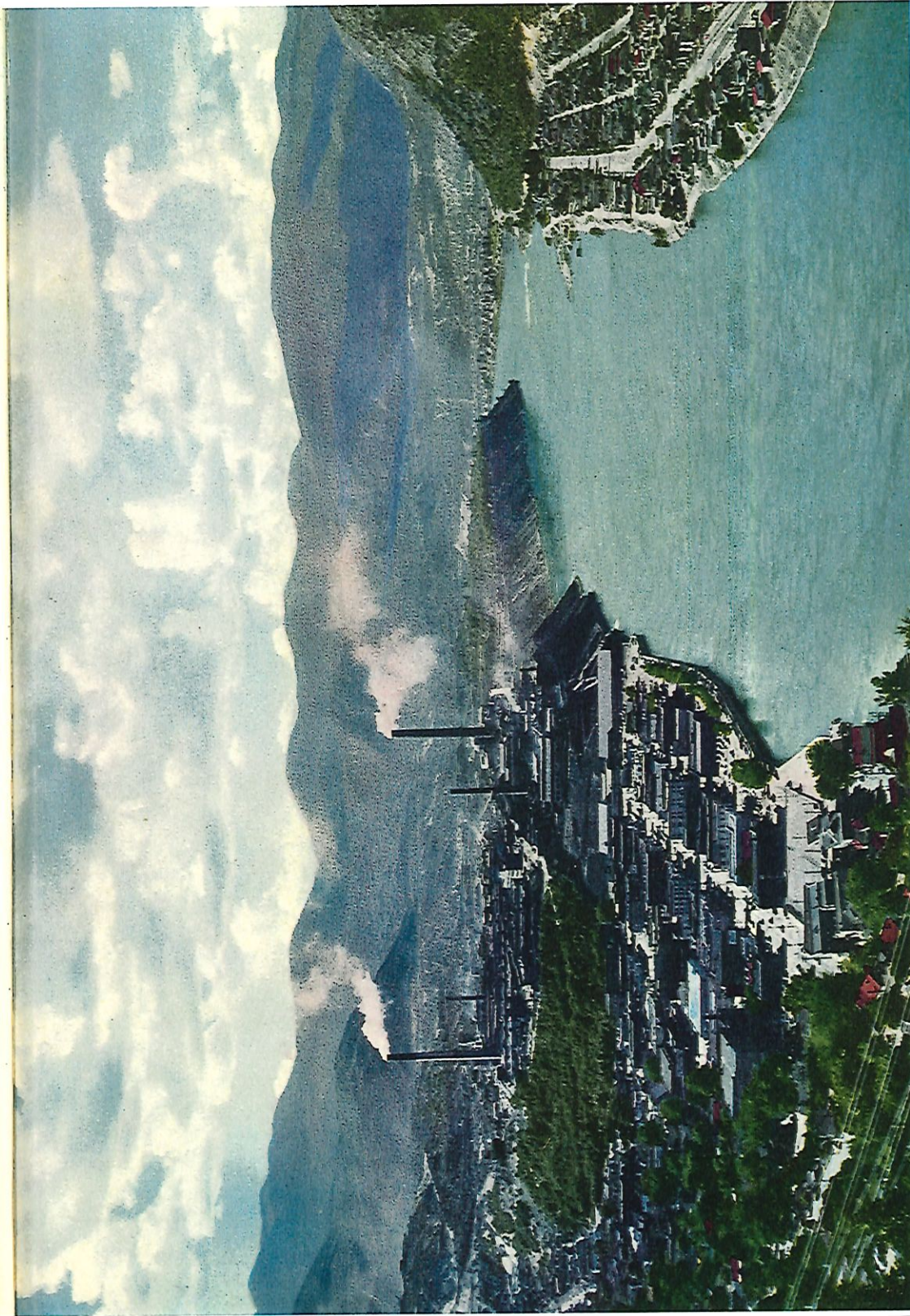
Except on Slough Creek, north of Barkerville, where an English company spent years futilely pumping water, and at Wingdam, on lower Lightning, where an American company did likewise, hydraulicking was generally effective in the Cariboo and prevailed there from about 1880 until quite recently, when drag-line dredges and other types of power equipment have come into use. In this way most of the former diggings have been re-worked

and the Cariboo has been kept well up on the list of gold-producing districts.

Since there was no check on miners carrying gold out of the country in the early years, actual production figures for that period are unavailable. Therefore when, in 1874, the first statistics were being compiled, estimates based on all data at hand were made and taken as the official record. According to these figures, 1863 was the banner year, when \$3,913,563 came from the sluice-boxes. In 1864, the total was \$3,735,850, and in 1865, \$3,491,205. For the years from 1859 to 1869, inclusive, the total production in British Columbia is shown as \$29,598,178, practically all of which came from Cariboo.

In comparison with the production of California, Australia or the Yukon, the above record is not very impressive, but its real significance is out of all proportion to the amount of money involved. Had gold not been discovered in British Columbia at that particular time, the colony would most certainly have continued as a preserve of the Hudson's Bay Company, ultimately to meet a fate similar to that which had befallen Oregon a short while before. Without the incentive of gold, the Cariboo Road would never have been built, and the country beyond the first line of mountains would indefinitely have remained a wilderness. It is inconceivable that without the thriving settlements (and large cattle ranches) which the Cariboo Road made possible, as well as the prospect of further goldfields, the newly united eastern colonies would ever have had the temerity to undertake the building of a railway across three thousand miles of muskeg, prairie and mountain; without such a railway, British Columbia would not have become a province of Canada. Thus it can be said that from the outset mining has been a vital factor in Canada's career as a nation.

Trail, B.C., and Cominco's Smelter →
—George Hunter Photo



II

The Kootenays

THE PROVINCE OF BRITISH COLUMBIA, COMPRISING A ZONE APPROXIMATELY four hundred miles in width, consists of what might appear to be a jumbled mass of mountains, but upon examination it is found that the mountains lie generally parallel to each other, in a northwest-to-southeast direction. And while to the uninitiated one mountain may seem much like any other, these mountains, distinguished by their geological structure, fall into three more or less distinct belts, extending from the southernmost part of the province to the Yukon border, and beyond. On the east are the Rocky Mountains, composed almost entirely of sedimentary rocks. To the west of them is a belt of slightly lower and older mountains—in reality a dissected plateau—composed of rocks partly sedimentary and partly granitic, which in the southern part of the province are called Purcell, Selkirk and Monashee, and in the northern part, Cariboo, Omineca and Cassiar. Farther west, bordering the Pacific, is the loftiest belt, the Coast Mountains, consisting chiefly of granitic rocks.

Aside from coal, little mineralization of economic value has yet been found in the Rockies, but in the rocks of the two other belts nearly every known metal is found, often in commercially profitable quantities. The country generally is covered with a thick mantle of overburden, supporting, especially on the west side of the Coast Mountains, a heavy growth of timber. For this reason, and because of the difficulty of getting about in a mountainous country, prospecting is not easy; and it is perhaps significant that the principal mineral deposits so far discovered lie on or near the coast, along rivers or the larger lakes, or at an elevation between three and four thousand feet above sea level. At these elevations, outcrops are more easily found than in valleys

where great thicknesses of glacial drift prevail, or on the heavily timbered intermediate slopes.

Although the first mining in British Columbia was placer, lode-mining was not far behind. However, it was not in the Cariboo that mineral deposits were discovered but in the southern part of the province. The region was almost as hard to reach from the Pacific coast settlements as the Cariboo had been before the trails were cut. Even today it is a land apart; but before railways and highways came it seemed, and was in fact, much more a northward extension of the United States Territories than part of British Columbia. This region consists of a narrow strip along the International Boundary, nowhere a hundred miles wide, extending from the Rockies on the east to the Cascades on the west, an airline distance of about two hundred and fifty miles. It comprises what are now known as East and West Kootenay, the Boundary country, and the Similkameen, and is drained entirely by the Columbia and its tributaries—the Kootenay in the eastern part, the Kettle and Okanagan in the Boundary country, and the Similkameen in the west. Almost every known mineral is found in its rocks, even including diamonds. It has produced mines which after yielding their millions are now forgotten, and it has also produced the largest lead-zinc-silver mine in the world. It is ridged with mountains, its valleys are cut by southward-flowing rivers (part of the time flowing northward), and its slim lakes are beautiful.

Until the C.P.R. line was built through, the easiest means of access was from the south; and it was from the south that the prospectors came who were to find the metal mines. Shortly after the California gold boom, placer gold was found at a number of widely scattered points in the Territories that were later to become the states of Oregon, Washington, Idaho and Montana. Between 1855 and 1867, these placers produced an estimated total of \$140,000,000, making possible the creation of established communities, the encouragement of agriculture and the development of permanent transportation routes. In 1863, prospectors from Idaho, descending the Kootenay (on its northward lap), discovered gold on Wildhorse Creek, a tributary flowing in about fifty miles north of the Boundary. By the middle of the following

summer, when Gold Commissioner John C. Haynes arrived from Victoria to take charge, about a thousand men were sluicing on Wildhorse and nearby creeks. By 1865 there were probably two thousand men working in the district, and it is estimated that the 1865 clean-up amounted to about a million dollars. The following year, Chinese (not welcome in flush times) were re-working the leavings, and the decline had set in. This was hastened by the sudden departure of many miners stampeding to new diggings in the Big Bend country of the upper Columbia. As usual, the supply of gold in the Big Bend creeks was not sufficient to satisfy the needs of all, and men drifted away to search for other creeks, perhaps richer, which everyone believed would still be found.

Although Governor Douglas had already exceeded his financial resources by undertaking the Cariboo Road, he was unwilling to see this new area taken over entirely by Americans. He could not build another wagon road, but he did provide for the extension eastward of the Dewdney Trail which had been built in to the Similkameen country during the first gold rush by Edgar Dewdney of the Royal Engineers. Continuing down the valley of the Tulameen to its junction with the Similkameen at Princeton, the new trail went over the mountains to Grand Forks, in the Boundary country; then, passing south of the site of the future Nelson, it crossed the Kootenay at the head of the lake, from there passed around Goat Mountain to the Moyie River, and continued to Fort Steele. The trail was well built, four feet wide; but the route was an arduous one and in consequence supplies continued to come chiefly from the United States. Official gold shipments, however, went to the coast by the Dewdney Trail.

Placer mining opened up the northwestern Territories of the United States, but it was metal mining that converted them into stable communities. The discovery of copper at Butte, Montana, in 1881, in "the Richest Hill on Earth," transformed that frontier community into a prosperous city, although by some standards still tinged with frontier ways; the mines produced traffic for railways, without which permanent settlements were impossible. Later, the discovery of gold ores in the Coeur d'Alenes in Idaho

and Washington put Spokane on the map. It became the centre for men who had done well out of mining and, like most of their kind, were willing to put money back into the ground. So far as they were concerned, the Kootenay section of British Columbia was but an extension of their own country.

In 1886, a party of prospectors consisting of Nelson Demers, Melt Oakes and Frank Emmet headed north into British Columbia from Colville, a former Hudson's Bay Company trading-post in Washington Territory. After some weeks of fruitless searching, while camped on the side of a mountain overlooking the west arm of Kootenay Lake, Demers picked up a piece of "peacock" float. That night Emmet quarrelled with Oakes and left the camp, taking the cayuses with him. This left Demers and Oakes without supplies, and they returned to Colville to find the little place in great excitement. Emmet had come in a day or so before, saying that on his way back he had found a creek in British Columbia from which he had panned forty dollars in gold. Although no one had seen the gold, Emmet was able to borrow some money on the strength of his story and had left town, ostensibly to continue prospecting.

Within a few days, a party of twelve men headed by William Hall and including Oakes, but not Demers, were on their way to the Kootenay country with fourteen cayuses and plenty of provisions. Whether guided by Oakes or not, they soon reached the mountain (since known as Toad Mountain) on which Demers had found the peacock float a few weeks before. One night the horses strayed farther than usual and Hall, who with another man had gone to look for them, stumbled on the outcrop of what later became the Silver King mine, only two hundred yards from where Demers had picked up the peacock float. When the party returned to Colville, a sample of the ore was given to an assayer who for purposes of his own reported only \$20 a ton, silver. A friend of the stakers named Jake Colebaugh, suspecting the assayer, had a sample tested by another assayer, whose report showed 465 ounces of silver to the ton. When a third assayer confirmed the high finding, the grateful stakers gave Colebaugh a one-thirteenth interest in the claims.* Although the fortunes

*This account is based on an interview with Nelson Demers written by Robert T. Lowery, editor of the *Nakusp Ledge*, in his paper for July 12, 1894.

of the town of Nelson were founded upon the Silver King mine, and it produced many millions of dollars, its history was a chequered one, involving litigation, strife and loss for a large number of people.

The group generally referred to as the Hall Mines consisted of the Silver King, Kootenay, Bonanza and American Flag, all located along the lode, which was from twelve to sixteen feet wide, with six feet said to be "solid ore." Development, confined to the Silver King, was by adit, which by 1889 reached a distance of sixty feet. At the end of this adit a fifty-foot winze disclosed a mass of high-grade peacock ore, forty tons of which, shipped to the smelter at Butte, yielded 11,960 ounces of silver and twenty per cent copper. By 1892 the adit had been extended to 912 feet, and by 1898 four adits, all connected by winzes and uprisers, were in operation, the lowest one tapping the lode at a depth of six hundred feet.

Operating costs were high. From Toad Mountain to Nelson, a seven-mile trail distance, packers' charges were \$10 a ton, while freight to Butte and the cost of smelting added a further \$47. Costs were cut in 1895 when an aerial ropeway, four and a half miles long, comprising 875 buckets with a total capacity of ten tons an hour, was installed from the mines to Nelson; and further savings resulted from the construction, at the tramway terminal, of a one-stack water-jacket smelter with a daily capacity of 100 tons. Blown in the following January, and later considerably improved and enlarged, it was for a time reputed to be "the largest copper blast-furnace in existence."

High-grade ore eventually becoming scarce, the mine was operated for some years on a contract basis, but with decreasing production. The smelter was kept going on custom ores from the Slocan and copper matte from Trail, but with the Slocan's decline, the once busy smelter was closed permanently. For many years nothing has remained to mark its site but a few heaps of bricks, rotted timbers and rusted iron.

In a sense, the Silver King was not the first mine to be discovered in the Kootenay country, for the existence of silver-lead deposits on the east shore of Kootenay Lake had been known for many years to Hudson's Bay people and others. In fact, it was

widely believed that Indians had come to these deposits to get lead for bullets long before there was a prospector in the country. This could, of course, be another of the many legends associated with what came to be known as the Bluebell mine, in whose history even murder has been more than hinted. The mine was first operated in 1889, but the undertaking failed, and the abandoned smelter with its tall smokestacks, rising above the shore of the lake, served for many years as a reminder that something more than hope and optimism are needed to make a mine. In recent years, with the benefit of modern mining and metallurgical methods, the Bluebell mine has come into successful production. An outline of its history will be found in the next chapter.

In the territory with which this chapter deals, many exciting camps have had their day; but Rossland, which blossomed in the eighties and nineties, had a glamour all its own. The most fertile-minded fiction writer could not have invented anything to match it. In Rossland, as later in Dawson and Cobalt, an atmosphere of high adventure permeated the whole community. The land was new; all were young; everyone had money; the golden tide would roll on forever. In a placer camp the gold can be seen and handled as it comes from the sluices, and this generates a peculiar type of fervour; but in lode mining (especially before the days of diamond drills and geophysics) the values are hidden within the rocks and rumour gets full rein. The nearest smelters were in the United States; means of transport were crude, and costs high. But none of these disabilities dampened the ardour of men who hopefully staked claims, bought them, and dug feverishly into the earth in search of ore.

Rossland may be said to have begun when George Bohman and George Leyson staked the Lily May in 1887, but the Lily May struck no spark. On July 2, 1890, Joe Bourgeois and Joe Moris, in a single day, staked five claims (one more than the law allowed) on the lower slope of Red Mountain, northwest of where the city was to be, and named them Centre Star, War Eagle, Idaho, Virginia and Le Wise.

The nearest Mining Recorder's office was at Nelson, and there they went, but before spending money on recording fees they

had their specimens assayed. Much to their disappointment, six out of ten samples showed not a trace of gold, while the best of the others was worth only \$3.25 a ton. Disgusted, Bourgeois refused to part with the \$12.50 required to record the claims. Moris, who was broke, failed to persuade his partner, and in the end the Mining Recorder, "Colonel" E. S. Topping, offered to pay the fees in return for the extra claim. As luck would have it, he drew Le Wise, which he grandiloquently renamed the Le Roi—the claim that was to spread the fame of Rossland far and wide and launch Topping into the most exciting phase of an adventurous career.

Eugene Sayre Topping, born in New York State, had travelled much and tried his hand at many things before his arrival in the Kootenay country as a prospector. In early life he had been a sailor; his later occupations had included newspaper reporting but, despite his title, no military service; and he had written a book, *Chronicles of Yellowstone*, which had met with some success. An accident put an end to his prospecting and after a short spell as a store-keeper in Nelson he was appointed Deputy Recorder and constable. The hope of riches had led him to the Kootenay, and now, in this roundabout way, his ambition was about to be achieved. It was not with Nelson, however, nor even with Rossland, but with a community not then conceived, that his fate was to be linked most firmly.

Topping proved a useful ally for the prospectors. Placer mining, at least in the early days of a camp, can be carried on with little or no capital; but that is not the case with lode mining. Topping therefore set off almost immediately for Spokane, where he knew there was money for mines; and within a short time the Le Roi Mining and Smelting Company was organized. Associated with this company was a group of men consisting of Oliver Durant, George and W. W. Turner, W. W. Ridpath, I. N. Peyton, Alex Tarbet and W. J. Harris, who were to play an important part in the development of Rossland mines. Oliver Durant bought the Centre Star; Patsy Clark, another mining man, later bought the War Eagle.

Ross Thompson, who had worked for a time as a miner in the Centre Star, was to leave his stamp on the community in another

way. Realizing quite early that the camp might have a future, he filed on a pre-emption of 160 acres in January 1892, later plotting it as a townsite, and named the place after himself. The Post Office Department objected to this because some other British Columbia town had already assumed the name, so Thompson compromised by making use of his given name, and the town became Rossland. Before that it had been known as Trail Creek Camp, after the creek whose name had been derived from the Dewdney Trail. Stern-wheelers bringing passengers and supplies for the new mines discharged their cargoes near the mouth of Trail Creek.

The first ore to reach a smelter consisted of ten tons from the bottom of the Le Roi's 35-foot shaft. Packed to the Landing on mules, and shipped by boat and rail to Butte, it proved to be worth \$84.60 a ton, averaging three ounces of silver, 5.21 per cent copper, and about four ounces of gold. Rich as this was by most standards, the greater part of the price went for transportation charges. In 1894, in order to profit by this situation, F. Augustus Heinze, of the Montana Ore Purchasing Company, Butte, commissioned A. E. Humphrey of Duluth and two of his own lieutenants, Farrell and Breen, to investigate on his behalf. They suggested that the ore be smelted nearer the source of supply, recommending that a smelter be built at Trail Landing. Heinze went to Rossland in 1895 to see for himself, and acted quickly on Humphrey's recommendation. Within a year the smelter was in operation and Canada's first gold ingot, weighing 250 ounces, was poured at Trail Landing in 1897.

Smelters vary in accordance with the metal or metals to be treated, but in each case the principle is the same. The type then in common use consisted of an iron or steel furnace, cooled by a water jacket and fired by coal. A forced draught was caused by a blast of compressed air blown through the contents from below. Silica or some other flux was added to collect the melted rock and other unwanted constituents of the ore into a slag which rose to the top of the molten mass, allowing the remainder to be tapped off at the bottom. This remainder, known as "matte," was cooled in moulds and was then ready for refining.

A few years before his Kootenay venture and soon after his graduation from the Columbia School of Mines, Heinze had arrived in Butte, and while working for the Boston Montana Consolidated Copper and Silver Mining Company had made himself familiar with mining law, especially the notorious "apex" law which provided that the owner of a mining claim could follow any vein or other form of deposit outcropping on his property as far as he wished down the dip, provided he stayed within the projections of vertical planes passed through his parallel end-lines. As long as veins ran in relatively straight lines the law worked well enough, but few veins continue straight, and who could say where a vein might eventually go, especially thousands of feet below the surface?

At that time Butte was rocked by the furious legal and financial struggle between Marcus Daly and W. A. Clark. Heinze, in his way an abler man than either, and no less unscrupulous, joined forces with Clark, probably because the Daly crowd were the more vulnerable to his projected form of piracy; but before he was finished he found himself faced by a combination of most of the large Butte copper-mining interests, organized as the Amalgamated Copper Company, with all the power and resources of Standard Oil behind them. Having bought the right judges, Heinze was able to tie up the Amalgamated by injunctions which brought their mining operations practically to a standstill. The war then went underground, each side attempting to remove the contested ore before the other could reach it. In some cases drives were run from one property into the territory of the other, and these operations were resisted by force. Many miners were killed and others maimed for life. At last the Amalgamated, wearied of a fight that was causing litigation costs of \$1,000,000 a year, undertook to settle with Heinze, paying him \$14,000,000 cash and a large stock interest.* But this was yet ahead of Heinze as he arrived in Trail to build a smelter.

In 1890 or 1891, Topping and his partner, Frank Hanna, had taken out a pre-emption at Trail Landing and had laid out a townsite. Anxious to have Heinze's smelter located on his property, he had made Heinze a gift of forty acres on the bench over-

*See Ira B. Joralemon's *Romantic Copper*, 1942.

looking the little settlement, and a one-third interest in the remainder of the townsite. According to the story that is told, Topping, Heinze and Hanna, in order to determine who owned which lots, agreed to draw for them by taking out of a hat slips of paper each bearing a lot number. Tiring of this while there were 150 lots still to be decided upon, they began to play "freeze-out" for them. Hanna was out first, and once Topping had Heinze down to his last four chips; but Heinze's luck, or skill, won out in the end.

Having a smelter within six or seven miles of the mines, Heinze's next move was to secure a franchise from the British Columbia government and build a narrow-gauge railway to bring down the ore. The line was completed in 1896 and officially opened on December 20 of that year. The first rolling stock, a motley collection of equipment, included the discarded private car of the Mormon leader Brigham Young.

Heinze's smelter at Trail, his narrow-gauge Trail Creek Tramway, and the standard-gauge Red Mountain Railroad built at the same time by D. C. Corbin, of Spokane, to connect Rossland with his Spokane Falls & Northern Railroad at Northport, Washington, were developments that might have resulted in the knitting of the Kootenay country into the fabric of the American economy. But when Heinze built a standard-gauge line north along the Columbia River from Trail to Robson (now Castlegar), where the Kootenay River joins the Columbia below the foot of the Lower Arrow Lake, and followed this by securing from the British Columbia government a franchise for a railway (which he called the Columbia & Western) from Robson to the Okanagan; and possibly farther west, carrying a land grant of twenty thousand acres to the mile, the Canadian Pacific Railway could not ignore this threat to its hoped-for hegemony over the Kootenay country. Already, plans were well advanced for a line through the Crowsnest Pass and southern British Columbia, ultimately to connect with its main line at Hope, in the lower Fraser valley. The C.P.R. therefore offered to buy Heinze's interests. Heinze was willing to sell them—for two million dollars. It was too high, but Heinze seemed to hold the trumps and, in his own idiom, was "sitting pat."

Since this was a matter of top-level strategy, William Van Horne, the president, and Thomas Shaughnessy, the general manager, handled the negotiations themselves; but this merely strengthened Heinze's determination to get his price. Van Horne then tried a different approach. He hired an American mining engineer, Walter H. Aldridge, a class-mate of Heinze at the Columbia School of Mines, who was familiar with his activities in Montana and suspected that he would be pressed for money. On arriving at Trail, Aldridge ignored Heinze, causing rumours to be circulated that he had been commissioned by the C.P.R. to build a smelter at Blueberry, between Trail and Robson. This brought Heinze down in his price, though he still demanded more than Aldridge was willing to pay. At one stage he offered to settle the outstanding difference by a few hands of poker, but Aldridge did not think his employers would condone such a settlement. Eventually the decision of a local arbitrator was accepted; and on March 1, 1898, the Canadian Pacific Railway became the owner of Heinze's interests in British Columbia, including the Trail smelter, by paying him something in the neighbourhood of \$800,000. This transaction, which was undoubtedly one of the most significant in the annals of the C.P.R., was also of primary importance in the development of the Kootenays.

Meanwhile the Rossland prospects had become producing mines. The Le Roi had been digging ore since pack-horse days, of course, but the War Eagle, Centre Star and other adjoining properties were slower in getting started. Patsy Clark and his associates in the War Eagle had some trouble locating ore but eventually struck a high-grade shoot, which set off a fresh wave of speculation. Shares in hundreds of new companies were eagerly bought by people all over the world, most of whom would have had difficulty in locating Rossland or the Kootenays on the map. Early in 1895, the War Eagle paid a dividend of \$27,000, the first substantial dividend in the Rossland camp. In the following year, the Le Roi began monthly dividends of \$25,000, and although that rate could not be maintained indefinitely, the company was a consistent dividend-payer for the next ten years. In 1897, the Le Roi company built a smelter at Northport and began smelting its own ore—a circumstance which may have increased Heinze's willingness to sell.

For some time a number of the relatively few Canadians in Rossland had been agitating for its incorporation as a city, and on March 4, 1897, they succeeded. The community became free of the none too enthusiastic tutelage of the provincial government, and being now empowered to borrow money for local improvements it at once proceeded to do so. "Over 7,000 people were listed as residents in 1897; the town boasted of 42 saloons, eight doctors, 17 law firms and a business district that was seeing substantial edifices being erected to a future that seemed certain of permanent prosperity."*

The incorporation of the West Kootenay Power and Light Company Limited, on May 8, 1897, was an important event. This company's completion of a plant, the following year, at Lower Bonnington Falls on the Kootenay River (about ten miles west of the outlet of Kootenay Lake) brought the first hydro-electric power to Trail and Rossland. It also brought Lorne A. Campbell into the affairs of the Kootenays; the development of power was only one of the ways in which he was to make his presence felt.

The coming of the C.P.R. and the incorporation of the West Kootenay Power company marked the beginning of a transfer of control from interests centred largely in Spokane to Canadians in Montreal and Toronto, although the development of the Slocan and Boundary regions, which were about to be opened up, would still be left almost entirely to Americans. Further evidence of the growing Canadian interest was the purchase of the Centre Star and War Eagle mines by the Gooderham-Blackstock syndicate of Toronto. But perhaps the transfer which caused the most stir was the acquisition of control of the Le Roi by the notorious Whittaker Wright, then riding the crest of his remarkable wave. On June 28, 1898, the majority shareholders of Le Roi, at a meeting in Spokane, transferred 284,000 shares to Wright's British America Corporation in London. A minority group objected and, taking advantage of a technicality in the laws of Washington state, where the Le Roi was registered, secured an injunction preventing transfer of ownership. For three years the contest continued in the

*This quotation is from *Rossland the Golden City*, published in 1949 by Rossland Miner Limited, from which certain other information has been secured for this chapter.

courts of three countries. The British America Corporation eventually won, and greater difficulties soon followed for the Le Roi when Whittaker Wright's flimsy financial empire collapsed.

That the transfer from American to British control in connection with another Kootenay mine left much to be desired is graphically shown by the following lament in the *New Denver Ledge*, of January 10, 1895:

What a hoodoo the Silver King has been to Nelson. Discovered years ago by a band of placer hunters from Colville, its history has been one of litigation and manipulation. Nelson has been built principally upon the expectation that this great mine would employ hundreds of men, and what do we find today? About a corporal's guard working upon it and the people of Nelson still living on expectation. With its main business in the Old Country, and its affairs conducted by men who can afford to play a waiting game without pawning their diamonds, it is hardly likely that the immediate future will see Nelson's streets worn threadbare by the wheels of Silver King ore teams . . . It would have been better for the Halls and the people of Nelson if the King had gone into the hands of some American company.

The miners of Rossland were responsible for the establishment by legislative action, for the first time in Canada, of an eight-hour day in metalliferous mines. As a side-effect of strikes in Montana, Idaho and Colorado during the latter part of the nineties, a considerable amount of labour unrest prevailed in Kootenay mines, where ten, and even twelve hours, constituted a working-day. In 1898 the leaders of the Rossland Miners' Union conceived the idea of securing relief by legal enactment. A provincial election was pending and they selected as their standard-bearer James Martin, a hardware merchant, who was elected as an Opposition candidate (party government had not yet come to B.C.). The Government was defeated and the Opposition took over. James Martin, although not holding office, was an influential member of the new administration and consequently an Act was passed at the first session establishing the eight-hour day, which became effective in the mines of Rossland in February 1899.

III

“Chickamen Stone”

AT ABOUT THE TIME THAT THE ROSSLAND BOOM WAS GETTING UNDER way, the great Slocan boom began. The Slocan comprises the area, mountainous like all the Kootenay, lying between the Lower Arrow and Kootenay lakes. In its northern part there are quartzites and slates, with big porphyry dikes and silver-lead-zinc ores; to the south, the area is partly underlain by what geologists have termed the Nelson batholith. Leading the van in 1892, Eli Carpenter, a circus performer turned prospector, headed into the Slocan hills and staked the Payne mine (near what later became Sandon), for a time the biggest dividend-payer in British Columbia. Within five years the Slocan had given birth to several lively towns: Kaslo, on the west shore of Kootenay Lake, soon boasted a population of four or five thousand, and New Denver and Slocan City were not far behind.

Many claims were located by men on snowshoes, more concerned with getting stakes planted than in finding ore in place, for speculators were anxious to buy, sight unseen. Only one in every hundred claims staked ever becomes a prospect, much less a mine; but before the Slocan boom was over about three hundred mines, mostly small, had become producers, shipping anything from a few tons to hundreds of thousands.

The first ore was shipped in 1892, from the Freddy Lee mine on Cody Creek, near Sandon. It was rich enough to justify hand-picking in bags, packing on horses or mules over a rough trail to Kaslo, and shipping south by boat on Kootenay Lake and River to the railway at Bonner's Ferry, Idaho. Before roads were built, ore from the richest claims was stripped from the workings and (in winter) “rawhided” down the mountain trails. This was done by lashing a number of sacks of ore in a cowhide and hitching a

mule to the contraption. Several mules could be handled by one “skinner.”

There was much deliberate claim-jumping, as well as the double-staking that occurred wholly or in part through ignorance or carelessness, and when surveyors eventually attempted to determine boundaries they found it almost impossible to unscramble the maze of conflicting lines and posts. Sometimes a claim might pass through several hands, the staker having no further interest, the ultimate “owner” never having seen it. In some cases, owing to prior staking of adjoining ground, claims were reduced to a mere fraction. (Previous to 1892, when the maximum area of a lode claim was fixed at 1,500 feet square, claims were 1,500 by 600 feet.) Here was a fruitful source of litigation; sometimes the lawyers did better than anyone else. The “apex law” which the British Columbia legislature, following the bad example of some American legislatures, had enacted in 1872, would have caused even more trouble, but fortunately it was repealed in 1892.

Kootenay lawyers soon became familiar with mining terminology; but judges, usually sent in from the Coast to conduct the assizes, were likely to find themselves beyond their depth. A celebrated case, tried at Sandon, was that between J. M. Harris, owner of the Rabbit Paw Fraction, and the Slocan Star Mining Company. The judge became weary of interminable technical arguments; and when one of the expert witnesses stated that the hanging wall of the “black fissure,” a fault traversing the disputed ground, had moved a thousand feet, this was more than he could stand. “Stop right there!” he warned. “I have been listening to a lot of nonsense for a long time while here; but to seriously take the stand that this mountain back of us here at one time moved a thousand feet is altogether too much for me to stomach and I don't want to hear any more of that sort of thing.”

The story of mining in Canada is largely an account of one boom after another. The type of mineral deposits and methods of mining may differ, but the behaviour of people is much the same in every boom. Therefore to describe each in detail would become monotonous. The Slocan boom had, however, a unique feature in the person of “Colonel” Robert T. Lowery, a newspaper publisher and editor who could scarcely have been produced in

any other environment. His first venture was at Kaslo, but he shortly moved to Nakusp, at the head of the Lower Arrow Lake, where Volume I, Number 1 of the *Nakusp Ledge* was issued on October 5, 1893.

This is the first issue of Nakusp's first paper, and it might be pleasing to the public to know what our intentions are and why we have brought this new journal into this wicked world. We have done so because the people here are enterprising enough to support a paper, and as this town grows in importance every day, we consider it a paying investment.

We are not particularly afraid of any government, clique or party, and will endeavour to use them all in a fair manner.

We will do everything in our power to promote the interests of this town, this district, and this glorious province of British Columbia.

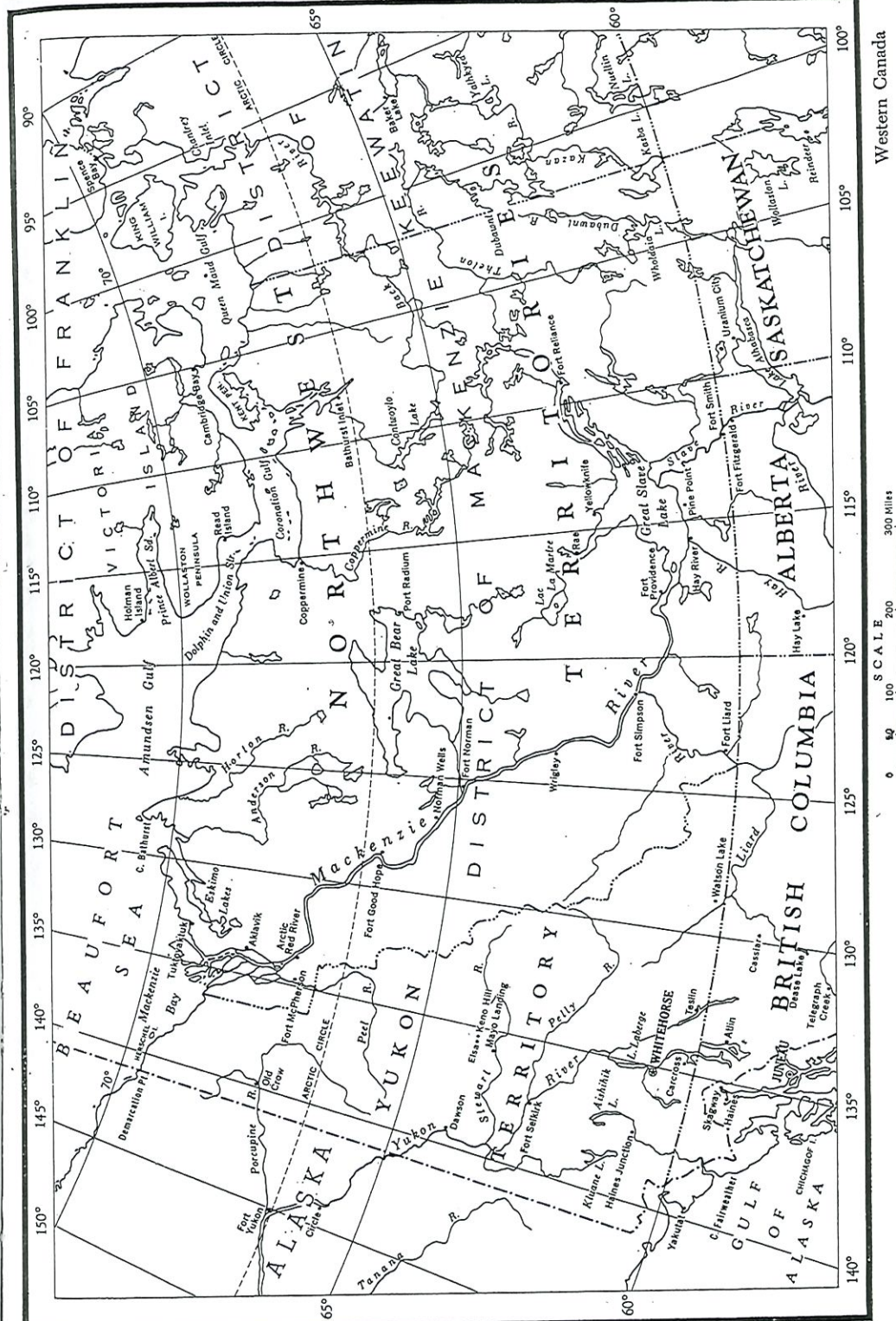
We are not prejudiced against any race or colour and will give the untutored Siwash 52 copies a year for three silver dollars just as quick as we would to one of the titled dandies of Europe.

It is not necessary to say any more about our intentions. You can judge for yourselves. If you do not like our style, do not support us. If you do, the sooner you show a silver lining to your feelings, the sooner we will be able to appreciate your efforts to build up the press of this great Kootenay country.

Nakusp did not live up to the editor's expectations, and once more he packed his press and editorial chair, moving to New Denver, where the next number of his *Ledge* appeared on December 27, 1895.

Lowery published the *New Denver Ledge* for nearly nine years, the longest span of any of his nine journalistic ventures in the Kootenay. It was at New Denver that he adopted his famous masthead showing a bearded editor seated at a table from which papers and dollar bills spilled over onto the floor. A fierce-looking dog, chained in a corner of the room, was busy tearing the pants off a prostrate "delinquent subscriber."

Each time Lowery packed his battered outfit he descanted sorrowfully upon the lack of public spirit shown by the citizens of the town he was leaving, but he always arrived at the next location full of hope and optimism. Thus the issue of October 26, 1904:



0 50 100 200 300 Miles
SCALE

Western Canada



William Barker
Francis J. Barnard



Sir Matthew Baillie Begbie
John A. "Cariboo" Cameron



All
Photos
Courtesy

Provincial
Archives,
Victoria, B.C.

The *Ledge* has moved into the Rocky Mountains and is now printed, published and edited in the greatest coal city in British Columbia. Its editor expects Fernie to become the second city in the province before many years, and it is the aim of this paper to bring this condition about as quickly as possible . . .

Prospectors had penetrated the region west of Rossland known as the Boundary country, and some placer gold had been taken from creeks in the Kettle River area. As these gravels were worked out, attention turned to the lode mining. The Bruce claim, near Midway, was staked as early as 1887 and was followed by others, but development was hindered by lack of railways; the C.P.R. did not reach Grand Forks, on the Kettle River, till 1899. Shortly afterwards, the line was extended to Greenwood. Phoenix, thirty-five miles from Grand Forks, was served by branch lines—first the C.P.R., and later, the Great Northern.

Phoenix, named after the principal mine, was built near the top of a mountain; it was 4,500 feet above sea level and had ten thousand people. It became a city in 1899, and Phoenixites boasted that theirs was the highest city in Canada. In 1905, twenty-six companies shipped ore out of the camp. Trains of empties required two locomotives to get up to Phoenix, but on the return trip, with loaded cars, only good brakes were needed.

As in most Kootenay camps, claims in Phoenix were largely controlled by Spokane mining men. In this instance, Jay P. Graves and A. L. Little of Spokane were the principals; but when they ran into financial difficulties they turned to eastern Canada. The rubber-footwear manufacturer, S. H. C. Miner, of Granby, Quebec, and others in the Eastern Townships of Quebec and in Montreal, became heavily interested; and within a short while the Miner-Graves syndicate had gained control of the chief companies. These were amalgamated in 1899 to form The Granby Consolidated Mining, Smelting and Power Company Limited, which still operates under that name.

Grand Forks was chosen as the site of the Granby smelter, which was blown in in 1900, with an ultimate capacity of 4,800 tons. Ore from the Phoenix mine, typical of the area, was relatively low-grade, running about one per cent copper and two dollars a ton gold, but it was easily mined and simple to treat,

being practically self-fluxing and requiring only the addition of coke.

Granby paid its first dividend in 1903—\$135,000—and by 1906 dividends had increased to \$1,602,000. By this time control had passed into the hands of American copper magnates such as John Stanton, W. H. Nichols, J. B. F. Herreshoff, George F. Baker, Jr., and Payne Whitney, who had become convinced that the Phoenix was a great mine. In 1905 the management decided to open up another level, and a winze was sunk to the 400-foot level, about 800 feet below the highest outcrop. Here a crosscut driven to the hanging wall passed through 220 feet of ore as fine as any ever taken from the mine; the width at right angles to the dip was 80 feet. "Then occurred one of those things that make mining so uncertain," remarked C. M. Campbell, Granby engineer and superintendent, writing in 1949.* "Drifts both ways soon ran into waste, the crosscut had gone through the deposit at its very widest place. The area blocked out was only one-fifth that of the level above, and diamond drilling bottomed it at forty feet below. The dream that we were working 'the greatest copper deposit in the known world' was over by 1908. The information was passed on, reached the directors, and the public, and Granby shares dropped from \$151 to \$23. About this time, also, limits were found to all the other major deposits in the district."

To say that Phoenix became a ghost town would be an understatement: it virtually disappeared. The railways ripped up their tracks; weeds and bushes took over. Untrue to its name, Phoenix has never risen from its ashes, although in 1955 it was reported that the re-opening of some of the mines was being considered. As for the Granby company, it has already risen twice and seems likely to do so again.

When the end of the Phoenix mine was in sight, the Granby company looked about for another and found a mine at Anyox, in the Coast Mountains of British Columbia, which it operated from 1914 to 1935. With an eye to the future, it acquired, in 1923, control of the Sunset Group, a large, relatively low-grade copper property on the top of Copper Mountain, near Princeton. Staked in 1892 by R. A. (Volcanic) Brown, it had passed through

**Western Miner*, Vol. XXII, No. 7, p. 49.

the hands of various owners, one of which, the Canadian Copper Company, had erected a 2,000-ton mill at Allenby, down in the valley about eight miles from the mine. For various reasons, chiefly the low price of copper, the property was operated only intermittently until 1937, when it became Granby's principal enterprise. The company now adopted a program of lowering mining costs and increasing production, and in this was very successful, stepping up production to over five thousand tons a day at a cost per ton among the lowest in the country. In 1951, Lawrence T. Postle became president and directing head of the company.

Another notable Similkameen mine was the Nickel Plate, a gold-producer at Hedley, twenty-five miles east of Princeton. Staked in 1897, it was brought into production in 1903 by M. K. Rogers for the Daly Reduction Company, controlled by Marcus Daly, of Butte. In 1909, the property was acquired by the Hedley Gold Mining Company Limited under which it was operated till 1932, when control passed to the Kelowna Exploration Company Limited (name changed in 1951 to Kelowna Mines Hedley Limited). By the end of 1936, the ore seemed to have come to an end, but shrewd reasoning on the part of Paul Billingsley, consulting geologist, gave the mine a new lease on life. As with most Kootenay mines, the deposits were near the top of Nickel Plate Mountain, the ore being brought by tramway to the concentrator in the valley where, among other processes, it passed through a battery of forty stamps, probably the only ones of their kind still in use in a Canadian mine. A field study of these deposits made by Charles A. Camsell for the Geological Survey of Canada, provided him with the subject for his thesis to the Massachusetts Institute of Technology in 1908, and they have since been classified in textbooks on economic geology as a distinct type.

Jacques Cartier learned of the mineral wealth of Canada from the Indians and, in legend if not in fact, Indians have had a hand in many of the subsequent mining discoveries. One such case is the discovery of the St. Eugene mine at Moyie, East Kootenay. Having some knowledge of mineralogy, Father N. Coccola, of

the St. Eugene Mission at Fort Steele, tried to teach his Indian charges the difference between mineralized and country rock. The former he called "chickamen" stone, chickamen, in the Chinook jargon, meaning money. He suggested that they should bring him any chickamen stone they might find.

In the spring of 1893, Father Coccola's lessons paid off. One day an Indian named Peter came riding up to the mission with a piece of very heavy rock tied to his saddle. Father Coccola showed the specimen to James Cronin, an Idaho mining man then visiting the mission. Cronin knew lead-zinc ore when he saw it. Saddling their horses, he and Father Coccola followed Peter to an outcrop on the mountainside high above the east shore of Moyie Lake.

Two claims were staked, the St. Eugene and the Peter. They were recorded on June 25, 1893, the St. Eugene in the name of Father Coccola and the Peter in the name of Cronin, although each had actually a half interest in both claims. When word of the discovery got abroad, the usual rush of prospectors occurred and the country round about was solidly staked; but the chief mine that emerged was the St. Eugene, comprising the claims located by Cronin and Father Coccola, which during its lifetime was to produce \$11,000,000. Cronin, acquainted with mining men in Spokane, found it easy to get money to develop the mine. He interested John A. Finch, who bought Father Coccola's share for \$12,000, sufficient to finance a new mission church and also to provide something for Peter. In 1899, Cronin and Finch, after spending \$80,000 in development, sold a two-thirds interest to the Gooderham-Blackstock syndicate. Combined with other nearby properties controlled by the syndicate, the mine was operated under the name of the St. Eugene Consolidated Mining Company Limited. A few years later, this company transferred its interest to the Canadian Pacific Railway.

We come now to the inconspicuous beginning of what was, after many vicissitudes, to be the greatest mine of its kind in the world. The discoverers, like many others in the Kootenay, were from south of the line, although one of them had come originally from Ireland and another from Germany. Walter

Burchett, a young man of twenty-five, and Ed C. Smith, one-time member of the Idaho Legislature, met in Clarks Forks, Idaho; and in the spring of 1892 Smith suggested that they make a trip into British Columbia, generally supposed to be rich in mineral. With two months' provisions, they boarded a river steamer which took them to Kaslo. After three weeks of strenuous mountain-climbing in the Slocan country to the west, Burchett and Smith were back in Kaslo where they met Pat Sullivan and John Cleaver, both previously known to Smith.

Sullivan and Cleaver were planning to travel eastward across country to Fort Steele, and easily persuaded Burchett and Smith to go along. They crossed Kootenay Lake by steamer, but after that they had to go on foot through a mountainous country, packing their supplies. These, at first, were more than they could carry, so that relays were necessary, but they soon ate their packs down to size. Prospecting as they went, they spent thirty-seven days on the trip and were entirely out of food when they reached the St. Eugene Mission. There they were fed by Father Coccola, and Sullivan and Smith went on to Fort Steele to buy a further supply.

When Sullivan and Smith returned they were full of the news that had set Fort Steele buzzing about the great strike at the North Star mine (owned by a company controlled by William Mackenzie and Donald Mann of Toronto), a few miles from Fort Steele. This gave their wanderings direction, and they lost no time in hiking to the North Star, where they found the reports not at all exaggerated. Open cuts exposed rich-looking ore for all to see. The four prospectors decided to split into two parties, to prospect across Mark Creek on the opposite side of the valley.

Here it was [wrote Burchett* many years later] that I made the discovery that was to be the Sullivan. The float I picked up on the way up the hill looked just as good as anything I had seen on the other side of the creek, and I called Cleaver, my partner on this sortie, up to where I was. Cleaver, too, was impressed and we wasted no time getting the others and tracking down the source of this promising lead. There remained then only the

*Walter Burchett: "The Discovery of the Sullivan Mine," *Western Miner*, August, 1944.

staking and recording. This was done and the four of us worked at the claims as long as our money and provisions held out. At the insistence of Sullivan and Smith, who had been quoting Shakespeare to each other at great length as a matter of passing the time on our long overland trip, the two claims were named the "Hamlet" and the "Shylock." Both men were well versed in the classics; in fact, Smith was one of the most widely read men I have ever had the pleasure of knowing.

When the time came for some of us to get back to work at wages in order to supply money to work the property, I wended my way back to Kaslo to work on a wagon road for a good part of the summer. Later, Sullivan and I did some prospecting for placer on Wild Horse Creek. We sank a fifty-foot shaft on the Creek but found little that was worthwhile working. It was during this time that Sullivan communicated to me his strange dream: he dreamed that he was buried under timbers that were pressing him in all around. It was a vivid nightmare that he recalled frequently, as though he had a strange premonition. It will be no news to oldtimers that his premonition came true. When he left me to continue on down to the Coeur d'Alene that summer, he was leaving me for the last time. He was killed a short time later in a cave-in at the Coeur d'Alene mines.

The three survivors worked the property spasmodically for the next four years. A number of people were interested, from time to time, but the partners were not tempted to sell until the Le Roi group of Rossland and Spokane offered them \$24,000, which they accepted. (Pat Sullivan's share was taken in charge by the proper government authority for the benefit of his heirs in Ireland.)

The new owners, operating as the Sullivan Group Mining Company, built a smelter (completed in 1903) at Marysville, on St. Mary's River, five miles from the mine. The ore, a sulphide replacement in argillites and argillaceous quartzites, was very complex, consisting of galena (lead sulphide), marmatite (zinc-iron sulphide), and pyrrhotite (iron sulphide), in addition to other minerals in greater or less amount. But these minerals were so thoroughly combined that they could not be profitably separated by any means yet discovered; and in 1907, both smelter and mine were shut down.

In 1909, the Sullivan mine was acquired by the Federal Mining and Smelting Company, subsidiary of the American Smelting and

Refining Company, which, through another subsidiary—the Fort Steele Mining and Smelting Company—leased it, under option, to The Consolidated Mining and Smelting Company of Canada Limited. The latter, a subsidiary of the C.P.R., had been incorporated in 1906 and already owned the Centre Star and War Eagle mines at Rossland and the St. Eugene at Moyie. In 1910, Cominco, as it came to be known, decided to exercise its option, completing the purchase in 1913 and thus rounding out its holdings in the Kootenays.

While from a metallurgical standpoint the Sullivan mine constituted a complex and difficult problem, mining was relatively simple. The orebody is large and fairly compact; it lies in an almost horizontal position (the dip averages about thirty degrees, east) and is easily reached from the surface by adits.

The outcrop and nearby areas were originally mined from small pits and later from short shafts and adits. During the period when only ore high in lead was taken out, an adit was driven on the 4600-level (height in feet above sea-level) from which ore was removed by open stoping, leaving support pillars where the ore was high in zinc and low in lead. Mining costs could be kept low because of the massive nature of the deposit and the fact that timbering was not required. From 1915 till 1947, the main haulageway was at the 3900-level, but in that year an adit more directly connected with the concentrator was established on the 3700-level. Since 1951, low-grade deposits at the south end of the property have been mined by open-pit methods at the rate of two thousand tons a day.

In the nature of things, selective mining could only be a temporary expedient; means must ultimately be found for the economical extraction of all the various constituents of the ore, especially the zinc. Purchase of the mine had been made on the recommendation of R. H. (Pat) Stewart, then manager of mines for Cominco, and S. G. Blaylock, a metallurgist in charge of the St. Eugene mine, who was destined to play an important role in the company's decisive years.

For a time it was thought that separation might be effected by gravity methods, but this did not prove practicable; in 1917, attention was turned to differential flotation and a research pro-

gram was instituted under the direction of R. W. Diamond, who was eventually to become Cominco's Executive Vice-President, Western Region. It was hoped that an economical process might be evolved by which the lead, zinc and iron minerals could be separated in three successive operations and, in March 1920, the first successful test-mill flotation of Sullivan ore was made. The test-mill was quickly increased to a capacity of 1,000 tons a day.

Meanwhile, the concentrator at Chapman Camp, three miles southeast of the Sullivan portal, had been under construction; and in August 1923 operation began with an initial capacity of 3,000 tons a day, since increased to 11,000 tons. The ore, crushed in the mine at the 3,800-foot level, is transported by electric trains (one forty-ton locomotive and forty cars carrying fourteen tons each). After being screened and washed, the ore goes to the concentrator. It passes first through the "Sink and Float" plant, consisting of tanks containing water with finely ground galena in suspension. Here the sulphides are separated from the barren rock, the heavy, mineralized pieces sinking, while the lighter gangue material is floated off and used as back fill for the mine.

The "sink" now proceeds through a large rod mill and batteries of ball mills, emerging as a pulp, ninety per cent of which will pass a 200 mesh, and goes next to the flotation cells where the sulphides of lead, zinc and iron are obtained, in that order. The lead sulphide (containing also the gold, silver and other metals, but little zinc, cadmium and indium) is, in turn, floated in three successive stages, resulting in about 64 per cent lead. The remaining pulp is then floated in three further stages to produce a zinc concentrate containing about 48 per cent zinc; and the residue is again floated to produce about 49 per cent iron. A final step is the removal of a tin concentrate by gravity process. From 11,000 tons of ore, about 1,600 tons of lead concentrate and zinc concentrate are recovered, together with enough tin concentrate to produce about 200 tons of tin a year.

Cominco metallurgists devoted many years to research and experiment before the flotation process required for the type of ore was perfected. That process is fairly simple to describe, although not always so simple in operation. It is well known that

oil will float on the surface of water, and also that some oils have what may be called an affinity for certain metals. Therefore, if it is proposed to separate finely ground lead sulphides from other similarly ground sulphides, the type of oil (called a reagent) must be found that will cling to the former only. Now, if the concentrates (well mixed with water) are kept moving through a series of tanks which contain also a certain amount of a particular reagent, and if low-pressure air is blown through from below, a froth of oily bubbles will form on top of the tank; the lead sulphides will cling to the surface of the bubbles, while all others will fall to the bottom. The froth (containing the lead) is then skimmed off the cell by revolving paddles. Next, adherence of zinc-bearing particles to a different type of reagent yields a zinc concentrate, and the iron mineral is separated from the waste in a final flotation step.

Concentrates of Sullivan ore are shipped to Trail, some two hundred miles to the west, for treatment, and since they are from sulphide ores (lead sulphides, for example, containing about thirteen per cent sulphur), they must be freed from the sulphur. In the case of the lead concentrate, this is done by "sintering." In this process, concentrate is fed onto long, narrow machines having grates moving like an endless belt; an oil torch ignites the sulphur, which is consumed as the material slowly moves along the length of the machines. Passage through two machines in succession is needed to bring the sulphur content down to two per cent, or less. This transforms lead sulphides into lead oxides; the gases resulting from the process are treated, in turn, for the recovery of sulphur dioxide.

Sulphur dioxide gas, once a liability, is now an asset. As the extent of the operations increased, this gas billowed from the stacks of the smelter in immense quantities. The fumes were carried by the prevailing winds down the Columbia River and across the border into the State of Washington, resulting in claims against the company for damage to crops; and, following extensive hearings by an international tribunal, the company was ordered to pay the losses of the farmers and to maintain strict control of the release of gas. This led Cominco to investigate the possibilities of making use of the fumes.

The production of sulphuric acid had already begun, but since Cominco alone could supply more sulphuric acid than the market would absorb, some other use for it must obviously be devised; and the possession of low-cost electric energy, plus the availability of a phosphate rock deposit in Montana, suggested the manufacture of commercial fertilizer. In 1931, the first fertilizer plant went into operation at Warfield, adjoining Trail. Expansions there, and additional plants at Kimberley and Calgary, have since placed Cominco among the world's leading fertilizer manufacturers.

The lead smelter occupied the site of the original Heinze plant. Lead-smelting began there in 1899 and was carried on side by side with the smelting of copper until 1929, when the latter was discontinued. Many changes have occurred through the years, due to improvements in smelting techniques and to meet the need for increased capacity, but the time came when the plant was obsolescent and difficult to operate economically. These handicaps were emphasized by the demands of World War II, and in 1949 a reconstruction program was instituted. By 1954, the first three phases had been completed and work was progressing on the final one.

As added to from time to time, the smelter contains five blast furnaces with a uniform shaft height of 17 feet and of varying lengths up to 22½ feet. (These are eventually to be replaced by two large ones.) In the high temperature of the blast furnaces the sinter is smelted with coke and other ingredients to produce molten metallic lead and slag. The molten lead, still containing small quantities of other metals, collects in the bottom of the furnaces, while the molten slag floats on top of the lead and is tapped off for later treatment in the slag-fuming furnaces. Gases from the furnaces are cooled in a tower by water sprays and, before reaching the stack, pass through a baghouse, where 99.9 per cent of their fume and dust are removed.

The baghouse is an interesting feature of the Trail plant. It consists of twenty compartments, each containing 396 bags. These bags are approximately ten feet in length and eight inches in diameter; they are made of Orlon fibre and constitute a cloth area of 108,240 square feet.

The lead bullion, now about 98 per cent lead (and containing gold, silver, arsenic, antimony, copper and bismuth) is transferred (still molten) to the drossing plant, where its temperature is allowed to drop to 1,000° F., causing part of the remaining impurities to rise to the surface as a dross which is skimmed off and stored for later production of copper-lead matte. The lead bullion now goes to the casting wheel where it is moulded into anode plates.

The lead refinery dates from May 26, 1902, when the world's first commercial production of electrolytic lead was begun. The process had been developed and patented the year before by Dr. Anson G. Betts of Troy, N.Y., and the Canadian rights were bought by the Canadian Smelting Works (forerunner of Cominco). By this process the lead anode is dissolved by an electric current passing through a solution of lead fluosilicate and hydro-fluosilicic acid and deposited in a pure form on a refined lead "starting sheet" cathode. When further purified by drossing, the lead, 99.997-per-cent pure, is ready for market.

The original installation had a rated capacity of ten tons a day; but expansion between 1922 and 1926 brought the plant to essentially its present size with a rated capacity of approximately 600 tons of lead a day. Constant research, however, suggested improvements under which a wartime peak of 700 tons was possible. Mechanical and metallurgical improvements since that day in 1902 when the refinery began operations have resulted in a tenfold increase in output per refinery-cell, and at the same time cathode purity has been continuously improved.

During electrolysis the impurities and other metals in the lead bullion remain on the anodes as a mud which is treated for the recovery of silver (some fifteen million ounces annually at capacity) and of bismuth, antimony and gold.

Zinc production began at Trail during World War I when, following successful laboratory and pilot-plant experiments, a commercial electrolytic plant was built. It began operation in 1916 with a rated capacity of thirty tons of cathode zinc a day, which was increased from time to time until 1952 when the present capacity of 560 tons was reached.

The main feed to the zinc department comes direct from the

Sullivan concentrator, the mineral being in the form of a zinc-iron sulphide. The zinc sulphide is converted, by roasting, into zinc oxide; the iron is converted to ferric oxide; and the sulphur is discharged as sulphur dioxide gas for conversion into sulphuric acid.

The roasted concentrate is delivered continuously to the leaching plant. Here it is treated with dilute sulphuric acid, giving an impure zinc sulphate solution containing cadmium, copper and various other minor impurities originally present in the concentrate. This impure solution is subjected to suitable purification methods, which produce a very pure zinc sulphate solution for electrolysis. Silver-lead alloy anodes are used and the zinc is deposited on aluminum cathodes. The zinc sheets arising from this process are melted and cast into 56-pound slabs. The insoluble residues and precipitated impurities contain valuable by-product metals which are recovered subsequently.

Cadmium occurs as an impurity in most zinc ores. Sullivan zinc concentrates average about 0.14 per cent cadmium, present in varying degree in all feed to the plant; by an electrolytic process, it is recovered at the rate of approximately two thousand pounds a day. The zinc concentrate also contains indium. As a result of extensive process-research, and in response to a growing demand, Cominco established commercial-scale indium production at Trail in 1955.

Cominco's position as one of the world's great mining corporations is due primarily to the Sullivan mine, and the technical achievements which have brought about its waste-free, maximum utilization. This great natural resource has provided the basis for the important metallurgical and chemical industry at Trail and the development of related operations elsewhere.

Next in importance to possession of the Sullivan mine are Cominco's power resources on the Kootenay and Pend Oreille rivers. The four plants on the Kootenay have a total rated capacity of 329,000 horse-power, while Cominco's Waneta plant on the Pend Oreille, completed in 1954 with an initial installation of 240,000 horse-power, has provision for 480,000 horse-power. In 1952, an 86-mile transmission line was built to connect the Kootenay River plants with the Sullivan mine and concentrator.

The line crosses Kootenay Lake by a two-mile unsupported span, until recently the longest span in the world; and, farther east, it crosses the Purcell Range at an altitude of 6,200 feet.

Having the resources in money and personnel, Cominco has undertaken the development of other mines in various parts of the country. Some of these will be dealt with in later chapters, but two are located in the Kootenay country and may properly be considered here.

Although presence of its outcrop was recorded in 1844, and known even earlier, the lead-zinc property called the Bluebell, at Riodel on the east shore of Kootenay Lake, was not staked until 1882, and litigation prevented any significant development until 1887. In the nineties, a mill and smelter were built some eight miles south of the mine, but after treating only 8,300 tons of concentrates, mine, mill and smelter were closed down. In 1905, the property was acquired by the Canadian Metal Company, whose headquarters were in Paris, France. A new mill was built, this time at the mine, concentrates and shipping ore being sent to Trail. The property was operated intermittently until again closed down in 1921, after some 490,000 tons of ore had been produced.

Better prospects seemed in sight when the mine was bought in 1924 by S. S. Fowler and B. L. Eastman, and flotation equipment was added to the mill; but within three years, chiefly owing to the low price of metal, the property was again closed down. Cominco now bought control, acquiring at the same time the Comfort group of claims, adjoining on the north, and the Kootenay Chief group, on the south. Additional claims were staked to protect the property along the strike and dip.

Low metal prices and the depression conspired to prolong the suspension of operations; and it was not till 1947 that Cominco, now with new ideas regarding the structure, undertook further development, not on the original Bluebell site, but on the Kootenay Chief, where an important new orebody had been located by diamond drilling. Plans were adopted for the recovery of this ore, and a 500-ton concentrator was built midway between the old site and the Kootenay Chief; but operations did not begin

until April 1952, when power was provided by a branch from the transmission line to Kimberley.

Cominco's other new Kootenay mine, the H.B., is located on the north side of Sheep Creek, seven miles southeast of Salmo. Its name is derived from the initials of its stakers, Horton and Benson, who, attracted by conspicuous gossan (highly stained rocks), staked the claims in 1907. Ore from the heavily oxidized surface zone was shipped to Trail and smelters elsewhere by various lessees during the next twenty years, but because of the difficulty of treating the ore such efforts were not financially successful, and no ore was found below the zone of oxidation, which does not go deeper than three hundred feet from the surface.

In 1927, Cominco bought the property, but not till after World War II did its geologists evolve a satisfactory theory concerning the location of the orebody. Subsequent drilling confirmed the theory, leading to underground exploration and the outlining of a sufficient tonnage of lead-zinc ore to justify a 1,000-ton mill, which, although ready for production in the spring of 1953, did not begin till 1955. Concentrates are trucked thirty miles to Trail.

On Iron Mountain, also in the Sheep Creek area, and almost within sight of the H.B., is the mine owned by Canadian Exploration Limited, of which C. A. Banks of Vancouver is the president. One section of the property is mined for tungsten, while within a few hundred feet the ground is worked for lead-zinc. Four mines are involved in this composite operation, the Dodger, Feeney and Emerald producing tungsten ore and the Jersey producing lead-zinc. A fifth, also called the Emerald, has been inactive since 1926; it was a lead-zinc producer. Ore from all mines is now crushed in a single underground plant and goes to two different concentrators—the tungsten concentrator being near the Emerald 3800 portal and the lead-zinc concentrator in the valley a mile away—by means of the same belt-conveyor system. This mining aggregation has another claim to distinction: it is a pioneer in Canada in what is called "trackless mining."

It is unlikely that John Waldbeser was the original staker, but he was the first to undertake development of any consequence.

In 1908, he operated the old Emerald lead-zinc property, mining chiefly the outcrops and producing in that way 426 tons of lead carbonate which he is reported to have sold for \$7,000.

Investors were attracted and, in June 1910, Iron Mountain Limited, a subsidiary of Pacific Coast Steel with headquarters in San Francisco, was organized to work the property, John Waldbeser being retained as manager. The new ownership did not, however, result in much more energetic development. By 1915, twelve thousand tons of ore had been shipped to the Trail smelter, and between 1917 and 1919 three short adits had been opened on the southernmost of the claims (Jersey), where further outcrops had been discovered, but these missed by forty feet some sixty thousand tons of lead-zinc ore which at a later day were to fall into the hands of the company's successor.

The first mill (with a capacity of twenty-five tons a day) was built in 1919 and remodelled the following year, but production was still on a modest scale, for only nine hundred tons of ore and concentrates passed through the mill that year.

Although unnoted at the time, 1924 marked the climax in the fortunes of the enterprise, for it was then that the influence of the Lakes brothers, Arthur and Harold, began. Arthur was retained by the Iron Mountain company to make the first detailed geological survey, while Harold was employed with a view to improving the flotation service in the mill, then extremely inefficient. Even the improvement in recovery which he was able to effect could not overcome the handicap of low metal prices; in 1926, all development and production were indefinitely suspended. In 1934, the mill, idle for eight years, was destroyed by a forest fire.

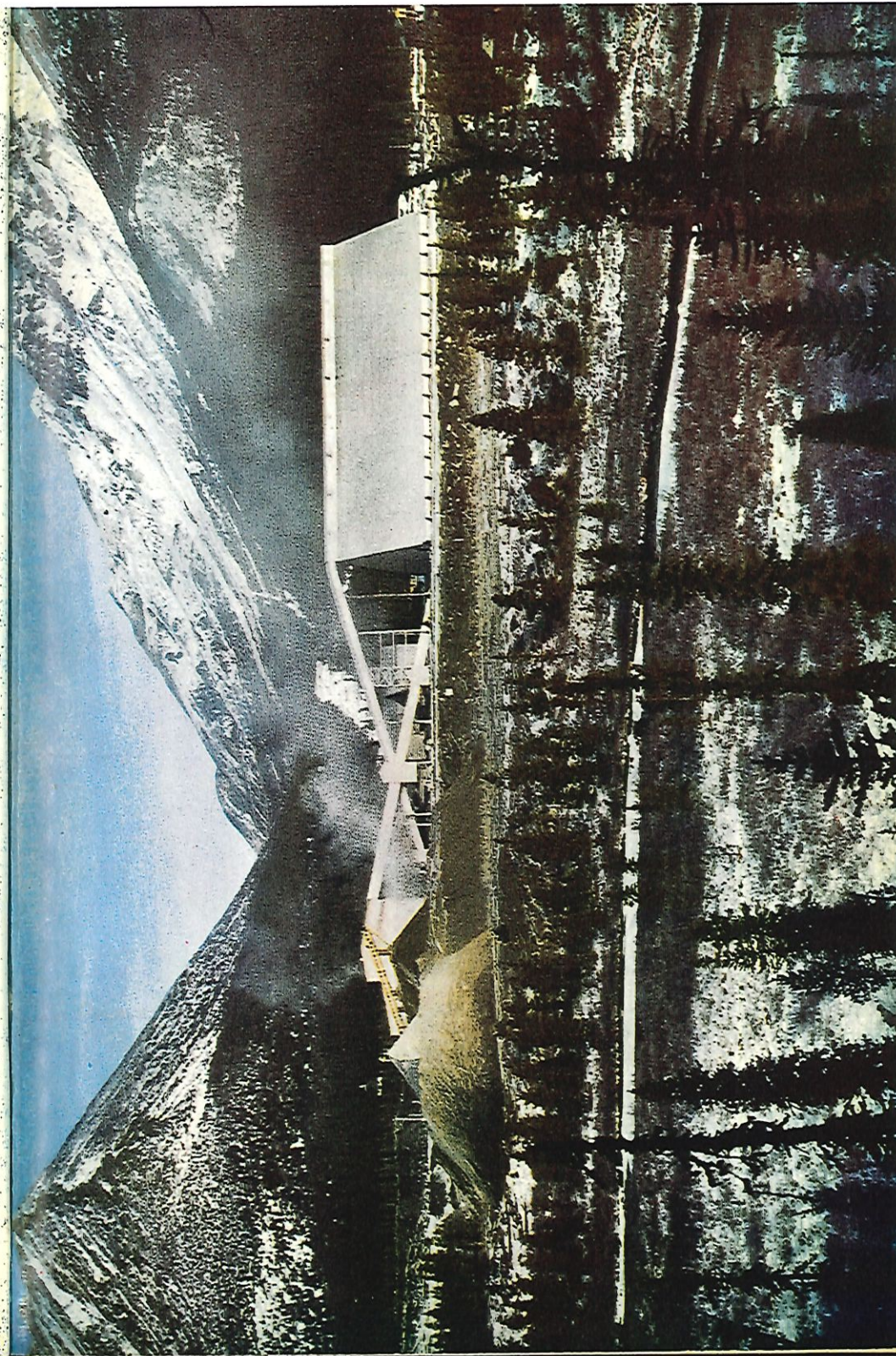
Another shift in the fortunes of the mine occurred in 1936 when, under the direction of Harold Lakes, further exploration was undertaken; in 1939-40 a tunnel was driven southward from the Dodger in search of further orebodies. In studying the geology it was noted that molybdenite was indicated in certain parts of Dodger territory; this being wartime, molybdenite was a "strategic" metal. Samples were sent to the mines departments in Victoria and Ottawa, where examination under the ultra-violet lamp disclosed the presence of scheelite, the mineral of tungsten,

then in great demand. This changed the picture. Now the search was for scheelite, bringing discoveries which resulted in the Wartime Metals Corporation taking over the mine and operating it (September, 1942) as the "Emerald Tungsten Project," with E. E. Mason in charge under instructions to bring the property into immediate production. For the first time ample capital was available; within fourteen months new camp buildings, a $4\frac{1}{2}$ -mile power line, a 6,000-foot tramway and a 300-ton concentrator were built, and new levels were opened underground. Then, in October 1943, tungsten apparently being no longer in short supply, the whole operation was discontinued.

Early in 1947, following an examination by H. L. Batten, engineer for Canadian Exploration Limited, that company acquired the forty-one claims and fractions held by Iron Mountain, including the old Emerald lead-zinc mine, the new Emerald tungsten mine, the Dodger, with its showings of scheelite, and the Jersey, with its deposits of lead-zinc. Harold Lakes was once more in charge. While, owing to relatively higher tungsten prices, the principal search was for scheelite, lead-zinc was not overlooked, with the result that, on the Jersey claims, the 60,000 tons of ore previously mentioned were discovered. Mined by open pit, this was bonanza ore, encouraging further drilling northward along the strike. Tungsten having again declined in price, rendering lead more profitable, it was then decided to increase the capacity of the mill and convert it from the treatment of tungsten to that of lead-zinc, and the Jersey mine was prepared for production at the rate of eight thousand tons a month.

Then came Korea, again increasing the demand for tungsten. This time the Government of Canada got into the picture by buying two blocks of ground (parts of Dodger and Emerald) from Canadian Exploration, the latter undertaking to mine them on a fixed fee basis. The government also built a new camp and tungsten mill close to the Emerald 3800 portal. But the company, drilling on its own account at the north end of the Dodger, encountered unexpected deposits of scheelite; and this brought another shift. The company now took over the new mill from the government and, in September 1952, bought back the two blocks previously sold. Since then the whole property, from the Dodger

Asbestos Concentrator, Cassiar, B.C. →



in the north to the Jersey in the south, has continued under the control of Canadian Exploration Limited, whose efforts have been directed toward the adoption of low-cost mining and ore handling. Mining is mainly by room-and-pillar methods; since 1953, adits and headings have been made large enough to accommodate diesel trucks, which are now chiefly used to transport ore from the workings to the crushing plant. Some of the older parts are still served by track haulage, but this is gradually being eliminated, and in future trackless haulage will be the rule.

Beaverdell, a small mining camp in the western part of the Kootenay country, thirty-five miles west of Midway, is another for which better metal prices and more efficient operation have tended to banish the "feast or famine" condition which characterized its earlier years. Its ores contain silver, lead, zinc, gold, and some cadmium, but the values are chiefly in the silver; when silver was up in price, ore moved out to the smelter, but when the price was down, inactivity reigned.

Claims, clustered on Wallace Mountain, were staked in the early years of the century, the principal ones being the Bell, Highland Lass, Sally, Beaver, Idaho and Wellington. Rich ore was found, but veins were narrow and disrupted by frequent faults. For years all ore was hand-sorted for direct shipment, often running as high as 125 ounces to the ton, sometimes higher, but generally much lower. The camp and main haulage level were at an altitude of approximately four thousand feet.

Many old-time prospectors and miners had been associated at one time or another with the camp. Bob Perry, known as the Lone Canadian—presumably because in those days a Canadian was somewhat of a novelty in the district—owned the Bell mine, but sold out about the time of World War I to Duncan McIntosh, who later sold at a good profit to a syndicate headed by R. B. Staples of Kelowna. This syndicate likewise acquired the Highland Lass and Beaver properties, organizing Highland-Bell Limited in 1936. In 1946, a syndicate of Toronto mining men headed by Karl J. Springer acquired control of the company and undertook to supply the benefits of adequate capital and modern metallurgical methods to the Beaverdell mines.

In 1950, a fifty-ton mill was constructed, which made it possible to mine ore somewhat lower in grade than formerly and to salvage ore dumped in previous years or left in the footwalls or hanging walls of abandoned stopes. At the same time the search for new ore was continued by diamond drilling and underground exploration. Toward the end of 1955 an adit begun in 1954 at an elevation of 2,900 feet (practically at valley level) intercepted the downward extension of an orebody, worked on upper levels, which a fault had displaced a distance of eight hundred feet. This promised the property at least several years' additional life.

Sometimes it seems that the worst that can happen to a mining district is to start with a boom, for the inevitable bursting quite often presents an almost insuperable obstacle to future development. This observation applies with particular force to the Slocan. For a few brief years a region of extravagant promise, it has for nearly fifty years been a land of abandoned hopes. Although both geology and common sense suggest that this does not correctly reflect the possibilities of the region, mine developers and others have continued to give the country the go-by.

There are exceptions to this general rule. And one of the exceptions is Mrs. Viola MacMillan of Toronto, president (actual, not honorary) of the Prospectors and Developers Association, and also of ViolaMac Mines Limited, which operates a silver-lead-zinc property near Sandon in the Slocan. This property, consisting of the Victor group of five claims and the adjoining Cinderella claim, was worked in early Slocan days; the present company has conducted operations only since 1945. Like most Kootenay mines, it is at an elevation of four thousand feet and is worked from a number of adits. The principal vein, the Victor, is nearly vertical, sometimes narrowing to a mere slit, and widening to a maximum of twenty feet. With depth, the vein seems to be improving; the No. 7 level disclosed a length of more than seven hundred feet of developed ore, and the No. 9 has exceeded it in length of ore developed and also in richness of values. The ore had an average grade of twenty-two ounces of silver to the ton, eight per cent zinc, and sixteen per cent lead. Production averages about two thousand tons a month. Clean galena is hand-

sorted and shipped to Trail, but the bulk of the ore is trucked six miles to the Western Exploration mill at Silverton, the concentrates going from there to the smelter.

ViolaMac Mines Limited is interested in a number of properties in various parts of the country and conducts an active outside program of exploration.

The Sheep Creek gold quartz camp, one of the earliest in the Kootenays, after passing through many vicissitudes, is no longer listed among producers. Prominent among mines of the early days were the Nugget and the Motherlode, followed by the Queen, whose history epitomizes the camp's career. Slow in getting under way, it suffered several managements without achieving much until 1933, when it was acquired by Sheep Creek Gold Mines Limited, organized by C. W. Witter of Moscow, Idaho, and managed by H. E. Doelle. Thereafter it produced upwards of three million dollars in dividends. Other profitable Sheep Creek gold mines were the Kootenay Belle and the Reno, both in their time paying substantial dividends.

Sheep Creek Gold Mines Limited typifies the trend from gold to base metals activated by the less favourable price of gold. The company has been careful to devote part of its profits to the development of outside properties, such as the Lucky Jim, a lead-zinc mine in the Slocan, which for a time helped swell its revenues. With the exhaustion of ore at the Queen, the company definitely shifted its interest to base metals, securing the Paradise mine, and later the Mineral King—both producers of zinc, lead and precious metals—at Invermere, in the Golden mining division. Formerly equipped with a 150-ton mill, the Paradise dressed its own ores but now ships to the Mineral King, whose mill capacity is five hundred tons a day.

As confirmation of the company's permanent abandonment of gold, it officially dropped the word from its name early in 1956, becoming simply Sheep Creek Mines Limited.

Yale Lead and Zinc Mines Limited operates a group of lead-zinc-silver mines variously worked for many years. They comprise eighty-four claims between Coffee and Cedar creeks, with

a continuous length of four miles along the strike, in the Ainsworth camp on Kootenay Lake. The mine and crushing plants and the mill are near the Kaslo-Nelson highway, three-quarters of a mile south of Ainsworth. Considerable underground development had been carried out by previous operators and the present company has followed this up with extensive diamond drilling and underground work since 1949. Production began in April 1951, with a 150-ton concentrator and a 250-ton sink-float plant; in 1954, an expansion program was started which, by July 1955, had increased the milling rate to three hundred tons a day.

In the Pend Oreille country, just north of the International Boundary, the Reeves MacDonald is a mine with a large potential, but its ore is so low-grade that any increase in costs or decrease in the price of metal can cause a suspension of operations. Early owners of the property, despairing of making it pay, allowed their claims to lapse, and the ground was re-staked during World War I by Bob Reeves and "Black Jack" MacDonald. Down the years, extensive underground development had been carried out, resulting in reserves amounting to some three million tons of 0.9 per cent lead and 3.5 per cent zinc ore. The owners, Pend Oreille Mines and Metals Company, with headquarters in Spokane, also operate the Pend Oreille mine just south of the Boundary. Hoping for favourable costs from large-scale production at Reeves MacDonald, the company began operations in 1949 with a 500-ton mill, which by mid-1952 had been extended to 1,200 tons a day, but after running a year at this rate, the mine was closed down.

Sunshine Lardeau Mines Limited, controlled by Newmont Mining Corporation, operates the Spider mine at Camborne, in the Lardeau district, producing 8.8 per cent lead, 10.3 per cent zinc, and 12.1 ounces of silver to the ton. The camp and mill are at Camborne and the mine is on Pool Creek, two miles distant. Mill capacity is eighty tons a day; production ranges up to two thousand tons a month, concentrates going to Trail and also to smelters at Kellogg, Idaho, and Black Eagle, Montana.

Writing about Canadian mining, especially for permanent record, is difficult because of the dynamic nature of the subject. Mines which seem well established may suddenly suspend, while properties which seem likely to remain prospects indefinitely can as suddenly blossom into producers. Similarly with the overall picture: shifts in world tension are immediately reflected in the condition of the industry, from prospector to refiner; and no mining region is more sensitive to these influences than the Kootenay country.

IV

Cayuse Country

ITS MOUNTAINS (IN WHICH MOST OF ITS MINES ARE FOUND) MAKE British Columbia a hard country to get about in. The Kootenay was developed first because it was accessible from south of the border; a portion of the Interior could be reached by means of the Cariboo Road, but for many years few other roads existed north of the C.P.R. mainline, and not many more were south of it. In the Canadian Shield, where short streams connect strings of lakes, prospectors can go almost anywhere by canoe, but lakes are relatively scarce in British Columbia and its rivers are always in a hurry. Consequently, if prospectors in British Columbia did not care to carry their outfits on their backs, their only recourse was to the patient pack-horse—in the language of the country, a cayuse. Boats could be used, of course, along the coast, and it is perhaps not strange that one of the earliest mines to be established was the Britannia, twenty-seven miles north of Vancouver.

In 1887, A. A. Forbes, a young American physician, established his home near Hopkins Landing on Howe Sound. He became acquainted with a man named Granger whose business consisted of extracting fish oil for the lubrication of skid-roads for loggers' operations along the coast nearby. Granger showed Dr. Forbes some samples of heavily stained float, which he said he had picked up on the mountain since known as Britannia. Appreciating its probable importance, Forbes offered to pay Granger four hundred dollars if he could show him similar ore in place. Although they climbed the mountain a number of times, Granger failed to locate the ore; but one day, according to an account given later by Forbes, they wounded a deer which, in its writhings, uncovered mineral. The showing in a hole which they dug satisfied the doctor and he paid Granger the promised reward on condition

that he tell no one about the find. Granger kept his word; with the money, he bought a boat and set off for Alaska, and Forbes saw him no more. Forbes subsequently sank a shaft to a depth of eighteen feet, but since no facilities existed for recording a claim, the property was neither staked nor recorded.

Shortly afterwards, Dr. Forbes accepted the post of resident doctor for a large logging operation at Wolffsohn Bay, but he found time to do some prospecting, and located on Texada Island two outcrops which were later found to consist of copper ore. He called them the Little Billy and the Copper Queen; the latter was to have an extensive history. The doctor had no means of developing his finds and was unable to spare time from his practice to search for capital, but he gave some samples of ore to a young man named Jack Sly who worked for the logging outfit and made occasional trips to his home in Seattle. Sly was to show these samples to people in Seattle who might be interested in mining. The samples, however, were lost.

Some time later Dr. Forbes noticed tents on Texada Island, and on paddling across the intervening strip of water he discovered that the campers were two Californian ranchers, the Bluett brothers, who had found Sly's samples on the window-sill of a Seattle saloon. The samples were marked with the location of the property, and the ranchers, coming to Texada Island, had soon found Dr. Forbes's Copper Queen workings. They could easily have jumped the doctor's claim, but they offered to form a company, put in \$250,000 and raise the additional money necessary to bring the property to production. Only then were the claims recorded. After the company (Vananda Copper Company) was incorporated, the elder Bluett went to New York to look for capital. There he met one H. W. Treet, who bought ten-thousand shares. Treet's wife had money of her own and became intrigued by the idea of owning a copper mine in the wilds of British Columbia. She and Treet travelled out to Texada Island where they built a log cabin and became so enamoured of the situation that they bought the Bluett brothers' controlling interest as well as Forbes's one-third. The mine has been operated intermittently by a succession of owners, chief of whom, the Tacoma Steel Com-

pany, is said to have shipped high-grade ore to the value of eleven million dollars.

Dr. Forbes was still interested in the outcrop on Britannia Mountain, but was unable to do anything about it until 1897 or 1898, when a Vancouver man named Turner came to see him, saying that he would like to stake some mining claims. Dr. Forbes supplied him with a chart by which he might find the Britannia outcrop and shaft. Turner, however, was no prospector; he grubstaked Oliver Furry to prospect for him, and Furry located what later became part of the Britannia mine. Turner was the Vancouver agent of Boscowitz and Company, Victoria merchants, who transferred the property to the Britannia Copper Syndicate in 1900 for \$100,000.

The Britannia Mining and Smelting Company (now wholly-owned subsidiary of the Howe Sound Company of New York), was incorporated in 1905 and has the oldest continuously-operated mine in British Columbia, with a total production valued at considerably over a hundred million dollars. Producing copper, zinc, gold and pyrite, it is worked from adits, shafts and winzes; its main haulage tunnel, at the 4,100-foot elevation, is approximately 20,175 feet long and is connected with many miles of underground workings, reaching a depth of nine hundred feet below sea level. The concentrating plant, rising tier upon tier from the water's edge, has a capacity of 6,500 to 7,000 tons daily, but in recent years production has averaged only about half that amount. An interesting feature of the mine is the manner in which mine water is made to contribute revenue by being diverted through a series of tanks filled with old cans from which the tin has been removed, allowing the underlying sheet iron to be absorbed and the copper in solution to be precipitated in its place.

Although the largest mines in British Columbia are base-metal, gold mines, because they cost relatively less to develop, have generally been preferred by both prospectors and operators. One of British Columbia's earliest gold mines, and one with a most varied history, is the Bralorne, in the Bridge River area. Bridge River is a tributary of the Fraser, flowing in a few miles above Lillooet. In 1897, and possibly earlier, prospectors looking for placer diggings located quartz outcrops along Cadwallader Creek,

a tributary of Bridge River near its headwaters. The gold-bearing structure comprises a diorite stock about three miles long and half a mile wide intruded into rocks consisting chiefly of quartzites, argillites and serpentine. Following the discovery, a number of claims were staked along the valley, but only two operating companies have survived; these, however, are among the most productive gold mines in the country.

The Lorne, principal ancestor of Bralorne, was controlled for many years by Arthur Noel, typical of those who, having become convinced they have a mine, hang on through all sorts of difficulties. His first plant consisted of an "arrastra," a home-made contraption, the original of which came up from Mexico. An arrastra consists of a heavy piece of granite, dragged with a circular motion over a confined, rock-paved floor. The granite block crushes and grinds the ore against the underlying rocky bed. Motive power is often supplied by a horse hitched to a long sweep; but at the Lorne the power was derived from an overshot water-wheel, twenty-eight feet in height, which drove two arrastras, each twelve feet in diameter. The gold was separated from the pulverized ore by the addition of a little mercury.

Sometimes Noel was able to grind out enough gold to pay and feed a few miners, but in times when unprofitable development work must be done he slaved alone or with the help of his wife, a hard-rock miner in her own right. Visitors reported having arrived when only she and her husband were on the property, to find her tramping ore to the arrastra, while Noel blasted it out of the diggings.

By 1900, sufficient had been done to justify the erection of a five-stamp mill, but the little plant stood idle for sixteen years while the property was tied up in litigation. Then came a company reorganization, when Lorne Amalgamated Mines was formed. The mine was operated for only a few months in summer, the most profitable ore being drawn from what was called the King vein. In 1928, Lorne Amalgamated was itself amalgamated with three nearby properties and a new company, Lorne Gold Mines Limited, was incorporated. Some money was raised, making possible a certain amount of underground work.

In 1931, when control was acquired by a group of Vancouver men headed by Austin Taylor, Bralorne Mines Limited, compris-

ing what once were three different mines, the King, the Empire and the Coronation, came into existence with sufficient working capital to finance a 100-ton mill, which began operations in February 1932. The mill has been extended from time to time until its capacity has reached 550 tons a day. The three original properties are connected by a main haulage tunnel six thousand feet long at the eighth level. In recent years new orebodies have been located containing mill-feed of a higher grade than the former average, and it would seem that this mine with more than half a century of chequered existence can still count on many years of profitable operation.

Much of Bralorne's success has been due to M. M. (Mel) O'Brien, one of the ablest and most popular mining men in western Canada. Son of a Nova Scotia miner, O'Brien began work in the coal mines of Springhill, N.S., during school vacations when only eleven years of age, and continued for seven years. After taking his degree in mining engineering at the Nova Scotia Technical College, he went west with the Geological Survey of Canada in 1913, remaining in British Columbia to work in mines at Rossland, Grand Forks and Kimberley. For seventeen years he was employed by Cominco, acquiring a wide variety of experience, and in 1944 became vice-president and managing director of Bralorne.

The Pioneer mine, sharing with Bralorne the productive area on Cadwallader Creek, was staked about the same time by F. H. Kinder, and its early history was similar to that of its neighbour. Pioneer's fortunes took a turn for the better with the coming of David Sloan, a mining engineer (born at Perth, Ontario, in 1881) who arrived in British Columbia shortly after World War I, on the lookout for a mining property that he might handle himself. Directed to Bridge River, he looked over the Pioneer and took an option. The great bull market that ended with the crash of 1929 had not yet begun, and money for a mine hidden among the mountains of British Columbia was not easy to get. Sloan succeeded in interesting A. H. Wallbridge of Vancouver, who undertook to raise \$6,500, the least for which the minimum amount of equipment could be bought; but in order to raise this trifling sum Wallbridge was compelled to interview some thirty or forty per-

sons before finding six who would take a chance on \$1,100 each. In 1928, Pioneer Gold Mines of B. C. Limited was organized, taking over from the original syndicate. Colonel Victor Spencer, member of a well-known British Columbia family, became president of the company and continued in the post for many years. The original mill (100 tons a day) turned over first in 1928, and since that time the mine has been a steady producer (mill capacity increased to 400 tons in 1933-34). David Sloan, a man of high character in whom his associates probably, at the time, had more faith than in the mine, met an untimely death in an aeroplane accident just as the picture at the mine was beginning to brighten.

Both the Bralorne and the Pioneer are typical of the sort of mines that encourage people to continue putting money into propositions which seemingly have little but the faith of their owners to commend them, yet which eventually justify that faith. Pioneer has produced ore valued at over forty million dollars, while Bralorne has produced over sixty-five millions.

Toward the end of the first decade of the twentieth century, a boom developed in Western Canada—not, however, caused by mining. It was an era of railway-building, with immigrants flocking into the country and creating a market for land. Every town had its little boom, while such cities as Vancouver and Edmonton had big ones. Money for mining was still hard to come by, but a loosening of the purse-strings did occur at the prospectors' level, especially in sections about to be opened by new railways.

Prince Rupert, terminus-to-be of the Grand Trunk Pacific Railway, was one such spot. It became the point of departure for prospectors with their eye on that section of the Coast Mountains about Portland Canal, 150 miles north of Prince Rupert.

What is known as the Alaska Panhandle is a narrow strip of territory, including offshore islands, extending southeastward for over four hundred miles from the main part of Alaska along the forefront of British Columbia. It varies in width according to the penetration inland of the numerous indentations, all of which, in their entirety, are within Alaskan territory.

Portland Canal is a long, narrow inlet which, with its entrance, forms about a hundred miles of the southeastern boundary of the

Panhandle. At the head of the canal is the town of Stewart. Roughly paralleling Portland Canal, at an average of about ten miles to the east, is Observatory Inlet, sharing a common entrance and extending inland for about fifty miles. The coastline trends northwesterly but both Portland Canal and Observatory Inlet run approximately north and south. Eighteen miles from its head, Observatory Inlet branches eastward into Alice Arm, at the upper end of which is the town of Alice Arm. Both inlets consist of narrow strips of ocean, hemmed by mountains towering to snow-capped heights, and both receive many glacier-fed streams. The Salmon and Bear, flowing into the head of Portland Canal, and the Kitsault and Illiance, flowing into Alice Arm, are the most important of these.

On Salmon River, near Joker Flats, about eighteen miles beyond the head of Portland Canal, Dan Lindeborg staked the Big Missouri group. Values were erratic, but over a wide area high assays could occasionally be secured. It was a teaser; and Lindeborg did well optioning it to one outfit after another, but all sooner or later wiped their hands of it—all, except, eventually, Cominco, which in some unaccountable way, despite the unfavourable history of the place, embarked upon a program involving a 700-ton mill, unique in the world inasmuch as the entire plant and all installations were completely underground to escape the effects of excessive snowfall. After several hundred thousand tons had gone through the mill, the whole thing was abandoned.

In 1910, also on Salmon River, the two Bunting brothers and a partner named Dilworth discovered gold-bearing quartz veins and staked five claims. Among the prospectors enticed to the region by news of the find was O. B. Bush of Vancouver, who staked five claims, samples from which assayed \$42 in gold and 671 ounces of silver to the ton. Bush organized the Salmon Bear River Mining Company, bought additional claims, and persuaded prospectors Morrison and Logan, with adjoining claims, to throw in their lot with him.

The boom collapsed shortly after this, not only in the Portland Canal region but everywhere else in the west. No one had any money for prospecting. Bush and his foreman, Pat Daly, hung on, however, attempting by means of an adit to discover the down-

ward extension of outcrops found higher up. Their trouble seemed over when H. R. Plate arrived, representing W. Boyce Thompson of New York, examined the property, liked the look of it, and bonded it for \$150,000. An exploratory adit eventually encountered high-grade ore, but when what seemed to be the vein had been followed for seventy or eighty feet, the ore suddenly disappeared. The adit was continued for some distance, but to no effect; and after spending \$100,000, Plate threw up the option.

Left in charge, Pat Daly kept grimly on, hoping to find the missing orebody, but he was unable to do much without money. He finally succeeded in persuading a capable mining engineer, R. K. Neill of Spokane, to take an option. With the backing of a group of Fernie capitalists, Neill decided to attack the problem by running a series of crosscuts, the first of which, run to the right near the spot where the ore had ceased in the adit, cut thirty feet of high-grade. A single round in a crosscut begun by Plate, farther along, also found ore. It was like a dream come true.

Dale L. Pitt, scout for the American Smelting and Refining Company, hearing the news, recommended the property to his principals, and in 1919 the big company took it over for \$1,000,000 cash and a 48-per-cent stock interest in the Premier Mining Company Limited, which was incorporated to operate the mine. Dale Pitt became its manager, a post he held, with occasional absences on other jobs, until shortly before his death in 1955.

The first ore, from the rich upper ore-shoots, continued for a number of years, averaging about 0.70 ounces of gold and 20.70 ounces of silver, but by 1934 these values had shrunk to 0.17 ounces of gold and 4.38 ounces of silver. The original milling capacity was 300 tons a day, later increased to 500, the higher grades being shipped for many years to the Tacoma smelter of the parent company; but in later years everything was concentrated at the mine. An aerial tramway, unequalled anywhere else in the world in some respects (length, height above valley floor, and length of spans), connected the mine with tidewater.

While these operations were in progress, C. A. Banks, a young mining engineer who was later to become Lieutenant-Governor of British Columbia and a famous mining man, had secured an adjacent tract not previously considered of much value. Into this he

drove a long crosscut, encountering a fine orebody which became the property of B.C. Silver Mines Limited. In 1935, an agreement was reached between Premier, B. C. Silver and the Selukwe Gold Mining and Finance Company of London, England, controlling other properties adjoining the Premier, to form a company called Silbak Premier Mines Limited. The new company was to operate these and nearby properties under the management of Selukwe, which held the controlling interest. Since World War II, lead and zinc, which were contained in some of the ores but formerly ignored, have been recovered, in addition to gold and silver. In 1951, Silbak Premier undertook to develop the adjoining property of the Premier Border Gold Mining Company Limited.

Although claims were staked beyond the upper end of Observatory Inlet and the head of Alice Arm as early as 1900, little came of these pioneer efforts, and it was not till 1910 that, under the influence of boom conditions, any extensive development was undertaken. Copper prospects on Hidden Creek, which flows into the west side of Observatory Inlet opposite the mouth of Alice Arm, had been staked in 1901 and were now optioned by M. K. Rogers, already mentioned in connection with the Nickel Plate mine at Hedley. Rogers turned them over to The Granby Consolidated Mining, Smelting and Power Company Limited, which was looking for a mine to succeed the apparently worked-out Phoenix, in the Boundary country. The Hidden Creek prospect contained extensive deposits of two-per-cent copper ore, and the Granby company built a mill and smelter at Anyox, on tidewater nearby. Some twenty-five million tons of ore were put through the mill between 1914 and 1935, when the mine was closed down for lack of ore; but, with high copper prices, it would not be surprising if the old camp should one day experience a new lease on life.

The Anyox-operation provided an incentive for prospectors; and many were busy along the Kitsault River. In 1910, Don Cameron, later well-known in British Columbia and the Northwest Territories and in Ontario, staked the Wolf group. About the same time, Gerhardi staked the Homestake; Ole Evindsen, the Dolly Varden; and Gus and John Strombeck, the Toric.

The Dolly Varden, seventeen miles up the Kitsault, where high-grade was struck in 1915, was first to get into production. The Dolly Varden Mining Company, controlled in Chicago, believed it to contain large deposits of silver-bearing ore which could be easily mined from adits. To get the ore from mine to tidewater, where it could be shipped to Anyox, the company decided to build a narrow-gauge railway; the contract for its construction was given to the Taylor Engineering Company of Vancouver, headed by A. J. T. Taylor, subsequently well known for his large realty promotions in and around Vancouver. Taylor took the contract on a cost-plus-ten-per-cent basis; the cost far exceeded the estimates; the company went broke, and Taylor came into possession of the mine. He now proceeded to operate the property, but apparently did not realize that high-grade replacement ore taken from shallow workings might not go to depth, for he undertook such expensive projects as an extension of the railway and the building of a hydro-electric plant and ore-bins at Alice Arm. Although 1,364,847 ounces of silver were taken from the mine in a short time, it could not meet the added costs when leaner ore became the rule, and 1921 saw the end of operations.

Aside from Granby's mine at Anyox, the most successful one in the Observatory Inlet region has been the Toric and its successor, Torbrit, located on the east side of the Kitsault River a short distance below the Dolly Varden. The stakers, Gus and John Strombeck, did the early development work, but Gerhardi, interrupted while transporting some heavy equipment to his prospect farther up the valley, took advantage of the opportunity to examine the Toric showings. He secured an option on the latter for the Consolidated Homestake Mining and Development Company Limited, which continued with development until 1927, by which time an orebody 280 feet long and apparently 70 feet in width had been disclosed. A reorganization then occurred, control passing to the Toric Mines Company Limited, and capital was raised to enable the installation of a fifty ton mill. During the next two years, 2,080 tons of ore passed through the mill, producing 30,533 ounces of silver.

In 1929, the Britannia Mining and Smelting Company Limited bought control, continuing with development. The declining

price of silver and the depression brought about suspension of operations, and for some years the mine was idle. In 1946 the property was bought by Torbrit Silver Mines Limited, in which The Mining Corporation of Canada Limited holds a controlling interest. A road, replacing the railway, was built from Alice Arm, the mine was developed, a power plant was built, and production started in 1949.

The Giant Mascot silver-lead-zinc mine, about eight miles west of Spillimacheen, in the Golden mining division, is the focal point of a good deal of British Columbia mining history. The property was staked in 1890 (on a tip from a half-breed named Baptiste Morjeau) by Fred M. Wells, who claimed to have been the first person actually to operate a lode mine in the province. Wells, who died in 1956 at the age of ninety-six, had to his credit, in addition to Giant Mascot, two other dividend-paying mines.

In the first years, little development work was undertaken, and it was not till 1907 that Golden Giant Mines Limited was organized and a small mill employing what was called the Elmore flotation process was erected. This operation was not a success. From 1908 till 1926, except for the occasional shipping of small quantities of hand-picked ore, the mine remained idle, but in the latter year it was acquired by A. B. Trites, a Vancouver promoter. Angus W. Davis, a well-known mining engineer, was put in charge and a considerable amount of development work was done—apparently to little avail, for within two years new interests were in control. Then, for nearly twenty years, the mine marked time. In 1947, a new effort was made to bring the property into production when Silver Giant Mines Limited was formed. Next year, Siscoe Gold Mines Limited secured an option, but dropped it after a year. Hedley Mascot Gold Mines Limited, whose mine at Hedley, adjoining the Nickel Plate mine, had exhausted its ore, assumed control in 1950, and this was followed a year later by the amalgamation of Hedley Mascot and Giant Mascot Mines Limited, with R. B. Buckerfield of Vancouver as president. The mine's wanderings in the wilderness seemed over. Under the direction of H. L. Hill, consulting engineer, new orebodies have been located and previously known orebodies extended. Production was begun late in 1951 with a mill capacity of 100 tons a day, increased shortly after to 250 tons and then, in 1952, to 600 tons.



R. H. "Pat" Stewart



W. Schultz Photo

Ralph W. Diamond

S. G. Blaylock

Associated Screen News



Walter H. Aldridge

Fabian Bachrach Photo





Charles A. Banks



Mel M. O'Brien
Courtesy Who's Who in Canada



Lawrence T. Postle
Courtesy The Northern Miner



Frederick Wells
Courtesy Vancouver Daily Province



Dredging for gold in the Klondike

Courtesy Canadian
Metal Mining Ass'n.

Hydraulic monitor sluicing gold-bearing gravel

Fed-News





George W. Carmack
Provincial Archives,
Victoria, B.C.



Joseph B. Tyrrell
Imperial Oil
Company



Robert W. Service



Robert Henderson
Courtesy Provincial Archives, Victoria, B.C.

Wells himself did not remain long in the Spillimacheen country; the Rossland boom drew him as iron to a magnet. He found no new mines there, but achieved success of another kind: in each of the years 1898, 1899 and 1900 he won the B.C. championship for snowshoe racing. With the collapse of the boom, he decided to try the Coast Mountains, and on Princess Royal Island, in the Skeena mining district, he located the Belmont-Surf Inlet mine which, when the ore became exhausted in 1926, had produced some eight million dollars.

Wells's most spectacular effort was yet to come. Like many others, he had speculated as to the origin of the rich Cariboo placer deposits, but he disagreed with the generally accepted theory that the mountains containing lodes from which the gold must have come had been ground down by glacial action until only barren gangue material was left. This theory seemed to be confirmed by the fact that wide quartz veins showing here and there through the heavy glacial drift did not carry any appreciable gold. Wells believed that the mountains still contained gold-bearing veins, not the ones with which everyone was familiar, but a secondary system—"B" veins, so classified by geologists Uglow and Johnston—which, because of oxidation, did not show on the surface.

Strange as it may seem, most of the citizens of Barkerville, especially the oldest inhabitants, strongly disagreed with this theory; and when Wells arrived on an exploratory visit the hostility he encountered soon caused him to leave in disgust. Some agreed with him—notably Fred J. Tregillus, who in 1956 was still living in Barkerville on the proceeds of his good judgment. Tregillus, who was born in Plymouth, England, in 1862 arrived in the Cariboo in 1886, and became a successful placer miner. This did not prevent him, however, from staking a number of quartz claims, one group of which he and his partner, T. A. Blair, are said to have sold for \$100,000.

Wells returned to Barkerville in 1926, determined to put his theories to the test, and this time he was backed by a syndicate of Vancouver men headed by Dr. W. B. Burnett. He examined the country about Jack of Clubs Lake, northeast of Barkerville, particularly on Cow Mountain, where a prospector named Al Sanders had some claims on which gold-bearing quartz had been

found. Wells persuaded Sanders to throw in with him, and acquired additional claims. In the fall of 1926, The Cariboo Gold Quartz Mining Company Limited was incorporated.

So far the going had not been particularly hard, but when Wells and Burnett attempted to raise money for development, the extent of the hostility became evident. Wells, in mistaken enthusiasm, described his ores as akin to the telluride ores of Cripple Creek and Grass Valley, two notable American mining camps. To this claim the British Columbia Department of Mines took strong exception and accused Wells of misrepresentation. He was declared to be an opinionated prospector, devoid of geological knowledge; Dr. Burnett, admittedly an honest man, was said to be Wells's dupe.

Disallowed from interesting Vancouver brokers in the stock, Wells and Burnett at length found in O. H. Solibakke of Seattle an associate whose enthusiasm never failed, a man capable of rising above every discouragement. Many ultimately successful mines have struggled for years on a shoestring, but few have encountered the obstacles which faced Cariboo Gold Quartz. Solibakke organized a selling force, disposing of the stock, a few shares at a time, in various parts of the United States in Honolulu and Alaska, in England and Norway; some were even sold in a few places in Canada. Wells was four years advancing his adit to the point where he could confront his detractors with geological realities, not theories; it eventually intersected six ore zones. Milling began on January 10, 1933, with a mill of 50-75 tons a day capacity, gradually increased to 360 tons. In 1936, payment of dividends began, and during the next seven years a total of \$1,679,968 was returned to shareholders—some of it unwisely perhaps, in view of later difficulties. During the war years, production was drastically cut back, while costs increased.

In 1954, the property (excluding plant) of Island Mountain Mines Company Limited, controlled by Newmont Mining Corporation of Canada Limited* was bought by Cariboo Gold Quartz for \$300,000. It consisted of thirty-two claims and fractions on the opposite side of Jack of Clubs Lake, and had been operated since 1952 on a salvage basis. The principal value of this acquisi-

*Subsidiary of Newmont Mining Corporation, representing the W. Boyce Thompon interests of New York.

tion was that Island Mountain's shaft, some nine hundred feet deeper than the lowest Gold Quartz workings, would enable Gold Quartz to explore lower levels at a minimum cost.

Following acquisition of the Island Mountain property (now called the Aurum zone), Cariboo Gold Quartz increased its daily production to 325 tons. This, with prospects of higher-grade ore at depth, gives the management reason to hope that the mine may before too long rejoin the ranks of dividend-payers.

A boom, short-lived but exciting while it lasted, occurred at Zeballos on the west coast of Vancouver Island in the period after World War I. Narrow but extremely high-grade gold quartz veins were discovered. As usual, the country round about was blanketed with claims, and stock in a considerable number of companies was sold to speculators in many countries. It was a gold camp whose future seemed to be assured when the price of gold advanced in 1934, and several mines succeeded in reaching the production stage. Only three, of which the Privateer was outstanding, were dividend-payers. World War II, during which gold mines were at a disadvantage because of the fixed price of gold, was unusually hard on Zeballos mines, and one by one they suspended. The camp will undoubtedly be heard from again should the price of gold ever rise in relation to that of other commodities.

In the extreme northwestern corner of British Columbia, three mines are more or less interdependent. The Tulsequah Chief was staked in 1923 by W. Kirkham, a prospector from Juneau, Alaska. During the next six years a considerable amount of development work was done by two different companies, but the depression put an end to all operations. The mine lay dormant until 1946 when Cominco undertook a drilling and underground exploration program, ultimately proving up sufficient ore (silver-lead-zinc-copper) to justify production.

The second mine, called the Big Bull, about ten miles from the Tulsequah Chief, was staked in 1929 by Victor Manville, who was grubstaked by a group of Juneau business men. After a number of companies had tried their hand at making a mine, the property was acquired in 1946 by Cominco, which in the next few years met with greater success.

Cominco had now two mines ready for production, but was without a mill; and here is where the third mine comes in. The Polaris-Taku mine, discovered in 1929 and originally known as the Whitewater, was located between the Tulsequah and the Big Bull. It was operated from 1937 to 1942 by a Duluth group; a 150-ton flotation mill was erected, and produced an arsenical-gold concentrate, but war shortages made suspension necessary. After the war, the mine was acquired by Transcontinental Resources Limited and operated from 1946 to 1950 under a subsidiary, New Taku Mines Limited. Rising costs, however, forced a second suspension.

In 1951, Cominco's two mines were ready for production and the idle Polaris-Taku mill seemed a natural complement to them. Cominco therefore rented the mill for a term of years, converting it to treat base metals and increasing its capacity in 1952 to five hundred tons a day. Ore from both mines is trucked to the mill, concentrates being shipped down the Taku River in barges propelled by tugs and transferred to ocean steamers at Taku Point. Lead and zinc concentrates go to Trail, while the copper concentrate goes to a custom smelter.

That the central interior region of British Columbia possesses great mineral possibilities has long been recognized, but although work has been done on many prospects, no outstanding mine has yet been produced. One of the most promising, perhaps, is the Silver Standard, a gold-silver-lead-zinc producer near Hazelton which has been worked off and on since World War I days, although not till 1948 was a mill provided (60 tons, increased to 80 in 1951). Aside from low metal prices, the chief reason for suspension has usually been the pinching-out of ore, but in each case enough new ore has eventually been found to justify resumption of production.

Another mine in the Hazelton district which has had its ups and downs is the Red Rose Tungsten, owned by Cominco and operated by that company during the early years of World War II, but closed down when the national need for tungsten declined. The mine was later leased (till 1960) to Western Tungsten Copper Mines Limited and production was resumed in 1952, but a further suspension occurred in 1954, when the United States Government discontinued its buying of tungsten concentrates.

In the same general region, but farther to the east, is a mine which some day may take its place as a steady producer but which so far has required a war to justify its operation. That mine, at Pinchi Lake, is Canada's chief source of mercury, and is also owned by Cominco. In 1943, it produced 20,000 flasks (flask: 76.5 pounds), or a little less than one-seventh of pre-war world production. While capable of supplying more than Canada's needs, it cannot produce at a price to compete with mines in Spain and Italy, where the most productive mines are, or even with mines in Mexico and the United States, which supply a smaller part of the world's needs.

From time to time, over many years, work has been done on various base-metal properties in the Ashcroft-Kamloops region of southern British Columbia, but the verdict usually was that values were too low to admit of economic development. In 1955, however, Bethlehem Copper Corporation Limited completed the acquisition of 141 claims in Highland Valley, twenty-six miles southeast of Ashcroft, and entered into an agreement with the American Smelting and Refining Company to undertake active exploration. Results of subsequent drilling indicate deposits which, although low in grade, are considered sufficient in tonnage to justify large-scale operation.

This chapter began with an account of the Britannia, a large copper mine on the flank of the Coast batholith, which has been a steady producer since the early days of the century; and it may quite appropriately end with an account of a prospective mine which could easily rival, if not exceed, Britannia's production and length of life.

In 1951, on behalf of Helicopter Exploration Company Limited, of which Karl J. Springer is the active head, E. Kvale and T. McQuillan staked a group of claims above the Leduc glacier in the Coast Mountains near Stewart, and additional claims have since been staked for the same principals. Examined the following year by engineers of Granby Consolidated, the property was acquired by Granduc Mines Limited, a newly incorporated company controlled by Granby in association with Newmont Mining Corporation. A mining plant, diamond drills and assaying equip-

ment were flown to the property and a tent camp was erected on the glacier, the discovery having been made that planes on floats could land with loads on the snow-covered surface of the glacier. Additional equipment and supplies were taken in by tractor train.

The property is twenty-five miles northwest of Stewart and about four miles east of the Panhandle boundary, which follows the crests of the mountains. Several outcrops have been located, the lowermost at an elevation of 3,260 feet, seventy-five feet above the surface of the glacier; and the uppermost at an elevation of 4,800 feet. Exploration is from adits run into the mountain in a generally northeasterly direction, and diamond drilling has proceeded, both underground and on the surface. About forty million tons of ore averaging 1.7 per cent copper were in sight at the time of writing, with not all orebodies yet tested nor the limits of any determined. Both tonnage and grade were such as to indicate a large-scale operation.

V

The Klondike

HAD IT NOT BEEN FOR THE HYSTERICAL BEHAVIOUR OF A HUNDRED thousand people drawn from the four quarters of the globe, but chiefly from the United States, who stampeded into the country in 1898 and the next couple of years, the Yukon Territory might have remained a largely unknown part of Canada. As it is, most Canadians associate the Yukon with more or less perpetual snow; malamutes and huskies; long lines of men struggling over the snowclad heights of Chilkoot; bearded miners scattering nuggets of gold among dancehall girlyies or betting their pokes on the turn of a card or a flip of the dice; with Dangerous Dan McGrew, Sam McGee, and the Lady That's Known as Lou. The Klondike Gold Rush was one of the most colourful episodes in Canadian history, and the Yukon has taken half a century to recover from it.

Yukon Territory, more than half the size of Ontario—it occupies 207,076 square miles—is a triangular area divided from Alaska on the west by the 141st meridian of west longitude, and from British Columbia on the south by the 60th parallel of north latitude. On the east, the crests of the Mackenzie and Richardson mountains separate it from the District of Mackenzie. In the north, for an airline distance of 120 miles, it is bordered by the Arctic Ocean. The Territory is cut diagonally by the Yukon River, which has a length of 714 miles in Canada and flows its final 1,265 miles to the sea through Alaska, making a total of 1,979 miles.*

The goldfields commonly referred to as the Klondike lie in the relatively small area (about 800 square miles) bounded on the west by the Yukon River; on the north, by the Klondike River;

*The length of the Yukon is variously given. This is due in part to the difficulty of measuring a river that continuously shifts its course. The above figure is from the *Canada Year Book*.

on the east, by Flat Creek, a tributary of the Klondike, and Dominion Creek, principal tributary of Indian River; and on the south, by Indian River. Most of the streams flowing through the area were gold-bearing in varying degree, not all rich enough to pay for working. The most important were Bonanza, with its famous tributary, Eldorado; Bear and Hunker, also flowing into the Klondike; and Dominion, with its tributaries Gold-run and Sulphur, flowing into Indian River.

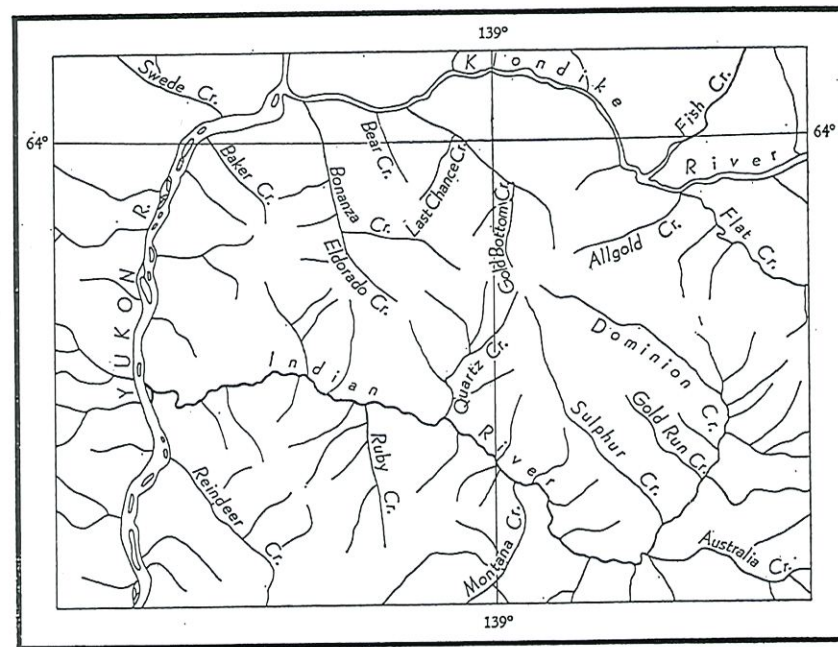
The Klondike region may be described as a high plateau cut in all directions by numerous deep, wide, flat-bottomed, branching valleys which are separated by a system of long, round-backed ridges averaging 1,500 feet above the valley floor. Most of these ridges centre in the Dome (4250 ft.), the highest eminence in the district, about nineteen miles southeast of Dawson and about midway between the Klondike and Indian rivers.

When the greater part of the North American continent lay under ice-sheets, the Klondike area seems to have been free of this encumbrance. Previous to that period, the Yukon plateau had been eroded to peneplain level, and there had then been a period of elevation and subsequent dissection by stream action. In more recent times a second rise has occurred, resulting in a deepening of the valleys by from 500 to 700 feet. As the Yukon River, the governing factor in the area, deepened its channel, streams draining into it steepened their grades, cutting V-shaped valleys and leaving portions of the old valley-bottoms at many points to form terraces of varying widths bordering the newer valleys. When the Yukon had again reached a base-level, these streams slackened their courses to meander down ever-widening U-shaped valleys. The placer gold has apparently been concentrated, during the course of the plateau's dissection by the action of these streams, from the disintegration of auriferous quartz veins intruding the Klondike schists. Despite the vast quantities of gold that have been taken from the Klondike, geologists are of the opinion that the percentage of gold in the rocks was relatively low. In this regard it is interesting to note the wide variations in the fineness of gold taken from the various creeks, and even from different places along the same stream. For example, on Dominion, the value of gold taken from the upper

section was \$16.75, a fair average for Klondike creeks; but at different points below, values were \$17.04, \$17.26 and \$17.50 per ounce. On Hunker, the average value above the mouth of Goldbottom was \$17.25, and \$16.50 to \$17.00 below. Farther down, the gold was worth less than \$15.00; while on Last Chance, another tributary of Hunker, values ran from \$14.50 to \$15.00 an ounce.

In the upper portion of the inset map, Goldbottom Creek may be seen flowing northward into Hunker Creek, just east of the 139th line of longitude, with Last Chance Creek joining Hunker farther to the northwest.

KLONDIKE GOLDFIELDS



Even before the country was denuded of timber and torn asunder by various forms of mining, the streams were generally small, seldom exceeding fifteen feet in width, even at their mouths; the fall near the head was usually rapid, but the grade decreased considerably in the lower reaches. The Klondike River,

much the largest, with a fall of from twelve to fifteen feet to the mile, interrupted by frequent bars, averaged about 150 feet in width. Indian River, a much smaller stream, had a width of from 60 to 120 feet, but was very shallow, the water over the bars seldom exceeding a few inches in depth. Bonanza Creek, comparatively small, joining the Klondike about three-quarters of a mile above its mouth after a course of little more than seventeen miles, was, in ordinary stages of water, about fifteen feet wide at the mouth, with three or four inches over the bars; while Eldorado, about seven miles long, was only from three to six feet wide at its mouth. Hunker, emptying into the Klondike about six miles above Bonanza, had a length of about fifteen miles. Dominion, the largest tributary of Indian River, and one of the most important of the gold-bearing creeks, had a circuitous course of about thirty miles and was about twenty-five feet wide at its mouth, with an average depth over the bars of about a foot. All these streams had many branches, which in turn had other branches.

Before the age of aviation, the Yukon River was the great highway of Alaska and the Yukon. Its headwaters, in Canadian territory, are less than twenty miles from tidewater, but the western slope of the Coast Mountains and the port of Skagway, at the top of Lynn Canal, are in Alaska, as is also the lower part of the river. This means that to reach Yukon Territory by way of the river, it is necessary to pass through some part of Alaska—not a serious matter at a time when only a few Canadians were in the country, but later a source of trouble and annoyance.

At one time the Hudson's Bay Company had two posts in what was believed to be Yukon Territory: Fort Selkirk, at the confluence of the Pelly and Yukon (or Lewes, as the Yukon above that point was then called), and Fort Yukon, where the Yukon's great northern tributary, the Porcupine, comes in. Selkirk was destroyed by Indians in 1852; and in 1889, when Fort Yukon was found to be in United States territory, the Hudson's Bay Company withdrew from the Yukon entirely.

The chief trading company in Alaska and the Yukon was the Alaska Commercial Company, which since 1901 has been known as the Northern Commercial Company. In 1871, it commissioned

Napoleon Leroy (Jack) McQuesten to establish a post called Fort Reliance on the Yukon River, six miles below the present Dawson. Although McQuesten later left the company and formed partnerships with Arthur Harper and others, he and his various partners were never really independent of the Alaska Commercial. In 1886, McQuesten and Harper built a post at the mouth of the Stewart River, and another the following year at the mouth of Fortymile Creek—so named because it was forty miles below Reliance.

Gold was discovered at a number of places in the Yukon valley. In 1884, two prospectors, working bars on Stewart River, were reported to have secured an average of \$100 a day each (which, with rockers, is good going); while four others were said to have cleaned up \$35,000 during the season, which also is not bad. News of this seeped out to settlements in Alaska farther downstream, and in the summer of 1886 about a hundred men worked bars along the Stewart. They were not uniformly successful, but it was estimated that their average clean-up amounted to about \$1,000 each.

In the same year, two prospectors, Franklin and Madison, left the Stewart for Fortymile Creek, which they ascended, and at a point twenty-three miles above its mouth (later found to be just across the border into Alaska), discovered coarse gold on bed-rock, the first of its kind in the region. When they returned to the Stewart in the fall, the announcement of their discovery caused a rush to stake on Fortymile, so that by the spring of 1887 the Stewart was practically abandoned, and the following summer some three hundred men were on Fortymile, taking out in all about \$200,000.

McQuesten and Harper dissolved partnership in 1889 and the latter went into business with Joe Ladue (a man of French descent, although born in New York State) who for some years had been associated with the previous firm. Ladue took charge of a new post at Ogilvie, about sixty miles above Reliance. Although neither Harper nor McQuesten was lacking in enthusiasm, Ladue is looked upon as the Yukon's Number 1 booster. Despite repeated disappointments, he never lost confidence in the country, and was always certain that every prospect would lead to riches.

It was not Ladue's fault that he was not responsible for the finding of the Klondike diggings. Many a discouraged prospector had been induced to try again after a talk with Ladue, and any prospector who was willing to work could count on supplies from him. In the summer of 1894, Robert Henderson, a native of Nova Scotia and a one-time sailor, but for the past dozen years a prospector in Colorado, arrived at Ladue's post with two partners. Ladue, at the moment, was enthusiastic about the chances of making a strike on Indian River, flowing into the Yukon about twenty miles below Ogilvie.

Henderson, unlike his partners, was willing to accept both advice and supplies from Ladue. With a variety of other partners he spent the next two years mining on tributaries of Indian River, chiefly one he called Quartz. Altogether he cleaned up something over six hundred dollars, but, not satisfied, he crossed the divide at the head of Quartz Creek to prospect a small creek flowing northward down the other side into a stream that ran roughly parallel to Indian River—a stream which Ladue and others called the Tron-diuck.* Finding ground that ran two cents to the pan, the best he had yet seen, Henderson decided to stake his discovery claims; he named the creek Goldbottom. Toward the end of July, travelling by way of Quartz Creek and Indian River on one of his periodical trips to Ogilvie for supplies, he found the water very low and decided to return by the Tron-diuck.

On the way back, as he headed his moosehide canoe into the Tron-diuck, he noticed some Indians catching salmon at the mouth of the river. Among them was George Carmack, who some years before had come over the pass from Skagway and had since followed the Indian way of life; the others were Skookum Jim, Tagish Charlie, and Jim's sister Kate, who was married to Carmack. A custom had grown up in the country whereby prospectors, once they had staked their own claims, would invite others to stake alongside. Henderson, who had started a small stampede to Goldbottom by announcing his discovery at Ogilvie, now invited Carmack to come up the river

*The miners' rendering of the Indian term, meaning "hammer-water," so-named because of their practice of hammering stakes into the bed of the stream to divert salmon into their traps.

and stake himself a claim. Carmack, agreeing, said he and the Indians would be along when they had finished their fishing, but Henderson, who seemed to have a prejudice against Indians, demurred at this, and continued up the stream whose mispronounced name would soon be on everyone's tongue.

In order to earn money for a more varied diet, Carmack and the Indians had planned to float a small raft of sawlogs down to Fortymile, where they could get twenty-five dollars per thousand feet, board measure. In scouting for suitable logs, Jim went a short distance up a small tributary called Rabbit Creek, and in examining the creek-bottom to see whether logs might be floated on its current, saw flecks of gold in the sand. When he rejoined his companions he told them about this, but the news does not seem to have excited them very much. So, fishing and cutting an occasional sawlog, Carmack, who usually took the lead, allowed almost three weeks to pass before deciding to go up and see Henderson's showing. At first they followed the Rabbit Creek valley, panning here and there—at one spot the ground ran ten cents to the pan—but later they found the going easier along the divide. By the time they had reached Henderson's camp their food supply was low and they were entirely out of tobacco. Their rifles could get them food, but tobacco was another matter; and when Henderson, whether short of it himself, or indisposed to supply Indians with it, refused to share his supply, they left without saying a word about the gold they had seen on Rabbit Creek.

Prospecting and fishing, they headed back for the scene of their discovery, and when they had reached Rabbit Creek (somewhat above the place where they had found gold) Jim shot a moose. While waiting for the others to come up, he lay down to drink out of the creek and in doing so noticed gold in greater quantities, and coarser, than any previously seen. They remained two days, panning up and down the creek until they thought they had found the best spot; and on August 17, 1896, the first claims on what came to be known as Bonanza Creek were staked. The regulations at that time set the size of a claim at five hundred feet along the course of the stream, from the base of the hills forming the valley on one side to the base of the hills on the

other. Since the discoverer was entitled to two such claims, Jim and Carmack argued as to which of them could rightfully claim to be the discoverer. Finally it was agreed that Carmack should stake two claims, transferring a half interest in one to Jim. Consequently Carmack staked in his own name the Discovery claim and No. 1 below; Jim staked No. 1 above, while No. 2 below was staked for Tagish Charlie. August 17 has since been celebrated as a public holiday in the Yukon.

Putting their gold dust into an empty cartridge shell, they returned to the mouth of the river and tied their logs into a raft, on which Carmack and Charlie set off for Fortymile to register the claims while Jim went back up Rabbit Creek to keep an eye on their property. The efficacy of the moccasin telegraph was demonstrated when within three days six claims had been staked on Rabbit Creek, shortly to be known as Bonanza. In a few days the creek was solidly staked; and so was a small branch named Eldorado, which proved to be even richer than Bonanza.

Carmack, who was not counted a prospector, was not believed when he told his story at Fortymile, but when he poured his gold dust out on the counter, those who knew gold were aware that it had come from a new creek and a general exodus began.

Henderson, on the other hand, having heard of what was happening a few miles downstream, and having found a spot on his creek that went thirty-five cents to the pan, decided to stake his Discovery claims and have them recorded without delay. He had not gone far down the valley before he met a German prospector named Andrew Hunker who, having failed to find a vacant spot on Bonanza, had followed the Klondike to Henderson's creek, continued along the main tributary, and there come upon ground running three dollars to the pan. Since this was much better than the thirty-five cents he was getting, Henderson decided to abandon his claims on Goldbottom and stake another below Hunker's Discovery claims; and it was Hunker's name, not Henderson's, that was given to the creek. He might still have done well, for Hunker Creek was one of the rich ones, but he had injured his leg. Needing money for medical treatment, he sold his rights for \$3,000 and left the country a bitter and disappointed man. By many he is considered as the discoverer of

the Klondike, a claim that the Canadian government subsequently recognized by a pension.

Accounts of the Klondike discovery vary, but most of them are based on that of William Ogilvie, an engineer who first visited the Yukon in 1887 in connection with the survey of the Alaska boundary. He returned in 1893 to continue that work and remained until the end of 1897. There can be no doubt of his familiarity with the country and its people; and since he was also a man of unimpeachable integrity, and a capable engineer accustomed to keeping records, his testimony is reliable. His book, *Early Days on the Yukon*, has been followed here.

Captain Charles Constantine of the North West Mounted Police, who first went into the Yukon in 1894 to establish Canadian jurisdiction, was appointed permanent Gold Commissioner, with his office at Fortymile, in 1895. He was also Magistrate, Land Agent and Collector of Customs, being then the only official representative of the government in the Territory. When it became evident that a police force was needed to cope with conditions during the gold rush, Constantine was given charge of a detachment of fourteen officers and men in 1897; he was succeeded in 1896 as Collector of Customs by D. W. Davis, and by Thomas Fawcett as Gold Commissioner in 1897.

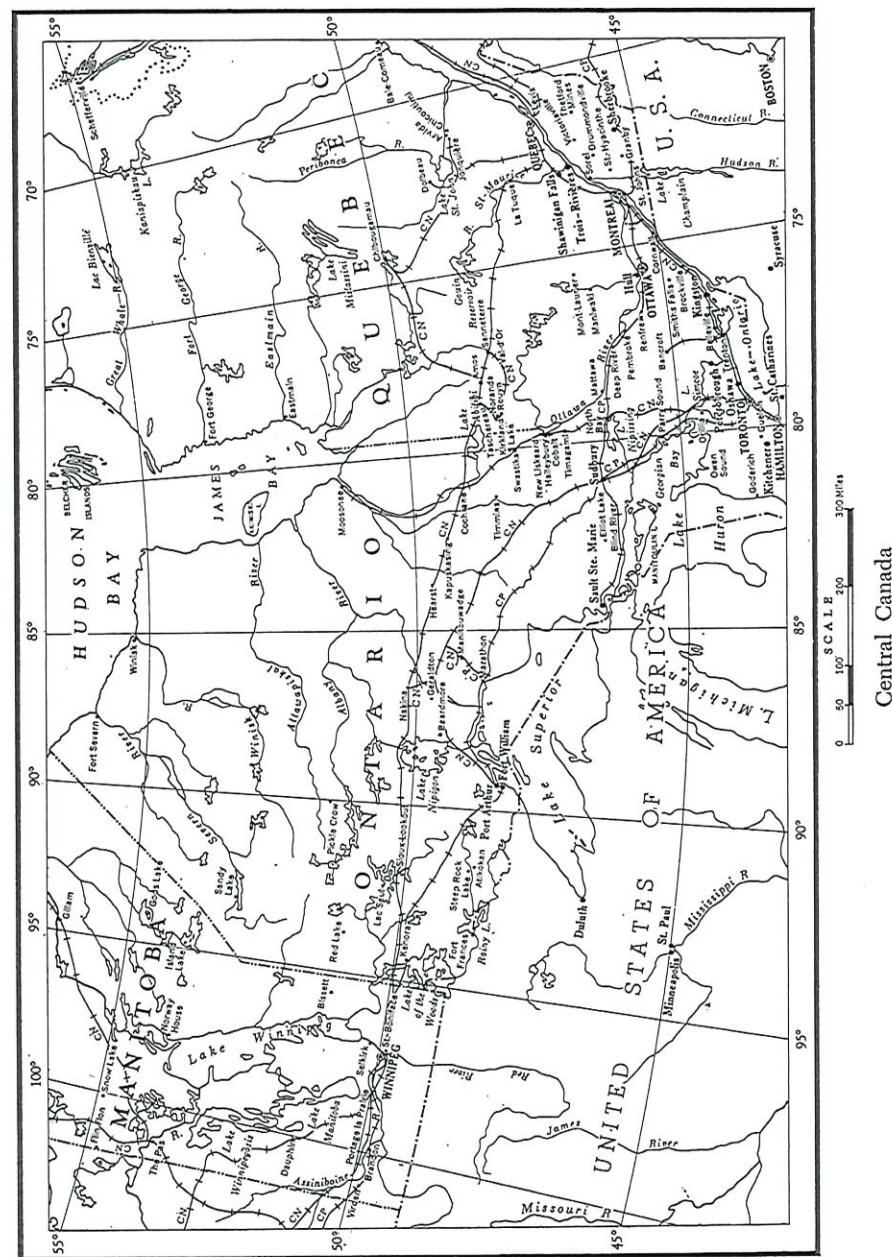
In the meantime, a serious situation had developed in the goldfields. As is usual in times of excitement, claims had been staked irregularly, few with proper stakes and practically none marked as required by blazed lines. In addition, there was a good deal of claim-jumping. A miners' committee had undertaken to straighten out the tangle but had increased rather than lessened the turmoil. Someone on the committee had measured off a piece of rope, said to be fifty feet in length, with which claims on Bonanza and Eldorado were re-measured and their boundaries readjusted. The rope was either incorrectly measured or dishonestly used, for some stakers' locations were given to claimants whose title seemed much less valid. Others were compelled to give up claims on one part of the creek in exchange for claims on another. Finally, a number of stakers went to Ogilvie and asked if he would undertake a proper survey of the creeks, which he offered to do if a majority were in favour of such a course.

One hundred and thirty signatures were secured and Ogilvie undertook the job, surveying 120 claims on Bonanza and 50 on Eldorado before the break-up of 1897.

Some of the decisions which Ogilvie had to make would have taxed a Solomon, but he succeeded in satisfying most of the claim-owners. One typical case must suffice to illustrate the difficulty. Clarence Berry and partner, holding each a half-interest in Nos. 3, 4, 5 and 6 on Eldorado, had decided to do on the upper end of Claim No. 5 all the work necessary to hold the four claims. But when Ogilvie arrived at the Berry claims with his survey he discovered that Claim No. 5 was forty-one feet, six inches, too long. Already it was known that this part of Eldorado was very rich. Anyone gaining an inkling that this over-staking had occurred could file on the fraction and get the benefit of all the work done by Berry and his partner. The problem was solved by tipping off George Byrne, a man known to be reliable. Byrne staked the fraction and immediately assigned it to Berry and partner, receiving in return an equal length off the end of No. 3. The No. 5 fraction eventually produced over \$136,000, while the end of No. 3 was much less profitable. Lest it appear that Ogilvie was guilty of playing favourites, one need only consider what might have happened if a score or more of frantic stakers had been invited to scramble for the prize—to say nothing of the loss to Berry and his partner of a season's hard work.

Joe Ladue, quick to seize the opportunity, had laid out a townsite on the east bank of the Yukon, below the mouth of the Klondike, establishing there a sawmill and a saloon. He wanted to call the place after himself but was persuaded to accept the name Dawson City after the former director of the Geological Survey of Canada, who had explored the southern part of Yukon Territory in 1887. Klondike City, more generally referred to as Lousetown, occupied the opposite shore of the Klondike; it was never a very serious rival. Dawson City began as a collection of tents and shacks which grew as people from other settlements along the Yukon moved in after hearing of the strike.

On Bonanza, Eldorado, Hunker, and one or two other creeks, men were busy sinking shafts or attempting to reach bedrock with open cuts. Never before, outside the Yukon valley, were





Yousuf Karsh Photo
Robert C. Stanley



Samuel J. Ritchie



James Stebbins



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J. Roy Gordon

miners forced to contend with permanently frozen ground, since known as *permafrost*. Before a shovelful of muck or gravel could be taken out, the ground had to be thawed, and this was done by building a fire on the spot to be excavated. When the fire had burned out, the ground would be thawed for a certain distance beneath and could easily be removed; another fire would then be kindled, and so forth, until bedrock was reached. The same process was needed for drives underground along the pay-streak. Later, when boilers could be obtained, the ground was thawed by steam conveyed to the face by rubber hose, to the end of which were fixed pointed steel tubes about four feet in length. These were driven into the frozen ground and steam was forced through them for six or eight hours at a pressure equal to about one horse-power for each point, thawing in that way from one to three cubic yards per shift. A variation was introduced when it was discovered that hot water would do as well as steam; and about the time that all the timber for miles around had gone up in smoke it was learned that cold water would thaw the ground quite as well!

The search for new Bonanzas and Eldorados continued feverishly, but the limits of the richer gold-bearing area soon became apparent. Those who failed to get a footing on the productive creeks, or were so unfortunate as to hit a barren spot, were forced to work for their luckier neighbours, in some cases—so high were wages—doing almost as well as their employers. Others arranged, with owners who did not care for pick-and-shovel work, to mine claims on a “lay,” that is to say, on a percentage basis. A great deal of trading and selling occurred; some who had saved their money while working for wages were able, before spring, to buy interests in claims that had not yet demonstrated their riches. One man, “Big” Alex MacDonald, borrowed money from anyone who would lend at any rate of interest, using it to make the first payment on claims, the balance to be paid in July—which would be after the spring clean-up. His was an excellent gamble: he had bought some forty claims, on a variety of terms; if the claims proved as valuable as seemed likely, he could easily complete the payments and would certainly be the richest man in the country; if they did not, he would be worse

than broke, but so would nearly everyone else, and being broke was no novelty to him.

When clean-up time came, he needed a pack-horse to transport his gold from the diggings to the bank. Big Alex MacDonald was richer than even in his wildest imagining. Ogilvie estimated that at least sixty claims on Bonanza and forty on Eldorado would average not less than a thousand dollars a running foot, and production figures proved him to be correct. The richest, of course, ran much higher, some eventually paying from a million and a half to two million dollars. A fair estimate of the gold taken out of the Klondike creeks in 1896-97 was about \$2,500,000.

So far, all connected with the gold strike were people who had been in the Yukon or Alaska before the discovery of Bonanza and Eldorado; but when they rushed into Dawson City they brought no supplies with them, and, despite the presence of budding millionaires, everyone was soon short of food. Prices soared, and many things could not be obtained at all. Alex MacDonald is said to have got his first claim in exchange for a sack of flour and a side of bacon.

Ogilvie tells a good story of the rags-to-riches condition of Dawson society in the spring of 1897. Among those who had drifted to the Yukon just ahead of the strike was an elderly couple whose name is not given. They had seen much of life and were inured to the hardships of frontier living. The husband succeeded in staking a claim in the first days of the rush, but, of course, would not know till the clean-up whether he was among the really lucky ones. While he spent the winter alternately thawing and hoisting gravel, the wife, also energetic and resourceful, undertook to earn the bacon and beans by taking in washing, even though, in such an unfastidious community as Dawson, customers were not over-plentiful. One steady customer was Edgar Mizner, manager of a trading company, who attempted to maintain amid his new surroundings the sartorial splendour to which he was accustomed. This in itself was enough to set him apart, but with it went a somewhat overbearing manner which gained for him the sobriquet, "the Pope." As spring advanced and paydirt began going through the sluice-boxes, the

husband sent encouraging messages to the hard-working laundress in town. And as the news became increasingly good, the laundress's work steadily deteriorated. When complaints proved unavailing, her irate customer returned a batch of botched laundry by messenger with curt instructions to have the clothes "done in a proper manner and returned in a proper condition." The woman, busy over the tub as this ultimatum was delivered, turned on the messenger, and with equal emphasis, said, "Tell the Pope to go plumb to hell; Jack's getting forty ounces to the pan now!"

The first boat of the season, the Alaska Commercial's *Bella*, was besieged when she arrived from down-river carrying, among other commodities, a goodly supply of whiskey. This quickly went to the heads of a community that had been reduced to the extremity of drinking Joe Ladue's slightly tintured river-water—at fifty cents a glass. A short while later, the largest boat on the river, the North American Transportation and Trading Company's *Portus B. Weare*, arrived. Although also loaded with supplies, the boat was welcomed for another reason. Men who had worked all winter in an atmosphere of acrid wood smoke while shaft-sinking and following the paystreak, and had spent the spring months sluicing dirt, were eager to view the bright lights of the outside world and, more particularly, to spend some of their hard-earned gold. Both the *Bella* and the *Portus B. Weare* were immediately booked to capacity by the bearded, smoke-tanned men who, still wearing the tattered, grime-encrusted garments of the creeks, staggered aboard under backloads of gold, while stevedores trundled other slim but heavy bundles consigned to the care of the pursers.

At the rate of two hundred miles a day the stern-wheelers raced for the sea with passengers impatient of delays caused by the many shifting sandbars; and when they reached the lonely outpost of St. Michael, seventy miles along the coast from the Yukon's many mouths, they put on an orgiastic exhibition, the like of which had not been seen there since the days of the Russian fur barons. They transferred at St. Michael to two small ocean-going ships; the *Excelsior*, bound for San Francisco, carried fourteen of them, and the *Portland* took sixty-eight bound for Seattle. From St. Michael to San Francisco is a longer voyage

than from New York to Liverpool, and the *Excelsior* was no sleek ocean liner, but on July 17, 1897, she eventually reached San Francisco dock. Word of her arrival had got around and a few interested persons were on hand. Even Hollywood, then unthought-of, has never staged a stranger scene than that which the watchers on the San Francisco dock witnessed as this advance-guard of the Klondike millionaires marched proudly ashore.

Ogilvie had already informed Ottawa of the strike, and the news had been passed on to the newspapers, but the sedate official hand-out had created no sensation. The stories sent out by San Francisco's ships' reporters and others who interviewed Ladue and his companions could not be accused of understatement, and their impact upon the world was intensified a few days later when the *Portland* reached Seattle. The scene at the Seattle dock bordered upon pandemonium when the sixty-eight soursdoughs arrived; the event was the greatest in the history of the port up to that time, for Seattle prided herself upon being "the Gateway to Alaska"—which, so far as Seattle and the American people were concerned, included the Klondike.

Times had not been good in the United States, where the depression, beginning in 1893, still continued. Cities all over the country were crowded with people out of work, and the Pacific Coast cities were perhaps the hardest hit. Consequently, the news of a land where gold could be scooped up by the panful, requiring no costly equipment or complicated metallurgical process to secure, and little or no experience, had an irresistible appeal to the hopeless millions.

The Klondike Gold Rush was on its way. As though in response to the tune of some Pied Piper, men—and many women, as well—pulled up stakes, not only in North America, but in countries beyond the seas, and headed for Seattle, San Francisco, Vancouver or Victoria in the hope of reaching this amazing land with the least loss of time. Shipping offices were jammed with frantic adventurers, convinced that once in the Klondike all would be well. Of what lay before them, they were blissfully unaware.

As we have seen, the gold-laden Klondikers had come out by way of St. Michael; but they had had the stiff Yukon current with

them. The journey upstream would be another matter. In any case, not many ships were available for that run, either from Seattle or from San Francisco, and all space on these few was soon taken up. The route to the goldfields which seemed to offer the best prospects lay northward along the sheltered Inside Passage, following the British Columbia and Alaska Panhandle coast to the head of the long, narrow Lynn Canal, from which, according to the map, it was but a short distance across the passes in the Coast Mountains to the head of the Yukon, and from there—a mere six hundred miles—the course was all downstream to the Klondike.

Except to serve a few salmon canneries at points along the coast there had been little need for steamboat services, and boats plying those waters were few and far between. But now, with thousands willing to pay almost anything to get up the coast, every bottom that might be expected to float at all was commandeered. Ships' graveyards were robbed of hulks long relegated to their last resting-place. Packed with passengers, horses and other animals, and with goods of all descriptions, this grotesque armada wound its way along the lovely sea-lane that has since become the delight of travellers. Its destination was Lynn Canal, terminating in a pair of narrow fiords, one leading to what was shortly to become Skagway, the other to Dyea. No facilities existed at either place for ships to dock; anchors were dropped a mile or so offshore, and passengers with their effects were lightered the rest of the way, often to be dumped within reach of incoming tides.

Between the top of Lynn Canal and the first of the succession of lakes forming the headwaters of the Yukon, the distance from Skagway was forty-five miles, and considerably less from Dyea, but in those few miles the jagged barrier of the Coast Mountains must be surmounted. For generations, Indians, trappers and others had crossed these mountains—if from the western fiord (Dyea), by Chilkoot Pass; if from the eastern one (Skagway), by White Pass. To Indians and others accustomed to such travel, the passes presented no great obstacle, although both were above timberline and thickly wooded on their lower slopes. Precipitation was heavy at all times, the snowfall exceptionally so.

Leaves were turning and fall rains had set in when the first stampedeers assembled their goods on the beach at Skagway and turned their eyes toward the grim mountain defile where, by this time, a detachment of North West Mounted Police had established themselves at what was supposed to be the boundary between United States and Canadian territory. The police would let no one pass without at least a year's supplies, which were taken to be about a ton. A good packer can carry a hundred pounds, but most of the stampedeers were not good packers. As a rule, each man took what he could conveniently carry for about six miles, cached the goods, and returned for another load. Soon there was snow on the pass, extending some distance down the slope, and before very long the trail was converted into a track of black mire below and slush above. As ships continued to dump their passengers, the number of helpless climbers increased; the littered confusion on the beach increased; and the number of straggling caches beside the trail also increased.

Some had brought horses with them, either to pack their own effects over the divide, or for hire, and soon these wretched creatures, poorly cared for, slipping and breaking their legs, were leaving their carcasses in hundreds along the trail. Horses finally getting to the top were often in such poor condition that the police mercifully put an end to their miseries.

As fall changed to winter, the sufferings of climbers became more intense. Fewer were able to reach the summit, while of those who did, many were too ill-equipped to face a winter on the northern side of the pass, to build boats, and in the spring undertake the six hundred miles of river navigation that lay before them. Skagway was full of broken-hearted adventurers, as anxious now to head south as they once were to go north.

Worse conditions, if possible, prevailed on the Dyea trail over the Chilkoot Pass. Here a glacier occupied the upper third, and steps had been cut in the ice and a rope strung along the trail so that men could pull themselves up. Later, tramways were constructed for the use of those who could pay the tolls, and travel over the Chilkoot Pass became somewhat easier; but one day in spring, when the snow on the upper slope had become

heavy with thaw-water, an avalanche swept down the mountain-side smothering sixty-eight men.

The shores of lakes Lindeman and Bennett were lined with tents and shacks that winter of 1897-98 as those who were sturdy or fortunate enough to get past the barrier of the passes whipsawed their lumber and fashioned their crude boats, barges or rafts for the next lap of the journey. Except for a five-mile stretch at Miles Canyon, about 460 miles above Dawson, no serious obstacle to navigation existed.

Ice goes out in the streams while the lakes are still frozen, and therefore as soon as Lindeman and Bennett were clear, that strangest of all flotillas got under way. Some of the stampedeers had had little experience with water craft and some accidents, and a few tragedies, occurred; but little seamanship is needed to navigate the Yukon, and in most cases as long as a craft would float it could be counted upon to reach its destination in due course.

A few of the more capable had gained a march by getting part way down the Yukon before the freeze-up, and they reached Dawson during May, but it was the first week in June before the vanguard of the spring contingent began to trickle in. Of those who had hoped to get through earlier by way of St. Michael, some had got frozen in at spots in the lower Yukon and, as a result of this and the slowness of upstream navigation, were later in reaching Dawson than those who had come by the passes. Dawson that spring was like no other place on earth. Without roads or sidewalks, the soft earth was churned knee-deep by the boots of hordes increasing almost hourly.

During all the summer of 1898 the motley human tide continued. A few arrived by one or other of the "overland" routes. Edmonton merchants, hoping to benefit by selling outfits to adventurers, pushed the Mackenzie and Liard routes, and some hardy ones followed their suggestions. Most of these eventually drifted back; a few remained to become Peace River pioneers. A number tried the trail blazed by the Collins Overland Telegraph Company, back in the sixties, when an abortive attempt was made to reach Asia and Europe by way of Bering Strait,

and some of these found a goldfield of their own at Atlin, but the majority failed even to reach Atlin.

Before the summer was over, Dawson's population had reached eighteen or twenty thousand. The Mounties had kept a good check on people crossing the passes, and those who came up-river were tallied at the boundary, so that the number in the country was more accurately known than is usually the case in mining booms. The first Yukon census, taken in 1901, showed a total of 28,219 persons, most of whom were in Dawson. By this time the exodus had begun; the population declined steadily year by year until, by the end of a decade, not more than five thousand remained in the whole territory.

Dawson in its heyday was a city made up mainly of exceptional people, for had they not been of more than usual imagination, resourcefulness and endurance most of them would never have been there. Jack London and Joaquin Miller—the latter known as the "Poet of the Sierras"—found in the Klondike rich material for their writings. Tex Rickard, a bartender in Dawson, was to become one of the world's greatest impresarios of sports events in Madison Square Garden, New York; Alex Pantages, who tended bar in Dawson, was to organize a well-known chain of vaudeville theatres in Canada and the United States; and Sid Grauman, later to become famous for his Chinese Theatre in Hollywood, was in Dawson as a boy. Not all who became famous were in the entertainment world, although Dawson seems to have had more than its share of theatrical people, which perhaps was not strange considering the need there was for relaxation. In the business field also, the men who represented the banks and other enterprises seem to have done extremely well after they returned outside. Colonel Sam Steele and Major Z. T. Wood were outstanding among the Mounted Police. Duff Pattullo became Premier of British Columbia, and William L. Walsh, Lieutenant-Governor of Alberta. And Robert W. Service, who immortalized the Yukon, was himself immortalized by it. Representing the Geological Survey of Canada in 1898, and remaining for the next five years in private practice as a geologist and mining engineer, was Joseph B. Tyrrell, already a famous northern traveller and explorer. In the course of his long life he was to become the

doyen of Canadian mining men, famous as the editor of the journals of such explorers as Hearne and Thompson and as a writer on a wide variety of scientific subjects. On January 1, 1901, when predictions were being widely made concerning the prospects for the new century, Dr. Tyrrell gave an interview to the *Dawson Daily News* in which he said: "In the next century, Canada may be expected to assume a somewhat similar position to that occupied by the United States in the last . . . and it is not improbable that the mineral wealth will equal or even exceed that of the United States itself. . . . As yet there are between one and three million square miles of country in Canada practically unprospected and the mineral wealth that lies hidden in this vast area will be an important factor in the progress of this northern continent."

In a short time the tents had disappeared and substantial buildings had succeeded many of the shacks. Sidewalks were laid, water was piped in, and Dawson lost much of its rawness. The city had four daily newspapers, and on September 20, 1899, a single-wire telegraph line was completed by the Government from Lake Bennett to Dawson, thus making it possible to transmit telegrams as far as Bennett to go forward by mail from Skagway. This served until 1901, when a line pushed through the wilderness from Quesnel, on the Cariboo Road, made contact with the Bennett-Dawson line, after which through service was possible between Vancouver and Dawson.

Steamers had been plying on the Yukon for some years as far south as the Miles Canyon, below which the town of Whitehorse had been established, and river boats were soon navigating the upper reaches of the river, while a tramway transported goods and passengers past the canyon. In 1898, the White Pass and Yukon Railway Company had begun the construction of a narrow-gauge line, starting at Skagway, crossing White Pass into British Columbia, and ending at Whitehorse in the Yukon, a distance of 111 miles. The line was completed in June, 1900. Thus it was not long before the horrors of the passes were forgotten, even though, as passengers travelled in comfort, carcasses of horses could still be seen from the car windows.

When ice put an end to river traffic, passengers and mail were transferred from the railway at Whitehorse to roomy sleighs drawn by relays of horses, and passengers were cared for at comfortable road-houses established at intervals along the winter road to Dawson.

Meanwhile, gold continued to pour from the creeks in a steady stream. Production increased fourfold to \$10,000,000 in 1898, and to \$16,000,000 in 1899. The peak was reached in 1900, when \$22,275,000 was produced, dropping to \$18,000,000 the following year, and diminishing gradually thereafter. The decrease, at first, was not due so much to a reduction in mining activity—if anything, a greater extent of ground was worked in 1903, when the total output was only \$12,500,000—but to exhaustion of the extremely rich ground on Bonanza, Eldorado, Hunker and Dominion. In a few years most of the richer and shallower ground had been worked out. The hydraulics then took over the worked-out ground. This called for expensive dams, ditches and flumes and the concentration under one management of large tracts of ground. Following this phase came the day of giant dredges, requiring even greater concentration of ground. For many years most of the dredging in the Klondike has been in the hands of The Yukon Consolidated Gold Corporation Limited, which in 1955 operated seven dredges and produced gold to the value of \$1,699,068.

VI

Sudbury Basin

EARLY EFFORTS TO DEVELOP MINES IN NORTHWESTERN ONTARIO, destined to become one of the most important mining regions in Canada, had been disappointing. Copper-mining had begun at Bruce Mines, near the head of Lake Huron, as early as 1848, but the deposits were shallow. Gold was discovered in 1878 in the Lake of the Woods area where more or less work was done on a number of prospects; some of these had become producers, but none had long survived. Much more productive, but equally short-lived, were silver-lead-zinc mines in the Thunder Bay district, on the north shore of Lake Superior. Mineralization was extensive, but only in a few places, where silver predominated, could deposits be profitably worked. The Beaver produced a total of \$550,000, the Silver Mountain almost as much, and the Badger and Porcupine mine, \$300,000.

Richest and most spectacular was the Silver Islet, from which silver to the value of \$3,500,000 was taken by various operators. This mine, part of a parcel embracing ten square miles secured in 1846 by James Woods, remained undeveloped until 1868 when the Montreal Mining Company, producing copper at Bruce Mines, began exploring properties it had acquired in the Thunder Bay area. Examining the Woods location in June of that year, a party landed on a rock some eighty feet square and about ten feet above the water in Lake Superior, a mile offshore and six miles northeast of Thunder Cape. A vein of galena-bearing material was noticed near the waterline and silver specimens valued at \$1,200 were obtained.

Thomas Macfarlane was in charge for the Montreal Mining Company. The following year, despite the difficulty of conducting mining operations on an exposed rock awash during storms, he

began sinking an incline shaft on the rock which he named Silver Islet. During the summer, 9,455 pounds of ore valued at \$6,751 were produced and shipped to Montreal. In the spring of 1870, picked ore weighing 17,669 pounds and valued at \$18,291 was shipped. In September of that year the Montreal Mining Company sold out to Detroit and New York interests and William B. Frue was placed in charge.

To check the ravages of the waves, Frue built a cribbing around the island. He continued with mining until the fall of 1873. From time to time, down to a depth of 360 feet, he encountered masses of rich silver ore, mostly in vein expansions. The ore, carrying high values in argentite and native silver, occurred in a vertical calcite vein at the point where it was cut by a broad diorite dike. Values continued downward to a depth of little more than a thousand feet; over two million ounces of silver was secured, but below this level the values pinched out. After 1884, when the works became flooded—owing to the failure of a drunken sea-captain to deliver a cargo of coal—the mine remained idle for many years. Finally, in 1922, it was de-watered to a depth of sixty feet to allow the recovery of ore left in the roof, amounting to 20,040 pounds, with a gross value of \$10,971 and a silver content of 16,652 ounces.

Many Canadian mines have been located on islands, but it is doubtful if any other was ever operated on so small a one; the shafthouse and other buildings almost covered its surface. The confined space led to difficulties, not the least of which was the labour problem, complicated by prejudices arising out of the clash of nationalities. At one time, four boarding-houses were required in the interests of peace, one for the Norwegians, one for the Cornishmen, another for those who were neither, and the fourth for mine officials. Liquor was a continuing complication. The allowance per man was three drinks a day, with an extra one in case of good behaviour; but if a man got drunk his supply was cut off entirely. As a further bonus for good behaviour, an extra quart was allowed on Saturday night. All work ceased, till Monday morning, at 4 P.M. on Saturday; and since the men were confined to the small island all day Sunday it is not surprising that brawls were the rule.

Most of these mining activities caused a certain amount of excitement attended by some wild speculation, but hopes thus raised were generally blasted. It was therefore inevitable that mining in Ontario should get a bad name. This, however, had nothing to do with the lack of interest with which the discovery and exploitation of what has since become the world's greatest source of nickel was received by prospectors and public alike. In the early eighties, the building of the Canadian Pacific Railway through that part of the country lying between the Ottawa River and the Prairies was opposed on the ground that the region was likely to remain forever a barren wilderness; but, fortunately, the builders of the C.P.R. were not dismayed. The grade had reached a point about three miles west of the newly named station of Sudbury, about two hundred miles beyond the Ottawa River, when, in August 1883, a blacksmith named Tom Flanagan noticed highly stained rocks along the face of a cutting. He was not a prospector, and probably more from curiosity than anything else he dug a hole in the bank and gathered from it some pieces of rock, thinking they might contain copper. Flanagan's guess as to copper was later confirmed by no less an authority than Dr. Alfred Selwyn, director of the Geological Survey of Canada, who identified the samples as copper sulphide but of negligible economic value.

Although Tom Flanagan did not exercise his right to locate a claim, others, no better qualified than he but perhaps more able to take advantage of the opportunity, did so; and in the following February an application was made to the Ontario government for permission to buy that particular land. The applicants were Thomas and William Murray, merchants of Pembroke, Henry Abbott, of Brockville, and John Loughrin, a merchant of Mattawa, who was also a politician. Since Loughrin had a tie contract with the railway, it is likely that he induced the others to join him in the venture. The cash outlay was \$310, for which the purchasers received title to 310 acres of land, including all it contained below as well as above the surface. Known as the Murray mine, the property was to pass through several hands, but for the past many years has been one of the steady producers of The International Nickel Company of Canada (Inco).

Word of the stained rocks got around, and others hurried to

secure claims. Few if any of these had ever located a mineral claim. Staking was not necessary, since the country had already been surveyed; anyone wishing to acquire land for any purpose need only make application to the Department of Crown Lands at Toronto, specifying the township and the concession and lot numbers. No knowledge of geology, or even of prospecting, was necessary to determine the possible presence of mineral, for the deeply stained gossan, or burn, was an unfailing indication. Furthermore, it soon became evident that the mineralization followed a definite pattern, extending along the rim of a well-defined geological structure, since known as Sudbury Basin.

The basin is a "lopolith" shaped like a square-sterned skiff, about thirty-eight miles long by about seventeen miles at its greatest width, striking approximately northeast and southwest. Except for its southeast corner, the portion at the edge dips inward at between thirty and seventy degrees. Geologists estimate that probably during Keweenawan time a mass of molten matter deep within the earth was forced by subterranean pressure toward the surface. Checked in its course by solid layers of sediments (Animiki), this molten stream spread out between the base of the sediments and the rocks below, causing considerable deformation in the sediments.

Up to this point the geologists are fairly unanimous, but one group believe that after the intrusive had been squeezed into position, and during the cooling, it separated into layers. The lighter, more acid, portions moved upward to crystallize into "micropegmatite," a granitic rock, while the heavier, more basic, portions sank to the bottom to form "norite." A transition zone partaking somewhat of both separates the two.

Then, owing to the weight of overlying sediments and lack of underlying support, the centre of the intrusive mass sank into the chasm from which it had emerged, displacing and disrupting the formations newly established as well as the sediments above, which ultimately settled into their present synclinal position.

The other view is that two more or less distinct upward thrusts occurred. The first comprised the norite intrusion which was injected directly into its basin shape. This was followed by a second upward thrust of the micropegmatite along the upper side of the norite.

So much for the rocks that form the Basin. The nickel-copper ores that make the basin famous are found in cracks and crevices

along the under-side of the norite, and in places penetrating the older rocks lying below. Sometimes the ore is found as pockets in narrow bands of norite that extend some two or more miles away from the Basin.

Here again are two questions. Did the ores travel with the norite and settle out like mud from water or did they follow behind the norite along the same trails?

The principal ore minerals are pyrrhotite (iron sulphide), pentlandite (nickel-iron sulphide) and chalcopyrite (copper-iron sulphide), the two latter being diffused throughout the former. The ore minerals, together with quartz, other gangue minerals and fragments of the enclosing rock form orebodies ranging from a few thousand to many millions of tons. For example, the orebody at Falconbridge is a more or less continuous tabular sheet of ore some 6,000 feet long, extending in depth for an unknown distance beyond 5,500 feet, with an average thickness of fifteen feet or more and containing several tens of millions of tons of ore.

Except for the eastern section, where the overburden is from 50 to 250 feet thick, frequent ore exposures occur along the contact between the norite and older formations. And it was the weathering of these exposures producing the highly coloured oxides of copper and iron that first attracted the attention of prospectors and led to the early discovery of the principal mineral deposits.*

Most of the prospectors had followed the railway into the country; many were timber rangers, more or less familiar with the countryside, among whom Rinaldo McConnell, Henry Ranger, John T. Cryderman and Richard Donally were prominent. McConnell early became convinced of the mineral possibilities of the region, giving up his work in the woods to devote full time to prospecting and to the promotion of mining properties. In both fields he was successful. Not only could he locate a mining property; he could induce men of wealth to spend money for development and, if necessary, himself open up a mine and bring it to production.

Other successful prospectors were Thomas Frood and James Stobie, whose names are perpetuated by Sudbury mines. Oddly enough, both had been school-teachers; Frood taught until shortly before he became a timekeeper on railway construction, but Stobie

*D. M. LeBourdais, *Sudbury Basin*, 1953.

had given it up much earlier and was one of the few with previous mining experience, having worked at Bruce Mines. Another former school-teacher was Aeneas McCharles, who located the North Star mine that was to provide him with a modest fortune. He left in the keeping of the University of Toronto a sum of money, the interest from which provides prizes for those making an outstanding contribution to scientific research; more particularly, for "any Canadian from one end of the country to the other, and whether student or not, who invents or discovers any new and improved process for the treatment of Canadian ores or minerals of any kind, after such process has been proved to be of special merit on a practical scale." (In 1950, the prize was awarded to W. S. Kirkpatrick of Trail, B.C., for his development of methods for the economic recovery of sulphur from gases of low sulphur dioxide concentration. It is interesting to note that his father, Professor F. S. Kirkpatrick, received the award in 1917 for the invention of a new and improved process for the precipitation of silver from its solutions in the ores of Cobalt and also for a process for the separation of cobalt and nickel in solutions made from Cobalt ores. In 1944, Dr. L. M. Pidgeon received the award for his achievement in developing a new practical method of producing metallic magnesium on a commercial scale; and, in 1955, the prize went to Dr. Frank Forward for his work in the invention and development of pressure leaching processes for the recovery of uranium, nickel, copper and cobalt.)

J. H. Metcalf and W. B. McAllister, Pembroke business men who were the earliest to recognize the possibilities of Sudbury ores, worked together, locating claims which are still among the most productive. Chief of these is the famous Creighton mine, for which they made application on July 10, 1885. By an earlier application in the same year they secured the property, located on their behalf by Thomas Frood, which became the Copper Cliff mine—the site of the present town of Copper Cliff.

During the first three or four years all locations were made in the western part of the south rim. Prospecting farther east was more difficult, owing to heavy overburden and because that area still consisted largely of timber holdings. But in November 1887, Richard Donally discovered an outcrop in what later became

Falconbridge Township, now part of the property of Falconbridge Nickel Mines Limited; and in 1891, John T. Cryderman happened on a huge gossan showing in Garson Township, west of Falconbridge, first known as the Cryderman mine and later as the Garson.

Not till 1889 was there much activity along the north rim, but in that year Stobie, McConnell and R. J. Tough (member of a family of prospectors), with the help of Indians, located mineral outcrops in various parts of Levack Township. The principal deposits became the nucleus of the Levack mine, also now the property of Inco.

Prospectors in the Cariboo, or the Klondike, did not need costly equipment to work their claims; they could begin to take out pay with a gold-pan, and sluice-boxes could be built at little expense. For prospectors in the Kootenay, experienced capitalists in nearby Spokane and other United States centres were available, and smelters were not too distant. But the prospector who located a claim in the Sudbury Basin was unable to do much with it. Canada did not yet have many men of wealth, and most of these had made money in the lumber business, which still required the bulk of their capital. Railway-building was yet in its infancy, and the few who had succeeded in that field were now chiefly concerned with the building of the Canadian Pacific Railway. Mining corporations such as have since become characteristic of Canada did not exist.

It was therefore not surprising that capital for Sudbury mines should have come from outside sources. Samuel J. Ritchie, of Cleveland, Ohio, owner of a carriage factory in Akron, in the same state, had come to Canada some years before in search of second-growth hickory. He became interested in Hastings County iron deposits, and induced several of his wealthy Ohio friends to join him in the enterprise. After building a railway to bring out the ore, he discovered that because of high sulphur content it was not marketable. Anxious to find a way to make good his and his friends' losses, Ritchie investigated the possibilities of Sudbury copper deposits, and soon their development became his chief concern.

Quietly he began securing options on the most likely claims;

and, on January 6, 1886, he organized the Canadian Copper Company, with head office in Cleveland. Among the first properties bought by the new company were the Frood, Stobie and Copper Cliff claims, each of which could be worked by the open-pit method. Deposits were "off-sets"; the ore, being in more or less massive formation, could almost be quarried and did not require the sinking of shafts or other underground development. Mining was begun on May 1, 1886, at the Copper Cliff mine, and the ore was shipped to England, the continent of Europe and the United States.

At first, everyone connected with the budding industry took for granted that the chief economic mineral in the ore was copper. Ritchie had made a contract with the Orford Copper Company of Constable Hook, N.J., to supply a certain quantity of specially picked copper ore containing a minimum of seven per cent copper, but when the ore arrived at the smelter the company refused to accept it. Ritchie rushed off to have it out with Colonel Robert M. Thompson, general manager of the Orford company, and was informed that while the ore contained only four and a half per cent copper, it also contained two and a half per cent nickel, and that no economical process yet existed for the separation of the nickel from the copper. Furthermore, even though this might eventually be accomplished, the market for nickel was limited. World production in 1886 was less than a thousand tons, and the selling price was a dollar a pound.

Nickel had received its name from miners in Saxony who found that certain copper ores could not be smelted by processes known to them; instead of the familiar red metal, their product was much lighter in colour and so hard that they could do nothing with it. In an age of superstition, it was perhaps natural that the miners should have believed their copper was bewitched, and they called it *kupfer-nickel*, or "Old Nick's copper."

The chief method of reducing nickel ores at the time that Ritchie and Thompson were confronted with the problem was by wet processes. Matte was ground up and treated with sulphuric acid, dissolving the nickel and iron, and setting free sulphuretted hydrogen which precipitated the copper. The solution of nickel and iron sulphide was then crystallized and roasted, forming a red

oxide of nickel and iron. The residue contained so much copper sulphate, however, that the action of the acid was very slow; and the slimy mass required re-melting in order to oxidize the sulphur.

Thompson appreciated the need for a process that would produce nickel from Sudbury ores more cheaply than was possible by the existing cumbersome processes. The problem presented a challenge which he could not resist; and although he was a lawyer, not a metallurgist, by profession, he (with others) eventually succeeded in perfecting a commercially feasible process and in the end became one of the principal founders of the nickel industry. His method, called the Orford process and sometimes referred to as the "tops and bottoms" process, was for many years one of the principal methods of nickel-refining.

While Thompson was battling with the problem of refining nickel, Ritchie undertook to increase the market for the metal, eventually succeeding in convincing the French and British governments of the superiority of nickel steel over ordinary steel for armour on warships; but it was not till the steel manufacturers of the United States had become convinced of the value of nickel as an alloy for steel that a steady and growing market was assured.

Another necessary step in bringing down the price of nickel, and so making practicable its wider use in industry, was to smelt the ore at or near the mine and thus eliminate freight costs on waste material; and on December 22, 1888, the first smelter unit at Copper Cliff was blown in.

Sudbury ores consist mainly of combinations of sulphides of iron, copper and nickel, containing an average of about two per cent combined nickel and copper in varying proportions, about forty per cent iron, and about thirty-five per cent sulphur. After rocky material had been removed by hand-sorting on belts and tables, the ore was taken by various means of transport to roast yards where much of the sulphur was removed by its own combustion. This was done by piling heaps of ore upon a foundation of cordwood sufficient to maintain a fire for about sixty hours, after which the sulphur would ignite and continue to burn, sometimes for several months, until all but ten or eleven per cent of the sulphur had been consumed.

Fumes from these roast heaps and the smelters soon denuded

the countryside (in the direction of the prevailing winds) of everything growing, thus contributing to the hideousness of Sudbury's surroundings and resulting in damage suits from farmers in the Basin. Tall stacks afterwards helped to mitigate the damage, but eventually a way was found to turn the fumes to good account.

From the roast yard the ore passed to the blast furnace, which removed further rocky material, thereby increasing the proportion of nickel and copper in relation to the iron and sulphur—usually up to about thirty-five per cent combined nickel and copper, though sometimes less. "Bessemerizing" by adding quartz (or some other flux) to the matte in a special type of furnace, and forcing an air blast through the molten material, caused the iron to combine with the silica in the quartz to form a slag on the surface of the molten charge. When the slag was poured off, it would leave a matte containing from seventy-five to eighty per cent nickel and copper, the balance being mostly sulphur and the precious metals—gold, silver, platinum, palladium, etc.

In its early days, the Canadian Copper Company passed through many vicissitudes, due principally to lack of experience in treating its ore; nevertheless, it was able to supply what demand there was for its product. From time to time competitors appeared, but one after another they went their way. Usually they were companies which had been formed to operate mines owned by the promoters, and they came to grief in attempting to treat their ores.

The most spectacular failure was that of H. H. Vivian and Company, of Swansea, Wales, whose reputation as smelters and dealers in metals was world-wide. In 1889 the Vivians bought the Murray property, at the spot where Tom Flanagan had first noticed the ore. A smelter was built where matte was bessemerized and then shipped to Wales for refining. Murray mine ore was of better than average richness, running about two and a half per cent nickel; failure was attributed to lack of efficiency in the smelting. The directors overseas had made the common mistake of thinking they could run a mine by remote control. When operations ceased, in 1894, the Vivians were said to have paid \$375,000 for their experience.

It might therefore have been expected that a group with no experience of mining, of the nickel industry, or of Canadian conditions, would hesitate to enter such a difficult field, and the Canadian Copper Company must have looked with some amusement at the attempt that was now made to win success where so many had failed. Yet, despite the apparently unpropitious circumstances, the new company was to have a resounding success.

Ludwig Mond, a chemical manufacturer of German origin who had established a prosperous chemical business in Cheshire, England, had evolved—more or less by accident—a process for refining nickel. One of his research engineers, Carl Langer, in working on a formula for the production of a bleaching powder, noted that carbon monoxide showed an affinity for nickel and this, after much experimenting, resulted in the discovery of the nickel carbonyl process for refining nickel matte.

The process as finally evolved consisted of extracting the copper from the matte with sulphuric acid, crystallizing the solution to form copper sulphate, then reducing the residue to a finely divided metallic powder and subjecting it to carbon monoxide gas. This picked up the nickel, forming nickel carbonyl, which was decomposed by being passed over heated nickel shot, each grain of shot receiving a coating of nickel. The shot then passed back and forth through the apparatus, receiving coat after coat of nickel until, having reached a certain size, it was eliminated by a screen.

After securing his patent, Dr. Mond, not wishing to become involved in the nickel business, offered to sell his process to the Canadian Copper Company. Since most of the gases employed in the Mond process were deadly poisons, and could not be detected by the sense of smell, the Canadian Copper Company considered it too dangerous: workmen who had gradually received a poisonous dose might go to bed one night apparently well, but, as one of their companions is reported to have said, "when they woke up they were dead."*

Mond then sent two agents to Sudbury to investigate the possibilities of securing a suitable supply of nickel ore. The verdict

*In spite of this, first Mond and then Inco continued to use the process in the Clydach refinery without lethal consequences, and it is still in use today.

was favourable, and Mond invited Rinaldo McConnell to go to London to discuss the sale of some of his properties. Mond was a quick trader; when McConnell caught up with him, in Italy, he offered to buy what was known as the McConnell claim (afterwards called the Victoria) for \$200,000 if, after five months' test, the existence of two hundred thousand tons of ore "with at least five per cent nickel plus copper" could be shown. The cost of the test was to be advanced by Mond but deducted from the purchase price in case of a sale; and he bought outright, for \$30,000, McConnell's seven-eighths interest in the Cryderman mine. The other eighth was owned by the Canadian Copper Company.

McConnell hurried back to Sudbury and with characteristic energy opened the Victoria mine, very quickly blocked out the stipulated amount of ore, and then returned to England to close the deal and discuss plans for a smelter near the mine. The Canadian Copper Company sold Mond its interest in the Cryderman mine; and within the year Mond had invested altogether \$320,000 in his Sudbury enterprise. To ensure his supply, he later bought the Levack property and also what was known as the Frood Extension. When the smelter at Victoria mine became inadequate a larger and more efficient one was built at Coniston, eight miles southeast of Sudbury, and a refinery was acquired at Clydach, Wales. In 1900, the Mond Nickel Company Limited was incorporated. Many, remembering the Vivians and others, were sceptical; but Mond avoided their mistakes, succeeding where they had failed.

In 1901 an event occurred which might have had a far-reaching effect upon the fortunes of Sudbury district; for in that year Thomas A. Edison, needing nickel and cobalt for his electrical equipment, acquired property in Falconbridge township and spent a few weeks there himself. He conducted a dip-needle survey and began sinking a shaft; the overburden was heavy and when quicksand was encountered the shaft was abandoned. This ended Edison's activities in the district, but some years later the diamond drill disclosed that had his shaft gone a few feet deeper it would have reached ore.

Once a nuisance and later a novelty, nickel had now become an important factor in the world's economy. This had been due

to the solution of metallurgical problems rather than to advances in mining methods, which in Sudbury mines are not particularly complicated. And it was at Sudbury that, for the first time in Canadian mining experience, the limiting effect of metallurgical problems upon the expansion of the mineral industry became apparent. Much was yet to be learned about extracting ore from the ground most efficiently, but the keys of the future were seen to be in the hands of the metallurgists.

With the entry of Canada into the base-metal field, markets became of increasing importance, and it is significant that at this stage in the development of the nickel industry a move should have been made to combine all processes, from mining to marketing, in one organization. In 1902, the International Nickel Company was incorporated under the laws of New Jersey, bringing together the Canadian Copper Company, the Orford Copper Company, the Société Minière Calédonienne and most of the other principal firms in both hemispheres engaged in the mining, smelting, refining and marketing of nickel. Among those behind the merger was Joseph R. Delamar, born in Denmark, whose exploits had gained him a leading place in the financial firmament of the United States, and who was to be closely associated thereafter with Canadian mining.

With the merger, Ritchie fades from the picture and A. P. Turner becomes directing head of Canadian operations, still conducted under the Canadian Copper Company name. At that time five mines were being operated, the Frood, McArthur, Creighton, Copper Cliff and Vermilion, and the company owned six others previously operated at different times but at the moment shut down; in addition, it owned or controlled several thousand acres of undeveloped territory in various parts of the Sudbury area.

In 1889, the tonnage mined in the Sudbury area was 44,490, of which 40,146 tons were treated. In 1891, tonnage mined had increased to 83,300, of which 72,558 tons were treated for 10,336 tons of matte, producing 2,018 tons of nickel and 2,064 tons of copper. Between 1891 and 1900, the advance, though fluctuating, was continuous, the nickel content of ore produced in the latter year being 3,540 tons.

With the coming of World War I, nickel suddenly became what

was known in a later war as a "strategic" metal. The United States, at first, was neutral; and it was disconcerting to Canadians to realize that since the bulk of Sudbury's nickel matte went to the United States for refining, its ultimate destination could easily be, and sometimes was, an enemy country. For some years there had been an agitation to have nickel refined in Canada; now this agitation was intensified.

As a result, the Government of Ontario appointed, on September 9, 1915, a commission (later converted into a Royal Commission) which was charged with the duty of making a full inquiry into "resources, industries, and capacities, both present and future . . . in connection with nickel and its ores." The chairman of the commission was George T. Holloway of London, England, associate of the Royal College of Sciences and vice-president of the Institution of Mining and Metallurgy. The other members were Willet G. Miller of Toronto, Provincial Geologist; McGregor Young of Toronto, a lawyer; and Thomas W. Gibson, Deputy Minister of Mines of Ontario, who acted as secretary.

The report, dated March 19, 1917, was a thorough-going piece of work and is the most valuable study of the nickel industry yet produced. Its conclusions were as follows:

1. The nickel ore deposits of Ontario are much more extensive and offer better facilities for the production of nickel at low cost than do those of any other country. Nickel-bearing ores occur in many parts of the world, but the great extent of the deposits in the province, their richness and uniformity in metal contents, and the success of the industry, point strongly to the conclusion that Ontario nickel has little to fear from competition.
2. Any of the processes now in use for the refining of nickel could be successfully worked in Ontario, and conditions and facilities are at least as good in this province as in any other part of Canada.
3. In view of the fact that practically no chemicals are required, that there is a much more complete saving of the precious metals, especially platinum and palladium, and that electric power is cheap and abundant, the most satisfactory method of refining in Ontario will be electrolytic.
4. The refining of nickel in Ontario will not only benefit the nickel industry, but will promote the welfare of existing branches

of the chemical and metallurgical industries, and lead to the introduction of others.

5. The methods employed at the Ontario plants of the two operating nickel companies are modern and efficient, although there are differences in both mining and smelting practice. It is the consistent practice of both companies to adopt all modern improvements in plant and treatment. Even during the present time of acute pressure the Canadian Copper Company has materially increased its output without substantial enlargement of its plant, and the losses in smelting are less both at Copper Cliff and the Mond plant at Coniston than they were a year ago. These companies have had their experimental stage, neither has asked nor received any governmental assistance, and both have earned the success which they have achieved.

The commission had been asked to suggest a just and equitable system of taxation, but reported that "the present system of taxation in Ontario is just and equitable and in the public interest."

The principal result of the inquiry was the decision of the International Nickel Company to build an electrolytic refinery at Port Colborne, Ontario, not far from the entrance to the Welland Canal, and another was the incorporation of The International Nickel Company of Canada, Limited, on July 25, 1916. To this company was transferred control over all mining, smelting and refining processes in Canada.

Although the British America Nickel Corporation Limited had been incorporated before the war, its promotion was due largely to the desire to retain, as far as possible, control of Canadian nickel resources within the Empire; it provided, as well, a further chapter in the tragic history of nickel-company failures. It had been organized by Dr. F. S. Pearson, an Anglo-American financier, James H. (later Sir James) Dunn, a Canadian financier living in London, and E. R. Wood of Toronto, who had previously secured options on extensive nickel-bearing lands in the Sudbury district in addition to the rights for North America of the refining process invented by Noak V. Hybinette. This process was then in use in a refinery at Kristiansand, Norway.

Strange as it may seem to a generation familiar with the vital importance of metals in wartime, the outbreak of World War I made financing of the company almost impossible, and the situ-

ation was rendered more difficult by the loss of Dr. Pearson in the sinking of the *Lusitania*. But when the need for greater control of the Empire's metal resources became apparent, the British government was induced not only to assume financial control of the company but to provide what seemed an assured market for its product.

The Murray mine, on the site of Tom Flanagan's discovery, was one of a number secured by British America and its smelter was built there. The refinery was established at Deschenes, Quebec, with an initial capacity of fifteen million pounds of nickel a year, which at little additional cost could be expanded to produce from twenty to twenty-four million pounds a year.

The war was over, however, before the company had got into its stride; the assured market promised by the British government failed to materialize; the new company lacked the ability to compete with the two existing companies for a share of the limited civilian market, and it therefore quickly joined the ranks of nickel companies that had failed. Its assets, subsequently sold under the hammer, were bought by a representative of Inco.

In 1914, a normal year, Inco and Mond had produced 45,517,937 pounds of nickel and 28,948,211 pounds of copper; but in 1918 they produced 92,507,293 pounds of nickel and 47,074,475 pounds of copper. During the war, production was geared almost entirely to military needs and civilian use was discouraged. Consequently, when the war ended the nickel industry was practically without markets. In 1921, Sudbury mines produced 19,293,060 pounds of nickel and 12,821,385 pounds of copper. In 1922, production dropped to 17,597,123 pounds of nickel and 10,943,636 pounds of copper.

With the election to the presidency of Robert C. Stanley, who had joined the Orford company as a metallurgist in 1901, Inco inaugurated in 1922 an aggressive program of development, research and sales promotion leading to many new uses for nickel. In England, the Mond company was equally active. Due in part to Mond's efforts in the first few peace-time years, nine new countries issued nickel coins.

Thus, beginning in 1923, without benefit of war or fear of war, the nickel industry (in so far as it consisted of Inco and Mond)

built itself securely into the world's economy. In 1928, Sudbury mines produced a record total of 96,755,578 pounds of nickel, and in the following year, 110,275,912 pounds. Then came the depression. In 1932, production dropped to 30,327,912 pounds of nickel, a challenge which the industry met with equal determination.

For more than a quarter of a century Inco and Mond, between them, had controlled the world's nickel industry, and they might have continued thus indefinitely but for a circumstance which neither had anticipated. Instead of being the owners of adjoining nickel deposits, known respectively as the Frood and the Frood Extension, it became evident that they were owners of opposite ends of a single great deposit. If development were to proceed independently, two complete sets of everything would be required, entailing unnecessary expense. The best solution seemed that one should sell its interest in the property to the other, but this neither cared to do. Amalgamation of the two companies was considered and found feasible, and in 1928 the matter was easily and quickly settled. It was not a case of a large corporation dominating a lesser one, but a mutually satisfactory arrangement that neither has ever had any reason to regret. The joint concern was not to remain for long in solitary control of the nickel industry, however, as shall be related in due course.

Until a short time before the merger, Inco's ore supply was derived almost entirely from the Creighton, chiefly from the open pit, which eventually reached a depth of 200 feet, a length of 670 feet and a width of 180 feet. Ore was at first removed by derricks, but when the pit got too deep for this, shafts were sunk in the footwall adjoining the pit, drives were run out at various levels, and the ore was trammed to the shaft and hoisted to surface. When all the ore that could be taken out in this way had been secured, the shafts were deepened and the ore recovered by overhand stopings.

Soon after the merger came the construction of an 8,000-ton mill at Copper Cliff. This necessitated a change at the smelting end, and five reverberatory furnaces were installed. Thus the first stage in the establishment of a fully modern plant was reached. Except for increases in capacity, and some modification, the pro-

cesses installed in 1930 continued unchanged for the next twenty years.

Part of the program was the competition in 1930 of an electrolytic copper refinery at Copper Cliff with a rated capacity of twenty million pounds of copper a month. This plant, built by the Ontario Refining Company, a subsidiary of the American Smelting and Refining Company, became the property of Inco in 1936. It occupies a sixty-acre site approximately one and a quarter miles southwest of the smelter, with which it is connected by a standard-gauge railway. Blister copper is shipped from smelter to refinery in molten condition in cars specially constructed of steel plate lined with magnesite refractories, backed by firebrick.

During World War II, Inco produced and delivered to the Allies about 1,500,000,000 pounds of nickel and about 1,750,000,000 pounds of refined copper as well as large quantities of the platinum group of metals. The company has stated that during this period the tonnage mined was equal to that produced by it and its predecessors in the previous fifty-four years. This great production required an investment of approximately \$150,000,000 to open additional mining properties, sink shafts and install surface and underground plant and equipment, in addition to the enlargement of concentrating, smelting and refining works.

Open-pit mining, still in use at the Creighton and the Frood (and later at the Stobie as well), was admirably adapted to expansion, eventually providing over forty per cent of the company's ore. This type of mining, however, has definite limits; and in anticipation of those limits being reached, a ten-year program of underground expansion was launched with the objective of mining, hoisting and treating thirteen million tons of ore a year. This was begun under the direction of Donald MacAskill, then vice-president of Canadian operation, who did not live to see it completed; his successor, R. Leslie Beattie, also died, and it was left to J. Roy Gordon, later to become executive-vice-president at New York, to see it through.

Where applicable, as at the Creighton and Frood-Stobie, low-cost, bulk-mining methods were adopted, such as caving and blast-hole mining. The former consists of undercutting large slabs of ore which eventually break loose of their own weight

and in their fall disintegrate, making unnecessary the use of explosives; blast-hole mining follows the same general principle, except that caving is induced by blasting.

In order to handle ore from the caving operation, Creighton No. 7 shaft, designed for ore-hoisting only, was sunk initially to a depth of 2,056 feet. Concrete-lined, it has two skip compartments separated by a manway and pipe compartment. The skips carry fifteen tons each. The concrete headframe is 197 feet high and, with the hoisthouse, is an integral part of the concentrator building. The hoist, with a capacity of 650 tons an hour, is automatic, operated by pushbutton from the loading pocket. Run by electricity and free from clanging signal bells, it is a model of quiet efficiency.

As in other modern mines, the handling of ore underground has likewise been mechanized. The lowly mucker, whose duty it once was to shovel broken ore into trams which he pushed by hand along the rails, has disappeared. In his place are cable-operated "slushers" which scrape the ore through drifts specially provided. The ore is dropped down chutes directly into cars hauled by electric locomotives, and is then dumped by automatic tipples into underground ore bins.

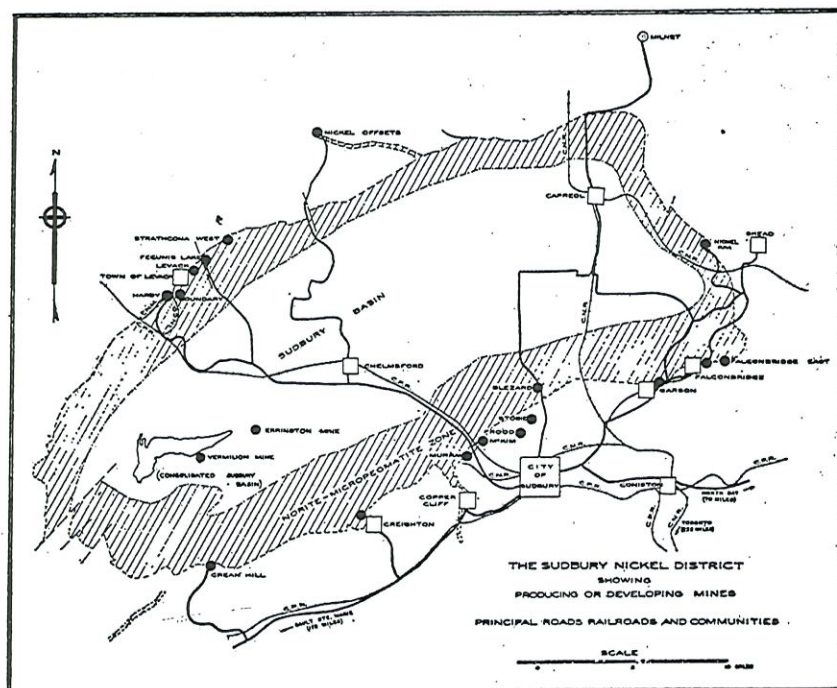
The Creighton mill, designed in 1948 to treat 6,000 tons a day, was first stepped up to 10,000 and later to 12,000 tons. Another feature tending toward low-cost operation is the substitution of a wood-stave pipeline in place of railway cars in transporting the concentrates the seven and a half miles from the concentrator to the smelter at Copper Cliff.

Completion of Inco's expansion program enabled the company to undertake delivery to the United States Defence Materials Procurement Agency of 120,000,000 pounds of nickel and 100,000,000 pounds of copper at regular monthly intervals over a five-year period, beginning in 1953. In 1955 the company produced 290,463,934 pounds of nickel, 263,189,108 pounds of copper and 1,637,405 pounds of cobalt, in addition to large quantities of the precious metals.

Another result of Inco's research program is the recovery of iron ore from Sudbury nickel-copper ores to produce a million tons of hematite a year. For nearly seventy years this iron has

been going off in the slag; now that it can be saved, Inco can treat ores previously considered uneconomical. Copper-nickel separation by controlled cooling and flotation of matte, and oxygen-flash smelting of copper concentrates, are other innovations. Initiation of the last-mentioned process has made possible the large-scale production of sulphur dioxide by arrangement with Canadian Industries Limited in a plant built for the purpose by the latter at Copper Cliff. To provide oxygen for flash smelting, Inco has built a plant which produces more than 7,500,000 cubic feet a day, or 300 tons of 95-per-cent-pure oxygen every twenty-four hours. This makes Inco by far the largest oxygen producer in Canada.

SUDBURY BASIN



VII

Cobalt

IT SEEMS STRANGE NOW, BUT THERE WAS A TIME NOT SO LONG AGO when no one believed that a mining boom could occur in any of the eastern provinces. No one was surprised that booms had occurred in such outlandish places as the Cariboo and the Klondike, for it was felt that an essential feature of a boom was that it should be in a spot hard to reach, and the harder to reach the more likely it was to be rich. This delusion was shattered in the early years of the twentieth century when one of the liveliest and most picturesque of booms occurred in the old province of Ontario, right beside the railway track, only an overnight jaunt from Toronto. Prospectors and old sourdoughs, Bay Street speculators and others hoping to make their fortunes did not need to tramp weary miles over mountains and through muskeg. They required neither dog-team nor pack-train. They could mush to El Dorado by pullman car.

In fact, if there had been no railway there would have been no boom, at least not then. As in the case of Sudbury Basin (where, however, a boom did *not* develop) railway construction was primarily responsible for the discovery; and, also as at Sudbury, one of the first persons to notice odd-looking rocks was a blacksmith. But, unlike Tom Flanagan, Fred LaRose knew enough to stake a claim. The time was fall, 1903, and the place came to be known as Cobalt.

Up till that time the huge tract of country lying between the C.P.R. main line and James and Hudson bays was largely a wilderness. Timber within reach of southward-flowing rivers had been logged off, that farther north was considered too far from transportation to be of value within the foreseeable future. In all this wasteland two small settlements on the western shore of

Lake Timiskaming, nostalgically called Haileybury and New Liskeard, occupied patches of the fertile soil left behind by retreating glaciers. More than a hundred miles from steel, they had been petitioning the Government of Ontario for a railway, or at least a wagon road, to enable them to get their products to market, and they compensated for their lack of numbers by the persistence of their efforts. At length the government was moved to action, but before undertaking the cost of a railway it dispatched ten different survey parties into the north to report on resources. The results exceeded the expectations of all but the most sanguine. A belt of fertile land consisting of post-glacial lake-bottoms was found to extend from the Quebec border almost across the northern part of Ontario, and forested areas were declared capable of some day nourishing an important pulp and paper industry. Less was said about mineral prospects, but they were by no means ruled out, even though not so specifically plotted in on the map.

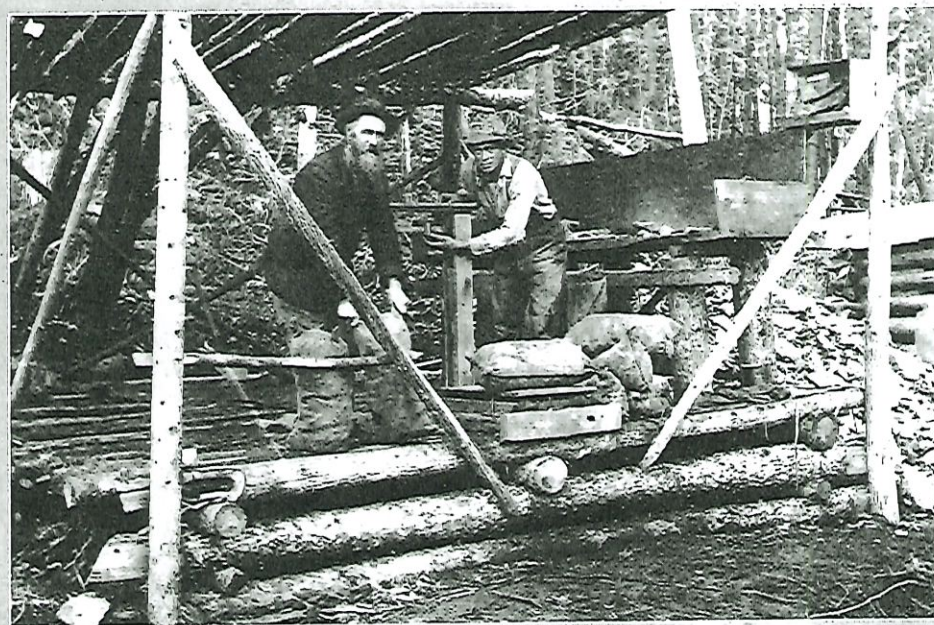
Nevertheless, it was in the possibilities of farm settlement that the big news lay. Immigrants, most of them headed for the prairies, were flocking into Canada; and the Ontario government, hoping to divert some of them to the newly discovered northern lands, decided to build a railway to be known as the Temiskaming* and Northern Ontario (now the Ontario Northland) from North Bay, on the C.P.R. main line, to New Liskeard, and farther north as occasion might warrant. Action was immediate, and once again the ring of steel on granite was heard as men blasted, filled, or otherwise shaped a railway across the rocks of the Canadian Shield. At Mile 104, where the grade skirted the west shore of Long Lake, mineral showings were noticed by some of the men, but as they were neither prospectors nor miners no attention was paid. The actual discovery of mineral is credited to James McKinley and Ernest Darragh, tie-cutting contractors. Having had some experience in mining, they recognized as silver (by testing with their teeth) some flakes of metal noticed in a vein at the southeast end of the lake, and on August 5, 1903, staked their claims. Their hopes were dashed when an

*The Canadian Board on Geographical Names prefers the spelling "Timiskaming," but the older form lingers in the names of certain firms and organizations.



Courtesy The Northern Miner

Bags of silver ore, LaRose mine, 1905.



Weighing silver ore, Foster mine, 1905.



Courtesy
The Northern Miner
Fraser D. Reid



International Press
Frederick M. Connell



Blank & Stoller Photo
Noah Timmins



Courtesy
The Northern Miner
J. H. C. "Ike" Waite

Ottawa assayer declared their specimens of no value, but a later assay by Dr. Milton Hersey, well-known Montreal assayer, disclosed silver amounting to four thousand ounces to the ton.

It was not till September 15 that Alfred (generally known as Fred) LaRose, the blacksmith, noticing some pinkish material (cobalt bloom), dug into it and found a heavy, coppery-looking mineral which seemed good enough to justify his staking two claims at the northwest end of the lake. As LaRose told it: "One evening I found a float, a piece as big as my hand, with little sharp points all over it. I say nothing, but come back and the next night I take a pick and look for the vein. The second evening I found it; you can see it on the side of the hill now. Then I go to the boss, Duncan McMartin, and say: 'Boss, I have a good thing, come with me, you give me a good show.' He says: 'Pull a gun on me if I don't.' Then I show him the vein and we stake two claims, one in his name and another in mine. We had one-half a share each."

Not familiar with official red tape, LaRose was worried and went to see his friend Arthur Ferland, proprietor of the Matabanic Hotel in Haileybury, four and a half miles to the north. In his application to the Department of Crown Lands at Toronto, dated September 29, for the claims staked two weeks earlier, he had stated that the mineral involved was copper, and now he was not so sure. Ferland was not sure, either; but when T. W. Gibson, director of the Ontario Bureau of Mines, arrived in Haileybury shortly after, he produced LaRose's specimens for the government official's inspection. Gibson thought the chunks of ore might be niccolite, "kupfer-nickel," bane of the miners of Saxony and Sudbury. On his return to Toronto, he wrote to Dr. Willet G. Miller, professor of geology at Queen's University, Kingston, and also part-time provincial geologist, suggesting that Miller visit the district. Miller did so, and was impressed by what he saw. Thereafter, prospectors and others were to find him ready with both expert and sympathetic advice.

LaRose had meantime completed the sale of a half interest to his employers, Duncan and John McMartin (who were cousins as well as partners) for \$1,500, and had left for a holiday at his home in Hull, Quebec. On the way through, he stopped over at

Mattawa, and while there exhibited his "copper" to Noah Timmins who, in partnership with his brother Henry, owned Mattawa's principal general store. Despite his limited experience, Noah Timmins was an extraordinarily able and resourceful man. He did not appear to be much impressed by LaRose's specimens, but as soon as the blacksmith was on his way, Timmins telegraphed his brother, who was then in Montreal, to find LaRose and make the best possible deal with him. Henry Timmins caught up with LaRose and bought a quarter interest in his equity for \$3,500. The price was going up!

Henry Timmins hurried to Mattawa and the brothers set off for the scene of the strike, but when they arrived they found that the property into which they had bought had since been jumped. The McMartins were also involved; and so the brothers and the cousins got together to consider what they might do to thwart this threat to their interests. David A. Dunlap, a lawyer of Mattawa, happened to be in Haileybury, and they arranged with him to act in their behalf, agreeing to give him a one-fifth share of their holdings. Neil King, a fire ranger who disputed LaRose's claim, asserting prior discovery, had assigned his presumed rights to M. J. O'Brien, wealthy lumberman and railway contractor of Renfrew. The case was one for the head of the Department of Crown Lands to decide; a commission composed of three of his chief executive officers sat for three weeks and, after examining many witnesses and hearing counsel for both sides, awarded the property to LaRose, who had transferred his remaining interest to the Timmins-McMartin-Dunlap syndicate for \$25,000.

This case and others of the same nature caused the government to appoint a resident Mining Commissioner to whom was given authority to hear witnesses and make decisions without reference to the Department, and this led later to the establishment of a Mining Court presided over by a judge with adequate powers and authority.

The syndicate immediately began sinking a shaft on the LaRose property, but after the rich surface showing had been removed all signs of silver disappeared. Willet Miller's advice, and the knowledge that high-grade ore was being taken from

other veins in the neighbourhood, encouraged the partners to continue their costly shaft-sinking. At length, at a depth of nearly a hundred feet, high-grade silver again appeared in the shaft, and the sceptics, whose carpings had grown louder with each unsuccessful foot of shaft, were silenced.

The third discovery was not made till October 21, when Tom Hébert, a lumberjack working for the Booth Lumber Company, owners of the timber rights surrounding the lake, noticed a vein skirting a rocky ridge on the east side of the lake, and with the assistance of Arthur Ferland (who seems to have been a universal friend) and R. A. Galbraith, a railway location engineer, staked a claim. Shortly after, Hébert sold his rights to a group consisting of Ferland, Galbraith, W. B. Russell and R. R. Russell, who had staked adjoining claims. Not being miners, and not yet realizing that all that was required to begin mining was a pick, shovel, wheelbarrow and a little blasting powder, the buyers thought only of selling at a profit. Someone suggested that Ellis P. Earle, a New York financier whose fame had reached even the Canadian backwoods, might be interested. A parcel of silver ore brought him to Long Lake on the jump and he quickly grasped the situation. A quarter of a million dollars soon changed hands, and Earle promptly had a gang of men digging into a vein (the Little vein) exposed on the cliff from which a heap of silver nuggets had fallen of their own weight. Without machinery, other than that which any quarryman might need, Earle in a few months recovered not only the purchase price but a hundred thousand dollars to boot.

Organization of the Nipissing Mining Company soon followed. The company was capitalized at \$250,000, and to it were transferred the 846 acres acquired by Earle. It was succeeded in a few months by Nipissing Mines Company, incorporated under the laws of the State of Maine, with an authorized capital of \$6,000,000. "Big Nip" was to play a major part in the affairs of the camp, earning fortunes for many persons. Although reorganized twice, it is still in existence as The Nipissing Mines Company Limited.

In the little town of New Liskeard, a group of men had gathered on July 23, 1903, to organize a company—the Temis-

kaming and Hudson Bay—to exploit some iron ore that had been found in the Township of Boston and to employ prospectors to search for minerals generally. The president of the company was George Taylor, head of a hardware firm that has since spread throughout northern Ontario and into Quebec; other officers and directors were business men and farmers of New Liskeard, as were most of the shareholders. The capital was set at a modest \$25,000, with shares of one dollar par value, of which 7,460 were sold at ten per cent down and the balance in monthly instalments. Money was still a scarce commodity in that part of the country.

Disappointed in its iron ore, the company could not have been in a better spot when news of the silver strike at Long Lake reached New Liskeard. One of its prospectors, John Piché, was immediately dispatched to the scene, where eleven claims comprising 360 acres were staked. Development was begun early in 1904 on a claim called the Silver Queen, south of the townsite and west of the railway track. The first shipment of high-grade ore brought \$32,000, and the T. & H.B. declared a dividend of two dollars a share. The number of shares issued had risen to 7,761, and the directors decided not to sell any others.

W. G. Trethewey, a Cornishman who had sold his Edmonton real-estate business in the fall of 1903, visited Montreal where Dr. Milton Hersey told him about the silver strike, showing him some of the McKinley and Darragh specimens. Impressed by what he saw and heard, Trethewey decided to see for himself, eventually arriving at Long Lake camp early in May, 1904. He pitched his tent on the site of the future O'Brien mine, sharing it with a young engineer named Alex Longwell who had come to scout for Colonel R. W. Leonard of St. Catharines, Ontario, and was later to discover the Buffalo mine. On the second day Trethewey located a silver vein, and he has given a graphic account of how a prospector feels at such a moment:

My first anxiety was to find if anyone had been there before me, but after careful examination I concluded that it was a virgin discovery. I had no axe with me, and there were fellows down at the camp who would have made a wild rush up there if they had known, and I would have lost my mine. So I hid it as well

as I could by throwing sticks and moss over the rock where I had chipped it, and came down to the camp and quietly had my tea. I then started out with my axe on my shoulder, slowly enough until I got out of sight of the camp, and then I only hit the ground at the high places. I squared a post, put my name and the number of my licence on it, planted it firmly over the discovery, and made a witness tree; then I started along the bluff a little farther and discovered the Coniagas mine. I knew by the indications that there was a vein, but it was dark and I was afraid of getting caught in the woods. I saw Professor Miller that night and told him I had made a find and asked him to say nothing. He and his assistant, Cyril Knight, visited the property with me the next morning and re-examined it thoroughly to see if there were any signs of prior discovery, but there were none.

Trethewey's claims were marked J.B.7 and J.B.6 on the sketch map drawn by W. J. Blair, O.L.S., then engaged in making a topographical survey; the first comprised forty-three acres and the second, forty acres. That Trethewey's fear of claim-jumpers had not been unwarranted was shown by his subsequent discovery of a clumsy attempt to jump the ground by cutting an earlier date into a log lying nearby. It was far from being a legal staking, but Trethewey did not care to take any chances and proposed to Alex Longwell the transfer of a half interest in claim J.B.6 to Colonel Leonard, if Leonard would back him in a possible suit. The jumper did not appear in court and Trethewey's title was clear, but Colonel Leonard received his half interest (he subsequently bought the other half) in what proved to be one of the most productive mines in the camp. The name Coniagas was coined for it by Dr. Miller from a combination of the symbols representing the four principal elements: cobalt, nickel, silver, and arsenic. About the same time, Dr. Miller also gave the camp its future name. Scratching on a board the legend COBALT STATION, T. & N.O. RAILWAY, he nailed it to a post beside the track, and the name stuck. Later, it was confirmed by the railway and by the Post Office Department. It was a prophetic name. To Miller it seemed appropriate because the veins contained more or less smaltite, the mineral with which cobalt is mostly associated. At that time, however, small percentages of cobalt were worse than useless; for ores containing

less than six per cent, the smelter made an extra charge. Fifty years later, the old dumps would be re-worked to recover cobalt earlier discarded; it would have become one of the most sought-after metals, and what once had been a nuisance in the camp named for it might one day prove to be the source of that camp's regeneration.

Since claims were staked in bush-covered, unsurveyed land, and the overburden in most cases was heavy, it was to be expected that disputes over ownership would occur, but another cause for dispute was the requirement that an applicant must have discovered "valuable mineral in place," which the law defined as "a vein, lode or deposit of mineral in place, appearing at the time of discovery to be of such a nature as to contain in the part thereof then exposed such kind and quantity of mineral or minerals in place, other than limestone, marble, clay, marl, peat or building stone, as to make it probable that the vein, lode or deposit was capable of being developed into a producing mine likely to be worked at a profit."

The most celebrated case turning on this point involved the staking of four claims adjoining the LaRose, and interest in this case was heightened by the fact that the same principals had been involved in another legal tangle, already mentioned. The four claims now in dispute were staked on the same day by Fred LaRose and by Neil King, and LaRose challenged King on the ground that "valuable mineral in place" had not been discovered by him prior to staking. King transferred his rights to M. J. O'Brien for \$5,000 cash, while the Timmins-McMartin-Dunlap group acquired LaRose's interest. After two years' judicial jockeying, a settlement was reached under which O'Brien was allowed to retain the property but was required to pay the provincial government a royalty of twenty-five per cent, later reduced to fifteen per cent, while the syndicate was awarded \$130,000. Senator O'Brien, who was to become an important figure in Canadian mining, thus acquired the longest and steadiest producer in the Cobalt camp.

One of the first men to reach Cobalt was Clement A. Foster who, stirred by newspaper articles written by Willet Miller, rushed in during the winter of 1903-4. He failed to find a suit-

able claim, but in May 1906 his father, who had come to visit him, discovered the vein which gave rise to the Foster mine.

Among those who got in ahead of the break-up were four young mining graduates from Queen's University: R. Anson-Cartwright, Tom F. Sutherland, Fraser D. Reid and Vincent Gleeson. They had come by rail as far as the tracks were laid and then walked the remaining forty-seven miles, carrying their goods on their backs. They did not find a mine at Cobalt but, except for Gleeson, all continued for the rest of their lives in some activity connected with mining. Anson-Cartwright joined Dr. Miller and Cyril W. Knight in making the geological survey of the camp; Tom Sutherland, after prospecting in Ontario and British Columbia, became successively Inspector of Mines and Deputy Minister of Mines for Ontario; Fraser Reid was to become an outstanding mine executive; while Vincent Gleeson, after prospecting for a while, devoted his engineering talents to the location and laying-out of railways, in northern Ontario and in the West.

Other early prospectors were N. C. Wright of Haileybury and his brother, M. F. Wright, who located two silver veins in the Kerr Lake area on the west side of the camp. One of these, sold to J. A. Jacobs of Montreal, became the very productive Kerr Lake mine. A prospector from Nova Scotia, J. B. Woodsworth, found a vein at the eastern end of Peterson Lake and called the mine after his native province. George C. Glendinning, assistant to W. J. Blair, the surveyor, found a vein near Giroux Lake which became the University mine. The famous Lawson mine was located by a group consisting of Murdoch and J. M. McLeod and Thomas and James Crawford.

In order to preserve the timber contained in what was known as the Gillies Limit, a tract of about a hundred square miles adjoining the Cobalt camp, the Ontario government reserved it from prospecting. This resulted in a persistent belief that the area was rich in mineral, but when the timber was removed a geological survey failed to disclose any mineral deposit of consequence. Finally, after the government had offered a bonus of \$150 an inch to any member of the survey party who might locate a vein in the area, Thomas Brown and R. G. MacLaren, on July 18, 1906, found a seven-inch vein carrying smaltite and

niccolite accompanied by native silver. Since there had been a general demand that any mineral found on the limit should be developed as a public enterprise, the government for the first time undertook to operate a mine; but values at depth did not bear out surface indications and the mine was eventually sold. The purchasers also failed to operate it at a profit.

The geological formations in the Cobalt area belong to the Precambrian, the youngest member of which, the Nipissing diabase, was responsible for the deposition of the silver ores. It occurs in the form of a sill of varying thickness which was intruded into the lower members in an undulating fashion. Lying unconformably upon the Keewatin is a group of fragmental rocks of sedimentary origin called the Timiskamian; next in order is a group of igneous rocks called the Algoman, which is followed by the Cobalt series, a group of sediments consisting of conglomerate, greywacke, and quartzite. The Nipissing diabase succeeds the Cobalt series, parts of which as well as large areas of overlying rocks have been eroded by glacial action, so that outcrops of diabase are common.

The ore-bearing veins, varying from half an inch to eight or ten inches in width, occur near the margins of the sill, widening out considerably in places as, for example, at junction points. The greater part of the richer ore was found at the lower contact of a thin layer of Cobalt conglomerate caught between two great masses of igneous rocks—the Nipissing diabase above and the Keewatin below. The conglomerate layer had become much fractured, providing many openings to receive the silver-bearing solutions brought by the intrusive material. The tough Keewatin lavas were very little fractured and seem to have acted, in most places, as a barrier to the downward passage of the ore solutions.

Despite the narrowness of the veins in general, their importance was greater than might have been expected because much additional ore was derived from branch veins and the country rock adjoining them. The gangue consisted of calcite, with rarely a little quartz, the vein-matter usually split up, fractured, faulted and brecciated. Branches split off, often following secondary dislocations associated with the many disturbances that had

caused the vein. There was usually, however, a contiguity of values along the general plane of fracture. On either side of this broken-up and interrupted plane, the wall rock might contain much native silver in the form of plates, sheets and leaves, filling small fissures or gashes. Many of these, averaging in some cases from a quarter to a half pound each, had extremely ragged and irregular edges.

For example, the principal vein on the Trethewey mine (J.B.7), as disclosed by workings during 1905, was eight inches wide, running nearly east and west. A shaft was sunk on it to a depth of seventy feet. On driving eastward at this depth, it was found that the vein soon forked. The drift was continued forty feet on the northern, and 190 feet on the southern division. The latter again split up into branch veins comprised in a breadth of seven or eight feet; the intervening wall-rock was well charged with silver, and the small branches were also "shot through" with the native metal. After much work had been done on the south fork, an experimental break was made into its southern wall and a crosscut of only four feet struck a larger vein than the one being worked.

The Lawson's "silver sidewalk," planed to a smooth surface by the glaciers, presented a strip of solid silver extending down the slope and continuing beneath the water of Kerr Lake. In other mines, metallic silver was found in chunks weighing anything from a few pounds to over two tons. The largest, weighing 4,402 pounds and containing 24,222 ounces of silver, was taken from the Keeley mine at South Lorrain. It was bought by the Ontario government and has since occupied a showcase on the main floor of the parliament buildings in Toronto.

During the fall of 1903, the following winter, all 1904, and well into 1905, the moccasin telegraph failed to create any widespread interest in the mines being developed at Cobalt. This apathy is attributed to the scepticism caused by the speculative boom which followed the discovery of rich ore at Silver Islet. Millions of shares had been sold in companies which never had any prospects at all but were organized merely to enable their promoters to make some easy money. Many investors were still

licking their wounds, and for the time being were quite immune to the siren voice of silver.

The slowness with which the boom got under way is illustrated by the record of company incorporations. Only one was incorporated in 1903, and, as we have seen, it was organized before the silver strike was made. Although, during 1904, many tons of high-grade had been taken from a dozen different mines, one company only—the Nipissing—was organized. By 1905, the pace had quickened, and thirty-one companies were incorporated; but by 1906, with the boom in full swing, no fewer than 263 companies were organized, with an even greater number in 1907. That only a fraction of these had any prospect of making any return whatsoever goes without saying.

Early in the fall of 1904 the long-awaited rails reached Cobalt, and ore that had been stacked in bags beside the pits could be shipped to smelters in the United States and cheques received in payment. Before winter put an end to active mining, 158 tons of high-grade were shipped, bringing average returns per ton of \$862 for a total value of \$136,218. The following year, shipments amounted to 2,144 tons, averaging \$692 per ton for a total of \$1,473,196; in 1906, shipments amounted to 5,335 tons at an average of \$705 a ton, for a total of \$3,764,113; and 14,040 tons were shipped in 1907 from twenty-five mines, valued at an average of \$428 a ton, for total of \$6,020,649.

In most cases, investors have a long wait between the floating of a company and the payment of dividends; most companies must spend immense sums on equipment and development before there is any chance of return. In such circumstances booms do not start easily and are hard to keep going after they do start. The public soon loses interest if news is not frequent and favourable. In this respect, Cobalt was ideal; many veins were exposed and others easily located, often merely by scraping away the moss or by removing a few feet of overburden. (Nipissing used a hydraulic monitor to clear the surface). This gave the Cobalt boom its peculiar character: while it attracted its share of card-sharpers, harpies and adventurers, they were merely hangers-on. The real basis of the Cobalt boom was speculation. The camp was but an overnight run from Toronto, and not much more

from New York; as soon as they were satisfied that it was not a flash in the pan, men with money to invest flocked in. The speculation fever spread throughout the financial world. In New York, during the height of the excitement, special mounted police were required in the Wall Street district, to control the crowds eager to invest in Cobalt shares.

In Cobalt, although the game was largely a no-limit one, those with but a few white chips could sit in while they lasted, and often the prospector of yesterday dealt the hands. The fate of many other camps depended upon a few large mines crowded as close together as storefronts, but here someone was always striking a high-grade vein—often several different veins at once. Anyone with energy and resource could find an opportunity to get a finger in the pie. Some were content to follow the ore through its twisting and diverging veins, while others preferred to get control of a piece of ground, organize a company and sell shares. In many cases success came quickly, dividends were immediately forthcoming, and shares skyrocketed. Nearly everyone made money; there was not much excuse for anyone's losing his money, for what a company had to offer was usually in plain sight.

On the other hand, adverse reports could quickly do their damage. Toward the close of 1906, it was rumoured that the Guggenheims of New York had their eye on Nipissing, and Nip shares responded, particularly after it was officially announced that they had secured an option on 400,000 shares at \$25 a share and had paid \$2,500,000 on account, taking 40,000 shares and leaving 60,000 shares as a guarantee of future payments. The pendulum swung the other way, however, when, a month later, the Guggenheims stated that they were not taking up their option, but would forfeit the shares retained by the company. The reason given was that a question had been raised concerning the validity of Nipissing's title in view of a writ (later withdrawn) issued against the company by the Attorney-General of Ontario in connection with alleged irregularities in applications for leases.

The government had previously reserved the unalienated portions of the beds of Cobalt (Long) and Kerr lakes, and late in

1906 announced its intention to sell the mining rights in these parcels at auction, calling early in December for tenders. Syndicates were formed in Montreal, Toronto and Ottawa, and syndicate members, headed by Sir Henry Pellatt of Toronto, formed the Cobalt Lake Mining Company Limited with a capital of five million shares of one dollar par value. This company's tender of \$1,085,000 for the Cobalt Lake rights was accepted. Tenders for Kerr Lake rights were disappointing and the property was at first withdrawn from sale, but within a few weeks it was announced that the Crown Reserve Mining Company Limited had secured the rights for \$178,500, plus a royalty of ten per cent of the gross value of ore mined.

Cobalt companies represented a great variety of "deals." Peterson Lake Silver Cobalt Mining Company Limited controlled two hundred acres under Peterson Lake and also the rights under the 33-foot road allowance around the shore. In addition to developing a portion of its own holdings, the company leased 155.8 acres to nine different syndicates for twenty-five per cent of the ore produced. The City of Cobalt Mining Company Limited had a 99-year lease on forty acres near the south end of the townsite at a royalty of twenty-five per cent of its net profits; the Cobalt Townsite Mining Company Limited had a like arrangement with the railway, covering thirty-eight acres southwest of the townsite; while the Right of Way Mining Company Limited had, in addition to a fraction consisting of three and three-quarter acres adjoining the LaRose, the mineral rights underlying four miles of the Temiskaming and Northern Ontario Railway. In order to reach its property under Kerr Lake, the Crown Reserve Company was forced to dig a ditch five hundred feet long for the purpose of lowering the lake-level about eight feet, thus exposing some three acres of lake-bottom. Later, in 1909, the Silver Leaf property adjoining was leased for five years to make possible the working of a vein crossing from one property to the other. Values ran as high as 22,000 ounces of silver to the ton, and from one vein, the Carson, over \$4,000,000 worth of ore was produced.

At first, there seemed no reason to believe that silver ore was confined to the limited region accidentally discovered by railway-builders. Prospectors hopefully spread into the surrounding terri-

tory, but the farther they got from the original discoveries the less ore they found; and while hope of a more extensive area did not die easily, it was at length realized that the Cobalt field was indeed limited. Prospectors are a hard tribe to discourage, and mines were located which did for a time seem to suggest other Cobalts. One of these was the Keeley mine at South Lorrain, on the Montreal River, not far from where it rushes into Lake Timiskaming about twenty miles southeast of Cobalt.

One of the locators of the Keeley claim was Robert J. Jowsey, who was at that time getting his first taste of prospecting and has since become an outstanding mining man. He remembered the story, heard as a boy in western Quebec, of a piece of mineral owned by William Purcell, a neighbour. In 1878, when Purcell was operating a logging camp near the mouth of the Montreal River, one of his loggers, Pat Manion (whose son was later to attain political fame), had dislodged the bit of mineral near the foot of a tree. The ore at Cobalt reminded Jowsey of Purcell's specimen and he was determined to locate the spot from which it had come. In July 1907, he formed a partnership with two chance acquaintances, J. M. Wood and Charles Keeley, who also were thinking of prospecting in that region. On arrival there the partners found the country solidly staked, although many of the claims would lapse in time through the failure of stakers to do their assessment work. After some search, Jowsey located what he thought was the spot on which Manion's find had been made; and in September, when the previous staking lapsed, they staked two claims and an additional one, which they called the Beaver Lake claim. Although Jowsey thought he had the right place, they did not at first find a vein, and the actual spot was later located on the Wettlaufer property. One day, however, when Jowsey and Keeley had gone to Haileybury for supplies, Wood found a piece of smaltite float on one of their claims. This led, after a few hours' digging by the partners, to the discovery of an ore-bearing vein. Being imbued with the prospector's belief that smaltite always meant silver, they were puzzled by the appearance of their sample. Only later, when it had dried out, were the fine silver hairs in evidence. When assayed, it ran 11,000 ounces to the ton.

The successful prospectors were offered all sorts of deals, and in the spring of 1908 sold the two claims for \$300,000 to a company called Keeley Mines Limited, organized by officers of the Farmers' Bank. In 1910, having become involved in the bank's failure, the company passed into the hands of the liquidators; the high promise of 1908 was not fulfilled, and the bank seemed to be stuck with an asset of doubtful value. Then, in 1913, Dr. J. Mackintosh Bell, on behalf of the Associated Gold Mines of Western Australia, Limited, an English company, bought the property from the liquidators for \$100,000. Bell next bought the Beaver Lake claim from the partners for \$50,000. Only fifty feet of drifting by the new owners of this claim disclosed the extension of the Wood vein and justified the geological acumen of Dr. Bell. The success of the Keeley mine started a boom in South Lorrain, and several other producers, such as the Wettlaufer, Crompton and Trout Lake, were developed. The Ontario government laid out a townsite called Silver Centre and in 1924 the T. & N.O. built a branch into the camp. But South Lorrain, like Cobalt and other silver camps nearby, had but a limited life. The end came about 1929; when the veins finally pinched out, Silver Centre became a ghost-town and the railway tracks were taken up.

This however, is ahead of the story. In 1908, hopes were still high that other Cobalts would be found elsewhere among the rocky ridges and little lakes of a vast country but superficially prospected. Such hopes seemed justified when David Bucknell, son of a farmer in Casey Township, about fifteen miles northeast of Cobalt, saw a sample of cobalt bloom and remembered having seen something like it on a rocky ridge not far from where he lived. He went home and staked a claim which eventually became the property of the Casey Cobalt Silver Mining Company Limited. It produced \$2,000,000 in silver. One other producer was developed in the area, but the two seem to have had most of the silver there was and the boom which Bucknell started was of short duration.

Farther north still, where the Montreal River spreads out into Elk Lake, a one-time circus performer—on a tip from a New York surgeon who had visited the place on hunting expeditions—located silver-bearing calcite veins and precipitated a new boom

which, while it lasted, was wide open. It did not last long, because there were no important discoveries, but it provided a convenient jumping-off place for Gowganda, where some real mines were found. Late in the summer of 1907, R. Anson-Cartwright and William Le Heup, one-time jeweller of Mattawa, discovered silver west of the Montreal River on a lake which they named after Dr. Willet Miller. Five claims were staked; they became the property of the Big Six Mining Company, and were later bought by M. J. O'Brien. (This property, now the Miller Lake-O'Brien mine, was bought by Siscoe Gold Mines Limited in 1945.) The following year, Anson-Cartwright and Bill Le Heup, with three associates, returned to Miller Lake on a tip from Donald McInnis, who was in charge of the Big Six mine, and staked a block of claims adjoining the mine. Money for development was put up by Sir Henry Pellatt, who retained a half interest in the Le Heup Mining Company. Later, Sir Henry bought out his prospector associates; and, some time thereafter, J. P. Bickell became interested in the mine, which was eventually acquired by McIntyre Porcupine Mines Limited and, as the Castle-Trethewey mine, is still (1956) in operation.

Meanwhile, Cobalt had developed into a competent mining community. It is true that a large percentage of amateurs were still operating mines, but with the coming of hydro-electric power in 1910, and the construction of an ingenious hydraulic ram for the compression of air, most of the principal mines had installed power drills and hoists. Power-operated aerial tramways transported ore from pit to concentrator, even though underground tramming was still done by hand. High-grading was no longer the rule, since it was possible to eliminate waste rock through concentration. These concentrating plants varied in the amount of equipment they contained, but methods were generally the same. The ore passed through a series of crushers (jaw or roller) and the material coming from each was sifted by screens (stationary, revolving or jiggling) and re-ground, the process being repeated until the ore had been so reduced as to pass through a very fine screen. After this, with water added, the pulp was passed over a series of tables (undulating or jiggling), which separated the heavier from the lighter material. The concen-

trate was then dried by passing through various filters and was dropped into the shipping bins, while the lighter material was diverted to the dump.

The narrow, irregular veins, with their many ramifications, put a premium on good mining, and consequently the principal properties soon found it advisable to engage competent engineers. The experience gained at Cobalt by many young mining engineers, and by some who had not the advantage of university training, has had a very great influence upon the history of Canadian mining. Joseph McDonough, who made the Madsen mine at Red Lake; the LaBines, Gilbert and Charles, of Eldorado and Gunnar fame; Balmer Neilly, who at his death was president of McIntyre Porcupine; Robert A. Bryce, of Macassa and Renabie; J. J. Byrne, of Discovery Yellowknife and other mines; Robert J. Jowsey, who discovered the God's Lake mine and has been associated with a host of others; Jack Hammell, who brought in the Howey, Pickle Crow and many more; Fred M. Connell and his brother W. H., of Conwest Exploration, a company which misses few mining bets; Cyril T. Young, of West Wasa—to mention but a few of the names that come to mind—all these spent their apprentice days in Cobalt.

In addition to mining men, many others who have attained eminence got their start in Cobalt: S. H. Logan, who opened the first bank in Cobalt for the Canadian Bank of Commerce, lived to become president of that great institution; a later president, Neil J. McKinnon, was born in Cobalt; and Harry Seguin, for many years a prominent Toronto broker, won lasting friends for the Imperial Bank of Canada. Senator Arthur Roebuck had published a weekly newspaper in Cobalt before he studied for the bar, and the Pearce brothers, who founded that unique mining journal, the *Northern Miner*, moved it to Toronto only after Cobalt's days seemed numbered. Dr. W. H. Drummond, the writer of "Habitant" verse, spent the final four years of his life in Cobalt. There he practised his profession and, in partnership with his brothers, was the owner of the Drummond mine, holding eighty acres of ground at the northeast end of Kerr Lake, where he also had his home. He died in 1907, just as the mining boom was gaining force; if he had lived, it is more than likely that he

would have done for Cobalt what Robert W. Service had done for the Klondike.

Cobalters do not hold periodical get-togethers as do, for example, Klondike sourdoughs. Wherever a group of them happen to meet, their reminiscences never fail to take on a nostalgic tinge; but the heyday of Cobalt is more than a happy memory and its present importance is that it produced a group of mining men—even though some were previously store-keepers, lawyers and contractors—who had money and experience to invest in mines elsewhere. The great iron-ore development in Labrador and New Quebec initiated by the Hollinger interests stems directly from Cobalt. The Mining Corporation of Canada, Limited, sponsors of mines in various parts of Canada and the first of the great holding and development companies now so characteristic of Canadian mining, was organized in Cobalt in 1914.

Cobalt's only serious labour conflict occurred in 1907. A year earlier, a branch of the Western Federation of Miners, with headquarters in Denver, Colorado, had been organized. At first the local's activities were mainly devoted to the promotion of social events. Early in 1907, however, a demand was made for higher wages (from \$3.25 to \$3.50) and shorter hours (from ten hours to nine), to which several of the mines agreed; when the others refused, a strike was called. The mine operators secured an injunction against the strikers, and their leader, John P. McGuire, was arrested. The back of the strike was broken by the arrival of a trainload of strikebreakers.

From the start, fear that the silver veins might not go to depth was at the back of everyone's mind. There was the example of the shallowness of silver veins in the Thunder Bay region and the gold-bearing veins of Lake of the Woods. The nature of the Cobalt vein system, consisting as it did of a network of veins, tended to postpone the answer. So long as parallel veins remained to be tapped there was no need to deepen shafts unduly; and even when some of the shafts lost the ore at 250 or 300 feet, it did not necessarily mean that others might not continue to greater depths. But as one vein after another reached its limit at about the same horizon, the unwelcome truth shot home that the only

hope of longer life lay in further discoveries beyond the restricted area of the camp, nearly all of which was within Coleman Township. With the passing of time and the failure of all prospecting efforts, the melancholy fact was at length accepted that Cobalt's days were numbered. Considering the relative shortness of its career, Cobalt had established an impressive record; between 1904 and 1920 it had produced 302,480,329 ounces of silver and 7,600,920 pounds of cobalt, valued at a total of \$186,809,746.

And even then, Cobalt was not dead. It is true that for many years between the wars its prospects were at a low ebb; but during the second war and afterwards, owing chiefly to the growing importance of the metal which had given the town its name, production figures once more followed an upward curve. From 1920 to the end of 1952, the camp produced 93,070,258 ounces of silver and 11,063,342 pounds of cobalt with a total value of \$63,292,976, bringing the grand totals—1904-1952—to 395,550,587 ounces of silver and 18,664,262 pounds of cobalt valued at \$250,102,722. The principal development since World War II has been that of Silver-Miller Mines Limited organized by H. G. Miller of Cobalt, who got together a number of once-famous mines, de-watered and rehabilitated them, and produced a profitable enterprise.

With the increasing market for cobalt, the old dumps were being worked for metal previously scorned; properties formerly considered marginal or uneconomic for other reasons had been put into production; and, owing to improved methods of exploration, new veins had been discovered. New buildings had appeared and older ones were repaired and repainted. The old town was taking on a new look.

VIII

Porcupine

THE TEMISKAMING AND NORTHERN ONTARIO RAILWAY WAS FIRST intended, as we have seen, to foster farm settlement in northern Ontario. New Liskeard, at Mile 112, was its first objective, but it had lifted its sights considerably before that point was reached. The Cobalt silver strike had shifted the emphasis to mineral development; and, with both ends in view, the provincial government had decided to build an additional 150 miles to connect with the newly projected National Transcontinental at Cochrane. But long before the rails reached Cochrane, mineral discoveries had been made which did much to justify the theory that railways should be built in advance of development.

The prospector who keeps on hoping, despite unfavourable indications, that each round of holes will bring the answer to his dreams is sometimes to be pitied; but also to be pitied is the one who might have hit bonanza had he persevered a little longer. If Thomas A. Edison had continued his shaft in Falconbridge Township for another forty feet, he would have cut rich copper-nickel ore; if R. J. Jowsey and his partners had run their drift fifty feet farther, they would have hit the Keeley jackpot; and if Reuben D'Aigle, in 1908, had persisted with his efforts on a quartz-veined knob in Tisdale Township, he might have anticipated the vast Hollinger empire. A native of Chipman, New Brunswick, he was only nineteen when he joined the throngs that flocked to the Klondike. He made no fortune there, but turned his hand to whatever offered, prospecting, working someone else's claims on a lay, or cutting cordwood. In the spring of 1902, he paddled his canoe down the Yukon to try his luck in the placer diggings along the upper reaches of the Kuyukuk, one of the Yukon's two principal tributaries wholly in Alaska.

Chances of making a stake on the Kuyukuk were even less than in the Klondike and he drifted down the Yukon to the Tanana, the other great tributary. Prospecting the stream and its branches, he was at Barette's cache on Chena Slough (site of the future Fairbanks) when Felix Pedro came in with the news that a placer gold discovery had been made on two nearby creeks. D'Aigle joined the rush, staking thirty claims, one of which—No. 6 below Discovery, on what became known as Cleary Creek—proved to be among the richest in the camp. He worked the claim until the fall of 1906 and sold it for a good price which, when added to gold dust already accumulated, amounted to a handsome stake. Like many of his kind he was reticent about his total takings but, packed in buckskin bags, there was evidently more than he could conveniently carry.

That fall he decided to go "outside," and, trundling his precious burden in a wheelbarrow, he boarded a river boat bound for St. Michael. There he caught a steamer for Seattle, where a truck took the place of a wheelbarrow in transporting his treasure to the Seattle branch of the United States mint.

Cobalt, dormant for two years, had begun to boom, and D'Aigle, his prospector's pulse quickened by rumour, headed for that glamorous spot, but, as in the Klondike, all available ground was taken. Offered a number of prospects, in each case he considered the price too high. The fact was that he had no great liking for claims already discovered; he was a prospector, and would find a claim of his own. For some reason, he decided to prospect in the country to the north of Cobalt.

Experienced only in placer mining, he made good some of his deficiencies by taking the short courses in mineralogy given by Queen's University. By this time (May, 1907) the T.&N.O. had reached Matheson, then called McDougall Chutes, but D'Aigle did not go by rail. Instead, he left the C.P.R. main line at Metagama station—seventy-one miles west of Sudbury, and with a companion, Billie Moore, paddled up the Spanish River to its headwaters, portaged northward into the Mattagami, and drifted down to a point about twenty miles below the Hudson's Bay Company post of Fort Mattagami.

A portage trail, cut more than a century before by H.B.C. trad-

ers, led eastward through what was called the white rock country (because of the quartz outcrops along the way) to the Abitibi River. It followed the line of a series of small lakes. The first, an unnamed one later known as Miller, lay a mile and a quarter from the Mattagami; between Miller and Delbert—now Gillies—the distance was only two hundred yards. (Both lakes are now filled with tailings.) From Delbert Lake, a portage of a quarter of a mile led to Jarvis, now called Pearl. Between Pearl and Porcupine lakes, the route consisted of a mile and three-quarters of portage, then a mile along a stream, followed by another mile and three-quarters of portage to Porcupine Lake, which is two miles long and half a mile wide—a much larger sheet of water than the ones farther west.

This was to become historic ground. The country had been surveyed some years before by Alex Niven, Ontario Land Surveyor, whose baseline (48° 27' 54"), formed the south boundary of Whitney and Tisdale townships. In 1896, the Ontario Bureau of Mines attached a young geologist, E. M. Burwash, to Niven's party. During that season the baseline reached the southeast corner of Whitney Township, and Burwash, noting the occurrence of quartz veins carrying traces of gold, expressed the opinion that, except for the drift, the country was a promising one for the prospector. Following the classification in use at the time, he wrote: "In the lower part of the series now considered to be mainly Keewatin, gold appears to be quite widely distributed, both in veins which are of tolerably frequent occurrence and in the mineralized portion of the rock itself. In two cases the veins were situated near the boundary of the granite areas."

In 1899, W. A. Parks (later head of the geology department of the University of Toronto) reported on the geology of the portage route referred to above: "I regard the region south of the trail to Porcupine Lake as giving promise of reward to the prospector." Such references as these would today evoke an instant response from a swarm of prospectors, but in that day prospectors set little store by geologists.

It is more than likely, however, that D'Aigle, during his sojourn at Queen's, had read these reports, or at least had heard of them; and so, for him, the portage route was not utterly unknown terri-

tory. Near the south shore of Delbert (Gillies) Lake, he encountered an upstanding knob of quartz, its whiteness contrasting with the surrounding greyness of the lichens, and here he staked seven claims. Although panning likely-looking chunks of rock, he did not find gold; but when he left for Toronto in the fall he took away with him a number of samples, one of which assayed \$3.80 in gold to the ton.

The following spring, D'Aigle arranged to do some intensive prospecting in the same area, bringing in a more elaborate outfit including an anvil, a forge and a supply of blacksmith's coal. Assisted this year by Bob Mustard, a prospector and lumberjack, with five half-breed canoemen and packers, he returned to his Tisdale discovery. With hand steel and powder, they sank a test pit, D'Aigle systematically panning the rock, but again there was disappointment at the lack of free gold. This, however, squared with what everyone had told him, and Mustard reiterated, that "quartz veins in Ontario never pay to work." Reluctantly, D'Aigle left the Porcupine country forever, to try elsewhere—in the Chibougamau, and in Ungava, where he was a generation ahead of his time. Still prospecting at seventy-seven, with two sons following in his footsteps, he hoped yet to bring in a mine.

Though D'Aigle missed becoming the discoverer of Porcupine, he was not the first to prospect in that region, and others were not far behind. In 1907, two Finns, Victor Mansén and Harry Benella, coming in from the Abitibi country, discovered gold-bearing quartz on Gold Island, in Night Hawk Lake. A company was formed and a small shaft put down, but the vein did not bear out its promise. More successful was Charlie Auer, who staked on a point jutting into Night Hawk Lake, near Gold Island. As the property of Night Hawk Peninsular Mines Limited, these claims, during the company's short and chequered life, produced about half a million dollars. In November 1907, prospectors employed by A. G. Hunter, a Toronto lawyer, found gold on the northeast shore of Porcupine Lake; but, although the property was worked at intervals, it did not succeed.

Another early prospector was Alex Kelso who, late in the fall

of 1907, found an outcrop of sulphides east of Night Hawk Lake, near the T. & N.O. right-of-way, which ultimately became the Alexo nickel mine. A producer during World War I, it was unable, when conditions became normal, to compete with more cheaply produced nickel at Sudbury. It is now the property of Noranda Mines Limited, and the end of its story is probably not yet. Two T.&N.O. stations—Kelso and Alexo—are named after this prospector; as the end of steel, Kelso was for a time a busy place. Other prospectors who might have gained the big spotlight were "Hardrock" Smith who, in 1909, staked three claims on the north-east side of Pearl Lake; Joe Vipond, who about the same time discovered what was later to become the mine bearing his name; and Bill Davidson, whose claims in the northern part of Tisdale, resulting in the Davidson mine, never produced much gold.

W. S. Edwards of Chicago seems to have been the instrument chosen by fate to crack open the Porcupine country; for early in 1909, in association with Dr. T. N. Jamieson, an American naval officer living in Chicago, he grubstaked John S. Wilson of Massey, Ontario, who had done some previous prospecting in Porcupine. Wilson, at the time, was working on T.&N.O. construction near Matheson, but with the opening of spring the urge to go prospecting was strong. Failing in an effort to get a grubstake, he wrote to Edwards, with whom he had had some previous correspondence concerning copper prospects, suggesting that Edwards back him. Within a few days a telegram came from Edwards saying that a cheque was in the mail.

Wilson had previously established a cache of supplies on the shore of Frederick House Lake. At the end of May he left Nellie Lake (then the end of steel) for the country west of Night Hawk Lake. With him were Harry A. Preston, John Campbell, Cliff Campbell, George Burns and Phil Mecklenburg. They travelled in canoes to Porcupine Lake, and established a camp at Deadman's Point. Here a difference of opinion developed; Preston later claimed that he wanted to prospect south and southwest along the portage leading to the Mattagami, but Wilson preferred to remain in Whitney Township. Nothing of promise had been

encountered, however, when a report reached Wilson of a silver strike in the Sudbury area and the whole party, except Preston, dashed off to get in on it.

Left to his own devices, Preston followed his hunch to prospect in Tisdale Township, where he located a showing of quartz and sulphides that he was still investigating when Wilson and party returned, having learned that the reported strike near Sudbury was but a mirage. They now found the country swarming with prospectors, attracted by the news that George Bannerman, who with Tom Geddes had been camped on the north side of Porcupine Lake, had made a rich gold strike.

Since everything in the vicinity of Bannerman's discovery was already taken, and nothing better was in sight, Wilson's party turned their attention to Preston's showing. There a 21-foot vein was uncovered when Harry Preston slipped on a knoll, stripping the moss from the slope with the heel of his boot and disclosing rough, ragged stringers of free gold. This they called the Ida May vein.

Wilson rushed off to Chicago to report. Edwards decided to visit the spot himself, but he declined to trust his exceeding stoutness to the insecurity of a canoe and got no farther than Matheson. Wilson returned alone to the scene of the strike to find that, during his absence, his partners had been actively prospecting the adjoining area and that Gilbert Rhault had discovered what was later called the Golden Stairway. (Rhault, like Tom Flanagan and Fred LaRose, was a blacksmith. He had taken Cliff Campbell's place in the party at the time of the Sudbury side-trip.) It was August 24 when a chance blast by Preston spread before the group's excited gaze a glittering array of gold-spattered quartz. Feverishly, the rest of the day was spent staking the claims that were to become the famous Dome mine.

According to Wilson's agreement, the prospectors were under obligation to stake fifteen claims for Edwards and Jamieson, and were then free to stake another fifteen for themselves in which Edwards and Jamieson would have only a quarter-interest. Fifteen claims had already been staked farther east, and these could have

been considered as fulfilling the first part of the agreement; the new staking, less a quarter-interest, would then be the property of the prospectors. The temptation to construe the agreement in this way was strong, but there was a division of opinion. Edwards was summoned for a conference, and this time he came, sustaining no greater damage than a sprained ankle and a ducking from a dumped canoe on the way in.

After much discussion it was agreed that Edwards and Jamieson should have a quarter-interest in all claims, and a further quarter-interest because of their undertaking to pay recording fees and the cost of assessment work. Each of the six prospectors received immediately \$1,000 in return for a three-eighths interest in their Discovery claim and a half interest in three others; Wilson was to have also an overriding ten-per-cent interest in all claims.

Jubilantly, Edwards telegraphed Dr. Jamieson in Chicago:

HAVE DISCOVERED THE GOLDEN POLE BEYOND DESCRIPTION ANSWER MATHESON WEDNESDAY HAILEYBURY THURSDAY. PROTECT CHECKS SIX THOUSAND MASSEY.

A facsimile of the handwritten message, later published, bears eloquent testimony to the writer's excitement.

Word of the find spread with the usual speed. Bert Hotchkiss, prospecting nearby, was the first to arrive; he staked the claims that were to become the West Dome mine. In a short while everything for miles around had been claimed by hopeful stakers.

Edwards had connections, and soon an option was given to a group of New York capitalists who, however, failed to go through with it. When the field was clear, another New York financial group, including Joseph R. Delamar and Ambrose Monell, who were already interested in Canadian mining in Sudbury and Cobalt, took up the deal; and it was on the advice of Robert C. Stanley, the young engineer who was later to become president of The International Nickel Company of Canada, Limited, that they exercised their option and bought into bonanza. On March 27, 1911, the Dome Mines Company Limited was incorporated

with an authorized capital of 250,000 shares of \$10 par value, increased in 1913 to 500,000 shares. The name was changed to Dome Mines Limited in 1923, when two shares of no par value were exchanged for each former share. A further two-for-one split was made in 1938.

Edwards, a Chicago manufacturer of electrical appliances, was the first president of the Dome company, and for many years was closely connected with Porcupine affairs. His associate, Dr. Jamieson, remains a mystery man. There is nothing in available records to show that he was ever interested in Porcupine mines; he is not shown as a director of any company that grew out of the staking he helped to finance. Presumably he received his share in stock or cash; perhaps, like Omar, he preferred the cash.

More than any other metal, gold has power to galvanize men into action, and in the case of Porcupine there was no such hesitation as there had been at Cobalt. Almost, it would seem, before word had got about, prospectors were on their way in. Among these were Benny Hollinger—a barber of Haileybury, still in his teens—and Alex Gillies, who was somewhat older. They had already spent two years together, prospecting in the territory between Haileybury and Porcupine, and when word of the Wilson party's strike reached them they were in Haileybury looking for a grubstake. News of the strike loosened grubstakers' pockets, but not very much. Gillies talked Jack Miller out of a hundred dollars, but Jack McMahon would let Hollinger have only forty-five, and this he hedged by selling a half-interest in his prospective gains to Gilbert LaBine for fifty-five dollars. The deal was made with Jim LaBine, Gilbert's cousin, but Gilbert claimed that the money belonged to him.

Thus, while working together, Hollinger and Gillies represented different grubstakers. On October 3, they established their headquarters camp on Porcupine Lake, working westward toward Pearl Lake. There they saw quartz outcrops that looked good to them, but they found no gold. Nevertheless, on October 8, they began to stake, and in the course of their work they came on an abandoned pit beside which were a rusted anvil and forge. When later a sample was taken from the bottom of the pit, it assayed \$52.00 in gold!

On the second day of staking, "I was cutting a discovery post," Gillies reported later, "and Benny was pulling the moss off the rocks a few feet away, when suddenly he let a roar out of him, and threw his hat to me. At first I thought he was crazy, but when I came over to where he was it was not hard to find the reason. The quartz where he had taken off the moss looked as though someone had dripped a candle along it, but instead of wax it was gold. The quartz stood up about three feet out of the ground and was about six feet wide, with gold all spattered over it and for about sixty feet along the vein."

Carefully replacing the moss for fear some wandering prospector might happen along, they eagerly searched the adjoining ground for signs of gold in order to validate their staking, and when they had succeeded in this, they staked twelve claims. They staked an additional one for Barney McEnany, an old partner who was crippled, and this claim later became the nucleus of the Porcupine Crown mine. The partners were now confronted by the problem of dividing their claims, since two separate grubstakers were involved. A coin was tossed; Hollinger won, and chose the six claims on the west. When the staking was done, and they were on their way to the Mining Recorder's office at Haileybury, they met Jack Miller and Tom Middleton on Porcupine River. Pulling the canoes together, Gillies showed Miller, his grubstaker, a piece of quartz from Hollinger's discovery, "three and a half inches long, one and a half inches wide, and seventy-five per cent gold." Middleton and Miller lost no time in getting to Gillies Lake and staking immediately south of Hollinger's claims. Middleton had already been in the area; he and Clarence Dixon had staked two groups of claims, one near the southeast corner of Tisdale, and the other at the east end of Pearl Lake.

At Haileybury, Hollinger and McMahon had a talk with a young McGill mining student named Alphonse Paré, who was a nephew of Noah Timmins. Paré left immediately for Porcupine to look the claims over. One look was enough; and without even taking a sample he advised his uncle not to let the claims get away from him. Timmins acted quickly and soon had Hollinger and McMahon under contract. For Hollinger's six claims he

agreed to pay \$330,000 at the rate of \$30,000 down and a similar amount monthly for ten months. Timmins later got his Cobalt partners to join him—a move which they never had any reason to regret. Despite the glittering surface showing, times were to come when their wisdom could be doubted; but, perhaps remembering a similar situation in connection with LaRose, they held on, and success greater than they could have hoped for was their reward.

The Gillies-Miller claims (later the Acme mine) were optioned to the M. J. O'Brien interests, neighbours and antagonists of the Timmins group at Cobalt. The O'Briens decided, before any considerable portion of the purchase price had been handed over, to test the ground by drilling. A young engineer, tramping the trail with cores for assay strapped to his back, and wishing to lighten his load, jettisoned those that were not high in quartz. It was learned later that the principal values were in the wall-rock schist, which was interspersed with quartz stringers; but meanwhile the O'Briens had dropped their option because the assays they obtained were low. The Timmins-McMartin-Dunlap quintet gleefully snapped up the claims. They also secured the Miller-Middleton claims, known as the Millerton mine.

Sandy McIntyre had joined Hans Buttner in Haileybury, and together they headed for the scene of the Wilson-Preston staking. Despite the amount of staking already done in the vicinity, Buttner staked two claims. They then continued on to Gillies Lake, where they staked four claims adjoining Hollinger's on the north. Buttner sold his claims almost immediately for \$10,000, but McIntyre held on to his for a while, doing some occasional prospecting on them until he came upon a vein rich in gold. This was later found to be a continuation of the Hollinger vein.

Most of the vicissitudes of McIntyre's career can be attributed to his fondness for the bottle. Born Alexander Oliphant, in Scotland, he was a moulder by trade and had worked in the north of England, supporting a wife in Glasgow. According to his own account he was a bit slow one week in remitting the wife's share of his pay, and received in consequence a blistering missive. This, he felt, was the last straw. Deciding to try his luck in a new land under a new name, he sailed for Canada out of his

wife's ken. He found himself at length in northern Ontario and got a job on a T.&N.O. construction gang, but the nomadic life of a prospector beckoned to him and he shortly took to the bush. This was much better than pouring molten metal into moulds, and he need consult only his own inclinations whenever he desired a change of scene. In those years the grapevine was busy with rumours of strikes in many parts of the country—Larder Lake, Swastika, Gowganda. He happened to be in Haileybury when word came of the Porcupine strike.

In the summer of 1910, having held his property for almost a year while other claims were selling for large sums, McIntyre sold a quarter interest to Weldon Young of Ottawa for \$300 and, later in the same day, a one-eighth interest to Jim Hughes for \$25—transactions that testify to the condition of the vendor at the time of the sale. Later, when presumably in a more responsible frame of mind, he sold a half interest to A. J. Young of North Bay for \$5,000 cash and an additional \$60,000 on option. Townsley* says McIntyre was tricked out of the \$60,000, which is not surprising. At any rate, Sandy McIntyre received a very small part of the millions which ultimately came from the claims he staked in 1909. It should be mentioned, however, that his later years were made easier by a pension from McIntyre Porcupine Gold Mines Limited.

Vipond, situated about three-quarters of a mile south of Pearl Lake, and adjoining the Hollinger to the south, was discovered by Joe Vipond, already mentioned as one of Porcupine's early prospectors. A test-mill, put up in 1911, was destroyed by the great fire of that year, and was followed by one of 150 tons. Down to the end of 1912, Vipond had the greatest total production of any Porcupine mine, amounting to \$7,811,079; but after that it was overtaken by Hollinger and Dome. In 1933, Vipond became the nucleus of Anglo-Huronian, Limited, now a prominent holding and development company.

Coniaurum Mines Limited, incorporated in July 1924 with an authorized capital of \$5,000,000, was formed to take over New-ray Mines Limited, Goldale Mines Limited and Strong Bow Mines Limited, whose properties comprised a block of 640 acres

B. F. Townsley, *Mine-Finders*, 1935.

adjoining McIntyre Porcupine on the east and northeast. Additional ground was subsequently acquired to increase the company's holdings to 760 acres. Previously, work at Newray had been carried on by Coniagas Mines Limited, under a working option. In 1929, the company was reorganized and taken over by Ventures Limited who installed new equipment underground and on surface. Production had begun in 1928 with a 500-ton mill, that year's output being \$220,534; by the end of 1955 it had reached a total of \$31,969,243.

The first settlements in the district were on Porcupine Lake; "towns" sprang up at various places along the shore. Golden City and Pottsville, the earliest established, were at its north-eastern end. These were typical mining communities, doing their best to emulate the ways of boom towns everywhere. When it was announced that the Porcupine extension of the T. & N.O. (completed in 1911) would run south of the lake, touching its shore only at the southwestern end, A. C. Brown, in partnership with Cliff Moore, began to lay out the townsite of South Porcupine. The new town, in time, eclipsed both Golden City and Pottsville. The latter, unfortunately, was on the wrong side of the lake; the wagon road, such as it was, ran also on the south side, until supplanted by the present highway. And although Golden City had been more central to early mining activity, and the recording office was there, the failure of the Scottish-Ontario mine (based on George Bannerman's find) to live up to its rich surface showings, coupled with the spectacular developments in the Dome and Hollinger areas, slanted the advantage in favour of South Porcupine.

Another rival was soon to appear. South Porcupine was five or six miles east of the mines about Gillies and Pearl lakes, and the far-seeing eye of Noah Timmins envisaged a more appropriate metropolis for the community that would grow up around the great mines. Westward of Miller Lake, extending to the bank of the Mattagami, lay a relatively level stretch of park-like, sandy land, the obvious location for such a townsite. As with other Timmins enterprises, reality followed fast on the heels of imagination. In the fall of 1911, an auction sale of lots in the new town

was held; business and residential lots were disposed of, and some of the former, still growing trees, brought as much as fifteen hundred dollars. Soon the sound of hammers and saws could be heard among the poplar and jack pine as the city-to-be quickly took shape. On January 1, 1912, the Town of Timmins was incorporated.

That the chief town in Porcupine should be called Timmins is eminently fitting. Before Noah Timmins and his brother Henry were swept into large-scale mining through the purchase of the LaRose mine at Cobalt, their experience had been that of small-town store-keepers. They saw very little money from one year's end to the other, for Mattawa was dependent upon the timber trade, and nearby timber had long since been logged off. Noah, the leader, had the capacity to recognize an opportunity when it arrived, and also the ability to act promptly and decisively. Not only was mining a new experience for him, but gold-mining activities in Ontario had not been fortunate. It therefore took a great deal of courage in 1909 to bid \$330,000 for a gold prospect in Porcupine, practically sight-unseen. Despite the promising showings at the Hollinger, there were times in the mine's early days when all Noah's determination was needed to keep things going. After the Hollinger had become an established producer and funds were available, he was always ready to extend a helping hand to others caught up in toils such as he himself had passed through. Long before his death in 1936, Noah Timmins had become recognized as one of Canada's outstanding citizens.

It is interesting to note that the very early discoveries were also the ones that resulted in the largest mines, such as the Hollinger, the McIntyre and the Dome. Outstanding is the Hollinger, one of the world's great gold mines. The first company, Hollinger Gold Mines Limited, with an authorized capital of \$3,000,000, was incorporated on June 28, 1910, and a subsidiary, the Canadian Mining and Finance Company Limited, with a capital of \$500,000, in December 1911. The purpose of the latter was to facilitate the acquisition and consolidation of nearby claims on behalf of Hollinger, acting also in the meantime as the operator of the Acme and Millerton properties. In

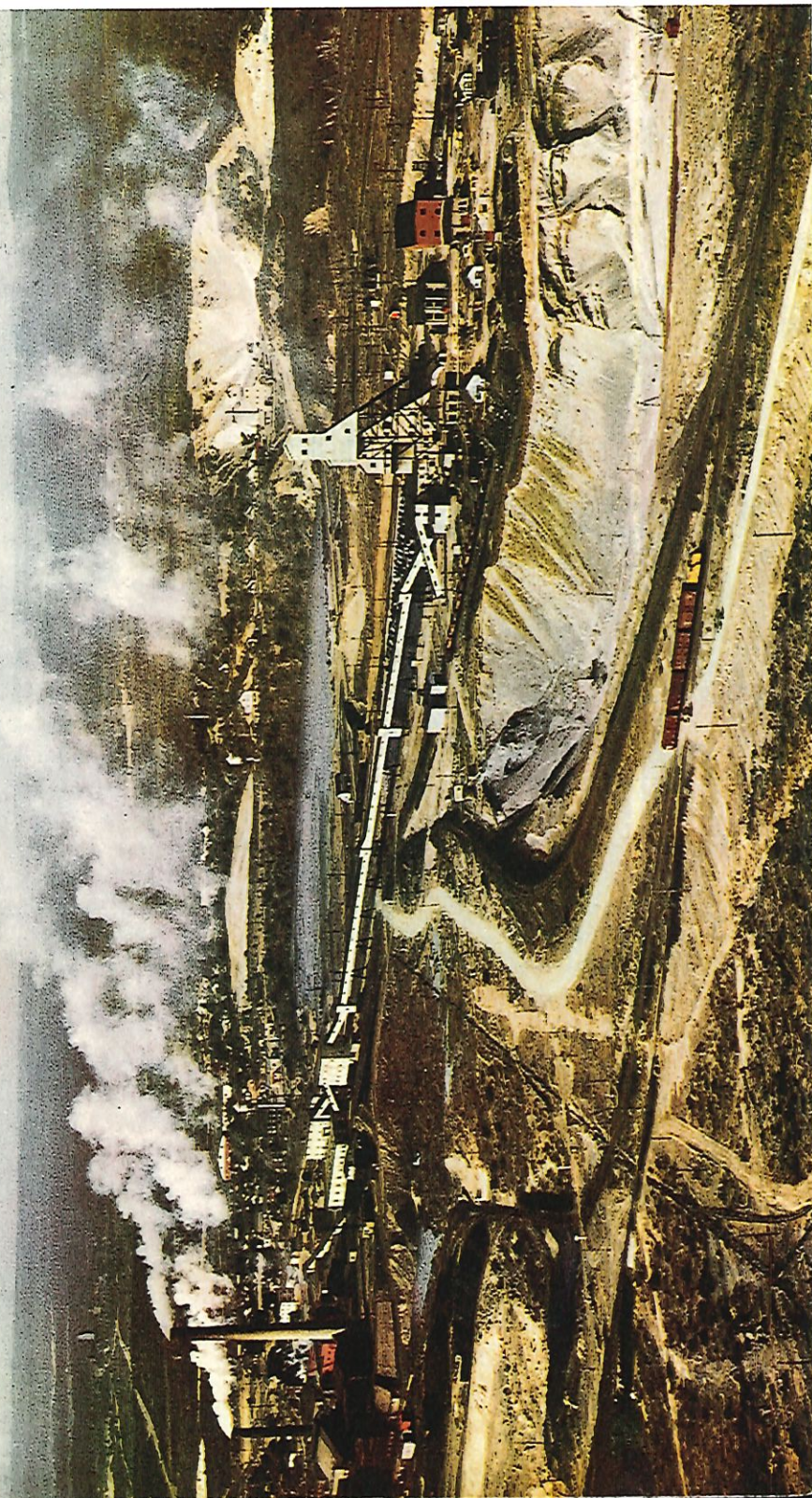
May 1916, Hollinger Gold Mines, Acme Gold Mines, Millerton Gold Mines, and the Canadian Mining and Finance Company were merged in Hollinger Consolidated Gold Mines Limited, with an authorized capital of \$25,000,000.

The first Hollinger mill, of two stamps, was set up in 1910, and after the nature of the ore had been determined a forty-stamp mill was installed; with a capacity of three hundred tons a day. In May 1911, the plant was destroyed by a forest fire, but within a year it had been rebuilt at a cost, according to the annual report issued in October 1912, of \$593,728. Although the mine had been in production only four weeks, a dividend of three per cent was declared. The general manager, P. A. Robbins (formerly of the McKinley-Darragh at Cobalt), reported: "At present we are treating on an average 300 tons daily, and making 97 per cent extraction from \$30 ore." All ore treated was not, however, of such grade, owing to the inclusion of development ore.

An important addition to the mine was made in 1922 when adjoining ground was bought from Frederick W. Schumacher, whose name is perpetuated by the town on the south shore of Pearl Lake, east of Timmins. Shortly after the first Porcupine discoveries, Schumacher, a wealthy resident of Columbus, Ohio, commissioned Shirley Cragg, a geologist, to secure some claims in the district for him. Cragg bought the rights on two "Veterans' claims" which had been awarded by the Ontario government to soldiers who served in the South African War. The one now bought by Hollinger (for \$1,631,376) adjoined the mine on the southeast; the other lay north of the Dome, and more will be said of it later.

Development of the Hollinger has proceeded by means of many shafts, which for several years previous to the time of writing had been reduced to four. The Main Central Schumacher shaft was 3,950 feet in depth, with an internal sub-shaft, known as No. 25, extending from the 3,950-foot level to 5,750 feet. A lower-level shaft, No. 27, at the Schumacher end of the mine, continued from the 2,450-foot level to 5,300 feet; and No. 26, of six compartments, sunk fifteen hundred feet north of the Central shaft, was 3,060 feet deep. The intention was eventually to

Falconbridge Shaft, Concentrator and Smelter →
—George Hunter Photo



abandon the Central shaft, which would release a considerable amount of ore left in pillars nearby. The mine's total underground workings had reached three hundred and sixty miles by 1955; its mill had a nominal daily capacity of from 3,500 to 4,000 tons, although in previous times it had been rated at 5,000 tons. The Ross mine, a gold producer wholly-owned by Hollinger (in Hislop Township, east of Porcupine) produced 360 tons a day, and the combined daily production of Hollinger and Ross in 1955 was 3,802 tons. To the end of the latter year the total production from both mines was approximately \$470,723,906.

Since the death of Noah Timmins, Jules R. Timmins, son of Henry, had been president, and during most of that time the general manager (later, consulting engineer) was John Knox, who played an important part in Hollinger's expansion into other fields.

One of the constant hazards of a community freshly hewn from the forest is fire. On May 19, 1911, a fire had destroyed the Hollinger plant. As the hot, dry weather continued into mid-summer the threat increased; and on July 11, menace became reality. Billows of thick, acrid smoke rolled in from the west upon the people of South Porcupine; beyond the murk, leaping tongues of fire could be seen. The young town, still with scaffolds about it, seemed doomed. People carried their belongings to the beach in an effort to save them, but as the wall of fire came nearer it was painfully evident that many would be lucky to save their lives. Every boat, raft or other craft that could float was loaded with women and children fleeing across the two-mile stretch of water to Golden City in the hope that it might prove a haven; and, as it turned out, most of Golden City, filled to overflowing with refugees, was saved, but Pottsville was destroyed.

The catastrophe was deeply etched into the memories of Porcupine people. Few there were who did not have a friend or relative to mourn in a death toll of seventy-one; those not burned to death were either drowned or suffocated. Adequate disposal of the dead was a problem in a community so recent as to have set aside no burial ground. But the T. & N.O. line had by that

time reached the camp, so that aid could be sent; and southern Ontario, not waiting for appeals, responded nobly to the need. Though scars remained in the hearts of many, evidences of the holocaust were obliterated in a surprisingly short time as new structures rose to replace the old. The tragedy became but one more episode in the remarkable pageant of Porcupine.

On March 30, 1912, Dome Mines Limited inaugurated its new forty-stamp mill by a banquet at which the president, Ambrose Monell, stated that all the company's works had been reconstructed after the fire at a cost of a million dollars. First operations were by open-cut; then, as the excavation increased in size, mining methods were changed to orthodox shaft-sinking and the opening-up of levels. The ore was found in large irregular lenses or masses of quartz varying from 15 to 150 feet in width and up to 600 feet in length. The best values were along the contacts of quartz and schists, where gold could frequently be seen. Some of the gold was very coarse, particularly in the surface showings of the Golden Stairway vein, where streaks of it had a thickness of about a quarter of an inch.

From time to time the Dome company took in adjoining territory. In 1916 it acquired the Dome Extension Mines Company Limited, which held five claims adjoining on the east; and in 1935 the Foley-O'Brien property, with its 520 acres extending eastward from Dome Extension, was taken over. Several times during a period of years, F. W. Schumacher offered to sell his claim adjoining on the north, but the Dome company was in no hurry to buy. Each time the offer was declined, Schumacher raised his price, and in 1936, when the property had become essential to the company's operations, it paid him \$1,125,000 in cash in addition to twenty thousand shares (which, two years later, were split two for one). Eventually, the mining rights to the greater part of the bed of Porcupine Lake were secured, giving Dome a five-mile stretch of territory, with three and a half miles along the strike.

The Dome mine is operated chiefly from its No. 3 shaft of four compartments, which is bottomed at the eighteenth level (2,400 feet). A series of winzes connects the shaft at the sixteenth level with workings in the Dome Extension area down to

the twenty-seventh level; and at a point 4,500 feet northeast of No. 3 shaft, a large internal shaft extends from the sixteenth level to the twenty-ninth (3,900 feet).

In 1955 the Dome mill operated at the rate of 1,977 tons a day, and to the end of that year had produced a total of \$201,889,673. It had paid dividends amounting to \$76,499,885 and had accumulated a large portfolio of investments in addition to the control of profitable mines which are dealt with elsewhere.

From its inception, the Dome company has been controlled from New York. The Canadian vice-president and general manager for many years was Joseph H. Stovel, and he was succeeded upon retirement by James B. Redpath.

McIntyre Porcupine Mines Limited was incorporated in March 1911 with an initial capital of \$1,000,000. Its original holdings comprised 145 acres on both sides of Pearl Lake, and under it as well. The early mining was done on the south side, near the Hollinger boundary, where the workings were along the south contact of the porphyry, most of the ore being obtained from irregular shoots in the volcanic schist. When the south dip of the porphyry was found to restrict the area of volcanic schist below the 600-foot level, operations were transferred to a vein (No. 5) lying north of the porphyry, on the opposite side of the lake. In 1911, West McIntyre's thirty-four acres were bought, as well as sixty-eight acres underlying Pearl Lake. In 1915, the McIntyre Extension Company was formed, and acquired one hundred and twenty acres from the Pearl Lake Company; and the McIntyre Jupiter Company was formed to take over holdings of the Jupiter mine. In 1916, McIntyre Porcupine, McIntyre Extension and McIntyre Jupiter were amalgamated. Most of these extensions and consolidations occurred during the presidency of Colonel Alexander M. Hay, beginning in April 1915 and ending with his death in January 1917, one day before McIntyre's first dividend was declared. Until 1914 control was in New York. The Flynns—Charles, his brothers, and other relatives—had gathered together the various interests distributed by Sandy McIntyre and with the aid of Albert Freeman, a New York broker, raised the first capital which, however, never seemed sufficient. It was on the invitation of the Flynns that

R. J. (Dick) Ennis had come from Colorado in 1912, and it was largely due to Ennis's determination and resourcefulness that the company survived its early disorders. Ennis's initial period was filled with crises, one of which was averted when the first gold brick, hot from the crucible, was rushed to the bank to meet the payroll and save embarrassment to a friendly bank manager whose faith in Ennis and the mine had led him out on the end of a limb. Ennis was to remain in charge of McIntyre's mining operations until his retirement a few months before his death in 1951. To Ennis and J. P. Bickell, a Toronto stock-broker who had come in when the New York crowd went out, plus a greatly improved ore situation, McIntyre's position in Porcupine—second only to Hollinger—is due.

The mine has been developed through twelve shafts, four of which were in use at the time of writing. The main shaft (No. 11) was 4,150 feet deep; No. 12, an internal shaft, extended from the 3,875-foot level to 6,995 feet, and in 1955 a new internal shaft was begun, connecting the 3,500-foot level with the 7,000-foot horizon to open up the deepest ground yet tapped in Porcupine. The mill was treating about 2,200 tons a day, and from 1912 to the end of 1955 total production had amounted to \$230,119,293. Dividends amounting to \$62,015,033 had been paid, and the company had outside investments valued at some sixty million dollars. In addition, McIntyre controlled the Belleterre gold mine in northwest Quebec and the Castle-Trethewey (silver) in Gowganda.

Bickell, who remained as chairman of the board until his death in 1951, was succeeded as president by Balmer Neilly, and upon the latter's death F. V. C. Hewett became president, with W. B. Dix, treasurer for many years, as executive vice-president.

The Porcupine gold deposits occur within a belt of heavily folded greenstones and Timiskaming sediments that stretches east and west across Tisdale and Whitney townships, its greatest width being about two and a half miles. Stocks and tongues of quartz porphyry have been intruded along the margins of the syncline, and the principal vein systems occur within zones of shearing and fracturing associated with these intrusions. The

veins consist chiefly of quartz; the wall rocks are usually well mineralized with pyrite; and the gold occurs in the vein matter and in the wall rock.

The area comprised in this twelve-mile strip is not all gold-bearing. The productive portions are largely confined to the two limbs of the syncline, with Hollinger and McIntyre marking the north limb and Dome the south. Stakers, however, have not been hampered by any such limitations and, as is usual in mining booms, the surrounding country has from the start been fairly well blanketed. Depressions and wars (except where "strategic" metals are concerned) discourage mining, and at such times large numbers of claims revert to the Crown, only to be re-staked when conditions improve. Mining companies fare accordingly; during dull times their mortality is extremely high. In Porcupine, only the big three have continued unchanged through the years.

Preston East Dome Mines Limited was organized in 1911 to operate 120 acres adjoining the Dome on the southeast and a claim in Deloro Township. Work had barely started when the company's plant was destroyed by the fire that wiped out most of Porcupine. From this it did not recover until the rise in the price of gold in 1934 infused fresh life into the gold-mining industry, resulting in the rejuvenation of many properties hitherto unprofitable to work.

Douglas G. H. Wright, a geologist in the employ of Dome Mines, having a good chance to examine the idle ground, became impressed by its possibilities and managed to get control of it and some additional territory. Even though gold mines were less affected by the depression than base-metal mines, for example, it was still not easy to interest investors in a defunct gold mine along Porcupine's "Lemon Belt," as it was called. The saying about giving a dog a bad name applies with special force to mines.

Wright's geological theories were either ridiculed or ignored by Bay Street, but he at length found a broker who, though frankly admitting he knew little about geology, knew a good selling proposition when he saw it. Joseph H. Hirshhorn had come up the hard way. Leaving school in Brooklyn at an early

age, he had set himself to master the mysteries of the stock-market, and while still a young man had largely succeeded. Becoming interested in Canadian mines, while still maintaining his New York connections, he had come to Toronto in 1932. Although he had not always picked a winner, the country did not owe him anything when he agreed to back Doug Wright and Preston East Dome.

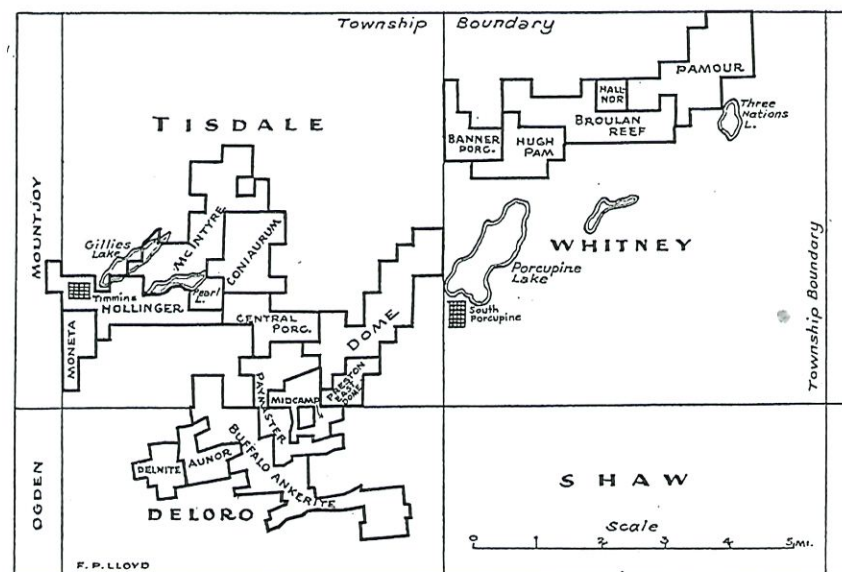
With Hirshhorn's money, Wright began drilling. The first holes were encouraging, and Joe Hirshhorn made the most of them. He succeeded in persuading a firm of contractors to build a 300-ton mill, taking in payment bonds to the amount of \$700,000. The mill went into production in March 1939; the bond issue was paid off within a year, and the payment of dividends began, which to the end of 1954 had amounted to \$5,865,000 from a production valued at \$34,157,326. This story might be matched by many others in different parts of Canada, but Hirshhorn and Preston East Dome were destined to become the principals in a much more dramatic affair which shall be discussed in due course.

Buffalo Ankerite Gold Mines Limited was incorporated in October 1932 to operate four claims in Deloro Township, southwest of the Dome. In December 1935, the adjoining property, known as the March mine and renamed Marbuan, was acquired and was thenceforth worked jointly with Buffalo Ankerite's previous holdings. Operations were suspended in March 1953, when all known ore had become exhausted. The two mines had by that time produced ore to the value of \$35,433,157 and dividends of \$2,763,009. The company has continued as an agency for investment and exploration.

Among the promoters and adventurers who flocked to Porcupine when news of Hollinger and Dome got out was F. Augustus Heinze, who, a few years before, had cut a wide swath in the Kootenay country. Securing a group of claims adjoining the Dome on the west, he organized West Dome Mines Limited in March, 1911, with Sir Henry Pellatt as president and himself as managing director. Surface showings were good, and on the strength of findings at the Dome, Heinze and his friends had little difficulty in disposing of sufficient shares to pay for the

claims and provide working capital of \$250,000. Sir Henry, who had not yet achieved the crowning glory of Casa Loma, his Toronto "castle," was still counted as a financial genius. Also early in 1911, Dome Lake Mining Company Limited was incorporated to operate three claims of forty acres each, south and west of West Dome; farther to the southwest, a number of Montreal men secured a group of claims and formed Standard

PORCUPINE CAMP



Gold Mines Limited; and Ottawa men became interested in McLean Gold Mines Limited adjoining Standard Gold Mines. These companies were successful in their financing; they had erected mine buildings, and undertaken considerable development work, when the great fire completely destroyed everything above ground. Manager Weiss of West Dome with his family and twenty-seven employees, who had sought shelter in the shaft, were all suffocated. The buildings had been rebuilt and development had re-started when World War I broke out. Rising costs, lack of man-power, and inability to secure new capital

caused these companies and many others to curtail and finally to cease operations.

Archie S. Fuller, who had come to northern Ontario from Boston in 1909 and had become interested in mines in Porcupine, Cobalt and elsewhere, secured an option on the properties of Standard Gold Mines in 1916, and for a while resumed underground development with a small steam-powered plant. In 1919, he organized Porcupine Paymaster Mines Limited to assume control of the Standard and adjoining properties. This was preliminary to the amalgamation in 1930 of eleven companies in Paymaster Consolidated Mines Limited, with an authorized capital of nine million shares of one dollar par value, its principal holdings consisting of 748 acres adjoining the Dome on the west and south, with approximately 1,100 acres elsewhere in the Porcupine area. E. H. Walker was president for many years and C. E. Cook, who was general manager, succeeded Walker as president when the latter retired.

The new company began with a load of liabilities and was forced to spend a great deal of money in unifying the workings of its constituent properties. The de-watering of the Dome Lake or No. 5 shaft was a huge undertaking. With the increase in the price of gold, Paymaster at first found it possible to contend with rising costs, beginning payment of dividends in 1938 which, except for 1941, were paid annually until 1946, and since then occasionally. While the mine was shut down between October 1953 and December 1954, advantage was taken of the opportunity to remodel the mill and carry out considerable underground rehabilitation. Since resumption of operations new ore has been located, some of higher than average grade.

Also on the southern limb, Augite Porcupine Mines Limited, holding ground west of Buffalo-Ankerite, made the discovery in 1939 that its ore was pitching toward a group of claims owned by Noranda Mines Limited. Augite and Noranda properties, worked from the Augite shaft, were merged to form Aunor Gold Mines Limited. It later became evident that most of the Aunor ore was in the western part of the company's holdings, with the general rake in the direction of ground held by Sylvanite Gold Mines' subsidiary, Delnite Mines Limited, and excellent ore has

since been located on Aunor property by drifting from Delnite workings.

This form of joint operation, now becoming common in Porcupine, is not as complicated as it may seem, but is a natural outcome of small mining claims differently owned. Eventually, ore extends into an adjoining property, leading to amalgamation or operating agreements. The mines involved here are on the south limb, but in recent years similar situations have developed along the north limb, in Whitney Township. Due chiefly to the initiative of Bert W. Lang, an amalgamation of Broulan Porcupine Mines Limited, Porcupine Reef Mines Limited and Bonetal Gold Mines Limited, holding contiguous ground, was effected in 1951 to form Broulan Reef Mines Limited. Later, Bonwhit Mines was absorbed and its ground is worked through extension of drifts from the Broulan Reef mine. Properties of Banner Porcupine Mines Limited and Hugh-Pam Porcupine Mines Limited, both independent companies, are also operated by Broulan Reef under agreements concerning division of profits.

Another extension of the north limb was brought about in 1933 by D'Arcy Bogue of Montreal through the amalgamation of three properties in the northeast corner of Whitney Township. These were the Three Nations group, owned by Wilfrid D'Amour of Ottawa, and the holdings of LaPalme Porcupine Mines Limited and Porcupine Grande Gold Mines Limited, which had all been dormant for some years; indeed the Three Nations property was once sold for taxes. Now that he had the makings of a mine, so far as acreage was concerned, Bogue attempted to interest some of the larger mining companies, and succeeded in getting Cominco to make an investigation, but Cominco declined to proceed further. Bogue then tried the Quebec Gold Mining Corporation (now Consolidated Quebec Gold Mining and Metals Corporation) which not only investigated but agreed to undertake development. Pamour Porcupine Mines Limited was incorporated in 1934 with a capitalization of 3,500,000 shares of no par value, 1,500,000 of which were transferred to the vendors for the properties, the balance being optioned to the Quebec Gold Mining Corporation. A thorough examination of surface geology was made, and R. M. Macaulay was placed in charge

of development. Later, the old Three Nations workings were de-watered to allow of underground exploration, which disclosed sufficient values (with gold at \$35 an ounce) to justify further development.

The Quebec Gold Mining Corporation having demonstrated the likelihood of a profitable mine, Noranda Mines Limited, with ample facilities, now entered the picture, buying control of Pamour, whose capitalization was increased to 5,000,000 shares. Under Noranda management, development was continued from the Three Nations shaft, but in 1935 a five-compartment shaft was begun and an extensive program of surface drilling was undertaken in the area between the old and new shafts. Sufficient ore reserves were determined, by this means and by underground development, to justify construction of a 500-ton mill, which went into operation in 1936, capacity gradually increasing until in 1955 the mill handled an average of 1,742 tons a day.

Success at Pamour suggested the possibility of the extension westward of favourable ground, and in 1935 options were taken by Noranda on the adjoining Poulet Veteran claim of 160 acres, owned by the Porcupine Quartette Syndicate, and 320 acres owned by Bonetal Gold Mines Limited. When drilling on the latter failed to locate ore, the drills were moved to the Quartette claim, where the first hole brought results. Hallnor Mines Limited (named in honour of Oliver Hall, then Noranda's Assistant General Manager) was incorporated in 1936 to operate the Quartette property, purchased for \$25,000 and 67,000 shares in the company. A three-compartment shaft was begun immediately, followed as soon as possible by underground development. In 1938, a mill began operation at the rate of 250 tons, later increased to 400 tons a day. Despite rising costs, and the difficulties of gold mines generally, Hallnor has continued to be a profitable venture for Noranda. Dividends started in 1939, and to the end of 1955 had amounted to \$11,340,000.

Porcupine mines have now been worked for nearly half a century. The deepest workings (in the McIntyre) are more than a mile and a quarter below the surface, and in the Hollinger their

ramifications total more than 360 miles. Many mines that at some time in the past were numbered among the producers have suspended operations, either because their ore had become exhausted or because what remained could not be profitably worked.

Nevertheless, considerable areas within the generally accepted limits of the gold-bearing structure still remain to be fully tested. Attention has hitherto been concentrated principally upon following the strike along the two limbs of the syncline, but there is a possibility that ore in quantity may be discovered down the dip, between the limbs. On this assumption, an attempt is being made to explore the deeper levels in the midsection. Under an agreement made in 1951, Coniaurum Mines Limited has run a long drive from its 5,500-foot level into ground belonging to Central Porcupine Mines Limited, adjoining Coniaurum on the south. At the end of this drive an internal shaft was sunk to the 6,800-foot level, where a station was cut from which drilling into adjacent territory could be done. That drilling was in progress at the time of writing and some ore had been located.

What, then, of the future?

As with other gold camps, most of Porcupine's problems could be cured by a sufficient rise in the price of gold—or a drop in the cost of other commodities. Gold mines, in the Canadian economy, are in a class by themselves; no matter how high the cost of production may be, the selling price of their product is fixed by international agreement. Recognizing, in a measure, its responsibility for this arrangement, and the effect of a sudden collapse upon the gold-mining communities with their thousands of people depending on the industry, the Government of Canada in 1948 enacted the Emergency Gold Mining Assistance Act under which financial assistance would be given to gold mines, based on their relative costs.

While from 1934 onward, the price of gold has been fixed at \$35.00 U.S. an ounce, the price to the Canadian gold-miner has fluctuated in response to a number of circumstances. Previous to September 20, 1949, with a fixed rate of exchange, the price to the seller was \$35.00 an ounce; but, on that date the Canadian dollar was devalued, increasing the price paid by the mint to

\$38.50 an ounce. Then, on September 30, 1950, the abolition of fixed rates of exchange resulted in a lowering of the price paid by the mint. In consequence, the average received was about \$38.06 an ounce in 1950 and about \$34.07 in 1954.

The Act as first passed applied to the years 1948, 1949 and 1950; it has been re-enacted at intervals of one or two years, and in 1956 was extended to 1958. The rate of assistance has varied slightly from time to time, the tendency being to increase the benefits received by mines with higher costs and reduce them to those with lower costs. For the gold mines receiving assistance in 1954, the cost of producing an ounce of gold varied from \$24 to \$45 and over. The average rate of assistance paid to gold mines per ounce of gold produced has varied from a low of \$2.33 in 1950 to a high of \$4.58 in 1953. The total cost to the Government varied from \$8,990,970 in 1950 to \$15,582,560 in the fiscal year ending March 31, 1954.

No matter how long deferred, the time must come when every community depending solely upon mining will face the prospect of extinction unless some other kind of industry is provided. The fate of well-organized communities such as that which has grown up about the mines of Porcupine is a matter of more than local concern, and it will assume ever greater importance. The problem will vary with the community and might very well be the responsibility of a special department of government.*

The life of Porcupine is meanwhile being extended in another way—through investment, elsewhere in Canada, of the money derived from its mines. (The camp, to the end of 1955, had produced \$1,210,391,101, of which \$316,024,976 was paid in dividends.) The most notable instance is, of course, Hollinger's iron-ore project in Labrador and New Quebec.

*See the author's *Canada's Century* (Revised Edition), pp. 191-192, for a discussion of this subject.

IX

Kirkland Lake

BEFORE THE DISCOVERY OF SILVER AT COBALT, AND DESPITE THE remarkable nickel deposits at Sudbury, most Ontario people still thought—if they thought about it at all—that northern Ontario would never produce many mines. But when the facts regarding Cobalt's riches became known, people rushed to the opposite extreme and expected to find other Cobalts almost anywhere. The country swarmed with prospectors, many unable to tell one rock from another, but all full of hope. Unfortunates whose business or other responsibilities prevented their taking to the bush got their feet in by grubstaking a prospector or joining with a few others in some prospecting syndicate.

While prospecting was not confined to Cobalt and vicinity, much of it fanned out from there. Some of the searchers clung to the railway, moving north as the steel advanced, but others followed the age-old highway of river and lake, reaching in that way places at a greater distance from Cobalt. Thus, as early as 1906, sparks from the Cobalt conflagration had set new fires at Larder Lake.

In 1903, a young geology student named H. L. Kerr had graduated from the University of Toronto, and the following year acted as field assistant to W. A. Parks who, some years before, had examined the geology of Porcupine. Their survey included a cursory examination of the rocks in the vicinity of Larder Lake; Parks was impressed by the formation along the east arm, and remarked to Kerr that he would like to return and make a more thorough investigation.

Two years later, when Parks's assistant had become part owner (with George Glendinning and W. J. Blair) of the University mine at Cobalt, he was visited by two former university associ-

ates, William H. F. Addison and Julian D. Loudon, both graduates in medicine, who were anxious to stake some claims. They asked Kerr to suggest a good spot for them to begin prospecting and he directed them to Larder Lake. The two young prospectors were almost as new to paddling northern rivers as they were to prospecting, but in due course they arrived at the spot recommended by Kerr. To their surprise, someone was there ahead of them. The intruder proved to be Dr. R. Reddick, of Winchester, Ontario, who was working a number of claims which he and four associates had staked a short while before. The area was dominated by a dome-shaped dolomite dike, shot through with quartz veinlets; it was 450 to 500 feet wide and was exposed for a distance of about half a mile. Even to their inexperienced eyes the occurrence was impressive, and they quickly staked three claims adjoining Dr. Reddick's seven. Dr. Loudon paddled to Haileybury to record the claims, one each for Addison, Kerr and himself.

Dr. Reddick, acting for Dr. Reddick Larder Lake Gold Mines Limited, which had acquired a majority interest in his claims, later sank a hundred-foot shaft. At the 83-foot level he did about a thousand feet of drifting and located a small quantity of ore which assayed about ten dollars in gold to the ton. The Reddick company erected a ten-stamp mill, and it has been claimed, though not conclusively proved, that the first gold coins minted in Canada were struck from gold mined by Dr. Reddick at Larder Lake.

Dr. Reddick's discovery started a boom in the winter of 1906-7, when prospectors from all over northern Ontario flocked to Larder Lake and the surrounding country. As is generally the case with winter staking during a rush, most of the claims were not worth recording when the snow went off and the stakers (or purchasers) could see what they had. The surveyors had a merry time trying to fit north-south lines to stakes seemingly set out by demented jig-saw-puzzle designers.

A townsite called Larder City was laid out, which its promoters attempted to make (on paper) as fine a place as draughtsmanship could devise. It had wide streets, and ample space was set aside to provide parks for the people who might one day

be herded together in this community set among the lakes and rocky hillocks of the Canadian Shield. The planners took as their model the City of Johannesburg, said to be the best-planned mining town in the world.

In its issue of November 3, 1907, the *Toronto Sunday World* published a special mining section which was devoted to "Larder Lake and Its Great Possibilities." After dealing in detail with the district generally and a dozen or so of the most active companies, the leading article summed up as follows:

The showing made throughout the entire district is a remarkable one. Anyone can find samples of free gold on almost any one of the ore dumps without trouble. The size of the veins uncovered is simply astonishing and it is not necessary that the assay from them should run up into the thousands or even the hundreds of dollars to make this district one of the great gold-producing districts of the world If the average is not more than \$5 a ton, thousands of dollars, yes, millions, should be paid from the profits of the working of the same The only thing that is holding the Larder Lake Country back at the present time is the lack of capital for development purposes, but it is safe to predict that it is only a matter of a few months at most, when Larder will be sending out the gold bullion from many mills.

Kerr, the only one of the Kerr-Addison-Loudon trio with mining experience, lived within easy reach of Larder Lake; he made sure that sufficient work was done to keep the claims in good standing, and in 1910 secured the patent. In the same year, the partners sold their claims to a company called Goldfields Limited, receiving in payment a small amount of cash and the balance in shares. The Dr. Reddick company also sold out to Goldfields Limited which, in the years that followed, did a certain amount of work on the combined properties, but no ore of consequence was located.

In the meantime, several other companies, chief of which were the Tournie (Old Indian) Mining Company Limited, the Harris-Maxwell Gold Mining Company Limited, and Larder Lake Gold Mines Limited, had properties in various stages of development. In 1923, or shortly after, these were amalgamated with Associated Goldfields in a new company called Canadian Associated Goldfields Limited. This company built a mill and

began production, but at the end of a year's run it went into bankruptcy.

In 1930, another reorganization occurred, when Proprietary Mines Limited was organized by Dr. George A. MacKay of Toronto to acquire the assets of Canadian Associated Goldfields. Matters remained at a standstill, however, so far as mining was concerned. And then, in 1935, with gold at \$35 U.S. an ounce, George B. Webster, a Toronto mining engineer, secured an option on some of the ground held by Proprietary Mines and attempted to interest capital in development. He offered property formerly owned by Crown Reserve Mines Limited, and claims adjoining, to J. P. Bickell of McIntyre Porcupine and after some negotiation Bickell, acting on behalf of Castle-Trethewey, a McIntyre subsidiary, undertook to organize and finance a company. Omega Gold Mines Limited was incorporated and Angus Campbell, former manager of Castle, was given direction of the new enterprise. The old mill was rehabilitated and production began in February 1936 at three hundred tons a day, which was soon advanced to five hundred. In 1944, Noranda and Anglo-Huronian interests bought the Castle-Trethewey shares and assumed control. The operation had been a marginal one from the start, and the end came in May 1947. Total production from 1936 to 1947 had amounted to \$7,640,737.

With the Omega in operation, George Webster next turned his attention to the Kerr-Addison-Loudon and Reddick claims, which he also had under option from Proprietary Mines. He first offered them to Bickell, who declined them, and then proceeded to organize—and finance—Kerr-Addison Gold Mines Limited, with an authorized capital of 5,000,000 shares, one dollar par value, of which Proprietary received 1,250,000 shares. Kerr, Addison and Loudon had long since ceased to have any equity in the property which became the most productive portion of the Kerr-Addison holdings. In 1956, the only one of the three alive was Dr. Julian Loudon, a well-known Toronto physician.

Kerr-Addison Gold Mines had been organized in the belief that a large deposit of low-grade ore might be opened up. Of the four adits, four hundred yards apart, that were run into the base of the dolomite structure, two encountered ore of satisfactory



Randolph Macdonald Eaton's photo
F. V. C. Hewett



Herb Nott Photo
James B. Redpath



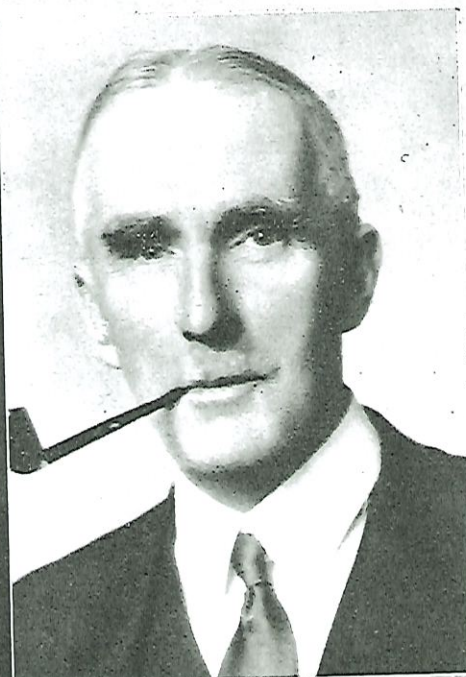
R. J. "Dick" Ennis



Turofsky Photo
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Canadian Newspaper Service
Viola R. MacMillan



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Karl Springer



Gordon W. Powley Photo
Joseph McDonough

grade. Drifting from these resulted in orebodies of good length and width, running about eight dollars to the ton, which encouraged the promoters to invest further money and continue the exploration by underground workings and by diamond drilling. So successful was this effort that the construction of a 500-ton mill soon followed, production commencing in 1938. Within a year, mill capacity had been increased to 1,200 tons, and subsequently by stages to 4,500 tons, giving Kerr-Addison the distinction of being Canada's largest gold-producer.

At the end of 1955, the mine was evidently still far from having reached its peak. The year just ended had been the most productive in its history; 1,660,533 tons of ore had been milled—an average of 4,549 a day. Realized value of the year's product was \$14,797,153, or \$8.91 a ton. Due to the installation of a tailings re-treatment plant which became effective on April 1, 1955, the mill recovery rate was raised from 92.8 per cent to 97.65. The new treatment plant also made possible the profitable handling of sulphide ores encountered in the lower reaches of the mine which, although richer than the average run of mill-feed, had previously been by-passed owing to the relatively low rate of recovery possible in a straight cyanide mill circuit. For this reason, and also because the lower-grade ore in upper levels has largely been removed, Kerr-Addison's performance will be watched with interest in the years immediately ahead, when mill-feed will be drawn chiefly from richer ore already blocked out in lower levels. At the end of 1955, ore reserves amounted to 15,231,862 tons, with a grade of 0.31 ounces to the ton, after allowing for dilution. Since 1938, the mine had produced a total of \$131,073,037, and from August 1, 1940, had paid in dividends a total of \$37,085,560. Since the beginning W. S. Row has been mine manager or executive vice-president and G. A. Cavin has been secretary-treasurer.

With Kerr-Addison supporting its own community (Virginiatown) and apparently headed for success, the hopes of others holding property in the Larder Lake area revived. Once more the financial pages of newspapers and the mining journals blossomed forth with enticing advertisements offering shares in a variety of mines; again enthusiastic reporters wrote glowing ac-

counts of the camp's prospects. As time went on, however, these bright new hopes faded and, in most cases, died. One by one, the new or refurbished companies were relegated to the inactive list; and it began to look as though the Larder Lake area, while boasting Canada's largest gold-producer, would have no others. Yet, who can tell? For many years previous to 1936 it seemed unlikely that the region would ever have such a mine as Kerr-Addison.

Prospectors following the railway had made their first stand in Boston Township, where gold was discovered in several places in 1906—the year that Dr. Reddick located in Larder Lake—and the whole township was staked. Nothing resulted from this staking, and the centre of activity soon shifted to Swastika, selected by the T.&N.O. Railway for a station. In some cases, mines take their names from the locality in which they are situated; but in others, a mine gives its name to the community. This happened with Swastika. Jim Dusty, principal owner of a mine that was later to have the first gold-mill in northern Ontario, was strolling one day with his daughter in Toronto when, in a jeweller's window, a brooch in the form of a swastika caught her eye. It is not known whether the young lady got the brooch, but there and then the mine got its name. With the Swastika Mining Company's property in production, followed shortly by the Lucky Cross, the camp soon attracted its share of prospectors, who hung about Doige's store or Joe Boisvert's hotel. And with a boom in progress at Larder Lake, an airline distance of about twenty miles eastward, it was only natural that prospectors should examine the area in between. As early as 1906, the Burrows brothers staked claims on what later became known as Kirkland Lake, in Teck Township, five miles east of Swastika. (Incidentally, the lake was named after Winnie Kirkland, a stenographer in the Department of Mines at Toronto.) The Burrows brothers did little work on their claims, but succeeded in persuading the recorder, whose office was at Matheson, to grant them extensions.

Men make mining camps, and mining camps make men. While it was William H. Wright who started the Kirkland Lake staking in real earnest, someone else would have done so if he had not;

but had it not been for Kirkland Lake, the man who became a millionaire mining magnate, endowed a Toronto daily newspaper, and died a legendary character in 1951, might have remained unknown. Born in Lincolnshire, England, and by occupation a butcher, Wright had hung up the cleaver to serve as a soldier in India, Egypt and South Africa. After returning for a time to his trade he decided, in 1907, to visit cousins in Canada. One of the cousins, also a veteran of the South African War, had received a Veteran's claim in Porcupine from the Ontario government. The cousin borrowed money from Wright on the security of his claim; it proved to be worthless, but it took Wright to Porcupine in time to be infected with mining fever. Then, hearing of gold at Swastika, he and his brother-in-law Ed Hargreaves, also a former butcher, set off for that new camp in 1911. They decided to try the territory to the eastward and took a circuitous course by stream and lake, travelling thirty miles to reach a point only five miles from Swastika. What happened next is better told in Wright's own words as related in an interview with the *Northern Miner*. (October 1, 1936):

Hargreaves and I spent two days exploring the country to the east, and liking the few rocks that outcropped we had pretty well decided to stake some ground. Late the second day, Hargreaves left the camp to hunt for rabbits or what he could find to bolster up our provisions. As darkness would soon set in, we agreed that if he should become confused, and wished directions back to the lake and camp, he would fire his rifle and I would answer. Sure enough, he signalled and I answered, at the same time starting into the bush to meet him. On the way, I ran into a quartz outcrop. It was too close to night to investigate the discovery, but we cut a discovery post, placed it on the outcrop, and returned to camp. Early next morning, we returned to complete the staking.

Three claims were all we could stake, because we had little more than the \$30.00 required for recording. These claims became part of the Wright-Hargreaves mine, along with one staked some days later.

Hargreaves rushed off to Cobalt to make a deal with Ralph Robbins, whom they knew, at the McKinley-Darragh. He succeeded in persuading Robbins to put up a little cash for an interest

in claims which they were to stake along the strike, adjoining their Discovery claim. This money enabled them to record their fourth claim, and the ground they staked became the Sylvanite mine.

The gold-bearing rocks in the Kirkland Lake camp consist chiefly of a reddish feldspar porphyry, and by blind chance Wright, no expert, had planted his stakes on the main fracture near the centre of the productive field, where the porphyry rocks were at their widest exposure. Hargreaves was anxious to cash in on his share of the discovery and soon sold half his interest to Weldy Young for \$6,000. Young must have secured part of Wright's interest as well, for he gave an option to the Cartwright brothers of Haileybury and Cobalt on a five-eighths interest. They discovered a rich vein in 1913, sank a shallow shaft, and took out 3.4 tons of ore, which gave a return of \$331.35 per ton. When, because of business reverses, they dropped the option, Young sold a three-eighths interest to George Symmes, who sold out to E. S. Miller and Albert Wende—all three of Buffalo, and already interested in Cobalt mines. Oliver Cabana, also of Buffalo, bought a three-sixteenths interest from Young. In June 1916, Wright-Hargreaves Mines Limited was organized with an authorized capital of 2,500,00 shares of one dollar par value, afterwards increased to 5,500,000 shares of no par value. A mining plant was installed, and a mill, but owing to the shortage of labour and lack of interest in mining during World War I, production did not begin till 1921.

Wright-Hargreaves went on to become an important mine. Beginning with a 150-ton mill, the daily rate reached a maximum of 1,250 tons in 1940, but as mining difficulties increased with depth, production was reduced to an average of 525 tons in 1954. In common with other Kirkland Lake mines, the Wright-Hargreaves orebody dips to the south, and the property adjoining on the south was owned by Kirkland Townsite Gold Mines Limited. As its name implies, this latter property extended under part of the town. Its acquisition had been the subject of prolonged negotiations; and it was not till Wright-Hargreaves workings had reached the Kirkland Townsite line that an understanding was arrived at, by which Wright-Hargreaves was granted the right to mine the property, the proceeds, after all costs were paid,

to be divided on a 75-25 per cent basis. Although operations in the original property had reached a depth of 7,200 feet, much good ore still remained, and the arrangement with Kirkland Townsite, which is for fifty years, should considerably extend the life of the mine. Value of total production to the end of 1955 amounted to \$136,732,612; dividends, beginning in January 1922, had by the end of 1955 reached the sum of \$51,562,500.

Wright's discovery directed little attention to the area; in 1911, Swastika seemed much more important, and six months went by before the next scene in the Kirkland Lake drama was unfolded and the principal character made his entrance. Harry Oakes, born in New England, had received some training in engineering at Bowdoin College and had chosen the career of a prospector. Having first visited mining regions in the American West, Australia, Mexico and the Yukon, he had almost run out of cash when he reached Boston Township in June 1911.

The evening of January 12, 1912, found Oakes in Doige's store swapping yarns with some of the Tough brothers. The four Toughs — George, Tom, Bob and Jack — had a contract slashing the right-of-way for the projected road between Swastika and Larder Lake. Congenital prospectors, they had been searching the rocks in their spare time and had staked some claims in Lebel Township to the east of Kirkland Lake. On this occasion, Tom Tough remarked that he would like to secure some ground near the Wright find. Oakes said that he knew of some claims about to fall open in that locality, and offered to share his information with anyone who would put up the staking fees. Tough wanted to know how soon the claims would be open for re-staking; Oakes, pulling out his watch, replied, "In about four hours." They would lapse at midnight.

The deal was made. Shortly after midnight, with the thermometer at 52 degrees below zero, Oakes, wearing five pairs of trousers and accompanied by Tom and George Tough equally well clad, set off along the rough trail, which was covered now by seven inches of freshly fallen snow. Despite a moon nearing the full, Oakes carried a home-made "bug," or lantern; he led his companions to the Burrows claims, astride the line between Teck and

Lebel townships, and in the uncertain light of early dawn they staked the ground. Huddled about a small fire, they were attempting to thaw their chilled bones by gulping scalding tea when Bill Wright arrived, bound on the same errand, and Oakes for the first time set eyes on his future partner. The five claims so dramatically staked became the Tough-Oakes (later, the Toburn) mine. George Tough, three days later, found a vein with free gold showing, and staked himself a claim.

Meanwhile Oakes and Wright, taking to each other from the start, staked water lots along the south shore of the lake, in accordance with Oakes' theory that all veins in northern Ontario ran under lakes. Wright staked for himself the claim adjoining Oakes's on the west. In fact he overstaked, and the fraction in excess, found to be seven and a half acres, was filed upon by a syndicate consisting of Shirley Cragg, W. H. and F. M. Connell, and Arthur Cockeram—all to become prominent in Canadian mining—who added to their holdings by acquiring George Tough's adjoining claim for \$7,000.

Oakes immediately set about organizing Lake Shore Mines Limited, which was incorporated in 1914, with an authorized capital of two million shares of one dollar par value. He gave Wright 200,000 shares for his claim adjoining on the west, and some time later he bought the Cragg-Connell-Cockeram property for 50,000 shares and \$30,000 cash.* The main Kirkland Lake break extends across the Lake Shore property, which contained its richest portion. About half the property was covered by the south arm of the lake, and the rest was adjacent to the south shore. The ore was found in two veins which ran nearly parallel across the property, the No. 2, or more northerly one, carrying the higher values.

In order to concentrate on Lake Shore, Oakes made a deal with C. A. Foster, of Haileybury and Cobalt, in which Foster, for a one-third interest agreed to finance the Tough-Oakes property. Foster later made a deal in England for the sale of a two-thirds interest for a million dollars. Oakes was dissatisfied with the share of the proceeds allotted to him, and this led to a bitter lawsuit, ty-

*When Wright protested their staking of the fraction, the syndicate bought him off for \$1,000.

ing up the property when its sale might have been of valuable assistance in the financing of Lake Shore.

Undeterred, Oakes set out almost singlehanded to make a mine of Lake Shore. He had to contend with widespread distrust; newspapers refused his advertisements. His first offering was at fifteen cents a share, and a large part of the treasury stock was sold at thirty cents. World War I intervened, and consequently it was 1918 before production began with a fifty-ton mill, money for which came from Buffalo, through Albert Wende. That Oakes succeeded at all was a proof of his tenacity, and his is one of the few cases in the annals of Canadian mining in which a prospector, besides staking the claims, has financed and brought a mine to the dividend-paying stage, while still retaining control.

At its peak in the mid-thirties, Lake Shore was Canada's greatest gold mine, treating 2,500 tons of ore a day. Its stock sold as high as \$64 a share, dividends in one year amounting to \$6 a share. Since then, with greater depth and the difficulty of controlling rock-bursts, production has been considerably curtailed. For some years maintained at 1,000 tons, production averaged 648 tons a day in 1955. Value of total production to the end of 1955 was \$246,063,613, with dividends to the same date amounting to \$103,360,000.

To protect itself on the south, the company acquired in 1933 the holdings of Minaker-Kirkland Gold Mines Limited and the controlling interest in Kirkland - Hudson Bay Gold Mines Limited; and in 1951 it entered into an agreement with the latter and Hudson-Rand Gold Mines Limited, its subsidiary, for the exploration from Lake Shore workings of property belonging to these companies.

Harry Oakes, after living for a number of years at Niagara Falls, Ontario, removed in 1935 to Nassau, Bahamas, where he became active in the affairs of that colony. He was made a baronet in 1939, and his unsolved murder in 1943 created world-wide interest. Control of Lake Shore continued with the Oakes family until early in 1956, when Little Long Lac Gold Mines Limited acquired Lady Oakes's stock.

The Kirkland Lake "break" was found to extend approximately east and west for a distance of about three and a half miles, and along this zone the principal mines have been developed. The lake is underlain by the break.

It was found that the main ore bodies, especially in the west end of the camp, were located along a strong fault, and it was predicted the structure favourable for ore deposition would extend to great depth. Further exploration resulted in the discovery of ore bodies off the so-called "main break" and sometimes in host rocks which were at first thought to be unfavourable for the occurrence of ore. In the western part of the camp, subsidiary veins on the hanging wall of the Main Break, or Kirkland Lake fault, became increasingly important as ore producers, and at the east end a broad zone of vein-fracturing was developed. In the early days the syenite and syenite porphyry were regarded as the favourable host rocks for ore, and the so-called "lamprophyre" was believed to be unfavourable. In recent years excellent ore has been found in the once-despised "lamprophyre." In fact, ore is now found in all rock types of the camp with the exception of a few late diabase dikes, and the operators are willing to explore any promising pre-ore structure, regardless of the nature of the country rock.*

The first ore from the Kirkland Lake camp was shipped after the freeze-up in the fall of 1912 when Walter Little, who was one day to represent Timiskaming District in parliament, freighted two tons of hand-picked ore over the trail to Swastika. It was consigned to an American smelter and brought \$700 a ton. Surface prospecting had resulted in the finding of eleven veins in porphyry, greywacke and conglomerate, certain of the veins passing from one to the other. The veins were not wide, the average stoping-widths being about five feet. A section of ore in the 200-foot level had an assay value of \$78 per ton over a length of 218 feet, with a width of 65 inches. On the 300-foot level, the vein showed a value of \$32 over the same width.

High-grade ore was hand-picked during the first three years, its richness indicated by the following returns: in 1912 and 1913, 101.04 tons were worth \$46,221, or \$457.00 a ton; in 1914,

*James E. Thomson, "The Geology of the Main Ore Zone at Kirkland Lake"; 57th Annual Report (1948) of the Ontario Department of Mines, Part V, p. 58.

212.79 tons brought \$74,569.27, or \$350.53 a ton. What remained from hand sorting was put through a stamp mill and treated by amalgamation.

The Tough-Oakes No. 2 vein was worked, at first, by open-cut. Later, when an incline shaft was sunk, it was found that the workings had struck a basic dike that faulted the vein vertically into the Burnside property adjoining. This, while hard on Tough-Oakes, was a break for the Burnside, and an arrangement was made in 1919 for the merging of the two companies; they were known thereafter as the Tough-Oakes-Burnside, and the name was subsequently contracted to Toburn.

The company's later career was a chequered one; it passed through several reorganizations and at the time of its voluntary liquidation on April 16, 1953, all known ore being exhausted, the majority interest was held by the American Smelting and Refining Company.

The claims adjoining Harry Oakes's Lake Shore on the west were staked by the Hughes brothers, one of whom, it will be remembered, had bought a one-eighth interest in Sandy McIntyre's Porcupine prospects for twenty-five dollars. Teck-Hughes Gold Mines Limited was incorporated in April 1913, to work the property.

The mine was optioned to Nipissing Mines Company Limited, but when that option was dropped in 1915 the bottom fell out of Teck-Hughes, its stock going begging at less than five cents a share. The situation was saved by the coming of David H. L. Forbes, an able mining engineer, who took charge in 1918 (he was to remain with the company for over thirty years) and by the faith of Charles L. Denison of Buffalo, who was already interested in Cobalt silver mines. Denison and associates advanced over \$600,000, eventually taking payment in stock in the reorganized company which was incorporated in 1923 under the slightly changed name of The Teck-Hughes Gold Mines Limited, with an authorized capital of five million shares of one dollar par value. The property of Orr Gold Mines Limited, on the south, into which the Teck-Hughes orebody dipped below the fifth level, and upon which considerable work had previously been done without much result, was acquired in 1923, thus en-

suring continuation of production for Teck-Hughes and giving it a length of about 1,450 feet on surface along the strike of the main vein system.

The extension of the main break had been covered by heavy overburden, but, in 1924, underground drilling established ore to a depth of two thousand feet, indicating its persistence at lower levels. For some years production continued steadily, rising from \$1,023,825 in 1924 to a maximum of \$6,093,199 in 1931, after which output fell to \$2,887,422 in 1935. In 1934, owing to decreased ore-lengths, the daily milling rate was reduced from 1,300 to 1,100 tons, and later to 1,000 tons, and less. Since 1951, the mine has been on a salvage basis. Value of production to the end of 1955 was \$95,229,038. Dividends, beginning in 1926, had reached a total of \$47,906,038 by the end of 1955. In 1932, the company secured control of Lamaque Gold Mines Limited at Bourlamaque, Quebec (q.v.), which to the end of 1955 had paid \$15,855,000 in dividends.

The property lying north and east of Wright-Hargreaves and west of Toburn, consisting of five claims staked by W. H. Wright in 1911 and a fraction bought in 1935, is operated by Sylvanite Gold Mines Limited, which is controlled by Buffalo investors. It was slow in getting under way, but since 1927 has been a steady though modest producer. There are five shafts on the property, but the mine is worked principally from No. 2, with a depth of 3,643 feet, and from No. 5, an internal shaft, collared 1,250 feet west of No. 2, extending from the 3,150-foot level to 5,605 feet.

The original rated mill capacity of 200 tons a day was increased to 600 tons by 1940, but in recent years the amount treated has been in the neighbourhood of 475 tons, the average for 1955 being 471 tons a day. Total production to the end of December 1955 was \$48,743,468, while dividends, which began in 1930, had reached a total of \$11,994,138 in 1955. The company controls Delnite Mines Limited, operating a producing mine in the Porcupine area. The latter was managed for many years by John Beattie, who became executive director of the Ontario Min-

ing Association in 1956. Sylvanite and Delnite are jointly engaged in outside exploration.

Every boom passes through fairly distinct phases. First is the staking rush when prospectors flock to the scene of a discovery, each trying to get a piece of ground as near the first find as possible. If there are many prospectors, the holdings tend to be small, and are often made smaller as prospectors settle with grubstakers or sell interests for a little ready money. The next phase begins when the promoters arrive. They are a varied crew; some, merely speculators, hope to option a likely-looking piece of ground that can be passed on to someone else at a profit; others attempt to round up groups of claims on which companies can be formed. The latter sort can be subdivided into those chiefly interested in selling stock, and those looking for a property that will make a mine.

Many of the promoters who dropped off the train at Swastika to walk the five miles into the Kirkland Lake camp had cut their eye teeth in Cobalt or Porcupine; they knew something of mining; usually they had a little money; and, in most cases, they were in touch with financiers in Toronto, Montreal, Buffalo or New York who could find money for an attractive proposition. Bob Jowsey, one of the stakers of the Keeley mine at South Lorrain, had begun as a prospector and still considered himself to be one, but he also tried his hand at promoting. He had behind him a syndicate of Haileybury men, most of whom had made money in Cobalt. In January 1913, having stopped off at Swastika to see if he could pick up some claims at Kirkland Lake, he encountered Albert Wende at Joe Boisvert's hotel. Since the meals at the hotel were not of the best, he and Wende did not wait for breakfast, but set off on their tramp through the snow while it was still dark. On arrival at the camp, they saw smoke rising from Bill Wright's stove-pipe and dropped in to see him. He was making pancakes for his own breakfast and asked them to pull up a chair, an invitation they were glad to accept.

During the course of the meal, Wright mentioned that J. W. McKain, the Haileybury plumber, owned a claim west of Teck-

Hughes that he was willing to sell. Jowsey hurried back to Swastika and telephoned George A. Bagshaw, manager of the Haileybury branch of the Union Bank and a member of his syndicate, to tie up McKain. This Bagshaw did, securing the claim for \$3,500. Jowsey then telephoned Charles Richardson, another member of the syndicate, who happened to be in Toronto, asking him to inquire from the Registrar of Companies whether the name "Kirkland Lake" was still open, and if so to secure it for a company under that name. On February 25, 1913, Kirkland Lake Gold Mines Limited, with a capital of 1,000,000 shares of one dollar par value, was incorporated; and, in May 1913, the company acquired nine claims from various vendors, allotting to them 599,989 shares in payment.

With John M. Wood as manager, a program of trenching was begun on the McKain claim, but nothing of value was located. A pit was then sunk in a low, swampy area, which opened up a good showing, one sample from which ran as high as \$300 a ton, but no consistent vein system was located. In November 1915, the company was reorganized under the name Kirkland Lake Gold Mining Company Limited with a capital of two million shares of one dollar par value. In February 1916, Beaver Consolidated Mines Limited, of Cobalt, acquired control by purchase of treasury stock. Its president, Frank Culver, inaugurated a vigorous development program, installing the Beaver plant and mill, which he brought from Cobalt. The plant was too large for the needs of Kirkland Lake Gold at that time and the company rapidly ran into debt. Culver was soon at the end of his tether.

At this point, Dr. J. B. Tyrrell, who, after his return from the Klondike, had established a consulting practice in Toronto, was called in to examine the property and recommend a course of action. He was convinced that ore could be found at a depth of about 1,800 feet, and undertook to secure additional capital. In April 1924, the authorized capital was increased by three million shares, one million of which were preference shares. The Anglo-French Mining Company, of which Tyrrell was the

Canadian representative, was induced to put up half the sum required; the rest was secured from Toronto business men.

Ore was struck at about the depth predicted by Tyrrell, but the company's troubles were by no means over. The veins, although rich, were narrow, so that large quantities of unprofitable rock had to be mined. Culver remained as president and managing director, with Tyrrell as a member of the board; but in 1926, D. B. Hanna, one-time head of Canada's national railway system, became president, with Tyrrell as managing director; and in 1931, Tyrrell became president. Meanwhile, in 1927, the preference shares had been converted into common, and the following year the authorized capital was increased by 500,000 shares. Beaver Consolidated (whose name was changed to Northern Canada Mines in 1938) continued to hold control.

As with Lake Shore and Teck-Hughes, Kirkland Lake Gold's ore dipped to the south; in 1929, the adjoining Chaput-Hughes property was acquired, and there followed in 1936 the acquisition of Grozelle-Kirkland Gold Mines property. Although, with depth, some of the richest ore was found, profitable mining was eventually rendered impossible by the narrow veins and the amount of handling required. The deepest ground was at 5,850 feet, requiring three hoistings and tramming for long distances; and in 1954 and 1955 the mine was operated at a loss. Despite this, however, it must be listed among the successful ones, with production to the end of 1955 amounting to \$34,398,709 with dividends (beginning in 1934) of \$5,691,686.

The westernmost of the seven mines along the Kirkland Lake break is owned by Macassa Mines Limited. As with most of the surrounding territory, this mine's claims were first taken up shortly after Harry Oakes and his friends staked the Tough-Oakes. In fact, part of the property was staked (and held for many years) by Harry Oakes himself; other claims were staked by David Elliott, John M. Wood and a number of Haileybury prospectors.

In December 1916, Elliot-Kirkland Gold Mines Limited was incorporated by a group of Haileybury people, prominent among whom was George A. Bagshaw, and the two claims staked by David Elliott, adjoining Kirkland Lake Gold on the west, were

acquired by the company. During the next year, a 500-foot shaft was sunk and drifting was done on the 300, 400, and 500-foot levels, but results were so disappointing that operations were indefinitely suspended. In May 1917, United Kirkland Gold Mines Limited was incorporated, also by Bagshaw and a number of others, but no mining was done.

The boom which began in the early twenties was at its height when, in March 1926, Robert A. Bryce, a Toronto consulting mining engineer, secured options on the assets of Elliott-Kirkland, the four claims held by United Kirkland, and four claims owned by Harry Oakes and associates. In April, Bryce incorporated Macassa Mines Limited with an authorized capital of 3,500,000 shares of one dollar par value, to which the options were transferred, Bryce and his nominees receiving 2,100,000 Macassa shares. Harry Oakes was the first president of the company, with Bryce as managing director. (Bryce succeeded Oakes as president in 1931.) After a few months, the United Kirkland option, which required frequent cash payments, was dropped.

With the market boiling, it was not difficult to get a broker to handle the stock; although no ore was in sight and Macassa was considered as something of a wildcat, the stock sold from thirty cents to forty and fifty cents a share. Bryce opened up the abandoned Kirkland-Elliott workings and did some drifting on the 500-foot level, running a drift along a strong fracture that branched southward from what appeared to be the main break. When diamond drilling in 1927 did not disclose ore in quantity, the mine was shut down.

In the meantime, E. W. Todd (later, manager of Lake Shore), a geologist in the employ of the Ontario Department of Mines, had been commissioned to make a comprehensive study of the geological conditions governing the Kirkland Lake ore zone, to which he devoted the greater part of 1926 and 1927. In the latter year he and his assistants were allowed the use of the Macassa office, and Bryce and Todd were necessarily thrown together a great deal. Bryce came to have a high opinion of Todd's abilities, and long before publication of the report in 1928 he was convinced of its importance as a contribution not only to the

geology of Kirkland Lake but to that of Ontario as a whole.* As managing director of Macassa Mines he was particularly interested in it, for it made plain that the main break, in evidence farther east, continued at a greater depth into the Macassa property, and that branching fractures favourable for the deposition of ore extended southward.

Bryce began preparations for a resumption of development in the light of the picture he had got from Todd's maps and charts; but the company's stock was now practically exhausted and it was necessary to increase the capital. This was done in December 1927, when it was raised to five million shares. Such a procedure, however, causes the equity of shareholders to be proportionately reduced, while the further sale of stock is made more difficult.

A more serious obstacle than that was about to intervene in the shape of the great depression following the market crash of November 1929. And it was not till April 1931 that Bryce felt safe in going ahead with long-deferred plans and a central shaft was started. Since gold was practically the only commodity in the world that had not dropped in price, gold mines should have boomed, but at that time almost no one had money for investment, even in gold mines. As it happened, the first money Macassa received during the depression came through the efforts of Joe Hirshhorn, but recently arrived in Canada, who disposed of 350,000 shares at prices ranging from twenty-five to forty cents (net to the company). This enabled Bryce to begin a drilling program, in a section indicated by the Todd report, which proved the existence of ore at 2,400 feet. Under an agreement with Kirkland Lake Gold, which did the work on a contract basis, a long crosscut was driven into Macassa ground from Kirkland Gold's 2,475-foot level, making it possible to mine the ore which the drill had indicated.

This ore lay chiefly east of the shaft; but since the dip was toward the south where, in accordance with Todd's report, ore might be expected, it was desirable to protect Macassa's interests

*E. W. Todd, "Kirkland Lake Gold Area"; 37th Annual Report (1928) of the Ontario Department of Mines, Part II.

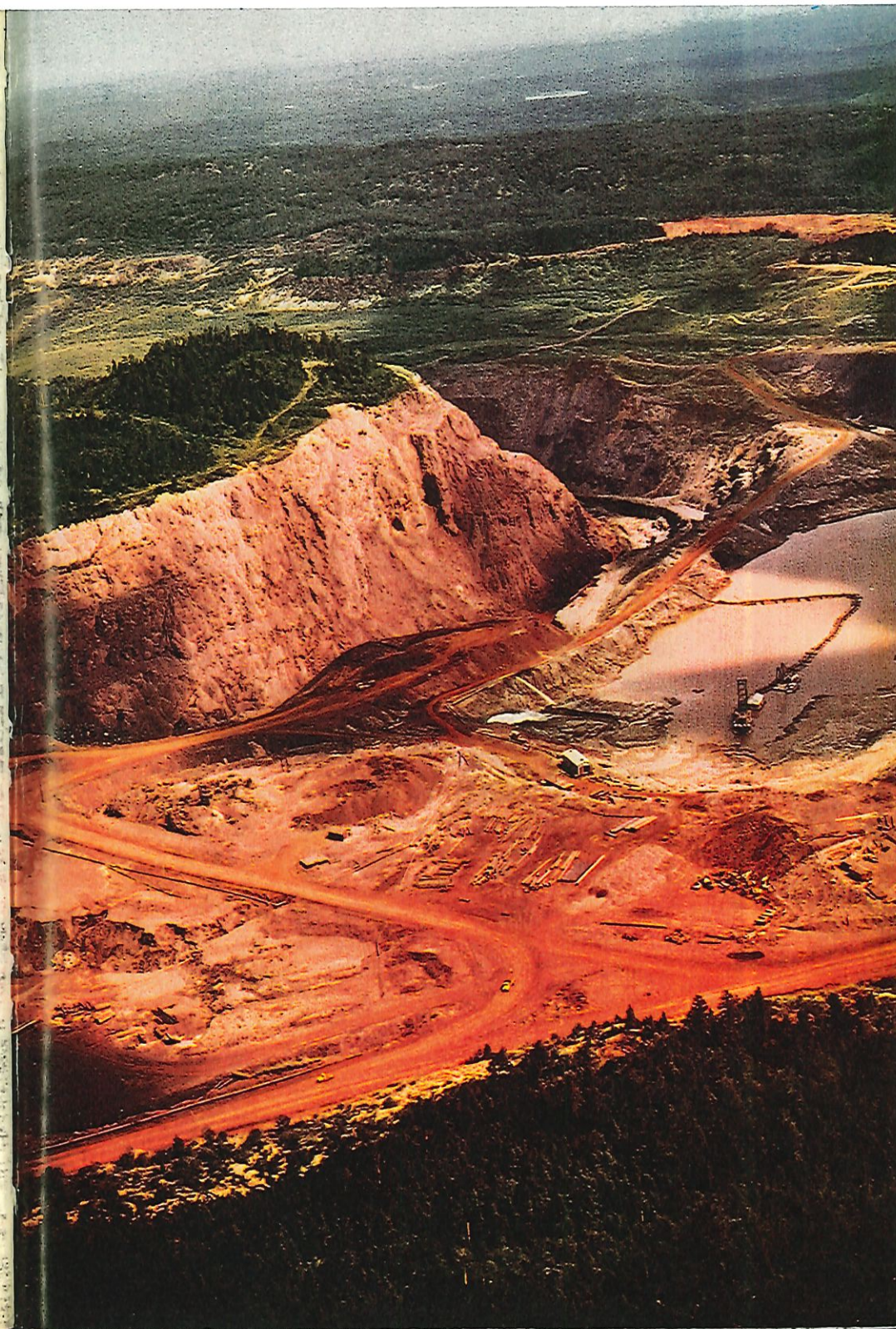
in that direction. Accordingly, an arrangement was made with United Kirkland finally to acquire the latter's property, which was done by the exchange of one Macassa share for ten United Kirkland. A reorganization of the capital structure was undertaken at the same time, the capital being reduced in 1934 from 5,000,000 shares to 2,500,000 shares, and then increased by 500,000. United Kirkland's shareholders received 130,000 shares.

The new shaft was bottomed at 3,000 feet. Deeper ground has been worked, in more recent years, from winzes, the second of which, 1,150 feet south of No. 1, extends from the 4,625-foot level to 5,750 feet. A crosscut driven south at the 3,000-foot level encountered, in August 1935, an orebody 18 feet wide, of better than average grade, and 1,100 feet long. This, with the increase in the price of gold in 1934, removed Macassa from the doubtful ranks. Production, which began in October 1933, with a 200-ton mill (later increased to 400 tons) had, by the end of 1955, reached a total value of \$36,730,191; and dividends, which began in 1934, amounted to \$9,513,032.

Macassa, youngest of Kirkland Lake mines, may look forward to a reasonably long life. Like many other carefully-managed companies, it has thrown an anchor to windward by investing some of its earnings in another mine. In 1941, it secured 76.2 per cent of the issued shares of Renabie Mines Limited, operating a gold mine in the Sudbury (Ontario) mining division, which, since 1954, has been paying dividends into the Macassa treasury. It also has a large interest in Bicroft Uranium Mines Limited, which in 1955 had secured a firm contract from Eldorado Mining and Refining Limited for the sale of uranium-bearing concentrates.

While not located on the Kirkland Lake break, the Upper Canada mine, a gold producer in Gauthier Township, east of Kirkland Lake, is generally listed as being within the Kirkland Lake field. Upper Canada Mines Limited, incorporated in 1929 with an authorized capital of three million shares of one dollar par value (increased to 3,500,000 in 1946) is an amalgamation

*Open Pit Operation, Steep Rock Iron Mines →
—Photographic Survey Corp'n*



of East Main Gold Mines Limited, Brock Gold Mines Limited and Eastward Mines Limited.

The combined property is worked from three shafts serving twenty-eight levels: No. 1 shaft reached a depth of 3,747 feet in 1955, while No. 2, located 2,900 feet west of No. 1, is 1,800 feet deep. The third shaft, 600 feet deep, serves the Brock section. Production began in October 1938, when the ore was shipped to the leased Morris Kirkland mill. In October 1939, the company started its own 100-ton mill, the rate of which has since been increased to over 500 tons, averaging 548 tons a day during 1955.

Kirkland Lake is an unincorporated community of about eighteen thousand people drawn from a score of different sources, dependent upon the product of mines whose headframes stand out like sentinels against the northern sky, and which since 1912 have added nearly seven hundred million dollars to the national wealth. It is no shack-town. Its main street, a segment of the former trail leading eastward from Swastika, is lined with substantial office buildings, banks, stores and hotels. Its residential districts, although lacking in symmetry because of inequalities of the Precambrian terrain, compare favourably with others in what might seem to be more permanent communities. Already one of the original mines has ceased production, another is now on a salvage basis, a third has recently been operated at a loss, and sooner or later others must follow suit. Does this mean, then, that Kirkland Lake, that once vital, pulsating community, is doomed to die? This, of course, could happen. On the other hand, it is a well-established distribution point within easy reach, both north and south, of regions whose mineral possibilities are far from fully explored and in which, to mention a few, iron, copper and asbestos showings are promising. Considering the capital invested in Kirkland Lake, its people may be expected to take a special interest in promoting the development of these nearby resources.

WITH MINES AND PROSPECTS AT LARDER LAKE, AND MINE AFTER mine being located at Kirkland Lake, prospectors were tempted to push on farther east, across the interprovincial boundary into Quebec. In fact, five years before W. H. Wright staked the Wright-Hargreaves, and in the same year that Dr. Reddick located his Larder Lake property, Alphonse Olier and Auguste Renault had discovered at Lake Fortune, ten miles beyond the border, the first gold in a region destined to become studded with many mines. In 1911, a twenty-stamp mill was set up there, thus establishing Lake Fortune as the first producing mine in what was called northwestern Quebec, but its life was short. Much farther east, J. J. Sullivan had staked, in 1911, the mine that has since borne his name; and about the same time Stanley Siscoe and associates had found a gold prospect on an island in Dubuisson Lake, not far from Sullivan's find.

The Sullivan and Siscoe prospects were to remain as such for many years, but events were on the march which would eventually roll back the wilderness from a belt of territory stretching eastward beyond the Ontario border for more than a hundred miles, and would mark the beginning of an era in Canadian mining. While the region in question was within the Province of Quebec, the initiative came from the Ontario side of the boundary. The man who became the star performer in this drama was a prospector named Edmund H. Horne, a former Nova Scotian then living in New Liskeard, who for many years had combed the country in all directions in search of gold.

In 1911, while prospecting about thirty miles beyond the border, he had seen some likely-looking rocks on the shore of Tremoy Lake (since known as Lake Osisko), which he thought

might be the answer to his quest. To his experienced eye and, more particularly, his prospector's instinct, the place appeared to have everything, but his persistent panning was unrewarded by even a glint of gold. Reluctantly, he moved on to try his luck in more promising pastures.

Years passed, and Ed Horne still had his mine to find. Yet he had never forgotten the showing on the shore of Lake Tremoy; again and again he returned. In 1914, although his hunch was still strong, his efforts were fruitless; but in 1917 he located some values in a large body of mineralized rhyolite—too low, however, to be anything but a teaser. By now he was determined to test the area thoroughly, but this would require money, and money was scarce. New Liskeard was a small place, but many of its people had done well out of mines, especially at Cobalt. Nevertheless, many months passed before he succeeded in forming a small syndicate among his fellow townsmen. Eventually, eleven men agreed to put up a few hundred dollars between them, beginning with contributions of \$25 each. These, with Horne himself and Ed Miller, whom he had taken in as a partner, constituted the Tremoy Lake Prospecting Syndicate. Many such syndicates have been organized at different times and places across the country, but few have ever been so fortunate.

It was late summer when Horne and Miller reached Tremoy Lake; and although nothing of promise was found, they staked seventy acres. Many hundreds of acres were staked later, but it is from these first seventy acres, staked on September 11, 1920, that the Horne mine's millions have been taken. Returning to New Liskeard by way of Ville Marie, the prospectors recorded their staking.

Horne and Miller, with the assistance of a syndicate member named Brett, were back the following year shortly after the break-up. They trenched the outcrops in an effort to find something to justify their hopes, but it was late in the season before they were rewarded by samples bearing every evidence of values. When these were found to run from \$15 to \$32 in gold, an additional 160 acres were staked. In New Liskeard during the winter, re-examining his samples, Horne became convinced

that at last he had found a mine; and, fearing other stakers, he, Miller, and a new syndicate member named Woodward, a tailor, made a trip through the snow to do more trenching, but principally to stake a further four hundred acres.

After the break-up, they returned to New Liskeard for supplies. In June they were back at Tremoy Lake, equipped to do some serious trenching. Toward the end of the season, a smudge made to discourage black flies developed into a minor forest fire which, by clearing away some of the brush and moss, brought to light outcrops where encouraging values were disclosed. These outcrops were later found to be part of Noranda's "A" orebody.

Although the new showings were good enough to justify development, no one cared to take a chance on a prospect a hundred miles from anywhere, surrounded by bush and muskeg. It seemed that finding financial backing was every bit as difficult as finding the prospect in the first place. More than one outfit on the lookout for a mine turned down the Tremoy Lake prospect, thereby joining the multitude of those who have failed to take at the flood the tide which leads on to fortune.

On February 15, 1922, a syndicate was formed which was to link fortunes with the Tremoy Lake Syndicate. It was composed of wealthy New Yorkers, headed by two mining engineers, Samuel C. Thomson and Humphrey W. Chadbourne, who were already interested in Canadian mining. Chadbourne was induced to go to Haileybury to meet Horne, and after considerable negotiation the Thomson-Chadbourne Syndicate took an option (August 11, 1922) on the Horne property. The purchase price was to be \$320,000 cash, in instalments extending over several years, and a ten per-cent interest in any company incorporated to operate the mine.

Although no money had changed hands (the first payment being due January 15, 1923), word of the deal sparked a rush to Rouyn Township. Among the first arrivals were Bob Gamble, Fred Davies, T. A. Powell, and Pete and Joe McDonough. (Another of the ubiquitous McDonough brothers, Pat, had previously been in the region.) Gamble and Davies staked claims adjoining Horne's find; the McDonoughs found something to

their liking near Pelletier Lake, southwest of Lake Osisko; Powell staked two miles to the northwest, and it was on Powell's ground that the best values were found, far outshadowing, at first, Horne's prospect. By the end of 1922, the whole of Rouyn Township was staked, spilling over into adjoining townships.

Having several months in which to examine the property before a payment was due, the Thomson-Chadbourne Syndicate nevertheless lost no time in getting men on the ground. They had hired L. K. Fletcher of Haileybury to act for them and he retained J. H. C. (Ike) Waite, a well-known mining engineer, to inspect the claims. Waite took along Arthur Cockeram, with eight or nine other prospectors and bushmen. Arrived in Rouyn Township, they found interest centred in the Powell claims, which Waite immediately optioned for his principals. Cockeram was busy, meantime, staking for the syndicate in Chadbourne's name a group of claims that lay between the Powell ground and the Horne.

When Waite returned to Haileybury, he was enthusiastic about the Powell property and correspondingly cool concerning the Horne claims. He strongly urged that drilling be undertaken on the former, but he did recommend that the option be continued on the Horne. Consequently, the January 15 instalment of \$7,500 was paid.

To avoid the individual-liability feature inherent in a syndicate, Noranda Mines Limited was incorporated under an Ontario charter on May 1, 1922, by the Thomson-Chadbourne group, but it was not till January 2, 1923, that the syndicate's holdings were turned over to it. In 1926, when the final payment on the Horne option was made, Horne Copper Corporation was formed under a Quebec charter with a capitalization of two million shares of no par value, ninety per cent of which were issued to Noranda and the remaining ten per cent to the Tremoy Lake Prospecting Syndicate, in accordance with the option agreement. Horne Copper Corporation was the actual operating agency of the mine until an arrangement was made for the exchange of Corporation shares for Noranda stock, and the Corporation's charter was eventually cancelled.

Drilling on the Powell had proved discouraging, and the drill was moved to the Chadbourne claims where results, later confirmed by underground development, were equally disappointing. An extension of time had been secured with respect to the payment of \$5,000 due on July 15, 1923; but in late August, having contracted for a certain footage of drilling, Noranda transferred the drill to the Horne. The first hole, drilled under a trench where Horne had found values of about seven dollars over a length of thirty feet, was blank. The drill was then moved about a thousand feet east, where gold values had been found in a trench cut across a pyrrhotite outcrop. "Thirteen feet from surface the drill struck solid sulphide and continued in it to a depth of 143 feet. The first 49 feet of core was almost solid pyrrhotite and averaged \$6.58 gold and 0.93 per cent copper, but the next 81 feet of core showed considerable chalcopyrite and averaged 8.45 per cent copper. This was the first intimation that the Horne mine might be a copper mine instead of a gold mine."*

By the end of 1923, the drilling had disclosed ore reserves of 375,000 tons above the depth of 120 feet. A small shaft, sunk to open the first level at 106 feet, increased the reserves to 611,500 tons, and this was increased to 1,022,425 tons when two lower levels were opened. In 1928, when (between the 600 and 975 levels) the now famous "H" orebody was located, the Horne mine was about to be established as one of the great mines of the world. With a length on the 725 and 975 foot levels of 700 feet, varying in width from 40 to 400 feet, it added fifty million dollars to the value of Noranda's reserves.

Below 1,000 feet the ore seemed to pinch out; but, in 1931, another massive sulphide orebody (the "Lower H") was found. It extended from the 1,600 to the 2,975 level, where it was 700 feet long and 200 feet wide.

No mine can succeed without ore. But the men who operate a mine are scarcely less important. Whether a company is to become an outstanding organization or another run-of-the-mine outfit depends in large measure upon the men behind it. In the

*R. C. Rowe, *Canadian Mining Journal*, April, 1934; pp. 144-147.

case of Noranda, while Thomson and Chadbourne were both competent mining engineers, and for some years acted jointly as managing directors, Noranda's big stroke of fortune, so far as the human element is concerned, was the selection of its president.

When Noranda Mines Limited was organized there was some question as to who should have the top position, and James Y. Murdoch, the young Toronto lawyer who had handled the incorporation, was asked to take the presidency for the time being. Next to the Horne option, this was the best move the company ever made. Murdoch remained as president; and the growth of Noranda from a single although always outstanding mine in an out-of-the-way corner of Quebec into a great industrial organization with many ramifications is due in large measure to him. He has surrounded himself with able associates, among whom, except for the ravages of time, there has been little change. After L. K. Fletcher had seen the mine through its early stages he was succeeded in 1925 by Ernest Hibbert, a mining engineer of wide experience who, as general manager, retired in 1938, but continued as consulting engineer. His place as general manager was taken by H. L. Roscoe, who had been with Noranda as assistant general manager since 1935. Roscoe remained as general manager until 1951, when he was succeeded by R. V. Porritt, continuing as vice-president. Another man who played an important part in Noranda's affairs was Oliver Hall, who came to the company from Inco in 1931 to act as assistant general manager, becoming consulting engineer in 1938. When arrangements were made in 1926 to put the mine in production, J. R. Bradfield was engaged as assistant superintendent of construction; he later became, successively, plant engineer, secretary of the company, executive assistant to the president and vice-president, and, early in 1956, president.

Getting a railway was one of the first problems which the Noranda management had to face after proving that it had a mine. Extension of the C.P.R. line between Mattawa and Angliers, forty miles south of Noranda, seemed the most feasible plan; but the C.P.R. management did not feel that the prospects would justify the expense. (It must be remembered that no

mine depending mainly on copper was yet in operation in eastern Canada, and the Noranda area was still largely bush and muskeg.)

The C.N.R. could build a branch southward forty-four miles from Taschereau on the National Transcontinental; but, although railway executives were favourable, other considerations prevented immediate construction. An extension of the T. & N.O. branch already in operation between Swastika and Cheminis, near the Quebec border, was also possible, but the T. & N.O. had only a provincial charter and the question arose as to whether it could build into an adjoining province. The Nipissing Central, an electric line operating between Cobalt and New Liskeard and owned by the T. & N.O., possessed a federal charter, and it was proposed that this charter be used for a line to Noranda. At this point, the Quebec government intervened, challenging the right of the T. & N.O. to build into Quebec by the use of the N.C. charter, and a Privy Council decision was needed before the way was clear. In the end, Noranda got both the C.N. and N.C. extensions.

Until the railways reached Noranda, most of the materials needed for plant construction were brought in during the winter. With misgivings on the part of some of the directors, the capacity of the projected smelter was set at a thousand tons a day. To finance this, a \$3,000,000 loan was arranged with Hollinger Consolidated Gold Mines Limited, Hollinger receiving a bonus of 30,000 shares of Noranda stock. This proved to be a very profitable transaction for Hollinger, but in 1925 it was considered by many to be pretty much of a gamble.

The village of Rouyn, on the west shore of Osisko Lake, had mushroomed into existence, but it was inevitable that it should remain a crude shack-town for some time to come. On the other side of the Lake, the Horne Copper Corporation decided to provide for its employees a model townsite, supplied with water, sewage system, and other requirements of comfortable living. On March 1, 1926, E. V. Neelands of New Liskeard, a civil engineer, was engaged to lay out the proposed town and its facilities. By December 1, it had taken shape, and the work was then con-

tinued by Alex Hogg, who had previously been Neelands's assistant. One of the first of the main buildings completed was the Noranda Hotel, which is gratefully remembered by a generation of mining men who have found it a veritable oasis.

When one visits the model town of Noranda today and sees beyond it the two tall smokestacks surmounting the huge smelter, with cars of metal on the tracks consigned to the Noranda-owned copper refinery in Montreal East, when the fortunes already taken from the ground, and the millions of tons of blocked-out ore providing mill-feed for the future are considered, it is hard to think back to those early days when many whose opinions carried weight were not so sure that the whole thing was not highly visionary.

Construction of the smelter was started in June, 1926. Since it was known that the mine contained ore of such grade that concentration would be desirable, roasters and reverberatory furnaces were the choice rather than blast furnaces.

The smelter was built as two duplicate units, each with a rated capacity of 500 tons of ore a day, the equipment consisting of eight roasters, two reverberatory furnaces and two converters. After operations had begun, it became evident that one unit alone could smelt 1,000 tons a day. Since only one hoisting shaft had yet been put down, and its capacity, and that of the crushing plant, was insufficient to supply ore for the two units at the increased rate, a new shaft was sunk, and a new crushing plant was constructed to handle the increased tonnage. The increased quantity of matte called for two more converters. In 1955, plans were adopted for the installation of a third reverberatory furnace, which would temporarily increase the capacity of the smelter and later permit the old furnace to be rebuilt.

The first year's operations demonstrated the advisability of establishing a concentrating plant, and it was started in October 1928. Noranda ore can be divided into two main classes, siliceous and massive sulphide ores. The former is needed by the smelter for flux, leaving the massive sulphides for either direct treatment by the smelter or a combination of smelting and concentrating. The sulphide ore can itself be divided into high-

and low-grade ores, the dividing-line varying with the relative prices of copper and gold.

Noranda has not been forced to contend with problems such as those which faced Cominco at Trail, and others at various mines since then. Concentration is by differential flotation. Among the minerals floated out is a certain amount of pyrite, containing gold; this is re-ground, and the gold recovered in a 500-ton cyanide plant. The sulphides, less the pyrite, then go to the smelter (where the higher grade goes direct) and are there cast into 600-pound anodes consisting of almost pure copper but containing gold and silver as well. The anodes are then shipped to the refinery at Montreal East, where the final separation takes place.

From the start of operations in 1927 to the end of 1955, the total tonnage of ore milled (from the Horne mine alone) was 38,569,890 tons, which produced 1,604,704,416 pounds of copper, and 5,883,673 ounces of gold.

The board of directors might have been content to manage such a mine, divide its profits among the shareholders, and consider their work well done. But in accordance with the Murdoch policy, Noranda became the agency through which a group of other mines, both gold and base-metal, industrial concerns and investment and development companies have been brought into close association. As early as 1927, control was acquired of what later became Waite Amulet Mines Limited, a copper-zinc-silver-gold property, which has provided by far the greater part of Noranda's extraneous income. In 1929, only two years after production from the Horne mine began, Noranda organized Canadian Copper Refiners Limited and built a refinery at Montreal East so that its own metal and that from other mines might be refined in Canada. In order to enlist their skill and experience, Murdoch induced the Nichols Copper Company of New York, now the Phelps Dodge Refining Company, to take a minority interest in the enterprise. Murdoch next turned his attention to the processing of copper products, and over a period of time acquired for Noranda a controlling interest in Canada Wire and Cable Company Limited, the largest wire and cable

manufacturer in Canada. A government-owned plant in Montreal East, making brass strip during World War II, was bought after the war, and Noranda Copper and Brass Limited came into being, with Bridgeport Brass Company, of Bridgeport, Connecticut, as a partner.

From time to time, as opportunity offered, Noranda Mines Limited has invested part of its income in gold prospects recommended by its engineers. In this way control was acquired in 1935 of Pamour Porcupine Mines Limited; and subsequently, Hallnor Mines Limited and Aunor Mines Limited were organized to operate two other gold mines in the Porcupine area.

In order not only to invest surplus capital, but also to form profitable connections, Noranda has acquired large interests in such holding companies as Anglo-Huronian Limited and The Mining Corporation of Canada, Limited. These have given the company indirect interests in Kerr-Addison Gold Mines Limited, Quemont Mining Corporation Limited, Normetal Mining Corporation Limited, Geco Mines Limited and a number of others.

Noranda has expanded in other directions. In 1938, the company optioned a group of claims in the Gaspé Peninsula, Quebec, where 67,000,000 tons of copper ore were subsequently disclosed by drilling and underground exploration under the agency of a subsidiary, Gaspé Copper Limited. A 6,500-ton plant was built, electric power was brought from the Quebec Hydro-Electric Commission's Bersimis River plant on the north shore of the St. Lawrence River, and production began at the end of 1955.*

*For a fuller account of Gaspé Copper, see pp. 319-322.

THE MAIN PART OF THE REGION TO BE DISCUSSED IN THIS CHAPTER extends from the Ontario border to Val d'Or and beyond. (The Horne mine and Noranda Mines Limited, which are of course among its most prominent features, have already a chapter to themselves.) Geologically, it consists of a great syncline, mainly overlain by Timiskaming sediments, which has been traced for at least 120 miles. The Cadillac-Bouzan Fault, marking the eastern portion, is believed to have been responsible for the many mineral occurrences along or adjacent to its strike. Some geologists believe that the structure may be continuous with the Larder Lake break, and if so it would have a minimum length of over 160 miles.

East and west, the productive area in northwestern Quebec extends across twelve townships (which in that province are ten miles square), and is not more than two townships wide, following the fault-zone along which the principal mines, prospects, and towns are strung. The break runs slightly south of east and consequently, in the western section, the mines are located in the northern tier of townships; about half way along the zone, they cross over into the southern tier.

Prospectors first invaded the territory surrounding the Horne, but within a short time staking had spread twenty miles westward to the Ontario border and eastward to Val d'Or and Senneterre; and in the next twenty years more than 120 prospects were located, although less than half would become producing mines. Gold had been in the minds of those staking most of the claims in this region—especially after the rise in its price—yet there had been from the beginning a number of base-metal mines; and as the relative values of gold and the base metals again altered in

favour of the latter, the newer mines tended to fall into that category.

In its general topographical features, the area is typical of the Canadian Shield as a whole, gently rolling, with here and there projecting knobs and ridges indicating the irregularities of the underlying surface upon which the silt and clay of glacial Barlow-Ojibway Lake was laid down. In the western part, these hills and ridges reach an elevation of about 1,650 feet above the general level, but farther east the country flattens out.

Although no physiographic divisions exist, the region can be roughly divided into three sections: Rouyn-Noranda, Cadillac, and Malartic-Val d'Or. The cities of Rouyn and Noranda, adjoining each other, with a combined population in 1956 of 27,087, are in Rouyn Township, third eastward from the Ontario border; next comes the town of Cadillac, in the township of the same name. The town of Malartic is not in Malartic Township, but in Fournière, next to the south; then come the twin towns of Bourlamaque and Val d'Or with a total population of 12,771, in Bourlamaque Township, second to the east from Fournière. Mines tributary to Val d'Or and Bourlamaque extend both east and west, across three townships.

The territory between Rouyn and Val d'Or is now served by a branch of the C.N.R. (completed in 1938) connecting with the National Transcontinental at Senneterre, and by a paved Quebec Highway, but, in the first years of the boom, travel east and west was almost impossible because of swamp, muskeg and bush covering most of the country. Slow-moving but navigable rivers, flowing northward to James Bay, provided the only access. Thus, from the National Transcontinental (before the more southerly branch was built), the Kinojevis River made possible the transport of most of the equipment needed to establish the Noranda plant; in the Cadillac and Malartic-Val d'Or areas the Harricana, connecting with the railway at Amos, provided the route by which supplies and equipment came into a large section of the country.

Most of the prospectors who flocked in during the years following the Horne discovery were veterans of Porcupine and Kirkland Lake; some had been rock-hunting since Cobalt days.

Among the latter were the nine McDonough brothers, who have left an indelible mark on Canadian mining. No rush since Cobalt was complete without one or more members of this family. One prospector declared that whenever he heard something crashing through the bush he could not be sure whether it was a jack rabbit or a McDonough!

The McDonough grandparents were pioneers in the Gatineau valley; they settled on a rocky farm near Maniwaki. The third generation consisted of nine boys and one girl, named here in order of age: Charles, Peter, William Patrick, Joseph, John, Mary, Michael, Albert, James Edmond and Timothy Alfred. Before prospecting claimed them, the elder boys had become expert woodsmen and Joe especially could "birl" a log with the best of the river drivers. When the oldest were growing up, educational facilities were not of the best and, as Joe has remarked, "the two weeks we attended school the teacher was absent"; nevertheless Joe himself has been able to hold his own from prospector through to top executive in a large and successful mining organization, and, with his help, three of the youngest brothers—Michael, Edmond and Timothy—have received college educations and have become mining engineers.

At the height of the Cobalt boom, Peter and Patrick went into the bush to prospect, and gradually the others followed as the different mining regions beckoned. Gowganda, Porcupine and Kirkland Lake attracted them in turn and they staked claims in each place, but none made the big money. Unless prospectors make a quick sale they can not afford to hold claims indefinitely, and some of the claims the McDonoughs had staked became producing mines when re-staked by others.

The McDonoughs were reunited in 1931, at Haileybury, where Mary provided an oasis of family life for any of the brothers who might have a few weeks of leisure between prospecting expeditions. The following year, Joe, shortly after becoming head fieldman for F. M. Connell, discovered a gold showing in Boston Township (Ontario), which was sold to a Toledo speculator for twenty thousand dollars. Known as the Miller Independence, it was rich on surface, but its life was short.

John S. Beattie staked the Beattie mine in Duparquet Township, twenty-three miles northwest of the Horne. It remained a prospect for many years, and was eventually optioned by Cominco, who dropped it without undertaking much development. In 1931, David Angus of Haileybury secured an option and made a deal with Thayer Lindsley. The depression was at its worst and money for mines was hard to come by, but Lindsley succeeded in getting Nipissing Mines, which had a considerable sum in its treasury, to take a joint interest.

Since the early thirties, Lindsley, who grew up in a suburb of Boston and was educated at Harvard, had, with his brother Halstead, been interested in Canadian mining. There had gathered about the brothers a group of mining men who were to remain in association for the rest of their lives: Joseph Errington, Donald M. Hogarth and C. D. H. MacAlpine. Together they shared in such promotions as that of the Beattie, and for that purpose a company called Ventures Limited was incorporated in 1928. In the interval, it has become one of the great organizations of its kind in the world. Through subsidiaries, or subsidiaries of subsidiaries, Ventures controls and shares in the control of mines, active and inactive, in every quarter of the globe (except Asia) from Greenland to Australia. Thayer Lindsley is the only one of the original group now alive; and in 1955 he resigned the presidency (becoming chairman of the board) in favour of R. B. Anderson,* one-time Assistant Secretary of the United States Department of Defence. Lindsley talked of retiring, but within a few months had organized Panamerican Ventures Limited to continue the development of new mines.

Diamond drilling at the Beattie disclosed a large deposit of low-grade gold-bearing ore. During the first years, production, which began in 1937, was from a "glory hole" or open pit. In 1943, pillars supporting the pit walls collapsed; clay and other debris fell into the stopes below, blocking several levels in the main shaft area. The mine was shut down for some months while the damage was repaired, but other slides and blockages occurred in 1944 and 1946, causing the loss of four lives in the

*Anderson later resigned to become U.S. Secretary of the Treasury, and was succeeded by F. V. C. Hewett.

latter year. Eventually, in 1947, the pit was sealed off from the levels below and mining was continued in the underground workings.

The first Beattie company, incorporated in 1931, was reorganized several times and in 1937 became Consolidated Beattie Mines Limited. In 1941, the assets of Donchester Mines (Quebec), whose property adjoined, were acquired; and, in 1947, control was secured of Duparquet Mines Limited, also adjoining. In the latter year, Ventures and Nipissing relinquished control to a group headed by David Angus. In 1951, Consolidated Beattie Mines and Consolidated Duquesne Mining Company Limited were amalgamated to form Beattie-Duquesne Mines Limited, and C. Glenn Hunter, president of Duquesne, became president of the new company; David Angus, former Beattie president, became chairman of the board. In addition to the Beattie holdings, the new company took over property held by Duquesne, including the Hunter claims, three and a half miles northeast of the Beattie mill, on which diamond drilling had disclosed a copper-bearing orebody.

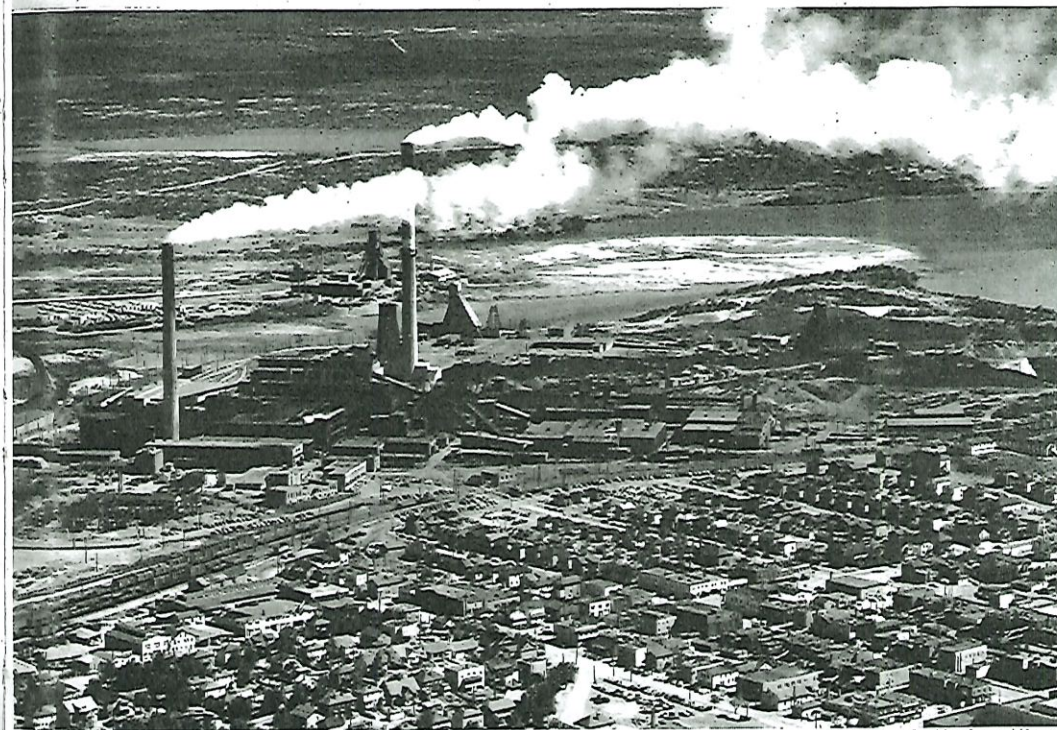
The original Beattie plant consisted of a flotation concentrator, roaster and cyanidation unit; in 1956, part of the gold flotation circuit was converted to copper flotation to treat ore from the Lyndhurst mine, and from the Hunter claims as well, where a three-compartment shaft had been sunk early in 1956 and underground development had begun on several levels.

The Lyndhurst mine, twenty miles northeast of the Beattie, is one of R. J. Jowsey's enterprises. Although the company (Lyndhurst Mining Company Limited) was incorporated in 1949, it was not till 1955 that its mine-making possibilities became evident; early in 1956 arrangements were concluded for the conversion of the Beattie mill to handle Lyndhurst ore and by mid-year shipments had begun at the rate of three hundred tons a day. The company has extensive holdings and its mineralized zone extends for a distance of about seven miles.

When prospectors go out to stake some claims and succeed in finding an outcrop of mineralized rock, much of their staking must of necessity be blind. Assuming that a deposit of com-



Noranda's first camp, 1926



Noranda, thirty years later

Courtesy The Northern Miner



Courtesy Who's Who in Canada
James Y. Murdoch



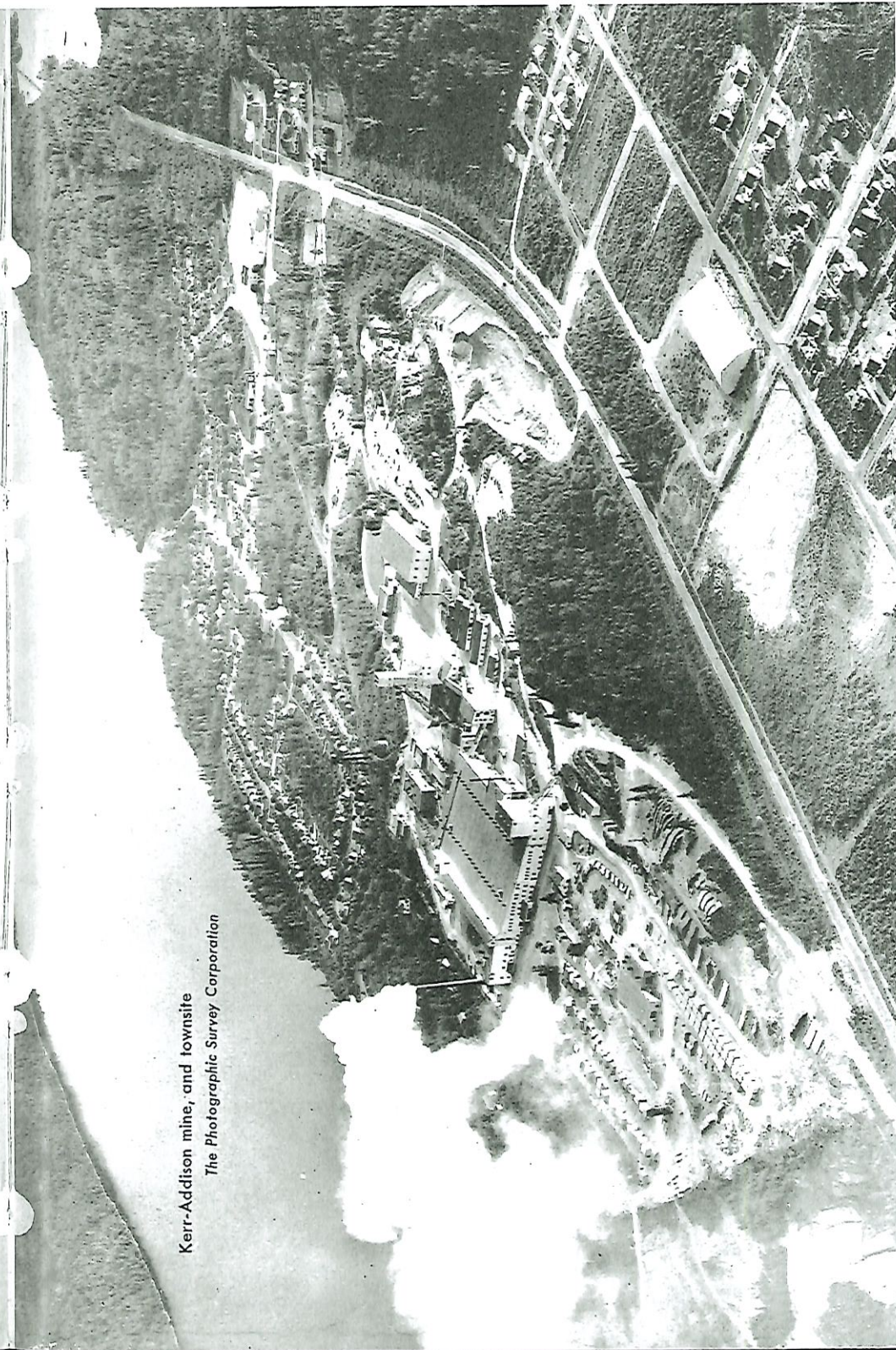
Ashley and, Crippen Photo
R. V. Porritt



John R. Bradfield



Shelburne Studios
H. L. Roscoe



Kerr-Addison mine, and townsite
The Photographic Survey Corporation



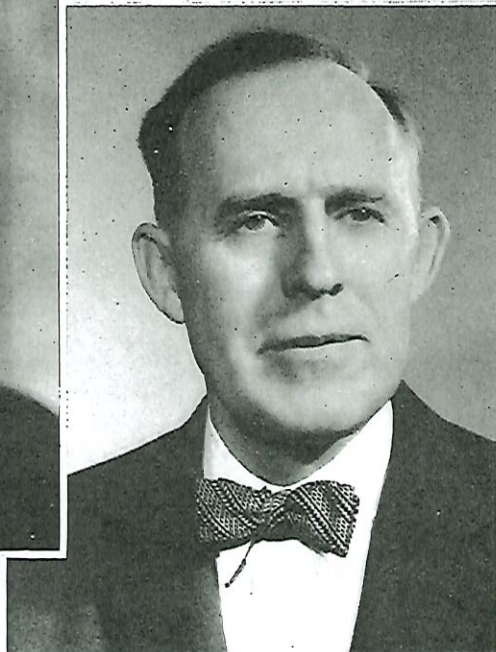
Marin Portraits
Pierre Beauchemin



The Northern Miner
James P. Norrie



International Press Service
M. J. O'Brien



Edmund Soame Photo
J. P. Millenbach

mercial grade is found, extensive enough to justify the large expenditure required for development, that fact will not be definitely determined until some type of geophysical exploration and, finally, diamond drilling, has been done. It is then sometimes discovered that the area staked does not include the complete orebody, or orebodies, which may now belong to others. Quite often, separate development projects are undertaken, and not till much money has been spent does it become evident that joint action of some sort, by amalgamation or by the formation of a separate company to conduct the joint operation, is the proper course to follow.

Such a situation arose at what is now the Waite Amulet mine, about six miles northwest of the Horne. During the rush to Rouyn, Tom Montgomery, prospecting for J. H. C. Waite and Colonel Charles Ackerman, staked a number of claims which later became the Waite-Ackerman-Montgomery mine; and at about the same time, Joe McDonough, his brother Peter, and William O'Reilly staked claims adjoining on the south, which they sold to Russel Popham and Senator J. H. Rainville and which eventually became the property of Amulet Mines Limited. Considerable development work was undertaken by this company following the discovery of the first orebody in 1924; production began in 1929 with a 300-ton mill, concentrates being shipped to the Noranda smelter.

When a mining company builds a smelter it immediately begins, if it is wise, to look about for additional ore or concentrates. Buying the Trail smelter put the C.P.R. into the mining business and led to the purchase of one mine after another and the solicitation of custom trade from as far away as the Yukon. Similarly, Noranda had not yet begun to treat its own ore when it cast about for other sources of smelter feed. The Waite-Ackerman-Montgomery mine, within easy distance, was an obvious choice and consequently, in 1927, control of that company was bought and R. V. Porritt, one day to become Noranda's general manager, was placed in charge. The next step was to acquire control of the Amulet, and the two were amalgamated in 1933. These were depression days and neither mine had been in operation since 1930, nor would be until 1937.

Exploration of the combined properties by deep drilling had continued and had been rewarded—in addition to the locating of several different orebodies on both properties—by the discovery, in the eastern portion of the former Amulet holdings, of a massive body of sulphides (Lower A), found to contain 3,158,260 tons averaging 6.2 per cent copper and 4.65 zinc, with small amounts of gold and silver. This was followed by the building of a new 1,000-ton mill on the Amulet site and by large-scale drilling to determine the extent and position of the orebody, which was eventually found to have a north-south length of 500 feet and a width of 400, between the 500-foot horizon and the 1,100.

In the meantime, owing to the initiative of the geologist J. G. MacGregor, various properties adjoining on the east had been brought together by Thayer Lindsley in a new company called Lake Dufault Mines Limited. These properties, purchased from Young-Shannon Gold Mines Limited, Area Mines, and Ventures, were found when drilled to possess an extension of Amulet's "Lower A" orebody. To meet this situation, Amulet Dufault Mines Limited (Waite Amulet, 3,300,000 shares, Lake Dufault, 220,000), owned jointly by Waite Amulet and Lake Dufault, was incorporated in 1940 to take over and operate "Lower A" ground on both sides of the line. The orebody in question was now found to be 960 feet long and 860 feet wide, extending from surface to a depth of 1,200 feet; below that level each company was to retain its former rights. Waite Amulet, drilling on its portion, has also continued to find ore. Lake Dufault, in its territory, discovered in 1946 a sulphide deposit (No. 2) at a depth of 1,800 feet, 400 feet long and about 150 feet wide and 16.5 feet thick, averaging 9.79 per cent zinc, with low copper, gold and silver values.

Continuing its policy of securing smelter feed from nearby sources, Noranda made an arrangement with Macdonald Mines Limited, operating a zinc-pyrite property about five miles east of Waite Amulet; a new company, West Macdonald Mines Limited, owned jointly by Noranda and Macdonald Mines, was incorporated in 1952 to operate an area in the western portion of the Macdonald property containing some nine million tons with an average of approximately eighty per cent pyrite and from three

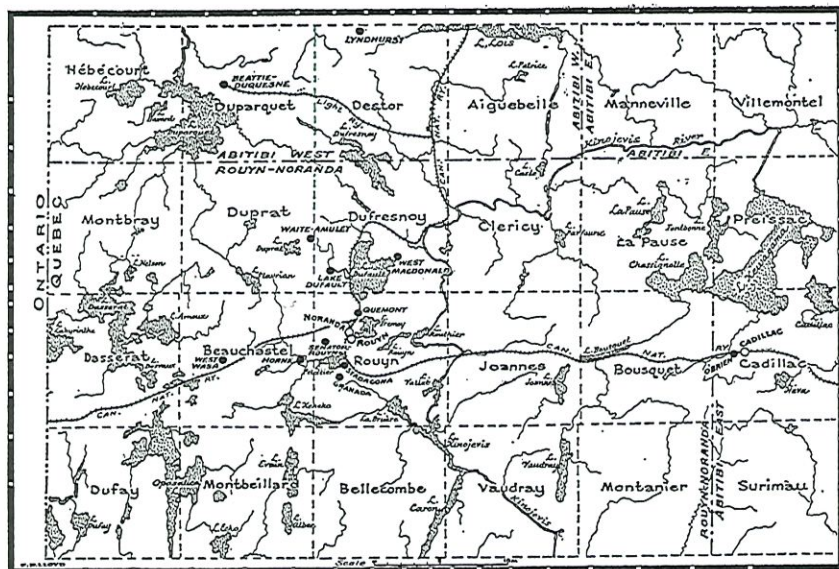
to three and a half per cent zinc. Ore is transported to the Waite Amulet mill by aerial tramway, and the capacity of the mill has been raised to two thousand tons a day.

The Aldermac, a copper-zinc property in Beauchastel Township, ten miles west of the Horne, was staked during the boom days by William Alderson and Allan MacKay. It came under Noranda management and control in 1927, with Ernest Craig in charge, but in 1929, the property was transferred to the Towagmac Exploration Company Limited which, in turn, passed it on to the Aldermac Copper Corporation Limited. Four hundred thousand dollars was raised through the sale of bonds to pay for a mill, but the enterprise failed. The mine went under the hammer in 1945 and was bought by Cyril T. Young, who organized West Wasa Mines Limited to undertake further exploration by magnetometer and diamond drilling.

R. C. Gamble, another prospector who began at Cobalt, was one of the first to reach Rouyn in the wake of Ed Horne. He staked the Granada and optioned it to McIntyre Porcupine, but that company let it go after having done some development work. Gamble then organized a company himself in 1927 and production began the following year with a hundred-ton mill. After between two and three million dollars in gold had been recovered, the veins began to pinch out. Although deep drilling established a new orebody at the 2,350-foot level, the margin of profit was not sufficient to justify the investment required to mine it, and operations were suspended. Fire, which destroyed plant and mine buildings in 1933, rendered resumption of operations more difficult still; but, if and when the price of gold in relation to other commodities improves, it is more than probable that Granada, in company with many other gold properties in this section of Quebec, will again join the producers' ranks.

Somewhat in the same class is the Senator-Rouyn, a gold mine adjoining the Horne on the west, also staked by Gamble during the Rouyn rush. It contains a large low-grade orebody, and although over eight million dollars was taken from the mine, cost of mining gradually reached the point in 1955 where profit ceased, and operations were suspended.

The nearby Stadacona mine, another Gamble enterprise, in-



corporated in 1925 as Stadacona Rouyn Mines Limited, reorganized in 1931, placed in liquidation in 1939, and sold by the liquidator in 1945 to Stadacona Mines (1944) Limited, has nevertheless kept fairly steadily in production. To the end of 1955 it produced over fifteen million dollars in gold, and with the exception of one year has paid dividends from 1948.

Because of the richness of the Noranda ore shoots, owners of adjoining properties were filled with lively expectations which dimmed, however, as the conviction grew that the Horne's deposits did not extend beyond Noranda boundaries. Hope lingered longest among those holding property immediately to the north, separated only by what was known as the Horne Creek Fault. Opinion was sharply divided as to whether the Noranda ore might be picked up north of this fault, and for twenty years the doubters seemed to have the better of the argument. Noranda held an option on the ground in 1923 and 1924, but dropped out. The Victoria Syndicate, subsidiary of the Mond Nickel Company, next tried its hand at finding the ore, but also failed. Then, in 1926, the United Verde Extension Company of Arizona took up the option, sinking a two-compartment prospect shaft to 235 feet, but drifting and underground diamond drilling failed to produce results.

In 1928, The Mining Corporation of Canada, Limited, bought a ninety-per-cent interest in the property, incorporating Mining Corporation (Quebec) Limited through which to conduct operations. The name was shortly changed to Quemont Mining Corporation Limited, and active exploration continued. The shaft had been deepened to 922 feet and three thousand feet of underground diamond-drilling had been done when, with no encouragement in either drift or drill-hole, and with the depression casting a pall over everything, operations ceased in 1930.

The Mining Corporation had not given up hope. In 1943, a magnetometer survey was undertaken. Magnetometer exploration is one of several forms of what is called "geophysical" surveying, or exploration. The methods and instruments may vary, but the principles are similar. Instruments used in geophysical exploration are sensitive to the earth's magnetic field and react to any distortion of its regularity. A magnetometer can be either carried by hand across country or slung from an aircraft passing back and forth over the area to be explored. If the magnetometer passes over a mineral deposit of some sort, a distortion, varying in intensity, is caused by the "warping" of the magnetic field. Lines resulting from this warping are recorded by the instrument, and when traced upon a map of the region traversed they indicate the spots (referred to as "anomalies") where further exploration, either by surface examination or by drilling, might be justified.

The survey turned up a number of interesting anomalies, but nearly six thousand feet of new drilling still failed to suggest that a mine was in the making. It was then decided to test anomalies under Osisko Lake; in February 1945, drilling through the ice was begun, and values were found which subsequent drilling and drifting expanded into a large deposit of copper-gold-silver-zinc-pyrite ore. A concentrator with a daily capacity of two thousand tons began operations in June 1949; cyanide and pyrite plants followed later in the year. Concentrates are piped to the Noranda smelter, within sight to the south.

Another mine which comes into the Noranda orbit through The Mining Corporation of Canada is Normetal, a copper-zinc producer twelve miles north of Dupuy station on the National

Transcontinental line of the C.N.R., a short distance east of the Ontario-Quebec boundary. The property was at one time owned by Abana Mines Limited which, when the depression came, was unable to meet its payments, whereupon The Mining Corporation put up \$40,000 to acquire full title. Normetal Mining Corporation Limited was incorporated in 1931 to hold the property thus acquired, and when the price of copper had improved sufficiently to justify development, the mine was opened up. In 1937, a concentrator was built with a capacity of 250 tons a day (later increased to over 1,000 tons). Copper concentrates are shipped to the Noranda smelter, while the zinc concentrates go to the United States. Transportation from mine to railway is over a standard-gauge tramway operated by the Normetal Railway Company, a wholly-owned subsidiary of Normetal Mining Corporation.

While these developments were taking place in the Rouyn-Noranda area, prospectors were busy in the region farther east, centring in Cadillac Township, where many gold showings were found. Half a dozen of these became producing mines, but in most cases their careers were short; only one, the O'Brien, has had a continuous history of production up to the present, and at the time of writing it was on a salvage basis. The original owner, M. J. O'Brien of Renfrew, Ontario—lumberman, railway contractor and mining magnate—had an uncanny instinct for the acquisition of prospects that ultimately became successful. He owned the silver mine which set the record for length of production at Cobalt; his was one of the two most productive mines in Gowganda; and he failed only by accident to become the owner of an important part of the Hollinger mine at Porcupine.

The most productive mines, however, were developed still farther east; principally in Malartic, Fournière, Dubuisson and Bourlamaque townships. In the years following World War I, although outcrops were few, prospectors had become fully aware of the significance of the Cadillac-Bouzan Fault which, as has been said, traverses the entire area. It cuts across the southwestern corner of Malartic Township and the northeastern corner of Fournière; and although the names of most mines and pros-

pects in this section contained the word "Malartic," or variants of it, the producing mines were in Fournière, rather than Malartic.

Many prospectors and mine developers were involved in these mines, but perhaps the one who most greatly influenced the area was James P. Norrie, who died at Noranda in 1945 at the age of fifty-four. Like Ed Horne, he was born in Nova Scotia—at Upper Onslow. Following graduation from the Nova Scotia Technical College in 1913, he was appointed Inspector of Mines for Nova Scotia, a post he held for some years before going to central Canada. He was engaged by R. C. Gamble to manage the Stadacona, where he remained for three and a half years, leaving to take charge of the first of several "Malartic" mines with which he was to be associated. This particular Malartic had been discovered in 1923 by St. Barbe Sladen, H. S. Kennedy and J. C. Carroll, prospecting for an Ottawa syndicate. It was optioned to an exploration company but the option was allowed to lapse after some surface sampling and the drilling of eighteen holes had been done.

A company called Malartic Gold Mines Limited next took up the deal, carrying on exploration under Norrie until 1929. A vertical prospect shaft was sunk and exploration was done on three levels, supplemented by surface and underground diamond drilling, but the grade was too low to justify further operations.

The advance in the price of gold to \$35 an ounce changed the picture. A new company, Canadian Malartic Mines Limited, was incorporated by the Lindsley group and funds were advanced for the acquisition of additional claims (increasing the holdings to 1,029 acres) and for further exploration. The option was exercised in August 1934, and J. P. Millenbach was placed in charge. Two large orebodies, mainly of low-grade ore in silicified zones in the sediments, had been disclosed; each consisted of a central core of higher grade ore, gradually diminishing in values as it merged without definite boundaries into the country rock. The ground was unusually firm, making possible open-stope mining.

Production began in May 1935, with a 150-ton mill, increasing eventually to 1,200 tons. In the following twenty years the mine

produced over twenty-six million dollars and in that time established a Canadian record by treating some seven million tons of ore (average value, \$3.72 a ton) and returning to investors over three million dollars.

The mines in this area which have continued in operation through the years have all been on the same strike. St. Barbe Sladen and Lee Coffin staked the Sladen Malartic, adjoining Canadian Malartic on the east. The original company was incorporated in 1927, the initial finances being supplied by the Montreal financial firm of Nesbitt, Thomson and Company. It was not till January 1938, however, that production began with a 250-ton mill, since increased to 700 tons, although that rate has not always been maintained. In 1948 a reorganization occurred when Sladen and National Malartic were merged to form Barnat Mines Limited. Ore in the Sladen section has since been worked out and mill-feed is supplied from the National workings.

Continuing eastward, East Malartic, staked first by Joe McDonough, and re-staked for its subsequent owners in 1932, comprises 3,250 acres adjoining Barnat. Its history is similar to that of its neighbours. Also a Nesbitt, Thomson promotion, East Malartic Mines Limited was incorporated in 1934. Shaft-sinking began the same year. Shafts No. 1 and No. 2, in the north contact area, were abandoned in 1938. Shaft No. 3, on the south contact 1,100 feet east of the west boundary of the property, was sunk to a depth of 1,769 feet and ten levels were opened from it. This shaft was sealed off in 1947 after one of the most disastrous fires in the history of Canadian mining. Shaft No. 4, of five compartments, on a sixty-per-cent incline, was sunk 300 feet from the west boundary and 560 feet south of the contact. It has since been deepened to 3,870 feet to serve twenty-five levels. Milling started in November 1938 at 750 tons a day, and was stepped up to 1,800 the following year, but the average production in recent years has been about 1,400 tons. The grade of ore is considerably higher than that at Canadian Malartic and about the same as at Barnat. Up to the end of 1955, East Malartic had produced over thirty-nine million dollars, out of which dividends amounting to over three million dollars have been paid.

The easternmost producer in this group is Malartic Gold Fields, about two miles beyond East Malartic. The company, also a Nesbitt, Thomson promotion, was developed by James Norrie after a comprehensive drilling campaign; it was incorporated in 1935. The first shaft was sunk to a depth of 1,870 feet and production began in December 1939, from a mill having a capacity of 335 tons a day, later increased to 700-750 tons. No. 2, a five-compartment shaft, sunk three thousand feet west of No. 1, has a depth of 2,700 feet. Following the sinking of No. 2, a new mill, capable of treating 750 tons a day, was erected nearby; and later, when the original mill (at the site of Shaft No. 1) was closed, the equipment was moved to the new mill, increasing its rate to 1,700 tons (average production, 1955: 1,841 tons). From 1939 to the end of 1955 Malartic Gold Fields produced almost forty-one million dollars, its grade of ore being slightly higher than that of other mines farther west on the strike.

The four producing mines in Fournière Township are served by the town of Malartic, adjoining Canadian Malartic and Barnat. It has a population of about 7,000 and, having the benefit of steady payrolls and being surrounded by good farming country, is a thriving community. It is forty-seven miles east of Rouyn-Noranda by rail. Twenty-seven miles farther east are the twin towns of Bourlamaque and Val d'Or, serving another and larger group of producing mines in Dubuisson, Bourlamaque and Louvencourt townships. The earliest to be developed were gold mines, but more recently base-metal mines have become the rule.

Stanley Siscoe, a Polish immigrant who arrived in Cobalt in 1910 and later organized a small prospecting syndicate, was responsible for the mine named after him. Shortly after the outbreak of World War I, Siscoe, Joe Samulski and others, prospecting on a small island in Dubuisson Lake, found evidences of gold. When the war was over, Siscoe tried to get money for development; but, although assays were high, the veins were narrow and the picture did not appeal to the few who could be induced to examine the property.

A group of brokers were at length persuaded to try their hand at getting money, but dropped the option after a small amount

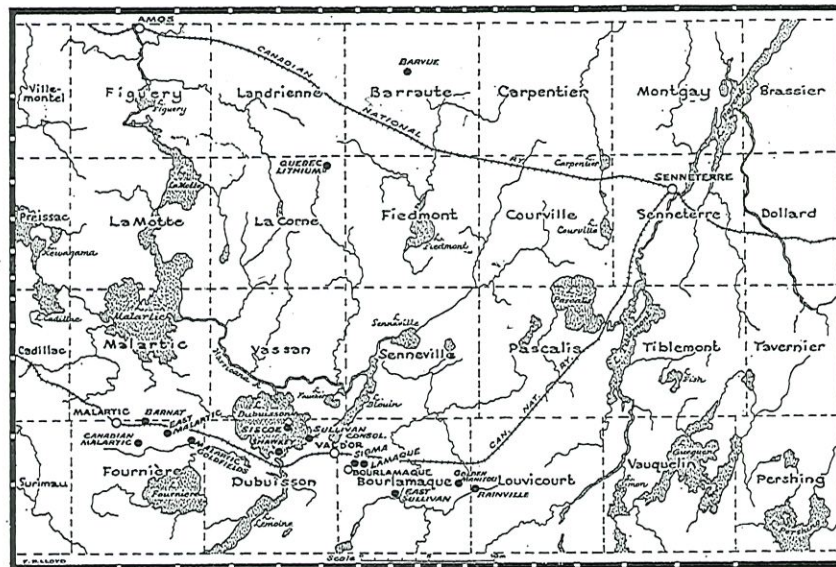
of work had been done. Thayer Lindsley, then but recently arrived in Canada, headed a syndicate that was not afraid to take a chance; and Jack Forbes, the geologist, after much study of the structure, evolved the theory that the ore was contained in a series of high-grade quartz lenses following one another down the dip. This ladder structure, as it was called, defied usual development methods, and Forbes solved the problem by a system of crosscuts and winzes.

Siscoe Gold Mines Limited was incorporated in 1923. Production began in 1929, but the results were disappointing; recovery was much less than assays had indicated. True, there was some "high-grading," but not enough to account for the apparent discrepancy. Within a short while the mine had accumulated a debt of \$120,000. That was the situation in 1930 when C. O. Stee was appointed manager. According to all calculations, the mine should pay, and Stee set himself to discover why it did not. Following the ore through the concentrator, he found that some of the fine free gold was lodging in the ball-mill liners; quantities were found under the rakes in the classifiers, and also in the bottom of the agitators. A clean-up of this equipment yielded fifty thousand dollars, and a second clean-up some time later netted eighty thousand. Cone classifiers, since in general use, were devised to catch the fine gold, and thus the mine became a profitable undertaking. The initial dividend was paid in March 1932; and when the mine was closed in 1949 because no further ore was in sight, it had produced almost forty million dollars. Siscoe Gold Mines Limited, with J. B. Lynch as president, has continued as both an operating and an investment company.

Stanley Siscoe died of exposure in March 1935 when his aeroplane was forced down on Lake Mitchimanitou, in Pershing Township. He was on his way from Montreal to Senneterre.

About the time that Siscoe and his friends were locating the Siscoe mine, George La Palme staked what was first called the Martin mine, on the south shore of Lake Dubuisson; it was known later as the Shawkey, after a well-known American baseball player who held a large interest. Arthur Le Blanc bought the property from La Palme for \$1,500, raised some money through

a Porcupine syndicate, and began operations. The ore was very rich, but the veins were narrow, and although high-graders did well, the operation was not a success. Joe McDonough thought he could do something with the mine and in 1933 raised enough money to have the shaft pumped out and the workings examined. Eventually, Gilbert and Charles LaBine joined McDonough in a



money-raising campaign which produced about \$800,000. The shaft, itself in high-grade ore, was deepened, and R. M. P. Hamilton and his brother, P. D. P., who had recently established their General Engineering Company at Toronto, were engaged to build a one hundred ton mill. At a depth of seventy feet, the ore began to pinch out in the shaft and also along the strike, and operations ceased after about a million dollars had been recovered. At this stage McDonough dropped out. The LaBines and Shawkey continued, but sufficient ore has never since been found to justify a resumption of production.

Following completion of the National Transcontinental line, prospectors advanced up the Harricana from Amos. In 1911 one of them, J. J. Sullivan, staked the mine later named after him on the north shore of Lake Dubuisson, but it was many years before it became a producer. The original company, Sullivan Gold

Mines Limited, was succeeded in 1932 by Sullivan Consolidated Mines Limited. Its holdings of 1,383 acres in Dubuison Township and 200 acres in Vassan, adjoining the Siscoe on the south-east, have been augmented by several thousand acres in nearby townships. Development of the main property has been by two shafts: No. 1, vertical, 1,300 feet deep, and No. 2, inclined, with a depth of 3,000 feet. Production started in April 1934, with a 50-ton mill, which was increased to 500 tons a day by 1948. From 1934 to the end of 1955 the mine produced nearly twenty-six million dollars.

A number of gold mines in the same section of Quebec have similar histories, but this mine is notable because it has been the means of introducing Pierre Beauchemin to Canadian mining. More than one mine operator has succeeded without the benefit of scientific training, but usually these are men who, beginning as prospectors, have subsequently mastered the techniques of mining and milling by many years of practical experience. Pierre Beauchemin, on the other hand, began life as a logger, eventually becoming a successful lumberman, and it was only after he had made a success in that field that his interest turned to mining. He has used the profits from Sullivan Consolidated to locate and develop other mines, such as Quebec Copper, in the Eastern Townships, and Quebec Lithium, twenty-five miles north of Val d'Or (to be discussed in later chapters), and East Sullivan, a copper-zinc mine in Bourlamaque Township, three and a half miles southeast of the town of Val d'Or.

Hector Authier, a lawyer whose place of business was at Amos, and Louis Brochu of Montreal, operating Read-Authier Mines Limited, grubstaked a number of prospectors, one of whom, R. Clark, staked some claims during the 1920's in the northwestern part of Bourlamaque Township. Not much was done to develop these until 1932, when work was begun under Heber Bambrick, engineer-in-charge for Read-Authier. About this time the claims were divided into two groups, the southern of which became the property of Lamaque Gold Mines Limited, subsidiary of Teck-Hughes.

At that time the area was still largely a wilderness; all supplies

were brought by water up the Harricana River from Amos. Living quarters and other amenities for those working at the mine were one of the first requirements and in 1935, with John Muir in charge of construction, fifty-three log cabins were built, most of which, renovated from time to time, are still in use. At the same time the Bourlamaque townsite was laid out by the company and the Bourlamaque Hotel, operated by a subsidiary company, was also built.

Lamaque has since become the largest straight gold producer in Quebec. It has been operated as two mines on the same property. The principal, or No. 1, had reached a depth of 3,600 feet at the end of 1955. Production began in April 1935, with a 500-ton mill, gradually increased to 2,000 tons. Up to the end of 1955 the mine had produced a total of over seventy-four million dollars, averaging a return of \$8.77 a ton of ore milled.

John C. Perry, who had been associated with Lamaque since 1934, became president in 1955. He succeeded H. C. McCloskey, who died shortly after taking over from Dr. David L. H. Forbes.

In the fall of 1933, Heber Bambrick visited the remainder of the original Read-Authier holdings to the north of Lamaque, where some surface work was in progress. He undertook a personal reconnaissance of the bush-covered claims and came upon some float (thrown up by the roots of a fallen tree) which led to the discovery of a quartz vein. Cross-trenching was carried out for about three hundred feet along the vein, followed by diamond drilling.

Although surface sampling had given a more favourable picture than the drilling, James G. L. McCrea, who in January 1934 examined the property as geologist and chief exploration engineer for Dome Mines Limited, reported favourably upon it and an option was taken by the company. In April of the same year Sigma Mines Limited was incorporated, ownership being divided between Dome and Read-Authier on a sixty-forty basis. Dome agreed to spend \$600,000 in development, with a loan of a further \$1,000,000.

An inclined prospect shaft was sunk to 260 feet, and from it two levels were partially developed, but results were inconclusive. A three-compartment vertical shaft was begun in 1935; it was

sunk to 1,000 feet and development was conducted from four levels. By June 1936 the results were so promising that construction of a mill was decided upon. Production began in March 1937, starting at 300 tons a day and increasing from time to time until 1955, when the daily average was 1,115 tons. Total production to the end of 1955 had reached nearly forty-five million dollars, with dividends amounting to over eight millions.

James B. Redpath, vice-president and general manager, has been connected with the mine since its inception. Others concerned with its development have been H. P. dePencier, general manager of Dome for many years, and J. H. Stovel, since retired, who succeeded him in that position in 1936; F. J. O'Connell, who came to Sigma from the Omega, is general manager.

In accordance with his policy of employing part of the earnings of Sullivan Consolidated in a search for other mines, Pierre Beauchemin acquired control of a considerable area in Bourlamaque Township, east of Val d'Or, on which a magnetometer survey located a number of anomalies. When extensive drilling brought disappointing results, Beauchemin became uneasy about the large expenditure of money and urged his geologist, George Dumont, to curtail the work. Dumont pleaded for just one more hole, and this time he clicked. But instead of a gold mine, as had been anticipated, the large orebody disclosed by further drilling was found to contain copper, zinc and silver, as well as gold.

East Sullivan Mines Limited was incorporated in 1944, financed principally by Sullivan Consolidated. A five-compartment shaft had a depth of 500 feet early in 1947 when underground development was begun. The shaft was deepened later to 1,000 feet and by 1955 had reached a depth of 3,092 feet. Production began in January 1949, with a modern mill of steel construction rated at 2,500 tons a day. Copper concentrates are shipped to the Noranda smelter and zinc concentrates are sold in the United States. In 1950, a plant for the recovery and drying of pyrite was installed. Lawrence T. Postle was manager of East Sullivan from 1946 to 1951, when he left to take charge of The Granby Consolidated Mining, Smelting and Power Company's operations in

British Columbia. East Sullivan has been a very profitable undertaking; from May 1950 to the end of 1955, dividends of more than fifteen and a half million dollars were paid.

The trend to base metals in this section was initiated by Golden Manitou Mines Limited, a Draper Dobie promotion, incorporated in 1941 to operate a zinc-gold-silver-lead-copper prospect comprising 1,850 acres in Bourlamaque Township about eight miles east of Val d'Or.

The previous owner, Quebec Manitou Mines Limited, had sunk a shaft to 385 feet, which Golden Manitou deepened eventually to 3,000 feet, with eighteen levels. In June 1949, a new gold-bearing zone was discovered north of the previous workings, and in 1951-52 a zone was located, also north of the main workings, containing 1,000,000 tons averaging 2.5 per cent copper. Production started in August 1942, with a 500-ton mill which, by 1954, had been increased to 1,100 tons. In 1955, half of the circuit, formerly devoted to zinc, was converted to copper.

In 1950, Dr. W. W. Weber, in charge of a survey party of the Quebec Department of Mines, discovered zinc mineralization in a strong regional shear structure in Barraute Township, about thirty-five miles north of Val d'Or. This set off a staking rush in the course of which Golden Manitou secured about seven hundred acres in the area. A subsidiary, Barvue Mines Limited, was incorporated to operate the property under Golden Manitou management. The first drill-hole cut ore, and within a few months an orebody had been outlined to a depth of 700 feet, along a strike length of 2,500 feet. It averaged slightly over 100 feet in width, indicating approximately fifteen million tons with 3.2 per cent zinc and 1.12 ounces of silver to the ton.

Plans for production were facilitated by the negotiation of a contract with the American Zinc Company for the sale of 175,000 tons of zinc concentrates at a price of 17.5 cents a pound of contained zinc. Since the position of the orebody lent itself to open-pit operation, it was first necessary to remove nearly a million cubic yards of clay overburden, which was done by hydraulic process. The plant, representing an investment of eight and a half million dollars, was at the time of completion one of the most modern on the continent. In November 1952—two years,

almost to the day, from the start of exploration—the first ore was fed to the concentrator, and production rose steadily until the rated capacity of five thousand tons a day was reached.

Rainville Mines Limited, which operates a copper-gold property comprising sixty-three claims southeast of Golden Manitou further exemplifies the shift to base metals in this region. Incorporated in 1942 as Rainville Copper Mines, it was reorganized in 1954 under the present name. Development is by a three-compartment shaft sunk to 730 feet. Production began early in 1956 with a 400-ton mill. Rainville, controlled by the Ventures organization, is managed by Canadian Malartic Gold Mines.

At first thought it might seem that Chibougamau, two hundred miles to the northeast, would be somewhat remote from the region to which this chapter has been chiefly devoted, but now that it is connected by a C.N.R. branch which leaves the National Transcontinental at Barraute, a short distance west of Senneterre (continuing through to St. Félicien, on Lake St. John), remoteness will no longer be a factor. Furthermore, there is reason to expect that in the near future the intervening region will produce its quota of new mines, for railways have yet to be built through good prospecting country without eliciting a response from prospectors.

Few mining regions so well known for so long as Chibougamau have been so slow in getting established. Remoteness was not the only cause, for regions even more remote have been developed, in much less time. These, however, have been chiefly gold camps, and gold, of course, can be produced without a railway if values are high enough.

Chibougamau is in the James Bay watershed, near the height of land, and until flying became general it could be reached only by roundabout water routes requiring numerous tiresome portages. Nevertheless, for many years, missionaries, explorers, trappers and an increasing host of prospectors had found their way there. High hopes were held for its future, but the day of realization was perpetually deferred; two wars and a depression played their parts in postponing it.

Chibougamau Lake, trending southwest and northeast, is twenty miles long and about six miles wide. With its bays and promontories, and its surface dotted with rocky wooded islets, it is typical of the lakes of the Canadian Shield. Doré Lake, lying parallel in its narrow basin, is considerably smaller. It is separated from Chibougamau Lake by a long, irregular granite ridge called Gouin Peninsula, and receives the overflow from the larger lake through two short outlets filled with rapids. (Chibougamau is a Montagnais Indian word, meaning "where the water is shut in.") The pair of lakes nestle like jewels against a green velvet background of forest.

Joseph Obalski, in 1904, and various other geologists since, including members of the Geological Survey of Canada—notably A. P. Low, J. B. Mawdsley and G. W. N. Norman—have reported favourably on the geology of the district. The McKenzie Fault (named after Peter McKenzie, one of the earliest Chibougamau pioneers) was apparently a primary factor in the deposition of mineral. Occurrences are associated with the contact between anorthosite intrusives and Keewatin lavas and tuffs. Gold was discovered in several places, and previous to the crash of 1929, a number of prospects were being developed, but everything was smothered by the depression.

The McKenzie Fault runs down the middle of Doré Lake. The first producer, however, was not in that area. It was on the Campbell Fault, about twenty-five miles to the southwest. Leo Springer, a prospector piloted by Lloyd Rochester in a Moth aeroplane, caught sight of a gossan stain one August day in the ill-fated year 1929. Rochester was employed by Prospectors Airways Limited; this was a group of air-minded mining men, the principal members of which were Robert Cockeram, Peter Graham, Lloyd Rochester, C. F. Tuer and Glynguard R. Burge, chief pilot. Leo Springer was associated with a syndicate composed of Joe McDonough, Larry T. Martin, S. S. Holden and D. B. Rochester (father of Lloyd), all of Ottawa. Prospectors Airways had arrangements with various syndicates to fly their prospectors to suggested locations, and was in this case to receive a forty-per-cent interest in any discovery.

Leo Springer was killed in an aeroplane crash coming out from Chibougamau in May 1936. The following account was written by him in 1934 when he participated in a symposium on prospecting at the annual meeting of the Canadian Institute of Mining and Metallurgy held in that year at Quebec City:

On August 7th, we took off from Doré Lake and in a few minutes were over Opemiska. We turned south and before us stretched a large area of barren country swept clean by repeated forest fires.

Flying at two thousand feet we clearly saw below us two distinctly different types of rock. The lighter we took for granite and the darker for the rocks of the Keewatin series. Following a low-flying reconnaissance, a few rapid sketches and notes of the general physical features of the country were made on our maps. These unexpected and interesting conditions prompted us to decide on establishing a camp to prospect the district.

We made camp four miles to the south of Opemiska Lake on August 15th. It was now that the knowledge gained by the flight was applied to useful purpose in enabling us to map out our traverses to advantage. On the fourth day of travelling, August 19th, in the early afternoon, four miles southwest of camp and at the base of a large ridge, I saw the first evidence of copper mineralization. This was in the form of malachite staining some of the broken rocks at the foot of the hill.

For twenty minutes I broke these rocks by putting them on a small ridge and cracking them with my hammer. Suddenly I noticed that the ridge itself was composed of a coarse gabbro cut by numerous small lenses of chalcopyrite. The chalcopyrite showed practically no oxidation but was tarnished to a dull greenish colour, very similar to that of the gabbro. This made it very difficult to distinguish except upon close examination.

Finding chalcopyrite in place, I immediately commenced to further explore the ridge. Climbing the hill I found numerous small lenses and on top, discovered what appeared to be two defined zones evidenced by slight depressions. At various places along these depressions, chalcopyrite was in evidence.

Ventures Limited, holding an interest in Prospectors Airways, formed Opemiska Copper Mines Limited (later changed to Opemiska Copper Mines [Quebec] Limited) and proceeded to develop the property. A shaft was sunk in 1936 from which underground work indicated approximately 283,000 tons of ore

with an average grade of over seven per cent copper to a depth of five hundred feet; but copper was at an almost all-time low, and this fact, together with the lack of transport facilities, forbade further development. The mine lay dormant until the completion in 1950 of an all-weather gravel road from St. Félicien to Chibougamau townsite (laid out by the Quebec government) four miles from Lake Doré, plus a considerable rise in the price of copper, encouraged Ventures to put the mine into production. Financing was done through T. A. Richardson and Company of Toronto who optioned Opemiska's remaining treasury shares and also handled an issue of first mortgage bonds which provided the company with a total of \$1,895,310. (The capitalization was later increased from 5,000,000 shares, \$1 par value, to 6,000,000.) J. M. Cunningham-Dunlop, president of Hoyle Mining Company and a director of Ventures, became president of Opemiska and under his management development was actively carried on.

Surface drilling disclosed a new vein (No. 3), which was outlined for two thousand feet, bringing indicated reserves to approximately a million tons, and another vein (No. 4), about four hundred feet south of No. 3, was cut by several drill-holes. Milling at the rate of 400 tons a day began early in 1954, concentrates being trucked to St. Félicien, thence by rail to Noranda. By 1955, mill capacity had been stepped up to 800 tons and plans were being considered for an early increase to 2,500 tons, with a new four-compartment shaft in prospect. Thayer Lindsley had assumed the presidency of the company, with J. P. Millenbach as vice-president and general manager. Fred G. Cooke, previously with the Ventures organization at Falconbridge and Canadian Malartic, was appointed resident manager.

Meanwhile, the attention of developers was largely directed toward Doré Lake. One of the first of these was Chibougamau Consolidated Goldfields Limited, controlled by Cominco, which began drilling on property at Cedar Bay, on the northwest shore of the lake; but the obstacles imposed by lack of transport and electric power were too great to be overcome. Another early effort was that of Obalski Mining Corporation Limited, organized by J. R. Giroux of Montreal, under which a considerable amount of diamond drilling was done. After the highway was com-

pleted, however, Campbell Chibougamau Mines Limited was organized by E. O. D. Campbell, a New York financier who was optimistic about the future of Chicougamau. The new company took over the Cedar Bay property from Chibougamau Consolidated and leased additional holdings from the Merrill Island Mining Corporation Limited on which drilling disclosed a million tons of ore grading 3.5 per cent copper and 0.15 ounces in gold. A four-compartment shaft was sunk and when underground development confirmed the drill, a 1,700-ton mill was built which began operations in May 1955, coincidentally with the introduction of hydro-electric power. Dr. Stanley E. Malouf, consulting geologist, has played a part in the mine's development, as has D. M. MacLean, mine manager.

Chibougamau Explorers Limited is a subsidiary of Anaconda Lead Mines Limited, controlled by M. J. Boylen of Toronto. It operates a gold-copper property of thirty-five claims, comprising 1,400 acres, forty miles south of Chibougamau townsite. The ground was staked by Rider Storn and Bert Oakley during the rush that followed completion of the highway. Although Storn's high-grade gold showing did not stand up, it led to the finding of the main shear by Oakley about two thousand feet distant. By the end of 1955, a three-compartment shaft had been sunk to 1,245 feet; underground development had disclosed 1,500,000 tons of ore grading 0.30 ounces in gold and 0.93 per cent copper, above the 1,200-foot level; and a 500-ton mill, designed to admit of expansion to 750 tons a day, was nearing completion as 1956 opened.

Merrill Island Mining Corporation, with Roy Robertson of Montreal as president, was incorporated in 1950, having acquired its property from Blake-Chibougamau Mining Corporation, one of the Chibougamau pioneers that had passed through all the vicissitudes of the camp. As mentioned above, part of its ground is under lease to Campbell Chibougamau, from which it receives regular returns. On the remainder, a three-compartment shaft had been sunk and at the time of writing work was in progress on underground development.

The most ambitious program in the Doré Lake area is that of Copper Rand Chibougamau Mines Limited, an amalgamation of

Copper Cliff Consolidated Mining Corporation Limited and New Royran Copper Mines Limited, holding between them 11,650 acres on which three shafts, one a five-compartment, were being sunk. Since large portions of the mineralized area are under the lake, the complete ore picture was dependent upon the results of drilling which could only be conducted in winter, but if indications at the time of writing were a fair criterion, an immense operation was in the making. This enterprise was due largely to the efforts of R. P. Mills and H. E. Corbett of Montreal, in association with J. Bradley Streit and associates of Toronto. Peter N. Pitcher, formerly of Giant Yellowknife, became general manager in 1956. Chibougamau Jaculet Mines Limited, holdings of which are on the northwest shore of Doré Lake, is also a Mills-Corbett project. Although Jaculet and Copper Rand were to be operated as separate mines, Jaculet was also to be under the general supervision of Peter N. Pitcher.

Farther to the southeast of Jaculet (but on the same side of the lake), beyond Cedar Bay, Quebec Chibougamau Goldfields Limited, headed by P. M. Malouf, and holding four hundred acres, had sunk a shaft to a depth of 1,000 feet, disclosing by diamond drilling approximately a million tons of good-grade copper ore.

Beyond the New Royran property (on the opposite side of the lake from Quebec Chibougamau), Bouzan Mines Limited, organized by J. J. Coghlan, an early Chibougamau prospector with many years' experience in the Rouyn-Cadillac area, came under Noranda control in 1956 and was being explored by diamond drilling.

Events in this chapter extend over about thirty-five years and involve territory that cuts across the map for some three hundred miles. The early emphasis was on gold, remaining so despite the success of the Horne mine, for the greater part of the time; but as the relative value of gold declined, interest shifted to base-metals, especially copper. Chibougamau could become one of Canada's major copper-producing regions. On the other hand, a shift in values could easily result in a great increase in gold production; economics, not prevalence of gold-bearing rocks, will be the governing factor.

XII

Manitoba

MANITOBA IS NOT PRIMARILY A PRAIRIE PROVINCE; IN FACT, ONLY about one-fourth of its area can be described as prairie. The rest is part of the Canadian Shield, underlain by Precambrian rocks similar to those which constitute the greater parts of Ontario and Quebec and about half of the "prairie" province of Saskatchewan. So long as furs were the mainstay of prairie economy, the rock-bound regions, because they are timbered, were under no disadvantage. But when wheat took the lead over furs, the effective area was largely confined to the limits of the prairie region. Now, with widespread evidence of mineral wealth, both the productive area and the possibilities are greatly enlarged.

The San Antonio, at (Big) Rice Lake, about 125 miles northeast of Winnipeg, was the first outstanding Manitoba mine. The original property was staked by Ephrem A. Pelletier, formerly an officer of what was then the North West Mounted Police, whose official journeys through the Canadian north had made him familiar with the rocks of the rugged hinterland. While still a member of the Force, he had tried his hand at prospecting in the vicinity of Norway House, at the north end of Lake Winnipeg. Later he staked and recorded the Ojibway claim farther to the southeast, in which he had interested a syndicate of Winnipeg men, but it remained a prospect.

In March 1911, on information from Duncan Twohearts, an Indian trapper, he visited (Big) Rice Lake, where he had previously prospected unsuccessfully. This time he had two dog-teams and was assisted by several trappers. The snow was still deep, but by using their snowshoes to clear it away, the party succeeded in finding an outcrop. They built a fire on the rocky

exposure and when the fire had burnt out they threw water on the heated rocks. This caused slabs of quartz to break off, exposing sulphides in which free gold was visible. On March 6, 1911, Pelletier staked a claim which he called the Gabrielle after, it is said, a girl in Old Quebec whom he had loved and left behind.

With an assistant named Alex Desautels, he returned in May to begin preliminary work on the Gabrielle; on May 17, 1911, Desautels staked the San Antonio claim; and the following day Pelletier staked an adjoining claim which he called the Rachel, after his "second best" girl. Definitely launched now as a mining man, Pelletier proceeded to work his claims, concentrating upon the San Antonio. The Gabrielle and Rachel were both incorporated separately. He bought a one-stamp mill, which he transported from the railway by canoe. He and Desautels operated it by hand. Crude though it was, it constituted Manitoba's first ore-dressing plant.

Pelletier was to discover, as many already had, that it is often easier to find a mine than to finance it. This was especially true in the days before World War I. The first development work of consequence on San Antonio was done in 1922, and in 1926-27 a mining plant was installed. Financing was through various syndicates until 1927, when Wanipigow Mines Limited was formed; the name was later changed to San Antonio Mines Limited. In 1931, the company was reorganized under the name of San Antonio Gold Mines Limited, shareholders receiving one new share for each three formerly held. The reorganization and subsequent development work were financed by Bobjo Mines Limited, which had been incorporated in 1928 by R. J. Jowsey to operate a gold prospect in Patricia District, Ontario. The prospect did not prove up, and Bobjo, having money in its treasury, had been on the lookout for a new venture.

Subsequently, the discovery was made that the ore had been followed off the San Antonio property, rendering the acquisition of adjoining ground imperative. This detail having been straightened out, that stalwart mine-maker, Noah Timmins, was encouraged to provide money for a 150-ton mill (later increased

to 550-575 tons), which began operations in May 1932. Production has since been continuous, and dividend payments began after the increase in the price of gold in 1934. In the same year, Forty-four Mines Limited, holding eighteen claims and fractions (including Pelletier's Rachel) adjoining San Antonio on the east, was incorporated as a subsidiary; and in 1935 the Gabrielle property was acquired by the issuance of shares. San Antonio orebodies plunge into Forty-Four's territory, and consequently its workings have been continued into the latter. Since May 1955, ore at the rate of 250 tons a day, mined in Forty-Four ground, has been treated in the San Antonio mill. Among those who have contributed to the making of the San Antonio, J. D. Perrin, its president, D. J. Kennedy, mine manager, and John D. Reid, consulting geologist, should be mentioned.

The discovery of gold on the Kiski-Wekusko claims at Herb (Wekusko) Lake in 1914 by Richard Woosey and M. J. Hackett precipitated the first gold rush in northern Manitoba, but although 28.5 tons of gold-bearing quartz was shipped to Trail in 1917 from the Moosehorn mine, returning \$91 a ton, no producing mines resulted.

Manitoba's first important producer was the Mandy mine, rich in copper. In 1915, Fred Jackson and Sidney S. Reynolds discovered an outcrop on a small peninsula on the west side of the northwestern arm of Schist Lake, about seventy miles north of The Pas. The mine that resulted became the Mandy, named after Jackson's wife. Assays were high, and when J. E. Spurr, scout for the Tonopah Mining Company of Philadelphia, learned of the discovery, he made a deal with Jackson under which the latter transferred the prospect to the company in return for fifteen per cent of the net profits.

The property, mined by open pit from 1917 to 1920, produced about 25,000 tons of high-grade copper ore which at current prices was valued at about \$2,000,000. But the cost of transportation—by barges and over bush roads, and then by boat on the Saskatchewan to The Pas and on the railway for a final haul of 1,200 miles to the Trail smelter—was fantastic, and Jackson was forced to accept the company's statement as to "net profits."

During World War II the mine was reopened and about 125,000 tons of copper ore were secured.

Encouraged by the construction of the Hudson Bay Railway, a number of prospectors had pushed out from The Pas into the country lying north and east during the years previous to the discovery of the Mandy mine. In 1908, a German immigrant named Biunne had staked the first claim in the Cranberry Lake region; and in 1911, Canadian Townsites Limited, real-estate operators at The Pas, backed a party of prospectors consisting of Hugh Vickers, George Bancroft and W. B. Wright, who staked copper claims at Wintering Lake in the country being opened by the railway.

The first real onslaught on the general area, however, began in April 1913, when Tom Creighton headed a party consisting, besides himself, of John and Dan Mosher and Léon Dion, to prospect in northern Saskatchewan, around Lac La Ronge. Later that year Creighton and John Mosher were grubstaked by a group of men in Prince Albert, Saskatchewan, to prospect in the region about Amisk (Beaver) Lake, just west of the interprovincial boundary. On the shore of this lake they staked the Prince Albert claims, the first gold discovery in the area.

Tom Creighton, who was to secure an enduring place in Canadian mining, was born at Dunedin, Ontario, in 1874. He had worked as a sailor on the Great Lakes for a number of years before the Cobalt boom attracted him to prospecting. He was not among the winners at Cobalt and soon took up the search for minerals that was to lead him through many promising regions until his big moment eventually came in northwestern Manitoba.

While Creighton and John Mosher were busy prospecting, brother Dan made a trip to Toronto and there encountered Jack Hammell, who had already attained a considerable reputation as a mining promoter. Hammell, born at Beeton, Ontario, in 1876, had left Canada for the United States while still quite young. There he worked at a variety of occupations, including professional boxing, for which his burly physique was well fitted. The Cobalt boom lured him back to Canada, and with characteristic energy he threw himself into the maelstrom of options and

deals which is the accompaniment of every boom. He did not become identified with any of the big producers, but gained a thorough grasp of mining and soon became known as one who could be counted upon to find money for a good prospect.

When Dan Mosher proposed a prospecting syndicate, Hammell agreed, and the Mosher-Hammell syndicate was formed, one half to be held by Hammell and associates, the other half to be held by Mosher and his partners. Hammell's associates were Alex. Fasken, a Toronto solicitor and financier, heavily interested in Cobalt and Porcupine mines, Frank Currie, a hotelkeeper, and Hugh Ryan, whose interest Hammell later acquired. The prospectors were Creighton, the two Moshers, Léon and Isadore Dion, and Dan Milligan.

While prospecting was their main pursuit, it was of necessity an intermittent occupation. Much of their time was devoted to trapping, which often required their dispersal over a considerable extent of territory. Thus, when Dan Mosher returned from Toronto, Creighton was camped at the outlet of Phantom Lake, some miles east of Amisk Lake. Early in January 1915, he was following his trapline when a moose cut across the trail. The need for fresh meat being always a pressing one, Creighton fell in behind the moose and was led toward a rocky promontory that jutted into the lake. An outcrop on the shore diverted his attention; he noted some chalcopyrite in the schist, which to his practised eye looked promising. It would have to wait until a more favourable season, but he was determined to give it a thorough inspection later on. The following summer he returned with John Mosher, and they were soon convinced that they had something big. Staking two claims (August 15), they hurried off to get the rest of the party, and fourteen additional claims were soon staked.

By chance, some little while later, Jack Hammell happened to be in the neighbourhood. With his wife, he had come to look at a prospect on Wolverine Lake and had taken a few days off to fish at the upper end of Amisk Lake. When one of the prospectors arrived at his camp with news of the discovery, Hammell lost no time in reaching the spot, which was later found to be on

the boundary between Manitoba and Saskatchewan. His own view confirmed the opinions of his partners.

"How much money would interest each of you for the rest of your lives?" he asked as he was leaving.

"Jack, get us a hundred thousand dollars apiece and Rockefeller can have the rest," John Mosher replied.

"I'll get it for you!" Hammell promised. He was to keep his word, but little did they then suspect how long they would have to wait.

Quite often a mine gets its name from the prospector who finds it, but in this case another name seemed so natural that it was unanimously adopted. Months before the strike, members of the party had found the remnants of a paper-back novel on one of the Churchill River portages, and it had helped to pass the time in camp. A fanciful tale of a subterranean cavern in which gold was so plentiful as to be almost useless, the book was called *The Sunless City*, and the principal character, who ruled the gilded cave, was named Josiah Flintabbatey Flonatin. Such a tale stimulated the imaginations of prospectors seaching eagerly for gold, and old "Flin Flon" was a constant topic of conversation. As they panned some ore in the bottom of a depression in the rock one day, Creighton suggested that the mine be called Flin Flon, and the others joyfully agreed.

Hammell returned to Toronto, but he realized that big money was required, which could only be secured in New York. Hayden, Stone and Company, veterans of many a mining camp, were interested; few who ever let Jack Hammell get a foot inside their door failed to be at least interested. They offered to send an engineer to investigate, and such an offer would have satisfied most promoters—but not Hammell.

There would be no time for that, he declared. The spring break-up would occur all too soon and equipment and supplies must be sent in immediately. He offered the New Yorkers a three-quarter interest for three million dollars in return for an agreement to spend fifty thousand dollars at once on diamond drilling.

Carried away by Hammell's enthusiasm, Charles Stone accepted the offer, and the option papers were soon signed.

When Stone telegraphed his associate, Daniel Jackling, the famous copper-mining operator of San Francisco, offering him a share in the venture, Jackling is reported to have replied at length, upbraiding Stone for having proceeded without securing an engineer's opinion; but, having faith in Stone's usual good judgment, he concluded his telegram, "I'll bite and you can cut me in for a one-tenth interest."

Meanwhile Hammell was heading for The Pas as fast as the train could carry him. Better than Stone and better than Jackling, he knew the importance of beating the break-up. While frost holds the northland in its grip, any part of it is relatively as accessible as any part of the ocean is to ships. It was a great day for The Pas when he arrived. Every available man and horse in the community was immediately hired and harnessed to the task of transporting two diamond drills and appurtenances and several tons of miscellaneous supplies to Flin Flon, where others were busy erecting a camp.

Jackling sent two engineers, Raymond Brooks and Olin Peterson, to take charge of the drilling; and after Brooks had made a preliminary examination, he telegraphed Jackling, "Hammell underestimates property."

Nevertheless Hayden, Stone and Company were far from satisfied. While the cores disclosed copper, zinc, gold, and silver (other metals were subsequently found), and the total values were high, the metallurgical problem involved in separating the various metals from each other had not yet been solved. Out at Trail, a similar problem was holding up development of Cominco's great Sullivan mine; and all over the world, wherever there were metallurgists, the best of them were working on the problem. Then there was the war. Canada was at war and the United States was not, as yet; and this lent an element of uncertainty to transactions between the two countries. Consequently, after having done some 7,500 feet of drilling, and having spent fifty thousand dollars, Hayden, Stone dropped their option.

Hammell then attempted to find someone nearer home and succeeded in interesting Alex Fasken's brother David, who with E.

P. Earle organized a syndicate which, for \$50,000, bought the seventeen-per-cent share held by Isadore Dion and Dan Milligan and took an option on the remaining partners' interests. In return for a further eighteen-per-cent interest, the syndicate agreed to do a certain amount of drilling. Under the direction of E. V. Neelands, this continued from March 1917 to July 1918. Forty-four holes were put down for a total of 25,664 feet; but, once more, complexity of the mineralization was the decisive factor, and the Fasken group, having earned its eighteen per cent, dropped the option.

Hammell was undismayed. With drill cores and valuable geological information now in his possession, he was more firmly convinced than ever that Flin Flon would some day make not only a mine, but a big one. In his estimation, the only thing that could definitely damn a mine was to have no ore, or not quite enough. Flin Flon was not in that class, and he felt sure that one day soon the metallurgists would come up with a process for the treatment of its ores. Time was to justify him, but many years would pass before that happened.

Today there are in Canada a dozen mining companies each of which is capable financially and technically of handling a deal like Flin Flon, but at that time there was only one, and financially it was not very strong. That company was The Mining Corporation of Canada, Limited, organized in 1914 to control and operate a number of silver properties in the Cobalt district. Its president, J. P. Watson, and its chief engineer, Scott Turner, were both men of capacity and enterprise. Turner, an engineer of wide experience, examined Hammell's records and reports and became convinced that Flin Flon had the makings of a great mine. He strongly recommended it to his company, especially if Hammell could get William Boyce Thompson of New York to take the majority interest. Thompson, accustomed to big deals and willing to take a chance if a proposition appealed to his imagination, had already both made and lost money in Canadian mines—in Cobalt, Porcupine, and elsewhere. He liked Hammell's spirit, and in twenty minutes the deal was made; Thompson had agreed to option a three-quarter interest.

Again, Hammell undertook the job of transportation. Scott Turner, in charge of operations, planned to sink two shafts, five hundred feet apart, to a depth of three hundred feet, and to explore the intervening area by drifting. In arranging for mining equipment, Hammell thought of the idle plant of Creighton's previous grubstakers, at Amisk Lake. The directors of the Prince Albert Company, seeing a chance to salvage some of their loss, asked Hammell a price much higher than he was prepared to pay. Knowing that he was in a hurry for the plant (as he usually was about everything) they felt they could take their time and that eventually he must meet their terms. But, for a change, Hammell seemed quite unconcerned, and, fearing that they might lose the sale, they capitulated, on condition that he buy the plant as it stood and assume full responsibility for its transfer to Flin Flon.

"Hell, boys, that plant has been set up at Flin Flon for the past month!" replied Hammell in great glee.

Underground exploration amply fulfilled Turner's expectations. It disclosed massive as well as disseminated sulphides aggregating, according to his calculations, a maximum of 15,900,000 tons (this closely approximated Neelands's estimate) and averaging 1.8 per cent copper, 3.8 per cent zinc, 1.2 ounces of silver and \$1.60 in gold to the ton. The cost had been \$400,000, which was cheap, considering the value of the ore in sight; but ore is one thing, and recoverable metal, another. The metallurgical problem still remained to be solved. Thompson, caught in the post-war slump, and needing cash for other commitments, threw up his option, and for the time being stepped out of Flin Flon.

The Mining Corporation, however, encouraged by its chief engineer, was far from withdrawing; in May 1921, the corporation bought out Hammell and his prospector partners for some \$600,000 of which about \$400,000 went, as promised, to the four prospectors who had held on to the end. The minority interest remained in the hands of the Fasken brothers. Manitoba Metals Mining Company Limited was incorporated to hold and operate the property.

Scott Turner, without spending a great deal of money, now set about extending and consolidating the property. He carefully surveyed and examined the adjoining territory and quietly added to the company's holdings, staking claims as their holders allowed them to lapse. Diamond drilling was done to extend and round out the area of orebodies already established.

The final location for the railway line from The Pas, just short of eighty-eight miles, was surveyed; plans and profiles were prepared. The railway project provided Hammell with another outlet for his energies. Although he was free now from responsibility for Flin Flon, its fortunes were still a matter of concern to him. He threw himself into a campaign to promote interest on the part of the people of Manitoba, to most of whom Flin Flon was little more than a name, and The North Line Association was organized. Members of the Manitoba Legislature were invited to visit the mine; Hammell even took part in a local political contest.

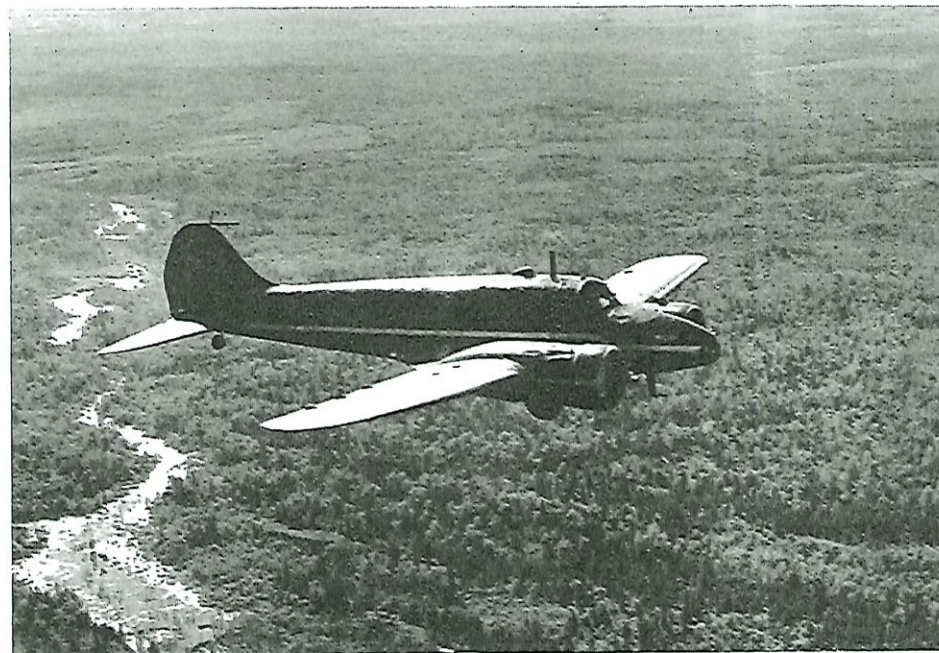
Meanwhile the search was continued for capitalists with the money and mining experience necessary to undertake the development of Flin Flon; and eventually, in 1925, the Harry Payne Whitney group of New York took a two-year option on the Mining Corporation's interest, sending Robert E. Phelan, one of their top engineers, to report on the property. The Whitneys were the first to whom the metallurgical problem was not a bogey. They had a subsidiary, the Complex Ore Recoveries Company, whose job it was to tackle metallurgical obstacles; and, in March 1926, a 25-ton test flotation mill and a 10-ton cyanide plant were in operation at the property. Before the year was out the scientists had so far succeeded that the Whitneys felt safe in exercising their option. Hudson Bay Mining and Smelting Co., Limited, was incorporated for over-all control, with Flin Flon Mines Limited as the operating company, headed by Phelan. The Mining Corporation turned over to Hudson Bay fifty-three per cent of its interest for cash, accepting shares for the balance. The Fasken interest was sold for cash to the Newmont Mining Corporation of New York, which was controlled by W. Boyce Thompson and so brought that astute financier back into the

Flin Flon picture. Hudson Bay Mining and Smelting raised \$17,500,000 by the sale of shares and another \$5,000,000 through a bond issue, thus providing funds for the varied undertakings ahead of it.

On April 23, 1926, the Manitoba Legislature had passed an Act incorporating the Manitoba Northern Railway to construct and operate a line from Flin Flon Junction, 4.24 miles northeast of The Pas. Subsequently an arrangement had been made with the Canadian National Railways for the building and operation of the line, the Manitoba government agreeing to contribute \$100,000 a year for the first five years toward operating deficits, and Flin Flon Mines Limited putting in \$250,000. Cost of construction was estimated at \$3,500,00. Work was begun in March 1928, and the line was finished on September 27 of the same year.

The next big project was the building of a plant at Island Falls, on the Churchill River, to supply electric power for the mine, townsite, and other mines and communities. As subsequently enlarged, it comprises six units with a total capacity of 110,000 horse-power. This plant is operated by a wholly-owned subsidiary, the Churchill River Power Company Limited, which distributes through two other subsidiaries.

Although Flin Flon had taken an unconscionable length of time getting started, it had nevertheless been lucky in the men entrusted with its development. Without the dogged determination, the enthusiasm and the energy of Jack Hammell, even such an important deposit, eighty-odd miles from the nearest railway point—and that a frontier settlement—might have remained an undeveloped prospect for many more years. It was a stroke of good fortune that, complementing and continuing Hammell's work, Scott Turner should next have had direction of the enterprise; and the Harry Payne Whitney interests, which eventually came into possession, were among the very few in the world competent to handle such an undertaking. The roster was complete when R. H. Channing (president of H.B.M. & S.) and R. E. Phelan assumed direction of the final stages of development. In recent years W. A. Green has been general manager.



Airborne electromagnetic survey

George Hunter Photo
Courtesy
International Nickel



Sherritt Gordon mine and townsite

George Hunter Photo



Capital Press Service
Eldon L. Brown



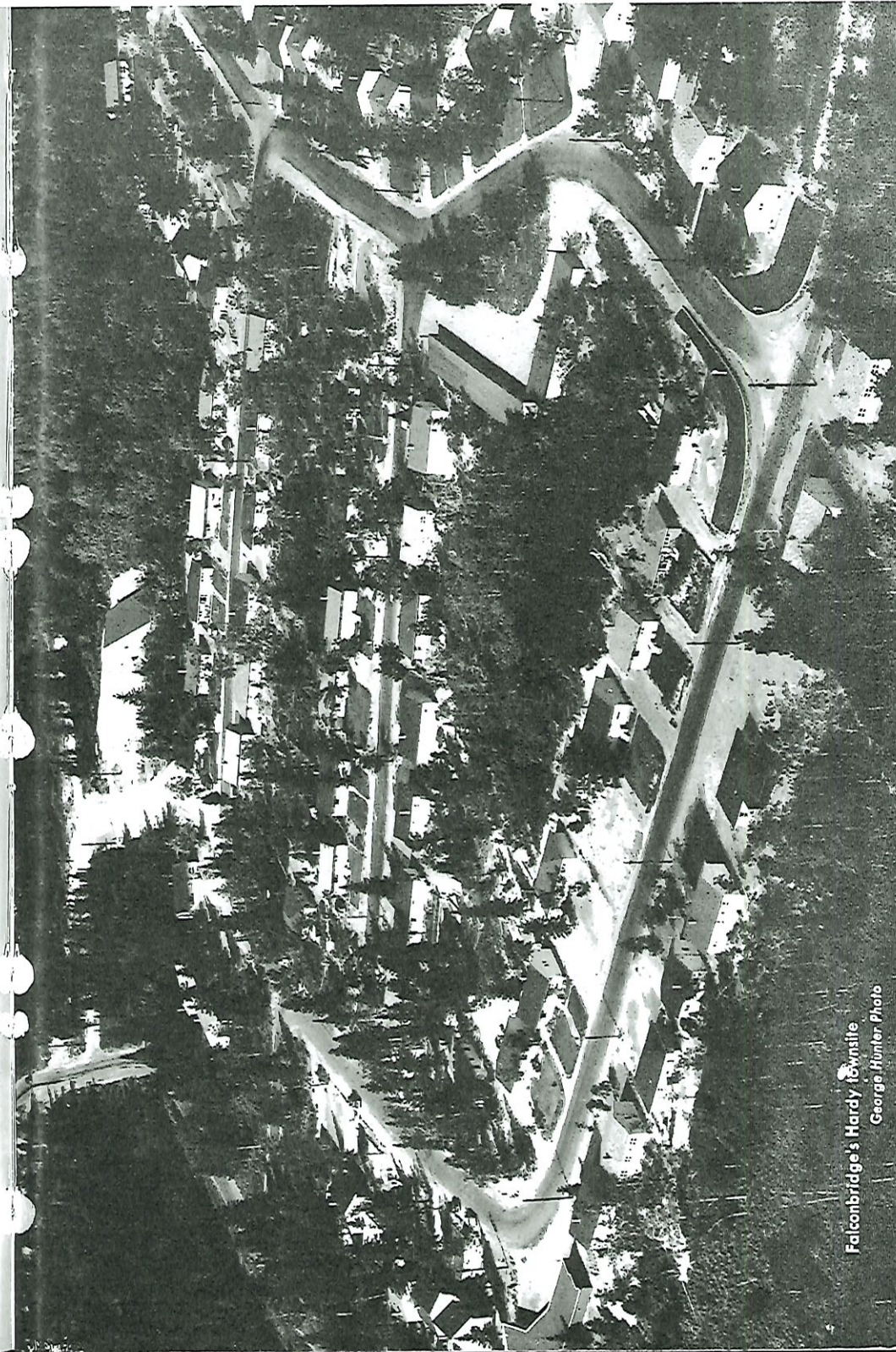
Ashley & Crippen Photo
John E. Hammell



Gordon W. Powley Photo
Austin McVeigh



John D. Perrin



Falconbridge's Hardy Township
George Hunter Photo



Rappoport Studios

Thayer Lindsley



Who's Who in Canada

J. M. Cunningham-Dunlop



Gilbert A. Milne Photo

J. Gordon Hardy



Gilbert A. Milne Photo

Horace J. Fraser

Phelan's job was to devise a mining procedure that would produce ore at the least cost, the fundamental problem of all mining, but accentuated here by a number of variables. By damming and pumping out a lake, he was able to begin operations with a daily production of 2,000 tons from an open pit and 1,000 tons from underground workings. The mine is now operated from three shafts. The main five-compartment shaft is 2,219 feet deep (in Manitoba); the south main shaft (in Saskatchewan) extends full-size to 4,073 feet, reaching by means of a winze the greatest depth at 5,059 feet; while No. 3 shaft is down 3,250 feet. The three are connected at various levels.

Once a process had been devised for the economical extraction of the different metals, it might seem that the building of the necessary plant was more or less a routine procedure, but the results of pilot-plant experimentation are not always easily translatable into large-scale operations, especially when the work is done far from the convenience of laboratory facilities. Phelan and his staff had their share of "bugs" to contend with, but eventually everything fell into place and the great metallurgical plant came to occupy a seemingly natural place among the rock, water and timber of the Canadian Shield.

Construction of the concentrator, copper smelter and zinc plant began in 1928, and production started in the latter part of 1930. Initial capacity was 3,000 tons a day, which during World War II was stepped up to 6,000 tons, and over, but since then the average has been somewhat less than 5,000 tons. In the twenties, the flotation process was relatively new, but in the interval, with variations to suit different kinds of ore, it has become standard procedure.* Products consist of copper, zinc, gold, silver, cadmium, selenium and tellurium.

When the price of zinc was low, and before full recovery was possible at Flin Flon, zinc residues were stockpiled. In 1951, the company put into operation a new \$7,000,000 zinc-fuming plant to handle 150 tons a day from current production and 150 tons from stockpile residue.

*For a description of the flotation process, see pp. 56-57.

During 1955, Flin Flon produced 93,304,255 pounds of copper, 134,711,316 pounds of zinc, 107,642 ounces of gold, 1,656,651 ounces of silver, 191,691 pounds of cadmium, and 130,582 pounds of selenium. At the end of the year the company's ore reserves stood at 16,516,665 tons averaging 3.15 per cent copper, 3.6 zinc, 0.068 ounces of gold, and 0.97 ounces of silver. Zinc plant residue amounted to 757,635 tons, averaging 26.6 per cent zinc, 1.04 per cent copper, 3.83 ounces of silver, and 0.143 ounces of gold, while impounded tailings reserved for future treatment stood at 31,366,000 tons, averaging 30 per cent iron and 29 per cent sulphur, with low values in copper, gold and silver.

While the history of the Sherritt Gordon mine at Sherridon is somewhat similar to that of its neighbour at Flin Flon, in so far as initial delay is concerned, the history of its successor at Lynn Lake provides an example of Canadian mining at its best.

When prospectors became active in 1913-14 about Amisk Lake, Saskatchewan, Indian trappers were tempted to try their hand at prospecting. Among these were David Collins (Colen) and Phillip Sherlett. Some time about 1919, Sherlett staked and recorded a copper-stained outcrop, farther east, in the Kississing Lake area of northwestern Manitoba. He was a good prospector and did a considerable amount of trenching, but eventually his claims were allowed to lapse. In 1922 they were re-staked by Carl Sherritt, who already had adjoining claims. Sherritt took in Dick Madole as a partner, but with a minor interest.

Sherritt appointed W. J. Young of The Pas as his agent; and, in 1925, Young found a purchaser in J. P. Gordon, a civil engineer formerly employed on the construction of the Hudson Bay Railway. Gordon represented a syndicate which included his brothers, Senator George of North Bay, and Alex of Toronto. The Gordons took an option, making a substantial cash payment, and then optioned the property to E. P. Earle and Alex Fasken. In January 1926, a diamond drill outfit consisting of two drills was transported from The Pas; and by the middle of May, when all work was suspended, five thousand feet of drilling had been completed.

The next payment on the option was due in August, but Earle and Fasken gave no intimation of their intentions. During the summer, a number of scouts for various mining companies looked over the property; among them were R. J. Jowsey and Eldon L. Brown, the latter representing the Victoria Syndicate, a subsidiary of the Mond Nickel Company and the Central Mining & Finance Corporation of London. Late in July, Brown learned that Earle and Fasken did not intend to make the August payment, and so informed the Mond company through its Canadian office at Coniston, Ontario. Dr. C. V. Corless, general manager for Mond, immediately took action to secure an option, effective at the termination of the existing one.

Brown, with a small crew, took over in September, preparing for a diamond-drilling campaign to be carried out during the winter. The 5,000 feet of drill core on hand were re-logged and sampled; surface trenches were re-sampled; and the property was consolidated by new staking. But, in spite of the desire of local Mond officials to go ahead with further drilling, the Central Mining group in England demurred, and it was decided that the option would be allowed to lapse.

At this point, informed of the situation by Dr. Corless, John L. Agnew, manager of The International Nickel Company of Canada, Limited, took over the option by arrangement with the Gordons. His intention was to continue the drilling program planned by the Victoria Syndicate, and, through Dr. Corless, he arranged with Eldon Brown to take charge of the work.

International Nickel did not go on with the deal, however, and Brown was informed by Agnew that he had changed his mind about the Sherritt property and proposed to let his option lapse. Brown then got in touch with Jowsey, supplying him with all the necessary information and stipulating that, if Jowsey should succeed in making a deal, he (Brown) should have the job of managing the property. Jowsey had previously discussed the matter with Thayer Lindsley, and within a short while an agreement between the Gordons and Lindsley had been arranged.

Sherritt Gordon Mines Limited, named after Carl Sherritt and the Gordons, was incorporated in 1927 with an authorized cap-

ital of six million shares, of \$1 par value. Lindsley's brother and partner, Halstead, was president. Eldon Brown became managing director and Jowsey a director, positions which both have held ever since. (Brown became president in 1945, when the Lindsley interest ceased.)

Neither of the stakers benefited much from what might have seemed to be their good fortune. To Madole, money was but something to spend and the greater part of his \$80,000 share of the \$250,000 purchase price slipped through his fingers in less than a year. Sheritt was of different calibre, but his end was tragic. He bought himself an aeroplane and qualified as a pilot, but was killed at The Pas in 1928 when he fell out of the plane during a demonstration flight. Phillip Sherlett was awarded a pension by the Sheritt Gordon company, and after his death it was paid to his wife until she died.

The Sheritt Gordon company, under Brown's able direction, proceeded with the drilling, beginning in the fall of 1927 and continuing through 1928 and 1929. Two shafts were sunk. Underground exploration, supplemented by drilling, established the existence of two orebodies with an aggregate of five million tons of ore containing principally copper, but also zinc, gold and silver. A forty-two mile railway was built into the property from Sheritt Junction, on the Flin Flon line, by the C.N.R. But by the time the mine was ready for production the depression had begun, drastically cutting the price of copper and greatly hampering efforts at financing. Although plans had been made for a 1,800-ton mill, production began only in a small way in April 1931, increasing to 1,000 tons within the year, and continuing at that rate until June 1932, when low copper prices caused the mine to shut down. It was not till August 1937, with war talk in the air, that the price advanced sufficiently to justify resumption of operations. In September 1951, the orebodies became exhausted and mining was permanently suspended.

During its life the mine had produced from 8,531,352 tons of ore, 366,244,801 pounds of copper, 148,961 tons of fifty-per-cent zinc concentrates, 101,026 ounces of gold and 3,218,324 ounces of silver, total production being valued at \$58,732,366. Prev-

ious to 1942, zinc was not saved. From the first, copper concentrates, and from 1942, both copper and zinc concentrates, were shipped to the smelter at Flin Flon for treatment.

Deep diamond-drilling had established that the orebodies would not go to depth and, like other prudent operators, Eldon Brown was vigilant in the search for a property that might continue the life of the company after the Sheridon ore was done. In the years 1928-32, a number of the larger mining and exploration companies had done a considerable amount of prospecting in the belt of greenstones and sediments lying north of Granville Lake, which is part of the Churchill River system. No discoveries of value had been found and consequently the area had fallen into disfavour, from the standpoint of both prospectors and sponsoring companies. Despite this, the Sheritt Gordon company, from 1937 onward, had maintained up to four different prospecting parties in that region. It is a difficult country to prospect; those parts of the terrain not covered by swamp, muskeg, or water are blanketed by thick bush. Outcrops are rare, and the drill must be resorted to for any conclusive picture of the geological structure. By 1940, the company had completed twenty thousand feet of drilling, with nothing but negative results to show for it.

Then, in September 1941, Austin McVeigh, who had been prospecting there for Sheritt Gordon since 1937, noticed mineral stains on a knob of rock, about two hundred feet in diameter, protruding about twenty feet above the surrounding muskeg. It was about half a mile north of a small lake that had been named Lynn, after Lynn Smith, one of the company's engineers. Clearing away some of the moss and soil, McVeigh uncovered a patch of massive sulphides about four feet long and about two feet at its greatest width. Cutting samples, he sent them to Sheridon for assay. They ran better than 1.5 per cent nickel and slightly less than one per cent copper, which brought Eldon Brown himself to Lynn Lake by plane.

The find was decidedly encouraging, but much work was required before it could be determined whether a mine was in the making or not. With the national economy geared to war, the

times were not propitious for the development of a prospect at such a remote spot. On the other hand, the showing was promising enough to start a staking rush should a whisper get out, and this was the last thing Eldon Brown desired. Time was needed to explore the area thoroughly. Consequently, no staking was done; all in the know were pledged to secrecy—and the secret was kept!

In the meantime, McVeigh traversed the area with magnetometer surveys. By the end of 1943 he had established four magnetic anomalies, three weak and irregular near Lynn Lake and one quite strong and evidently of major proportions near Ralph Lake, three and a half miles to the west. Nothing further was done till 1945, when a tract approximately six miles square, mostly swampy and drift-covered, was staked. Now that secrecy could no longer be maintained, a diamond drill outfit was flown in from Sherridon to prospect the big anomaly at Ralph Lake. Three holes were drilled, but the anomaly was found to be due to lenses of magnetite in quartzite.

This was disappointing, but it was not believed that the patch of sulphides found by McVeigh was entirely unrelated to the general geology and the drill was set up near Lynn Lake to test the weaker anomalies, the most promising of which was in a swamp to the north of the knoll on which the original find had been made. The first hole, drilled to a depth of 450 feet, cut sparsely disseminated sulphides, chiefly pyrrhotite with some chalcopryite, but not of ore grade. The next hole (afterwards found to have been drilled along a fault), caved badly and was abandoned; but the third hole, drilled vertically, located what was later called the "Upper A" orebody.

By the time this drilling was completed, the freeze-up had interrupted flying until the lakes were frozen solidly enough for planes to land. The time thus gained was utilized to secure further ground, in accordance with the latest drilling results, and Austin McVeigh's crews staked a total of 344 claims in a block approximately ten miles long and from two to three miles in width. With the resumption of flying, a number of staking parties arrived to tie on to McVeigh's staking; but, as events proved, Sherritt Gordon had secured the principal nickel deposits in the area. The

high-grade "EL" orebody, discovered in January 1947, put Sherritt Gordon definitely in the big mine category.

With prospects good for an adequate supply of ore, metallurgy became the principal problem of management. Techniques for the treatment of pyrrhotite ores had long since been worked out by Sudbury nickel mines, and little change in the methods of ore-dressing in use there was suggested. But, chiefly influenced by uranium metallurgy, refining processes had been evolved which promised lower costs than were the rule with electrolytic refining. In 1947, a 25-ton flotation pilot plant was set up at Sherridon, to which was hauled ore from an open pit on the "Upper A" orebody at Lynn Lake to supply concentrates for experimentation in refining processes.

In the same year, Professor Frank A. Forward of the University of British Columbia was retained by the company to direct the experimental program, and in the following year he discovered an ammonia leaching process which seemed to be the solution to the problem. A pilot plant, designed by the Chemical Construction Corporation to Professor Forward's specifications, was set up at Ottawa in 1949. Revised and rebuilt a number of times during the succeeding three years, it eventually became the model for the refinery which was built at Fort Saskatchewan, Alberta, to take advantage of low-cost natural gas fuel.

Since Sherritt Gordon was developing a nickel mine in a remote part of the country, and proposed to refine nickel by a previously untried process, it might have been expected that the large amount of money required would not be easy to raise. As a preliminary, the firm of Ford, Bacon and Davis Inc., of New York, was retained to provide an independent engineer's report, with the Battelle Memorial Institute of Columbus, Ohio, in an associate capacity, reporting specifically on the leaching process. The capitalization was increased in 1951 to twelve million shares; and in order to provide a basis for financing, sales contracts covering the entire nickel output and sixty per cent of cobalt and copper for the first five years of production were made with the U.S. Government and four of the larger nickel consumers among American steel producers.

Meanwhile, the mining plant, concentrator and principal buildings in the town of Sherridon had been transported overland on

sleds drawn by caterpillar tractors under the direction of The Patricia Transportation Company Limited, which already had a long record of successful tractor-train (and barge) operation. Its efficiency is illustrated by the fact that among the houses moved to Lynn Lake were some finished in stucco, which arrived without a crack and with chimneys standing, a remarkable feat when the ruggedness of the terrain is considered.

The company having demonstrated ore reserves sufficient to ensure a minimum life of twenty years for the mine, an agreement was entered into with the Canadian National Railways to build and operate a railway from Sherridon to Lynn Lake. The task of throwing a railway across 145 miles of Precambrian country, consisting chiefly of rock, water and muskeg, with the necessary trestles, culverts and bridges (including substructures for three major crossings of the Churchill River) was undertaken by C. A. Pitts General Contractor Limited, and associated contractors. Beginning late in 1951, they had finished the job before the end of 1953. The work of track-laying, ballasting, and so forth, was carried out by the C.N.R., and the line was in operation early in 1954.

To supply hydro-electric power, a plant with a capacity of 7,000 horse-power was built (also by the Pitts firm) on the Laurie River, about fifty miles south of Lynn Lake. In 1955, plans were made for a duplicate plant on the same river.

With twenty years' supply of ore assured, with electric power and a railway in prospect, and with a process already demonstrated as capable of treating the ore at a minimum cost (providing valuable by-products in addition), the problem of financing, while complicated, was not overly difficult once the interest of Newmont Mining Corporation was enlisted. That firm, the J. P. Morgan company and other United States banks, and a number of insurance companies provided the money.

At the end of 1955, after the first year's operation of the integrated enterprise (although operation was not at full capacity all year) a total of 761,584 tons of ore had been milled at Lynn Lake, and nickel to the amount of 16,666,574 pounds had been produced at Fort Saskatchewan, with prospects thereafter of an annual production of 20,000,000 pounds. During the year, Syd-

ney Nashner, under whom the Fort Saskatchewan refinery was built, had died; Heath H. Hales, manager of the mining and milling division, had retired owing to ill health and had been succeeded by Alan E. Gallie who had borne much of the brunt of the transfer from Sherridon and the opening up of the new mine. Eldon L. Brown, president and managing director, whose monument it is, was still the active ahead of the enterprise.

Ever since the Geological Survey of Canada was instituted under Sir William Logan in 1842, it has taken an active part in exploration of the country's mineral resources. Its influence could have been much greater, especially in earlier times, if prospectors and many practical miners had not been so contemptuous of "book learning" as applied to rocks. Happily, that situation no longer exists, and many mines and mining areas have been found by prospectors acting upon information gained from reports put out by the Geological Survey or by provincial departments of mines.

A case in point is the God's Lake mine in northeastern Manitoba, staked by R. J. Jowsey in 1932. In April of that year, Dr. J. F. Wright of the Survey delivered an address to the annual meeting of the Canadian Institute of Mining and Metallurgy on the geology of northeastern Manitoba. He mentioned Elk's Island in God's Lake as favourable prospecting ground. To one among his listeners his words had meaning, and Jowsey lost no time in organizing an expedition to God's Lake. Chartering a plane in Winnipeg, accompanied by "One-eyed" MacDonald, he landed on nearby Knife Lake on July 9. Four days later, while paddling out to Elk's Island, he chipped some samples from a vein on a small island since known as Jowsey, which, when panned, produced the "tail" of gold which is one of the most exciting sights that can meet the eye of a prospector. MacDonald had been getting supper while Jowsey panned, but supper was forgotten as, during the long summer evening, they staked six claims. They were wise in not delaying the staking, for Jowsey had not been able to keep his flight into the north a secret and within a few days other prospectors dropped from the skies. One

of these, Robert Brown of The Pas, staked the Akers claim which, with Jowsey's claims, became the nucleus of God's Lake Gold Mines Limited, which Jowsey organized. Financed by Bobjo and Coniagas, with an initial capital of three million shares (later increased to five million) of no par value, operations were begun in September 1935 with a 200-ton mill. When the mine closed down in September 1943, because of lack of ore, it had produced a total of nearly six million dollars in gold. God's Lake Gold Mines Limited, which had continued as an exploration and development company with extensive holdings in many mining concerns, both active and inactive, in various parts of Canada, was absorbed in March 1956 by the R. J. Jowsey Mining Company Limited.

If modern methods of mine-finding tend to prevent some of the uncertainty, they may also eliminate some of the more romantic means of locating mines. A good example of the latter is the discovery of the Nor-Acme mine in northern Manitoba. Some time in the nineties during his boyhood on a farm, Chris R. Parres had been attracted by a map of Canada on which natural resources were indicated. These, he was interested to note, included white fox, white bear, white whale, and whitefish; and seeing the words "much white quartz" in red letters along the east shore of Wekusko (Herb) Lake, in Manitoba, he had assumed that the quartz was another white animal until told by his teacher that it is the rock in which gold is found. Instead of going to find the gold-bearing rock when he grew up, Parres enlisted as a soldier in World War I. On leave in London, he met an Australian prospector from whom he received his first lessons in prospecting. These lessons he put to good use after the war when he found himself in the vicinity of Herb Lake and looked around for the "much white quartz" referred to on that well-remembered map. A few miles west of Herb Lake, on the shore of Snow Lake, he came across some of the same sort of rock, and in October 1924 he staked what became the Nor-Acme gold mine.

More often than not, romantic tales have also their share of disappointment, and Parres's story is no exception. A prospector

may find much white quartz, but he must then prove that he has a possible mine, and sometimes that requires much money. Consequently it was not till September 1940 that the Howe Sound Company (which owns the Britannia mine near Vancouver) sent its geologist, Frank Ebbutt, to examine the property. Diamond drilling indicated mine-making possibilities, but World War II caused further delays, and it was 1945 before construction was begun on a mining plant and concentrator with a capacity of two thousand tons a day. The first need was power, and a fifty-mile transmission line was built westward to Sherridon, where power was secured from the Churchill River Power Company (subsidiary of Hudson Bay Mining and Smelting) which was already supplying Sherritt Gordon. The Manitoba government laid out a model town and built the thirty-seven miles of road from Wekusko station on the Hudson Bay Railway, eighty-one miles from The Pas. Production was begun in March 1949 by the Howe Sound Exploration Company Limited, operating the property on a royalty basis. At long last, Chris Parres, in retirement at Kelowna, B.C., is receiving returns from the "much white quartz" of which he dreamed as a boy.*

In the years following World War I, many gold prospects were staked in the Herb Lake area; but with the exception of the Laguna, which in its short life produced \$1,733,668, and, in later years, the Nor-Acme, none was successful. Since World War II the emphasis has been on base metals; a number of the larger companies have been active with magnetometer surveys. At the time of writing, Hudson Bay Mining and Smelting had located several interesting showings in the general area. Farther to the east, at Mystery and Moak lakes, north of the Hudson Bay Railway, diamond drilling by International Nickel had located large nickel deposits;† and, on Fox River, about fifty miles east of Ilford station, the same company had discovered another promising region. The prospects for northeastern Manitoba seemed extremely promising.

*See George E. Cole's *Mining in Manitoba*, 1950.

†Subsequently, Inco announced plans for the development of two mines, to be known as the Thompson and Moak Mines, and a town to be named Thompson in honour of Dr. John F. Thompson, chairman of the Inco board.

XIII

Haileybury Heritage

DURING THE GREATER PART OF THE TIME SINCE CONFEDERATION, Canadians have considered their country to be a land of separate sections divided by barriers that could never be bridged. The most unbridgeable of these barriers was, of course, the great expanse of Precambrian rocks filling the gap between Old Ontario and the Prairies. Bitter controversy raged about this one when the route of the Canadian Pacific Railway was being considered; James J. Hill, an original syndicate member, withdrew when the decision was reached to follow the north shore of Lake Superior, traversing a region widely believed to be incapable of ever providing traffic enough "to pay for axle grease." Half a century later, after two additional railway lines had been pushed across the gap, a proposal was made—for the ostensible reason that the region was forever incapable of producing revenue traffic—to tear up one set of tracks. And even as late as 1955, when it was proposed to build a gas pipeline from the Prairies to Ontario, it was considered essential that the Government of Canada and the Government of Ontario should jointly provide the money for this section. The fallacy of such thinking was soon shown by the volume of gas contracts obtained from its towns, cities and industries—a volume which should not have surprised anyone who was aware of the fuel needs of that part of the country. Fifty years ago there was perhaps some excuse for failure to appreciate the economic importance of the Canadian Shield; that there can be no excuse now is due in great measure to the efforts of men from Haileybury.*

As it was said of Paul Bunyan's blue ox, that wherever he placed his hoof a lake can now be found, so it can be said of the men

*And of course from neighbouring towns such as Cobalt.

of Haileybury that wherever they stepped a mine can now be found. In the first place, men of Haileybury and its sister community New Liskeard, men such as the persistent C. C. Farr, were largely responsible for the building of the Temiskaming and Northern Ontario Railway, without which there would have been no Cobalt, no Porcupine or Noranda. Doubtless, the railway would some day have been built and mines would sooner or later have been discovered; but the course of history would not have been quite the same.

Haileybury initiative helped to get the railway started, and after that, events were in the saddle. But Haileyburians were not content merely with having given events their initial push; they kept on pushing. Thus their tracks can be traced through Porcupine to Kirkland Lake, Larder Lake, Noranda, and beyond. In addition, their influence persists through education. Since 1912, students wishing to get instruction in mining subjects have been accommodated at Haileybury. Part-time classes were held, at first, in the Haileybury High School. By 1931 these classes had been expanded into the Haileybury Mining School—still under the jurisdiction of the High School Board—where training was provided in general chemistry and base-metal analysis, mineralogy, geology, physics, drafting, surveying, milling, ore crushing and sampling, and gold and silver assaying. In 1945, the plant and equipment of the Mining School were taken over by the Ontario government, becoming the Provincial Institute of Mining. A surprising number of the men now holding important mining positions in all parts of the country—and, indeed, in many other countries—began their careers within the walls of the old Haileybury Mining School.

Lorne and Ray Howey, from Haileybury, with their partners, started the Red Lake camp, but they were not the first to find its gold. Dr. D. B. Dowling, of the Geological Survey of Canada, in a report published in 1894, mentioned the occurrence of "Huronian" rocks at Red Lake, and it is possible that this report induced members of an English company headed by the Earl of Portarlington to come to Canada in 1897. The party, led by R. I. Gilbert—described as a "big, powerful man"—set out from Dinorwic, on the main line of the C.P.R. After travelling for over

two hundred miles, they stopped to prospect on the shore of Red Lake—a beautiful, irregular stretch of water, lying southwest and northeast, its rocky, indented shores in the shape of a recumbent letter Y, with the stem to the southwest. In the wide crotch formed by the junction of the arms and the stem lies a large island called McKenzie.

The prospectors found gold on the surface of a decomposed vein near the shore, and staked eight claims. Then, in order not to take any chances, they decided to return to southern Ontario for an Ontario Land Surveyor to conduct a legal survey. As they were getting into their canoes, Gilbert's revolver was accidentally discharged and he was instantly killed. Despite the hot summer weather, the survivors carried his body with them for burial outside. They then secured the services of James W. Tyrrell of Hamilton, who four years before, had made a remarkable journey with his brother Joseph B. from Lake Athabasca to Churchill by way of the Dubawnt and Thelon rivers and Chesterfield Inlet. The claims at Red Lake were duly surveyed by Tyrrell; and, because of the lateness of the season, the party decided to remain on the spot till spring. When that time came, however, the difficulty of developing a mine so far from sources of supply prevailed over the lure of gold, and the project was abandoned.

Another discovery was made in 1924 when Gus McManus of Haileybury found some gold-bearing quartz stringers and staked a few claims, but he took no action to develop them. The district was known to be good prospecting ground, but what finally directed attention to it was a geological report made in 1924 by Dr. E. L. Bruce, Professor of Geology at Queen's University, who had been engaged by the Ontario Department of Mines to examine the area. Bruce noted greenstones and old sediments of the Timiskaming type, with intrusions of porphyry and granite which, in his opinion, indicated promising ground for prospecting.

The Howey brothers were not of the sort who scorn the advice of a geologist; after reading Dr. Bruce's report, they hurried to look the country over. Lorne and his brother-in-law, George McNeely, were grubstaked by a syndicate of Haileybury men. Ray Howey and W. F. Morgan were scouting for McIntyre Por-

cupine Mines. By this time the jumping-off place was at Hudson, on the C.N.R. line, and from there the four prospectors followed the canoe route which was soon to become a busy thoroughfare.

During the spring and early summer of 1925 they prospected steadily without turning up anything of interest, and it was late in July before their luck changed. Ray Howey and Morgan had been prospecting in advance of the others and had established their camp in what later became known as Howey Bay of Red Lake. Lorne, working along the opposite shore, crossed the bay to join his brother; together they followed up a small stringer running back from the water's edge, and a few hundred feet from the shore encountered a forty-foot shear zone. Working in opposite directions, they searched eagerly for free gold. Suddenly, Ray heard the sound of an axe and rushed over to see what his brother had found.

"Looks like we've got it!" shouted Lorne.

"Ain't that what we come for?" was the reply. "Now come and see what I've got!"

Since both had made finds at the same time, a line was drawn half way between the two. Ray and Morgan staked the nine claims to the west of the line; Lorne and McNeely staked on the east.

When they reached the outside and told of their discoveries, the Red Lake rush was on. Experienced prospectors got in early, but winter had come to the District of Patricia before the stampede began in real earnest. This was the first big rush in which dog-teams provided the chief means of transport; not only that, but most of the drivers were new to mushing. Some of the amateur prospectors endured hardships they would have put up with in no other cause. But the dogs suffered most of all; it was said that "there was a dead dog every hundred feet."

Back in Haileybury, Lorne Howey discussed financing with Robert Cockeram. (Robert and his brother Arthur, both well-known prospectors, have already been mentioned.)

"Jack Hammell is the man for you," Cockeram declared, and immediately got Hammell on the long-distance telephone, introducing Howey, who told his story.

"What do you want for it?" Hammell asked.

"Write your own ticket," Howey replied.

Hammell agreed to take a look and rushed in, accompanied by Alex Gillies, former partner of Benny Hollinger. He was impressed by the showing and agreed to spend \$50,000 on development. The Howey Gold Mine Syndicate, consisting of five thousand units, was formed, half to be held by Hammell and half by the stakers and their backers. Howey Gold Mines Limited was incorporated in 1926, each unit exchangeable for four hundred shares of stock.

Hammell immediately plunged into plans for the opening up of the property, the first step being to get a season's supplies in ahead of winter. Ontario Forestry Department planes droning overhead gave Hammell an idea; why not use them to transport his supplies? Such a thing had not been done before, but the government was willing to co-operate. Soon the first of many airlifts was underway, and work could begin without delay on the Howey claims.

While bush flying was not new, it received at Red Lake its greatest impetus up to that time. The first commercial flight was made in February 1926 by Harold Farrington, flying for the Elliott Air Service; supplies were carried from Hudson to Red Lake at a dollar a pound. In March, H. A. "Doc" Oaks, flying a Curtis "Lark" for Patricia Airways and Exploration Limited, made his first trip. He continued through the following summer with flights to Woman Lake and other points in Patricia District as well as to Red Lake.

Oaks, who first flew in World War I and returned afterward to finish his mining engineering course at the University of Toronto, was torn between two loves—flying and prospecting. When the winter rush to Red Lake was on, he and G. A. (Tommy) Thompson, another flier, mushed in with dogs and, after staking, returned to Toronto where they helped Frank Davidson organize Patricia Airways (on a shoestring, for the most part), trading their claims for interests in the company.

Upon further examination, the Howey seemed to consist of a big low-grade deposit which would require large capital, and Hammell planned accordingly, quickly negotiating an option

deal with Dome Mines on a 75-per-cent interest for \$500,000. But after spending \$50,000 in drilling, Dome, over the protest of its geologist, Douglas G. H. Wright, dropped the option. Wright then joined the Howey company as consulting geologist.

Although option-dropping was a common occurrence in mining development, Dome's action caused others to hesitate. At this point W. S. Cherry, Ontario-born merchant of Providence, Rhode Island, having received repayment of a Canadian investment, discussed with his Toronto solicitor, Ray T. Birks, K.C., the advisability of investing in a mine, and Birks advised him to buy 250,000 shares in the Howey for \$100,000.

With this sale in prospect, Draper Dobie and Company Limited, Toronto brokers, were encouraged to take on a deal, giving a firm commitment on a further 250,000 shares. Hammell brought in Harry Oakes and Albert Wende, each with a successful mine behind him at Kirkland Lake, and since his own exploits at Flin Flon were still fresh in people's minds, the remainder of the million-share issue was quickly taken up, chiefly among the mining fraternity.

Hammell engaged Horace G. Young, a well-known mining engineer, as mine manager, and sinking equipment was rushed in over the trail by tractor train. In June 1927, a three-compartment shaft was started with a first objective of 500 feet, and four levels were opened. The intention had been to begin mill-construction at this point, but, because of the disappointing nature of the ore encountered, it was decided to continue the shaft to 1,000 feet before doing so.

The orebody consisted of a network of quartz veins in a sheared and fractured porphyry dike, varying in width from 30 to 250 feet. The values seemed to depend on a fracturing of earlier quartz pyrite veins and subsequent filling by quartz, pyrite, sphalerite, galena and gold. Occasional erratic highgrade stringers with similar mineral associations were also found.

Since the values appeared to be concentrated near the footwall, fading gradually toward the hanging wall, it was thought that footwall drifts on each level, with crosscuts to the dike limits, would provide an accurate means of estimating the amount of ore susceptible of profitable production, which was apparently a zone

averaging sixteen feet in width with an average value of \$7.25 a ton.

Power developed by the Hydro-Electric Power Commission of Ontario at Ear Falls on English River was available by February 15, 1930, and on June 1, two years and nine months after the first round of holes for the shaft had been fired, the Howey went into production with a 500-ton mill. But the erratic nature of the orebody soon became evident, and instead of having seven-dollar ore, the average was found to be nearer four. The company was now out of money, and this situation would in most cases have brought the mine to an end; but Cherry, having decided upon his fling, was not one to quit when the going was hard. Before the corner was turned he and Frederick Webb, his associate, had lent the company \$750,000 on no greater security than its notes.

In the meantime, a firm of consulting engineers, hired to pass on whether further operation was justified, had reported that the mine might pay if costs were drastically cut. Hammell, who had been president, resigned in favour of Birks; Harry Oakes and Albert Wende went off the board, to be replaced by André Dorfman, J. A. Northway and R. Home Smith.

The following year, Hammell was back on the board, and Fraser D. Reid, former manager of the Coniagas mine at Cobalt, was general manager, with Edward Futterer as resident manager, while H. C. McCloskey, former manager of the McKinley-Daragh, also a Cobalt mine, became secretary-treasurer. By December 1932, Howey had paid off the last of the Cherry loans, and in 1934, with gold at \$35 an ounce, dividend payments were begun.

When operations ceased in 1941 because rising costs and war-time conditions had finally absorbed the profit-margin, Howey had established a record for mining at a profit the lowest grade of ore in Canada. Since then, under the name of Consolidated Howey Gold Mines Limited, its capital reduced again to the original two million shares (\$1 par value) from the five million to which it had been increased, it has continued as an investment and holding company. Assets, at the end of 1955, had a market value of eleven and a half million dollars.

Next to the Howey, the mine of most promise in the early days of the camp was undoubtedly Red Lake Gold Shore, comprising an extension of the Howey structure on the west. Staked during the first winter by C. E. St. Paul and the Campbell brothers, it encountered the usual delays and difficulties, aggravated by the depression, but when the price of gold went to \$35 the company was able to secure money to sink a shaft and build a mill. In 1936 production began at the rate of 115 tons a day, but as the shaft continued downward, the ore, never too plentiful nor consistent, seemed to be pinching out, and a winze, sunk to the 1,000-foot level, ran through it entirely. Although the Howey was now over the hump, this, the camp's first major fiasco, cast a gloom over the community and supplied sceptics with further ammunition.

Another mine launched with a flourish only to suspend after a short run was the Gold Eagle on McKenzie Island. In February 1934, Gold Eagle Gold Mines Limited was organized. Underground development seemed to justify mill-construction and the mill went into production in October 1937, at the rate of 125 tons a day. But the ore was limited, and when it ran out in 1941 the mine had produced approximately one and a half million dollars. Eventually, the mill and plant were sold and moved away.

Among the first flight of prospectors into Red Lake were W. M. (Bill) Cochenour and Dan Willans, long-time partners, and Bill's brother E. C. (Ed), all of Haileybury. Their first stakings were disappointing and eventually they set up their camp on the mainland east of McKenzie Island, where they located a promising showing. It was in a carbonate zone, the structure criss-crossed by tiny quartz stringers.

Prospectors, like other people, can be divided into two groups; those who are easily discouraged, and those who never know when to quit. Of the latter fraternity, the Cochenour brothers and Dan Willans were charter members. The story of the Cochenour-Willans mine is one of frustration and disappointment, dogged determination and eventual success, with few equals, if any, in the history of Canadian mining.

The first money was raised by the familiar syndicate method. In April 1928, a syndicate of ten thousand units valued at fifty

dollars each (though not always disposed of at that price) was organized, providing a little money from time to time to enable the prospectors to continue stripping and trenching. In November 1932 they succeeded in getting Ventures Limited to take an option and begin drilling, but the structure was such that the drills only added to the confusion; Ventures soon dropped out and, despite that famous organization's widespread interests, it has ever since remained aloof from Red Lake.

This was a sad setback, but the Cochenours, though disappointed, were not discouraged. Willans, not being a miner, continued prospecting out of Haileybury, but Bill and Ed Cochenour proceeded with their surface exploration and kept a lookout for someone with money for development. Late in 1935, Hollinger Consolidated stepped into the picture and began immediate shaft-sinking, with levels at 150 and 275 feet. Again, consistent values failed to show; and, after spending a hundred thousand dollars, Hollinger gave up.

With two such strikes against them, many prospectors would have conceded defeat, but the Cochenours were in no mood to give up the struggle. In the meantime a valued ally had appeared in the person of W. P. Mackle, a mining engineer who, in 1933, had become manager of the mine owned by the newly-incorporated McKenzie Red Lake Gold Mines Limited on some property west of Cochenour-Willans that had formerly belonged to the McNeely Red Lake Syndicate. Mackle was not disturbed by erratic values, but on the other hand was impressed by frequent occurrences of fairly high-grade ore, characteristic of both McKenzie and Cochenour-Willans.

In April 1936, Cochenour Willans Gold Mines Limited was organized with a capital of three million shares, one dollar par value, of which 1,250,000 were issued to members of the syndicate in payment for the property. This did not mean a great deal to the Cochenours and Willans, who now had shares instead of syndicate units, but the shares were a bit more easily negotiated.

This was demonstrated when two Toronto business men were persuaded to buy shares to the value of \$75,000 and Mackle, now resident engineer, was thus enabled to continue underground exploration. Cutting a raise above the 150-foot level, so dis-

couraging to Hollinger, he encountered splendid ore within twenty-five feet. A firm of Bay Street brokers now began to nibble at the proposition, stipulating as a preliminary that a report be made by John A. Reid, the well-known engineer and geologist. His report was favourable, and the brokers put \$80,000 into the treasury, taking options on the balance of the stock. They were not satisfied for long, however, and demanded a further report by a consultant firm, which was decidedly unfavourable. So, once again, the Cochenour Willans option was dropped and, to everyone but the indomitable prospectors and their engineer, the enterprise appeared to be washed up.

During 1938 a desperate effort was made to sell stock, and \$25,000 was secured. Mackle agreed to take shares for his services, and in January 1939 the mine was reopened. As a start, Mackle cleaned out broken ore in the first level, amounting to 4,959 tons, which he shipped by truck to the Gold Eagle mill. The shipment brought a return of \$83,106 or almost seventeen dollars a ton—an amazing thing in what was thought to be a low-grade camp. Stock was now somewhat easier to sell and Mackle, getting a clearer idea of the structural pattern, was finding enough of the characteristic pod-like occurrences, whose richness made up for their irregularity, to justify a mill. Production began on December 1, 1939, with a 150-ton mill. It continued till February 1944, when wartime conditions, not lack of ore, brought about a suspension.

Between 1940 and 1943, the company acquired the property of Kelson Red Lake Gold Mines Limited, adjoining on the east, whose 446-foot shaft was connected with the Cochenour Willans No. 1 shaft by a drive on the third level. In 1946, a new orebody was discovered 1,000–2,000 feet northeast of No. 1. With this discovery, and increased knowledge of the geological structure, the mine was for the first time assured of a promising future. The ups and downs were by no means over, but in the interval the picture has gradually improved. The year 1955 was the best in the company's history, with even better prospects indicated for 1956. Up to the end of 1955, the mine had produced more than sixteen and a half million dollars from slightly more than a million tons of ore.

Dan Willans has been missing these many years. He was always a man of mystery; an Englishman, and evidently a man of culture, he had probably been attracted to northern Ontario by news of Cobalt silver, and it was at the time of the Gowganda rush that he and Bill Cochenour first met and became partners. He never spoke of his past and Cochenour respected his reticence. When not prospecting, he lived alone in a Haileybury shack, doing his own simple housekeeping; but when occasionally the sale of a prospect brought a little cash, he would appear at the King Edward Hotel in Toronto where, immaculately dressed, he would call for the best the hotel could offer. In August 1936, while prospecting in the Lightning River area of northeastern Ontario, he disappeared from his camp, about two and a half miles from the Teddy Bear mine. When he had not returned on September 1, the manager of the mine reported the circumstance to the Ontario Provincial Police. Search parties were organized, and prospectors kept a watchful eye, but no sign of him was ever found. The Public Trustee took charge of his affairs, and advertisements with his photograph were put in the newspapers in the United Kingdom; but no one has ever come forward to claim his property, or to offer any information concerning his past. It is possible that he had changed his name when coming to Canada.

Although, because of its nature, mining is largely a man's occupation, the wives of many men prominently mentioned in these pages have been the partners of their husbands in the fullest sense of the term. Such was the relationship between Bill Cochenour and Margaret Green of Hamilton, Ontario, whom he married in 1929. She was one of the first women to make her home in Red Lake, and her death in 1940, just as the fortunes of the mine were beginning to brighten, was a blow to Cochenour which its subsequent success has only intensified.

Marius Madsen was one of a group of prospectors including the McVeigh brothers, Austin and Tom, and Dan McRae, who tramped the Red Lake trail during that first winter. Holdings of the company which now bears his name were acquired from the Falcon Gold Syndicate (staked by F. X. Hahn, Otto May, Madsen himself, and others); and later, from Jomac Syndicate (organ-

ized in 1941 by Joe McDonough); and from Rouge d'Or Mines Limited, whose claims adjoined the main Madsen property on the north.

Madsen Red Lake Gold Mines Limited was incorporated in 1935, McDonough's organization raising half a million dollars from the sale of stock. In 1936, development proceeded under the direction of Arthur Honsberger, and the mine was made when Austin McVeigh, working for the company as a prospector, discovered on the north the rich shear zone since named after him. The Howey organization was appointed to manage the mine in October 1936, with Ed Futterer as general manager; but, shortly after, a group consisting of D. M. Hogarth, J. P. Bickell, Charles Kaeding and Ben Smith became interested in its financing and placed a further half million dollars in the treasury. Kaeding, who once managed the Dome mine at Porcupine, became consultant, and Eldon Brown was general manager, with E. G. Crayston as his assistant. William R. Askwith later became managing director and Crayston, general manager. Joseph McDonough has been president since the beginning.

Production began in August 1938, with a 300-ton mill, the capacity of which has been gradually raised to 800 tons. The mine was worked originally from No. 1 shaft, sunk to 573 feet; but after the discovery of the McVeigh vein, No. 2 shaft was sunk to tap the new ground, eventually to 2,950 feet. In 1954, owing to the encouraging results of underground exploration and increasingly rich ore, the decision was reached to deepen the shaft to 5,000 feet and extend the mining plant to accommodate future production of 1,500 tons a day. Madsen thus takes its place among the major gold mines, and its success goes far to offset the failures with which Red Lake is debited.

In 1944, the Toronto brokerage firm of Brewis and White organized Dickenson Red Lake Mines Limited to develop a number of claims which had been staked and re-staked repeatedly since the boom days. Associated with them—and hence the name—was J. G. Dickenson, manager for many years of the M. J. O'Brien mine at Cobalt. An orebody was early located by drilling, and with interest revived by successes at Madsen and at Cochenour

Willans, the company's stock was easily sold. Milling started in December 1948 with a 150-ton mill, which has since been raised to 450 tons. In June 1949, the company was reorganized under the name of New Dickenson Mines Limited. Total production to December 31, 1955, amounted to over ten million dollars.

Campbell Red Lake Mines Limited, whose property adjoins New Dickenson on the west, is another Brewis and White promotion. It has escaped the vicissitudes which seem to have been the lot of most Red Lake mines, and an orebody of much higher grade than the camp average was quickly found. Dome Mines, despite its unfortunate Red Lake experience, promptly secured a controlling interest. Production began in June 1949 with a 300-ton mill, which by 1955 had been increased to 700 tons a day. Total production to December 31, 1955, was in excess of eighteen million dollars.

And how about Mr. Red Lake himself, Jack Hammell? No one mining camp was big enough to hold him, but he had lost neither faith nor interest in Red Lake. McIntyre Porcupine Mines had been in the camp since Ray Howey and W. F. Morgan had staked for them in 1925, but nothing much had been done with their claims and, in 1938, Jack Hammell bought them for \$110,000, buying also the property and plant of the defunct Red Lake Gold Shore. These were turned over by him to a new company called Hasaga Gold Mines Limited. Production from the Gold Shore plant began almost immediately, continuing with more or less success until, as some considered characteristic of Red Lake mines, "all known ore was exhausted." Hasaga has remained in existence as an exploration and investment company.

In 1945, largely with financial assistance from Hasaga, Hammell organized Starratt Olsen Gold Mines Limited to operate a property adjoining Madsen on the southwest, eight miles by road from Red Lake townsite. The plant and 500-ton mill belonging to Uchi Gold Mines Limited, an unsuccessful venture of Hammell's in Patricia District, northeast of Red Lake, were transported to the new mine and production began in 1948. Up

to the time of writing, Starratt Olsen had not been a spectacular performer, and its days seemed numbered; but in view of the experience of other Red Lake mines anything could happen.

Red Lake is one of the most scattered camps in the country, with separate townsites at several mines. As it happens, the present active mines are located in pairs. In the southwest are Madsen and Starratt Olsen; in the northwest, McKenzie and Cochenour Willans; in the southeast, Campbell and New Dickenson; while two mines of the past, Howey and Hasaga, occupy a position in south centre. Until 1947, Red Lake could not be reached by highway, but in that year an all-weather road was completed from a point on the C.N.R., seventy-one miles west of Sioux Lookout.

The first, and still the official, Red Lake, staked by Hammell in 1925, grew up about the Howey, but when production ceased there its growth became stunted. Red Lake, as a camp, was not like Kirkland Lake, where seven mines formed a backdrop for the town, nor like Porcupine, more widely spread out, where Hollinger and McIntyre helped to establish Timmins as the principal community while at the same time allowing South Porcupine, serving more especially the Dome, also to become an important place of business.

Considering the time, energy and enterprise that Hammell devoted to Red Lake, it might seem that the camp had not been overly kind to him, but one of his ventures—not in Red Lake, it is true, but starting from there—has paid off in handsome fashion.

Here a short digression is necessary. "Doc" Oaks who, in the spring of 1926, helped Frank Davidson to organize Patricia Airways, joined with James A. Richardson of Winnipeg, in the fall of the same year, in organizing Western Canada Airways. Oaks became manager of this enterprise, whose purpose was to provide air service over a much wider sector of the north. In the following year, he was awarded the McKee Trophy in recognition of his efforts in promoting aviation.

Not satisfied with this, Oaks approached Richardson, in the spring of 1928, with a scheme for a much more ambitious project which ultimately became Northern Aerial Minerals Explor-

ation Limited, and Richardson fell in with the idea, offering to subscribe a large part of the capital. Oaks went to New York to solicit further funds, returning with an assurance that money could be raised there if needed. Money from New York did not become necessary, however, because when Oaks took the proposition to Jack Hammell the latter welcomed the idea with great enthusiasm and thereafter, although Oaks continued as director of air operations and Richardson retained a large interest, N.A.M.E. became in effect a Hammell project.

The plan was to set prospectors down by plane in selected localities, moving them to new sites as the need arose and keeping them supplied with provisions. When the financial crash of 1929 brought the company's activities to an end, its pilots had already blazed a network of air trails across the northern hinterland, but little of promise had resulted. An exception was a gold showing at Pickle Lake, in the Albany River region, discovered on September 10, 1928, by Jock MacFarlane and his partner H. H. Howell. MacFarlane, a Scot, born in 1894, had come to live in Haileybury at the age of thirteen and, not surprisingly, had become a prospector.

The Pickle Lake prospect was a hundred miles from the railway in a direct line and a hundred and seventy miles by round-about water route. The veins were narrow and irregular, and this, added to the remoteness of the location, caused one engineer after another to report unfavourably. Hammell, however, was impressed by the showing and belligerently opposed experts' views. When capital was shy, and after N.A.M.E. had spent a hundred thousand dollars in preliminary work, he put up \$115,000 of his own money. Pickle Crow Gold Mines Limited was incorporated in 1934, with an authorized capital of three million shares of one dollar par value (increased to 3,500,000 in 1946, when Albany River Gold Mines Limited was absorbed.) Despite some early scepticism, Pickle Crow, under the direction of A. G. Hattie, proceeded to become a very successful gold mine. Instead of pinching out with depth, as the experts had predicted, the veins have broadened while retaining their richness. The ore is not hard to treat and good recovery is possible through a combination of amalgamation and cyanidation. The

first mill unit of 125 tons was completed in April 1935, and before the end of the year was handling 150 tons. Capacity was increased in stages and by 1937 had reached 400 tons a day. Up to the end of 1955 the mine had produced over thirty-eight million dollars, with dividends of over eleven millions.

Adjoining Pickle Crow, another profitable mine was operated from 1934 until 1951, and in that time produced gold to the value of nearly twenty-three million dollars. The property was staked in 1928 by Alex and Murdock Mosher on behalf of a prospecting group organized in 1927 by Louis Cohen of Haileybury and including Fred G. MacLeod, Lorne Howey and Jack Morrison. Fred M. Connell secured an option, and Central Patricia Mines Limited was incorporated in 1929 with Connell as president. Early difficulties forced a suspension of operations in 1930, leading to reorganization as Central Patricia Gold Mines Limited in 1931, and the following year operations were resumed under the direction of Allan J. Anderson, later to become a prominent officer of Ventures Limited. Anderson was succeeded in 1936 by R. E. Barrett, who remained in charge for the next eleven years.

By the spring of 1933, results of underground exploration were such as to justify a fifty-ton mill, but getting it to the mine was a problem. The nearest railway point (C.N.R.) was Hudson, on Lost Lake—a distance, through a succession of lakes, of one hundred and seventy miles. The season was already advanced when material and equipment for the mill, loaded upon a string of sleds hauled by a caterpillar tractor, set off across country, but in traversing a lake the tractor-train broke through and sank to the bottom. Nothing could be done at the time, but during the summer the submerged material was salvaged and left on the shore till the next freeze-up. (Incidentally, Allan Anderson, with no experience of diving, put on a diver's outfit and went below to examine the sunken outfit.) A year later, the mill was erected upon waiting foundations, and soon was in operation.

The ore, consisting largely of sulphides in iron formation, presented no milling problem and 96-per-cent recovery was possible by a straight cyanide process. Mill capacity was

doubled within a year, and increased later to four hundred tons daily.

Power was provided at first by steam, but the problem of cutting thirty cords of wood a day soon became a heavy drag on the operation. Pickle Crow was faced with a similar problem, which led the two mines to approach the Ontario Hydro-Electric Power Commission. As a result, an arrangement was made for the installation of a power plant twenty-six miles to the south at Rat Rapids on the Albany River, near the outlet of Lake St. Joseph. Power became available in 1935.

Transportation constituted another large element of cost, and consequently the Pickle Crow and Central Patricia companies joined in organizing the Lake St. Joseph Transportation Company which, during summer months, brought in supplies for both from Hudson. Freight was transported on fifteen-ton scows, seven or eight of which were towed by diesel-powered tugs. The route follows various lakes and streams to within five miles of Lake St. Joseph, which lies on the farther side of the watershed. In this final five miles, three dams equipped with marine railways were needed in addition to three miles of standard-gauge railway across which flatcars were hauled by a fourteen-ton gasoline locomotive. Trucks operating over a twenty-mile graded road from Doghole Bay, on the north shore of Lake St. Joseph, delivered the freight to the mines. Passengers, mail and light freight went in from Sioux Lookout by plane.

Since suspension of mining operations, Central Patricia Gold Mines Limited, as a holding and exploration company, has continued to play an important part in Canadian mining.

Another mine grew out of the collaboration of Oaks and Richardson. In the interval between the creation of Western Canada Airways and N.A.M.E., they had organized an aerial prospecting syndicate which they called K.U.P. (for Keewatin-Ungava-Patricia), putting Ken Murray into the field as chief prospector. His flights covered a wide segment of the north and in October 1927, on a tip from an Indian, he staked a gold-silver showing at Favourable Lake, one of the sources of the Severn River, which flows into James Bay.

Fred M. Connell formed the Favourable Lake Mining and Exploration Company Limited, in which James A. Richardson held a quarter interest and K.U.P. Syndicate, the rest. Connell secured options on the treasury stock in return for an agreement to develop the property, and drilling proceeded throughout 1928 and 1929, but the results were not considered sufficiently encouraging to justify his continuing.

The property lay dormant until 1935 when, with a better price for gold, John Drybrough, engineer in charge of Richardson's mining interests, approached Newmont Mining Corporation which took an option, moved in equipment, and started drilling. Berens River Mines Limited was incorporated in 1936 and production commenced with a 250-ton cyanide and flotation plant, continuing until the ore was exhausted in 1948, by which time approximately ten million dollars in gold and silver had been taken from the mine.

As mentioned at the beginning of this chapter, two railways in addition to the C.P.R. had been built through the Precambrian region lying between Old Ontario and the Prairies. Both were built during the first decade of the twentieth century. The more northerly line, the National Transcontinental—the Government's share in the Grand Trunk Railway's western extension scheme—passed from Quebec into Ontario on a northwesterly course through Cochrane to Nakina, just north of 50° N. latitude, and thence, roughly paralleling that imaginary line, continued to Winnipeg.

The National Transcontinental had been built from east to west, but the intermediate railway, part of the Canadian Northern system (Mackenzie and Mann) was built from west to east, beginning at Port Arthur. For the first two hundred miles it follows a northeasterly course, past the southeast angle of Lake Nipigon, until about thirty miles south of Nakina it rounds the north end of a lake appropriately called Long Lac and swings abruptly southeastward to North Bay and on to Montreal.

Except for woods activities, very little development occurred during the early part of the century in the region traversed by these railways; and it was the former Canadian Northern line

that was in most danger of being torn up during the timorous thirties. That this proposal was ultimately proven to be ridiculous was due in large measure to the efforts of prospectors who, despite the depression, persisted in finding mines.

The mines were discovered along that section of the line between Lake Nipigon and Long Lac, near Kenogamisis Lake, otherwise known as Little Long Lac. It is a region in which the consolidated rocks consist chiefly of Keewatin greenstones and Timiskaming sediments, mostly massive greywacke and bands of iron formation, the intrusive rocks being mainly porphyry and quartz diorite. Gold was first reported by A. G. Burrows, who made a geological reconnaissance of the area in 1916 for the Ontario Department of Mines, finding quartz schist and iron pyrites on the shore of the east arm of Little Long Lac. This was confirmed the following year by Dr. T. L. Tanton, of the Geological Survey of Canada. Values were too low to cause much excitement in wartime, but prospectors kept the district in mind. In 1925, Tom Powers and Philip Silams discovered gold at Beardmore, about twenty miles west of Burrows's find; and in 1929 Ross Barnum and Tom Currie made a further discovery on the eastern extension of the same vein. Excitedly, they wired their friend Percy E. Hopkins, a well-known Toronto geologist: "Have found a prospector's dream. Will hold till you come up."

When Hopkins arrived they showed him a two-foot vein carrying visible gold. He took an option and eventually transferred it to Newmont Mining Corporation, which also acquired the Powers and Silams property, and formed the Northern Empire Mining Company Limited in 1932.

Meanwhile, what was to develop into an important gold rush had begun a few miles to the eastward. In May 1931, "Hard Rock" Bill Smith, who had been in the rush to Porcupine, had taken part in the Red Lake rush, and had since been an active prospector in northern Ontario and northwestern Quebec, made a gold discovery on a rocky point jutting into the South Arm of Little Long Lac. He staked eighteen claims for the Toronto syndicate headed by T. H. Rea, by whom he was employed. Rea optioned the claims to the Homestake Mining Company of Lead, South Dakota; but that company, after a considerable amount of

rock-trenching, dropped out. In 1934, the syndicate incorporated Hard Rock Gold Mines Limited and itself raised money for drilling. The first holes were disappointing, but when the drill was moved to the "Porphyry Hill" vein, farther south, gold-bearing ore was encountered in porphyry, iron formation and quartz stringers. Production commenced in January 1938; up to the time when ore became exhausted in 1951, the mine had produced over ten million dollars.

As soon as Smith had completed his staking, he wired Fred G. MacLeod and Arthur Cockshutt of Haileybury, then prospecting in northwestern Quebec, informing them of his find. They hurried to the scene and staked claims adjoining on the west. Ventures Limited took an option on their claims and hired Smith to do surface exploration on them, but the results were not encouraging and the option was dropped. Fred H. Connell followed with an option, doing some drilling and sinking a 150-foot shaft. MacLeod-Cockshutt Gold Mines Limited was organized in 1933, Connell having options on the treasury stock; but, in 1935, after further development work, he dropped the option. With but sixteen thousand dollars left in the treasury, and with most of the treasury stock disposed of, MacLeod and Cockshutt now took control of the company themselves. In February 1936, the drills were started on new occurrences found in the western portion of the property. When three holes failed to get satisfactory results, the rigs were moved to new positions on the western extension of Hard Rock's Porphyry Hill discovery, and ore was located in the first hole. MacLeod now went to Joseph Errington who, with J. S. Fitzgerald and D. M. Morin, partners in the Sudbury Diamond Drilling Company, had contracts in the district, and arranged with him to take an option on a block of stock.

Errington was typical of the generation of men who discovered and developed mines along the northern frontier of Canada in the first half of the twentieth century. Born on an Ontario farm, he had set off while quite young for what was then the frontier outpost of Sudbury, and had worked for the Canadian Copper Company in various capacities. Leaving Sudbury in 1909, he went west to prospect for coal in the Rocky Mountains, after which he worked in mines in the western United States and

Mexico. Returning to Ontario in 1923, he became interested in gold mines at Porcupine, especially the McIntyre Porcupine, of which he was a director and considerable shareholder. It was at this time that Errington first met Thayer Lindsley, then a roving geologist for McIntyre.

Drilling results at the MacLeod-Cockshutt continued so promising that Errington exercised his option before the time limit expired; and on rights offered by the company a further four hundred thousand dollars was raised. This provided the money needed to put the mine into production in April 1938; and up to the time of writing total production had reached about thirty-three million dollars, with apparently many years of life still ahead.

Among the prospectors who rushed into the Little Long Lac area in the wake of Bill Smith was Murdock C. Mosher, another of the men of Haileybury, who staked claims tying on to MacLeod-Cockshutt on the west. Mosher Long Lac Gold Mines Limited was incorporated in 1934 and has twice been reorganized, becoming Consolidated Mosher Mines Limited in 1950. Hard Rock's mining and milling equipment was acquired in 1951, but the mine has not yet reached the production stage. At the end of 1955 ore reserves of over eight million tons were reported, although the average grade was low. Ventures Limited controls the company through one of its subsidiaries, Hoyle Mining Company Limited, and production plans are well advanced, with the possibility that Mosher may yet do something toward making up for the camp's decline in output during recent years.

Thomas A. Johnson and Robert Wells arrived late in the summer of 1931. After examining the country in the vicinity of the claims already staked, they paddled westward to Magnet Lake, up the creek that flows into Little Long Lac at Barton Bay, a distance of six miles. On October 3 they noticed an outcrop in the middle of the lake, and discovered a shear zone containing visible gold. The following day they staked six claims. Through Hopkins they made arrangements with Joseph Errington to take an option and begin drilling. After some delay, the orebody was located and, in 1936, Bankfield Gold Mines Limited was incorporated. Up to the time in 1942 when all ore was

exhausted, and the mine equipment and buildings were sold, the mine had produced nearly two and a half million dollars in gold. Now known as Bankfield Consolidated Mines Limited, the company continues as an investment and exploration agency.

Prospecting with his brother Bill, Tom Johnson staked nine claims adjoining Bankfield on the west. Hopkins took an option, agreeing to spend five thousand dollars in drilling; when the orebody was located he transferred control to Newmont, and Tombill Gold Mines Limited resulted in 1935. Production began in 1937 and up to the time of the mine's closing in 1942, its output had amounted to over two and a half million dollars.

While many prospectors had a hand in making up the Little Long Lac camp, Tom Johnson was the most active as well as the most successful. With Bankfield and Tombill to his credit, he was to add the greatest of them all in the discovery of the mine that bears the name generally given to the camp. In June 1932, he had formed a prospecting partnership with Tony Oklend, a trapper who claimed to have found, in 1917, a boulder containing free gold near the east end of Little Long Lac. The two of them searched in vain for this boulder, but in padding along the lakeshore they noticed quartz veins beneath the water, and on July 5 staked their discovery claim, in the next couple of days staking a number of additional claims.

Again through the agency of Percy Hopkins, Errington was brought into the deal. In 1933, Little Long Lac Gold Mines Limited was incorporated with Errington as president and Thayer Lindsley as vice-president, making possible one of the chief producers of the district. According to Dr. E. L. Bruce (1935), "the high gold content in the Little Long Lac lode is unique among discoveries so far made in the area." From November 1934 to December 15, 1953, when ore reserves were exhausted, the mine had produced more than twenty million dollars. Next to Errington, the man who had most to do with the Little Long Lac mine was Watkin Samuel. He was with the Ventures organization from 1928 until 1934, when he was transferred to Little Long Lac as exploratory engineer, sharing with A. A. Barton in the direction of affairs. After Errington's death in 1942, Samuel succeeded to the presidency, continuing in that office

until 1951, when a group consisting of J. C. L. Allen, J. G. Boeckh and S. J. Bird of Toronto, and R. C. Stanley, Jr. and T. D. Carlson of New York, acquired control. Since then the company has been used, by what has come to be known as the "Little Long Lac group," as a holding company in the acquisition of a number of other mines in various parts of the country.

In June 1934, Russell and James Cryderman found gold three miles north of Beardmore which led to the incorporation, in 1935, of the Sand River Gold Mining Company Limited. In the latter year, they discovered a rich quartz vein adjoining the Sand River property on an old iron claim patented in the name of P. A. Leitch of Port Arthur. The discovery was optioned by Karl Springer, himself a prospector, who incorporated Leitch Gold Mines Limited. The Sand River mine was acquired in 1944 by Undersill Gold Mining Company Limited, a subsidiary of Newmont, which operated it until 1954 and then transferred it to Leitch.

An interesting feature of the geological structure underlying Leitch, Sand River and Northern Empire is a diabase sill six hundred feet thick which cuts laterally through the orebody, dipping to the west at a ten-degree angle. Ground below the sill in the Leitch proved to be as rich as that above, but this was not so with respect to Sand River.

From January 1937 to the end of 1955, Leitch has produced over seventeen million dollars and from latest reports is doing better than ever, while from this beginning Karl Springer has evolved into one of the country's most successful mine-developers, operating mines both in the east and in the west.

Another discovery was made in 1934 in the Beardmore area. Staked by J. M. Wood and W. T. Brown, it became the property of Sturgeon River Gold Mines Limited, in which Coniagas held a two-thirds interest. From 1937 to 1942, the mine produced over two million, seven hundred thousand dollars.

Magnet Consolidated Mines Limited, originally Magnet Lake Gold Mines Limited, was incorporated in 1936 with thirty-one claims adjoining Bankfield on the east, and fifteen acquired from Wells Long Lac Mines Limited. Newmont was in control from

1937 until the property was sold to a Toronto group including Cyril W. Knight, who became president. Previous to 1941, Magnet, as well as Sand River and Tombill, also Newmont-owned, were operated from Northern Empire, but after Tombill was disposed of in 1941, the remaining mines were operated from Magnet, where W. S. Hargraft was in charge.

As Hammell's name has been associated with Red Lake and Timmins's with Porcupine, so has Joe Errington's been associated with the Little Long Lac camp. He is chiefly identified, of course, with the Little Long Lac mine, but he also had much to do with Bankfield, of which his friend and associate, C. D. H. MacAlpine, was president, and to a lesser extent with MacLeod-Cockshutt and Hard Rock. He was responsible for starting the town of Geraldton (incorporated Sept. 1, 1937), metropolis of the district, whose name is a composite of his and Fitzgerald's. Although Percy Hopkins's name was not given to either town or mine, he, as the record shows, also played a vital part in the fortunes of the camp. At a time when a dozen mines were in production, Geraldton could compare with many other such camps in their prime. Until 1939, when the highway was cut through, no means of access existed except the railway. Slashed out of the forest, with little natural beauty to commend it, much of its site little better than muskeg, Geraldton was nevertheless home to several thousand people. Despite the unfavourable nature of the terrain, they soon provided themselves with a nine-hole golf course laid out on MacLeod-Cockshutt ground by the celebrated golf-course planner, Stanley Thompson.

Like all gold camps, Little Long Lac has had to contend with the steady increase in cost of production, without any compensating increase in selling-price. From 1939 to 1944, inclusive, the average cost of producing an ounce of gold in Ontario mines increased from \$19.77 to \$27.13 before taxes; including taxes, the increase was from \$22.35 to \$30.95. In 1939, all mines were in operation, but by the end of 1944 only five—Little Long Lac, Leitch, MacLeod-Cockshutt, Hard Rock and Magnet—were still producing. Nevertheless, from 1934 to the end of 1955 the camp had produced slightly more than a hundred million dollars.

The advance in the stature of Canada's mining industry over the past quarter-century is graphically illustrated by the difference in the time required to put Hudson Bay Mining and Smelting Co.'s Flin Flon mine into production and that required for the Geco mine at Manitouwadge to reach the same stage. The Flin Flon mine was staked in 1915; ten years had passed before it was financed, and five years more elapsed before it was brought into production. Staking at Manitouwadge took place during the summer of 1953; financing of Geco was completed within six months, and in less than three years a modern plant was nearing production.

Yet, despite all this suggested advance, and despite the advent of scientific prospecting, mining still contains a large element of chance as well as drama and romance. This fantastic new camp owes its existence to three part-time prospectors of Geraldton who had a hunch. Roy Barker, a carpenter, and William Dawidowich, a lumber-camp foreman, had been partners on occasional prospecting forays for a number of years, but had not yet found a mine. That they were of the stuff that prospectors are made of is shown by their persistence in following up every likely lead. In the present case the lead was supplied by the report of a geological reconnaissance made in 1931 by Dr. J. E. Thomson of the Ontario Department of Mines, who reported the occurrence of sulphides near Lake Manitouwadge, in the heart of the bush country, sixty-five air miles southeast of Geraldton and some forty miles north of Lake Superior. Since the spot was hard to reach, and to save time and tramping, Barker and Dawidowich took in a third partner, John E. Forster, a Geraldton automobile dealer, who flew his own two-seater plane.

When the three arrived at the spot indicated in the report, they were greatly disappointed to find that two other prospectors, Fred Bergquist and "Windy" Sam Pretulac, both of Fort William, had beaten them to it. They staked six claims adjoining and returned to Geraldton to wait out with what patience they could muster the thirty days' grace which the first stakers were allowed before recording.

Bergquist and Pretulac had been on the lookout for nickel, and when their samples failed to show values in that metal they

saved their money by not recording. Barker and partners, having assayed for copper with highly encouraging results, rushed back to Manitouwadge and staked an additional thirty-six claims. Feeling sure they had the makings of a mine, they wrote to their friend, W. S. Hargraft, formerly in the employ of Newmont at various mines in the district and by that time, a partner of the Hamilton brothers of Toronto in General Engineering Company Limited.

Hargraft immediately examined the property and took on behalf of his firm an option which called for five thousand feet of drilling and the formation of a company. When word of the find got out, a rush occurred that was reminiscent of some of the great ones of the past. More than ten thousand claims were staked. General Engineering began drilling in September and, after the first hole, all were in ore—copper, zinc, and silver, with a considerable percentage of pyrite. When drilling was completed in August 1954, upwards of fifteen million tons, averaging 1.72 per cent copper, 3.55 per cent zinc, and 1.73 ounces of silver, with about 15 per cent pyrite, had been outlined.

In the meantime, Geco Mines Limited had been organized with an authorized capital of three million shares of one dollar par value. Financing was no problem; most of the large mining organizations were in competition for the deal. The Mining Corporation of Canada, Limited, was the successful bidder, taking down treasury stock at ten dollars a share and undertaking to provide sufficient additional money to bring the property to production. In July 1954, The Mining Corporation assumed active management, with J. A. H. Paterson, its general manager, as managing director, and J. A. Graham as mine manager.

Development plans were dictated both by the nature of the terrain and the desire of the management to provide a low-cost operation. A major north-south fault follows the line of Fox Creek through the property, displacing the orebody on the eastern side of the valley about two hundred feet north of that on the other side. Outcrops occur high above the valley floor on each side, facilitating the initial development by adit. Underground development will be continued from a five-compartment

shaft, supplied with the most modern hoisting equipment. The concentrator, designed to start at 3,300 tons a day, will be capable of expansion to 5,000 tons without much additional cost.

The Canadian Pacific, from the south, and the Canadian National, from the north, had both completed branches into Manitouwadge within the first year, while the Ontario Department of Highways had quickly extended existing woods roads to provide an all-weather highway.

Although, in the rush which followed the announcement of the original strike, thousands of claims were staked, and a great amount of drilling was done, only one other mine—that owned by Willroy Mines Limited—was under development at the time of writing. Part of its property had been staked by Barker and his partners, the rest by stakers employed by Consolidated Howey Mines and others. At the end of 1955, plans had been made for a four-compartment shaft and the building of a 1,000-ton concentrator.

Because of the isolated situation, it was essential that a town-site should be provided to supply facilities for those working at Geco and Willroy. An improvement district aggregating 144 square miles was set up, and under the supervision of the Department of Planning and Development of the Ontario Government a model town near Lake Manitouwadge was laid out.

At the time of writing a number of prospects are under development in various parts of the extensive area dealt with in this chapter. It is too soon to say whether all will make mines, but very likely some will; at least they provide further evidence of the productiveness of a region once written off as a barren waste. One of the most promising of these is a nickel property at Populus Lake, in the Kenora district, owned by Kenbridge Mines Limited, a subsidiary of Falconbridge; another, at Werner Lake, in the same district, owned by Werner Lake Nickel Mines, seemed to be developing towards a mine. Three of several copper properties might also be mentioned. Temagami Mining Company Limited, following diamond drilling on an island in Timagami Lake, has been shipping direct to the Noranda smelter

ore averaging 23 per cent copper. At Kashabowie, six miles south of the Port Arthur-Atikokan highway, Coldstream Copper Mines Limited reported over a million tons of 2-per-cent copper, with shaft-sinking in progress; and Coppercorp Limited, developing a prospect sixty miles north of Sault Ste. Marie, reported six hundred thousand tons of 2.75-per-cent copper. Market conditions may play a part in the development of some of the above.

IN THE YEARS FOLLOWING THE DISCOVERY OF NICKEL-COPPER ORE on the southern rim of Sudbury Basin, the greater part of the world's nickel came from mines along its border. Except for deposits such as that at the Frood, where the mineralization seems to have broken its bounds, nickel-copper ore is found only in a relatively narrow strip along the 110-mile perimeter of the Basin. The city of Sudbury and the town of Copper Cliff sprawl in a parallel zone outside the south rim.

Within the oval, once a glacial lake, the towns of Capreol, Chelmsford, Azilda and Larchwood serve a farming community and provide homes for mine workers. Vermilion River and its chief tributaries, Onaping River and Whitson Creek, flow toward the southwest, the river expanding into Vermilion Lake, about five miles long, near the southwestern end of the Basin.

The rocks underlying the oval constitute a series unrelated to those along the rim. Beginning with a basal conglomerate, they pass into tuff, slate and sandstone, to which local names have been given. The series has buckled into a basin-like syncline having an inward dip of about thirty degrees. The sandstone (Chelmsford), however, forms a succession of dome-shaped anticlines following the main axis.

While the mineralization differs from that along the rim, it is interesting enough to have attracted the early prospectors; and in 1897 James Stobie staked claims on outcrops which he thought might produce sulphur and arsenic. About the same time a Frenchman named Alphonse Olier discovered what proved to be a large silver-lead-copper-zinc deposit on an adjoining property, and staked it for himself and partners. Although this created a certain amount of interest, none of the few mining concerns in

the country would even consider a proposition when it was discovered that the ore responded to no known process. Nevertheless, Olier held on tenaciously.

Stobie optioned his claims to G. R. Leckie, of the Orford Copper Company, who put down a shaft. Joseph Errington, then a very young man, was chosen by Leckie to assist in the shaft-sinking, and although nothing of much promise was disclosed, Errington retained a lively interest in the property. Years later, when he and Thayer Lindsley had become friends, they often talked about the lead-zinc deposits in the Sudbury basin. Lindsley was of the opinion that recent advances in metallurgy would make possible the development of these deposits; they decided to find out, and the answers they received were encouraging. Olier, who meanwhile had kept his claims in good standing, was persuaded to grant an option, and Errington succeeded in interesting the Bradleys of San Francisco, who controlled the famous Treadwell-Yukon mine near Juneau, Alaska. They bought out Olier for \$57,000 cash, agreeing to spend further money in development. Engaged as manager by the Bradleys, Errington immediately began drilling along the southwest-northeast-trending fault zone following the slate-tuff contact, to which the mineralization seemed to be related.

In the meantime, Lindsley and Errington had staked for themselves a large area bordering Vermilion Lake, immediately to the west, and in 1926, organized Sudbury Basin Mines Limited as the operating company. These were boom days in Canada; the public was avid for mining shares, and Sudbury Basin Mines had little difficulty in disposing of its shares at good prices. Treadwell-Yukon was financed, of course, by the Bradleys, largely through companies controlled by them.

Errington sank three shafts (619, 1,572 and 409 feet, respectively) on what came to be known as the Errington mine, where 26,000 feet of lateral work was done on four levels. In April, 1928, a 200-ton pilot plant was installed, which continued in operation until November, 1930. During this time, 164,000 tons of ore were treated, averaging: gold, 0.03 ounces; silver, 1.67 ounces; copper, 1.09 per cent; lead, 1.06 per cent; and zinc 4.66

per cent. These returns were felt to justify the installation of a 2,000-ton mill, but before this could be done the deepening depression and the resultant decline in metal prices had forced suspension of all operations.

Sudbury Basin Mines Limited became a holding company, using its funds to assist in the development of other mining properties; and about this time, Thayer Lindsley presented it with an opportunity to participate in the flotation of a company destined to become a primary factor in the future of the Sudbury district.

Although circumstances had caused Lindsley and his associates to become interested in mines in other parts of Canada, he was still intrigued by the geology of Sudbury Basin, especially in the possibilities of nickel. But at that time nickel-mining was entirely in the hands of Inco and Mond, which were to join forces in 1929. From time to time a number of companies had tried to gain a foothold in the industry, but all had failed.

In Falconbridge Township, where Thomas Edison had unsuccessfully attempted to sink a shaft in 1902-3, the Edison holdings had reverted to the Crown; but in 1915 William E. Smith, formerly of Minneapolis—a lawyer turned prospector—became convinced of the property's possibilities. Through Hugh Roberts, a well-known geologist, he secured the backing of the Minneapolis and Michigan Development Company of Minneapolis, and on its behalf staked the ground, which was subsequently drilled by the E. J. Longyear Company, disclosing an orebody 7,500 feet in length along the contact and containing 5,700,000 tons of nickel-copper ore above the 500-foot level. The Minneapolis and Michigan Development Company was controlled by R. M. Bennett and E. J. Longyear, who incorporated Falconbridge Mines Limited, a Canadian company, to hold the former Edison claims and others in Falconbridge Township.

This property seemed most promising to Lindsley. In the summer of 1928 he commissioned Robert Hoffman, a Boston mining engineer well known in Canadian mining, to go to Minneapolis and sound out the Bennett-Longyear people. Hoffman returned with the information that a deal could be made. Then, accompanied by J. Gordon Hardy, a Scottish engineer (though

born in Chile), Lindsley went to Minneapolis himself to continue the negotiations. An arrangement was soon reached; Lindsley agreed to buy the claims for \$2,500,000 of which \$500,000 was to be in cash, the balance to be paid within a few months. Shortly after, the participants, with their lawyers and engineers, met in Toronto to complete the deal.

Falconbridge Nickel Mines Limited was incorporated by the Ventures group on August 28, 1928, and the properties were at once transferred to it, Ventures receiving stock in the new company for its cash advances. An additional \$250,000 was invested by Ventures, and Sudbury Basin also helped in the financing. (On December 31, 1930, Sudbury Basin Mines Limited held 39 per cent of Falconbridge's issued shares.)

When work began in the fall of 1928, only a bush road connected the mine with the nearest small settlement at Inco's Garson mine, three miles away. By the spring of 1930 the shaft was down and a smelter had been built, ready to treat upward of three hundred tons of ore a day; a branch railway had been secured; and a modern townsite having accommodation for five hundred people and a school for sixty pupils, with adequate water supply and sewage disposal works, had been provided.

Realizing that control of refining was essential to the success of any nickel project, Lindsley sent Gordon Hardy to Norway to acquire the refinery at Kristiansand, including the rights of the Hybinette refining process. A Norwegian chemical engineer S. B. Steen, was engaged as manager of the refinery; and Anton Gronningsater, who after many years with Inco at Copper Cliff had transferred to the first Falconbridge company in 1927, and to the new one on its formation, went to Norway to furnish metallurgical guidance during the enlargement and modernization of the refinery.

In mining the failures far exceed the successes. This, certainly, had been demonstrated in nickel-mining at Sudbury. Company after company had been hopefully launched, a number with apparently excellent prospects, yet all but two had failed up to the time of the incorporation of Falconbridge. In years to come, Lindsley, Errington, Hogarth, MacAlpine, would become historic names in Canadian mining; but at that time there was little

to suggest that they were likely to succeed where the Vivians, the Dominion Nickel-Copper Company, the Lake Superior Power Company and the British America Nickel Corporation had all come to grief. What had these new adventurers that their predecessors did not have?

They had Thayer Lindsley, for one thing; he firmly believed Sudbury Basin to be one of the most remarkable geological structures in the world. He was sure that in time many important new mines would be developed along its rim—as well as within its oval—and he was determined to make Falconbridge the chief agency and forerunner of these future mines. Consequently, through an associated company, he immediately began acquiring properties wherever possible along the rim, aggregating in the first year many thousands of acres besides the 7,960 acres held by Falconbridge itself.

Lindsley, as president, was ably supported by J. Gordon Hardy, vice-president and consulting engineer (later president). A shrewd and capable mining engineer, as well as a far-sighted business man, Hardy was a good foil for his sometimes over-optimistic chief. Halstead Lindsley was also a vice-president. Norman F. Parkinson, secretary of Ventures Limited, was secretary-treasurer, with W. S. Morlock, solicitor for Ventures and Falconbridge, as the fifth member of the board.

As mine superintendent, in actual charge of operations at the mine, Lindsley had chosen Ernest Craig, a practical miner, whose experience had been gained principally in northern Ontario and northwestern Quebec and who had a reputation for getting things done. During the previous year he had been in charge of the Aldermac mine. Craig lost no time in getting things started. The option agreement had been signed on August 20, 1928; by September 7, Craig had a crew on the ground, preparing for the sinking of a shaft. The three-compartment opening, collared on September 17, was sunk in the footwall, and at the end of thirty days was down 253 feet. The quicksand that had stopped Edison was lacking; bedrock was reached at sixty feet without any sign of it. The site for the shaft, which happened to be at a point where the rock was relatively close to the surface, had been happily chosen. In the Edison shaft, a

hundred feet away, quicksand had been encountered at eighty feet and bedrock had never been reached. Craig bottomed his shaft at 1,033 feet, with stations at the 225, 350, and 1,000 foot levels.

Early in 1929, work began on the smelter, which was located on the shore of a small lake about two thousand feet south of the shaft; by the end of the year the blast furnace, converters and other equipment were practically ready, and production was scheduled to start early in 1930. Building the smelter was not an easy matter for Craig and his crew, none of whom had had much experience in such work. Craig had seen other smelters erected, and his assistant, J. R. Gill, a civil engineer, had worked at the Murray mine for the British America Nickel Corporation while its smelter was being constructed, but that was the extent of their experience. Craig tried without avail to borrow expert smeltermen from Inco and elsewhere; but the reputation given Falconbridge by those sceptical of its success and by others even less well-disposed was effective in preventing his getting the required assistance. Contemptuous remarks were made about the nickel mine being run by a gold miner and a land surveyor. Eventually Craig succeeded in borrowing a man from Teck-Hughes, with whose help the work proceeded.

The smelter was blown in on February 4, 1930, and despite the inexperience of those who had built it, gave little trouble and soon exceeded its rated capacity. The blast furnace was of the usual water-cooled type, ten feet in length by fifty inches at the tuyere level, with four water-jackets fourteen feet by thirty inches on each side. The two converters were twenty feet by thirteen, lined with magnesite brick. A matte consisting of 83-per-cent nickel, plus copper, was produced.

Meanwhile the depression had descended upon the world. Although Falconbridge had been launched with what seemed to be ample financial resources, the heavy construction program, and the failure of brokers to make good on what had been considered firm commitments, caused the management a good deal of uneasiness; but the crisis passed. A sizable sale of nickel to U.S. Steel at the critical moment suggests the thought that

big steel was not averse to the continuance of competition in the nickel industry.

In 1932, work was begun on a 250-ton concentrator and sintering plant, and extensions were made to the smelter and crushing equipment, in order that ores not susceptible of direct-smelting might be treated. These additions and improvements raised the average daily rate to 779 tons from the 544 tons maintained during the first three months of 1933. With the building of the concentrator, Falconbridge gained the addition to its personnel of a man who was to play an increasingly important part in its affairs. He was R. C. Mott, who after graduation from Queen's University had joined the Ventures staff at Sherritt Gordon and now came to Falconbridge as mill superintendent.

Falconbridge had weathered the worst of the depression, had increased its plants' capacity, paying for the new equipment out of earnings, and at the end of 1933 was able to show a net profit for the year of \$1,122,999. Furthermore, in the same year, the first dividend (twenty-five cents a share) was paid. If proof were needed that this company was on the high road to success, this was it.

Hitherto, Canadian mines had not been greatly concerned with geology. On the staffs of some of the larger mines a young geologist might find a place under the supervision of the mining department. Inco was one of the first to depart from this practice when, in 1930, L. C. Graton, Professor of Economic Geology at Harvard, was retained to organize a department of geology at Copper Cliff. He selected A. B. Yates to head the new department, which was largely recruited from men who had done their graduate work at Harvard under Graton. Among these was Horace J. Fraser, a young Canadian with a brilliant scholastic record, who remained with Inco until 1935 when he took a post at the California Institute of Technology.

Thayer Lindsley, well aware of the need for geological direction in mining, was not slow to follow suit; he engaged Terence Connolly, formerly of the Bradleys' geological staff, to set up a geological department at Falconbridge. Connolly was asked to make a comprehensive report on the geology of the Basin, with a view to the acquiring of additional properties

along the rim. With the assistance of Stanley Davidson, as consultant, this policy was continued under Connolly's successors, F. M. Galbraith, R. C. Hart and D. R. Lochhead.

During 1934, a five-compartment shaft (No. 5) was begun at Falconbridge about 2,400 feet east of No. 1, and by the end of the following year it had reached a depth of 1,400 feet. In 1935, a change was made from shrinkage mining, hitherto the practice, to cut-and-fill, making possible the production of cleaner ore. In the first year about twenty-five per cent of the ore mined was by cut-and-fill, the percentage increasing as time went on.

On April 9, 1940, Falconbridge received a severe set-back when its Kristiansand refinery was seized by the invading Germans, making necessary a curtailment of operations until refining arrangements could be made with Inco. Nevertheless, Falconbridge had already established itself as an important factor in Canadian mining and in the world's markets. Its great period was yet to come, but the scoffers were long since silenced, and it could now be said that here at last was a company competent to stand with Inco and Mond as the only ones, in more than half a century, that had proved capable of meeting the peculiar problems of the nickel industry.

In the years prior to World War II, Falconbridge had continued to acquire properties on or near the contact along the rim. These were explored by magnetometer and when anomalies were indicated, drilling followed. One such anomaly, on the north rim, west of Inco's Levack mine, where no outcrop existed, was test-drilled in the fall of 1935, disclosing mineralization that ultimately was developed into the Hardy mine.

Exploration at Falconbridge was largely discontinued during the war and attention was focused on obtaining the greatest possible production from the Falconbridge mine. In the meantime H. J. Fraser, already mentioned, had become mine manager at Falconbridge in 1945, and later vice-president and general manager. After the United States entered the war, Fraser, on leave from Caltech, had served with the Office of Economic Warfare in Washington, having charge of the purchase abroad of nickel, manganese, chromium and iron. It was in this con-

nection that he had come under the eye of Thayer Lindsley, who urged him to come to Falconbridge. Born in Saskatchewan and educated at the University of Manitoba and at Harvard, he had welcomed an opportunity to come back to Canada.

The year 1946, with demand for the metal falling off after the war, was a low point for the nickel industry. Fraser's first job was to consolidate operations, curtail production and eliminate waste effort. With this accomplished, he and Lindsley launched the company on a four-point program in anticipation of the eventual increase in the demand for nickel which they believed was bound to come.

First came the formation of a metallurgical branch department, to investigate new treatment processes in preparation for the expansion of smelting facilities and to study ways and means for the recovery of iron, sulphur, and a greater part of the cobalt content of the ores.

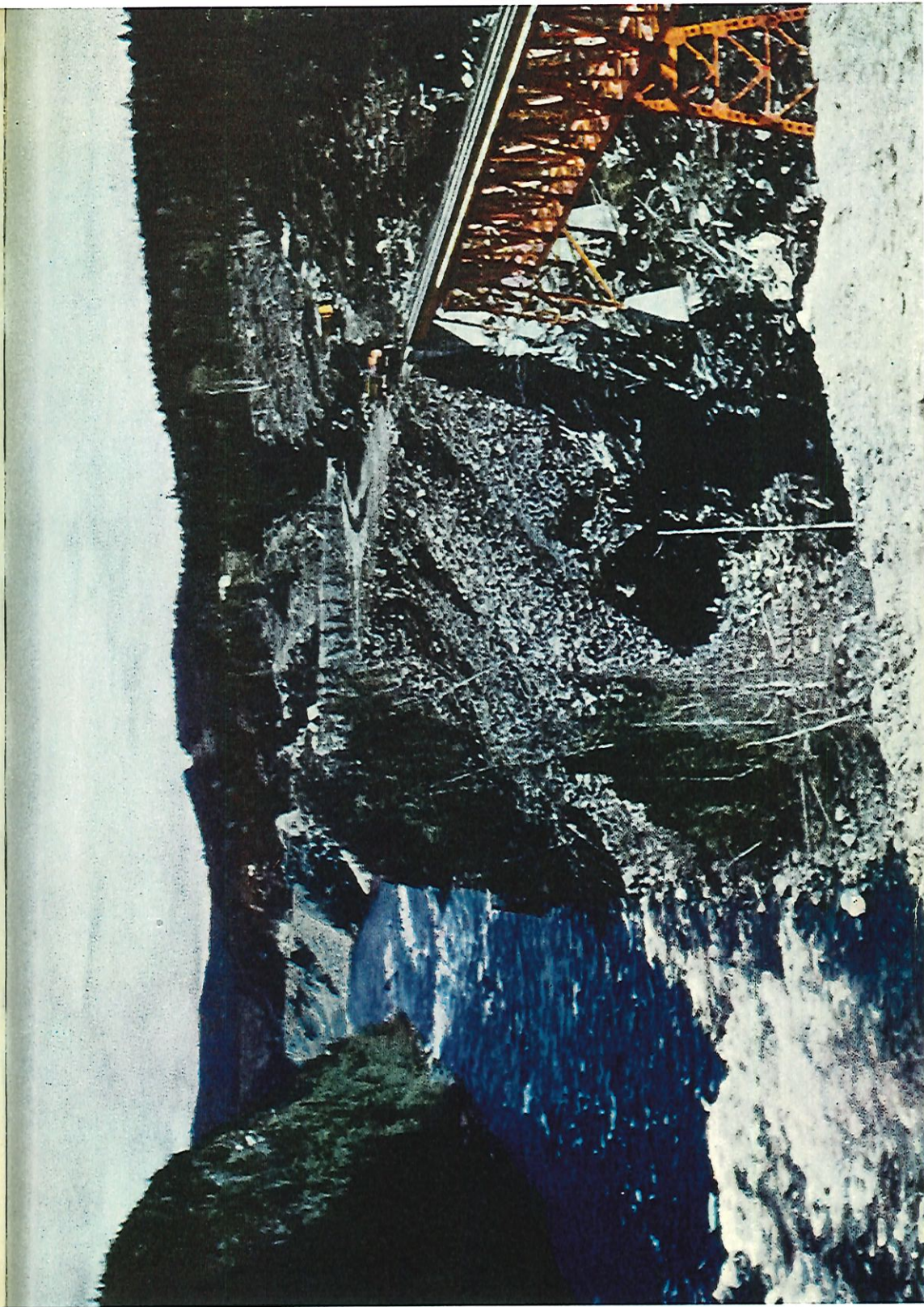
Secondly, a study of available ore deposits was undertaken to determine which, if any, were suitable for development to meet the expected expansion if and when it occurred. This survey resulted in the conviction that the plants could not safely continue to be tied to only one mine, and development of the recently discovered McKim mine followed.

Thirdly, with the discovery of encouraging nickel prospects in northern Manitoba (leading to the expectation that Sudbury's monopoly of the nickel industry might soon be challenged), the geological department was reorganized into two branches: one to deal with the Sudbury district and the other, operating from the head office in Toronto, to cover activities in the rest of the country.

Fourthly, in view of the recent loss of refining facilities in Norway, consideration was given to the possibility of refining in Canada, but after further study, which favoured a continuance of refining in Norway, plans were adopted for the expansion of the existing refinery.

This four-point program was progressing nicely when the combination of jet propulsion, atomic expansion and the Korean war shot the demand for nickel into an upward spiral. The United States government having entered the market, a sales

*Moisie River at Mile 12, Q.N.S.&L. Railway →
(Iron Ore Co. of Canada)*



contract was concluded with that government, enabling the company to develop the Hardy mine with the certainty that this increased production could be disposed of. A second and much larger contract was secured in 1952, making it possible for the company to embark on further expansion programs in the mines, smelter and refinery calculated to raise nickel production from 30,000,000 pounds a year to an ultimate 55,000,000 pounds.

This expansion involved the development and bringing into production of the Boundary mine, Fecunis Lake mine and Longvack mine, all in the Levack area, on the north rim. In addition, the old Mount Nickel property, in Blezard Township (staked by Stobie in 1885), was reopened and the East mine (half a mile east of the Falconbridge mine) was developed and brought into production. At the time of writing a new smelter was under construction at Falconbridge, and refinery expansion in Norway was practically completed.

Exploration outside the Sudbury district had resulted in several interesting nickel discoveries, the most important of which, near Kenora, Ontario, was being explored by means of shafts and drifts.

In the Sudbury district, exploration had disclosed an important deposit called Strathcona which was being drilled at the time of writing. A shaft, (called Onaping) was being sunk to 3,500 feet on the depth extension of the Boundary ore deposits to mine the ore involved and to explore the surroundings at greater depth than could economically be done by drilling from surface.

Important as these new properties were likely to become, the fruits of successful geological deduction were to be more fully demonstrated. To the east of Inco's Levack, a small weed-filled lake called Fecunis (fe, cu, ni, s) lies at a point on the norite contact where a well-marked fault has thrown the rim out of alignment. No ore was in sight, but Falconbridge geologists, now headed by D. R. Lochhead, deduced that deep beneath the lake a large orebody probably existed. It would cost a lot of money to find out but, with Lindsley's and Fraser's concurrence, the decision was reached to apply the diamond drill test.

During the winter of 1948-49 a drill was set up on the ice, and in March a small ore section was cut at 1,450 feet. This was decidedly encouraging and the following winter a second and larger drill was set up to test the ore horizon at a somewhat deeper point. Drilling continued until the break-up and the drill was then transferred to a barge specially designed for the purpose. Interest mounted as the drill neared the depth at which ore was expected. The result was spectacular. The narrow stringer of ore at 1,450 feet had blossomed into 300 feet at the 3,000-foot level, indicating ore in sufficient quantity to ensure a mining operation for many years to come.

To open up the property, two shafts have been sunk. No. 1, fourteen by twenty feet, was bottomed at 3,995 feet. The collar of this shaft is reached by an adit extending 650 feet into the hill and 190 feet below the hill-top. Ore is hoisted to above the adit level and transported by conveyor to the mill, which is situated at the foot of the hill. No. 1 is the hoisting shaft; No. 2, the one from which the ore is being developed, is 3,243 feet deep, and approximately eight feet by twenty-four. Located on lower ground near the lake, it is connected with No. 1 at convenient intervals.

Beginning in 1928 with an undeveloped orebody, lacking both road and railway connection with the nearest settlement, Falconbridge at the end of 1955 was operating five mines, with four others in various stages of development. Total ore reserves developed and indicated stood at 39,847,650 tons, containing 1.41 per cent nickel and 0.73 per cent copper.

Originally confining its efforts to the production of nickel and copper (including gold, silver and the platinum metals) Falconbridge, since World War II, has also become a prominent producer of cobalt and sulphur dioxide; and when present plans are perfected the iron and selenium content of its ores will also be utilized.

In 1953, Falconbridge's operations in the Sudbury district were divided into two jurisdictions, one centred about the Falconbridge mine and the other, called Onaping, in the Levack area, each with a general superintendent in charge.

Demand for nickel has brought two new nickel-copper mines into production in the Sudbury district since 1952. The first of these, owned by Nickel Rim Mines Limited (formerly East Rim Nickel Mines Limited), is located in MacLennan Township, where the company has twenty-three claims. Its mill is rated at 1,000 tons a day; concentrates are trucked to the Falconbridge smelter. The second, owned by Nickel Offsets Limited, is located beyond the north rim and comprises approximately 1,912 acres. Its mill has a daily capacity of three hundred tons, and its concentrates go to Falconbridge.

The Canadian economy was booming in 1928 when Thayer Lindsley and his associates in Ventures Limited incorporated Sudbury Basin Mines to develop the lead-zinc-gold-silver deposits within Sudbury Basin. A depression and a world war have held the project in abeyance. In the interval several corporate reorganizations have occurred; the two original companies merged under the name of Ontario Pyrites Limited, which eventually became Consolidated Sudbury Basin Mines Limited. Beginning in 1951, the company sought, by drilling and underground exploration, to determine the extent of possible ore reserves with a view to production plans. Shafts at the Errington mine were deepened, a fourth shaft was sunk at Vermilion Lake and underground development was undertaken at both places. By the end of 1955, ore reserves amounting to nearly fifteen million tons were indicated, averaging copper, 1.2 per cent; lead, 0.83 per cent; zinc, 3.63 per cent; gold, 0.019 ounces; silver, 1.65 ounces; and pyrite, 23 per cent, after making allowance for dilution.

In 1955, capitalization of the company was increased from 6,500,000 shares of no par value to 7,600,000 shares, and plans were adopted for the construction of a 3,000-ton mill. Lengthy experimentation had established the possibility of treating the ore economically.

If needed, here is another instance of the time-lag all too often inevitable in mining development. Of the original promoters, only Thayer Lindsley is alive. Full-scale production is not expected to be reached until 1958, thirty years exactly since the project was first launched.

EXCEPT WHERE EXTREMELY RICH DEPOSITS ARE CONCERNED, THE chief factor governing mining in the far north is transportation. For that reason the principal mines beyond the reach of railways are usually gold-producers. Placer gold, of course, is ideal for these far-away places, as was demonstrated in the Klondike; but while placer miners were feverishly digging on Bonanza, Eldorado and Dominion at the turn of the century, hard-rock prospectors were already searching the surrounding hills and gullies, hoping to locate veins studded with gold on a par with that being washed in such quantities from the gravel beds. Many gold-bearing veins were found, but few with values sufficient to stand lode-mining costs.

Sluice-boxes had produced variable amounts of silver, lead, zinc, copper, tin, tungsten and a number of other metals, so when hope of rich gold ore faded somewhat, prospectors began to look for some of these other metals which might be found in sufficient quantity, and high enough in value, to justify development even at such distance from the smelter. Whitehorse had railway connection with Skagway, and consequently most prospectors confined their efforts to that area, making some promising copper finds. In a few cases the ore was of sufficient grade to justify hand-picking for shipment to smelters outside, but none was found that would provide steady mill-feed for a smelter.

Stewart River was one of the early placer streams, and the hard-rock prospectors did not overlook it in their search. Among a group of outliers on the south flank of the Mackenzie Mountains (there lying almost east and west), in an area drained by the Mayo River, a tributary of the Stewart, important silver-lead-zinc deposits were discovered, principally on two "hills,"

Galena (5,000 ft.) and Keno (6,065 ft.). The mineralized zone extended from Lookout Mountain on the west to the eastern part of Keno Hill, a distance of about twenty miles, varying in width from a few hundred feet at the western end to over three miles on Keno Hill.

The rocks underlying this area consist chiefly of a thick series of interbedded sedimentary schists and quartzites intruded by greenstones and in a few places by rhyolite. The structure is much broken by folding and faulting, and the mineralization is in association with the fault zones. Veins vary from eighteen inches to thirty feet in width, with an average of eight or nine feet.

The first discovery, made in 1906 and later known as the Silver King mine, was on Galena Creek at the foot of the western slope of Galena Hill. It was worked intermittently till 1918. Hand-picked ore, packed in bags, was trucked to Mayo Landing and transferred to river steamers for the 180-mile run down the Stewart, followed by a further 390 miles against the current of the Yukon to Whitehorse. From there it was shipped over the White Pass and Yukon narrow-gauge railway to Skagway, where it was loaded on ocean steamers for Vancouver, completing the last lap to the smelter by railway. Because most of the values were in the silver (lead prices were low and lead unmarketable), only ore carrying more than a hundred ounces could be handled with profit.

Louis Beauvette's discovery of high-grade ore on the top of Keno Hill in 1919 started a staking rush which resulted in many more discoveries and established the region as potentially important. The Sadie-Friendship vein, on the northwest slope of Keno Hill between 3,950 and 4,490 feet above sea-level, was discovered in 1921. These discoveries brought into the picture the American Smelting and Refining Company which, through its subsidiary, Yukon Gold Company Limited—already operating placers in the Klondike—bought what was called the Number Nine vein and also the Sadie-Friendship. Operating through a new company, Keno Hill Limited, the A.S. and R. subsidiaries shipped, during the period 1920-23, some nine thousand tons of ore averaging 204 ounces of silver and 54 per cent lead.

In 1921, the Bradleys of San Francisco, by means of a Canadian company, the Treadwell-Yukon Corporation Limited, became interested in the area. The Bradleys' representative, Livingston Wernecke, a geologist, acquired control in turn of the Ladue, Sadie-Friendship (adjoining the former on the west) and Lucky Queen, all near the top of Keno Hill. The sale of high-grade ore from the Ladue began in 1923, and in January 1925 production was begun from a 140-ton mill built at Wernecke Camp.

In the meantime, Treadwell-Yukon secured options on the Silver King and the Elsa (three miles east) on Galena Hill. In 1932, when all the profitable ore in the Keno Hill properties was exhausted, it decided to transfer its plant to Elsa. The Calumet mine, on the northwest slope of Galena Hill, was acquired in 1935, and shortly afterwards an option was taken on the Hector group. An aerial tramway, approximately 13,700 feet long, was completed in 1939 between the portal of the Calumet-Hector adit and the Elsa mill, which had begun operations in March 1936.

The remaining interests of the Yukon Gold Company and Keno Hill Limited, after having been leased by Treadwell-Yukon, were purchased outright in 1939, and these companies then withdrew from the district.

At the time that Treadwell-Yukon's base of operations was moved from Keno Hill to Elsa, Livingston Wernecke was transferred to Juneau and thereafter his jurisdiction over the Mayo properties was much less, and to that extent the latter suffered. In 1941, a combination of difficulties due to the onset of the war, exhaustion of easily-reached ore and the death of Wernecke in an aeroplane crash, resulted in a suspension of operations. During its active period, the Treadwell-Yukon had shipped approximately sixty thousand tons of concentrates containing over thirty-one million ounces of silver and fifty-six million pounds of lead, worth nearly twenty-one million dollars.

The war was about over when the next phase in the history of the silver-lead-zinc deposits on Galena and Keno hills began. In 1943, Glynguard R. Burge, an aviator with an active interest in exploration, had become president of Lindsley's Frobisher Exploration Company Limited. (The name was changed in

1947 to Frobisher Limited.) Burge was interested in the Mayo properties and had made an unsuccessful attempt to secure an option. Trying again in January 1945, he sent Benjamin Meen, an experienced prospector and mining scout who was then field manager for Frobisher, to San Francisco to negotiate a deal with the Bradleys. Meen returned to Toronto with a year's option, the purchase price to be \$75,000 and 750,000 shares (\$1 par value) in a company to be incorporated.

Frobisher at the time was somewhat overloaded with projects requiring money, and the directors authorized Lindsley to find a suitable associate, capable not only of participating in the financing, but prepared to undertake the management for a period of years. Lindsley thought of Fred Connell and his Conwest Exploration Company Limited. Connell was devoting a large part of his time to his job as Metals Controller, and it was in Ottawa that Lindsley and he met to discuss the matter. Connell was agreeable to the idea and the two companies then went ahead on a fifty-fifty basis, incorporating for the purpose the Keno Hill Mining Company Limited (later renamed United Keno Hill Limited).

Conwest Exploration, which assumed the management of the new company, comprises a group of men who for some years have worked closely with Connell, including his brother, W. H., as vice-president, Alan Cockeram as secretary, C. R. Elliott as treasurer, and J. J. Rankin, as manager of exploration.

Frank Buckle, a mining engineer in the Conwest employ, was given the task of rehabilitating the Keno Hill plant and workings, always difficult after a lengthy suspension of operations. Ore had still to be shipped by truck, boat and rail to smelters outside, and the only power was that supplied by diesel engines, with fuel at forty cents a gallon at the mine. That Conwest was able to get the company on a paying basis while requiring a capital subscription by the two parent companies of less than \$900,000, at the same time enabling them to retain jointly better than a sixty-per-cent interest in the company after it was brought into production, is an achievement almost unique in the history of Canadian mining.

In 1947, Frank Buckle was succeeded by H. Brodie Hicks, formerly at Central Patricia Mines, with Nick Gritzuk as assistant manager and R. L. Segsworth as superintendent of mining. In June 1949, the concentrator burned down; but despite the difficulties due to distance and scarcity of equipment, a new mill was erected (capacity 250 tons a day) and placed in operation by October of the same year.

Until the fall of 1950, production was still rigidly controlled by the limitations imposed by river transport which would not permit the handling of more than twelve thousand tons of freight each way in a season. This transportation bottleneck seemed to offer insuperable obstacles to any idea of greatly increased production. But in October of that year completion of a highway built by the Government of Canada at a cost of five and a half million dollars, connecting Mayo with the Alaska Highway near Whitehorse, initiated a new era for United Keno Hill Mines. The new highway did not cause an immediate reduction in transportation costs, but it did make more economical operation possible because mining could now be carried on the year round. It also did away with the necessity for stockpiling and the accumulation of supplies to suffice during the long period when transportation was suspended. Maintenance costs are shared between the government and users of the road, the latter paying by toll.

Completion of the highway made necessary the organization of a transportation agency and this was put under the management of N. Gritzuk, former assistant manager, with headquarters at Whitehorse. Trucks were bought—gasoline at first, then diesel—for use in two convoys; one travels each way daily, except for about three weeks in spring and about six in the fall, when break-up and freeze-up make traffic difficult or impossible. At one time each convoy was attended by a "wrecker" for aid in case of accident, but this is no longer necessary. Between Mayo and Whitehorse, three rivers, the Stewart, Pelly and Yukon, are crossed, in summer by ferry and in winter by ice bridges. The latter consist of interwoven logs laid on the ice in early fall and frozen solid by water pumped onto the surface. Difference in the times at which these rivers freeze and break up is respon-

sible for the length of the interruptions to traffic. Time-loss could be reduced considerably if they were bridged.

Action of another sort by the government in the fall of 1950 was of prime importance. This was the announcement of its intention to undertake the three-million-dollar hydro-electric power installation on the Mayo River which would cut several hundred thousand dollars from each year's mining and milling costs. Plans were for an initial output of three thousand horsepower, capable of being increased to eight thousand. Construction was begun in 1951 and completed late in the following year.

The United Keno company had become the owner of about twenty-six square miles of territory, comprising finally (principally through further staking) some 490 claims; and important vein showings had been outlined along a favourable zone extending over twelve miles. On about twenty of these, more or less mining had been done at various times. At first the plan had been to develop a number of different mines, but results at the Hector on Galena Hill (acquired by purchase in 1946) were so promising that attention had been largely focused upon it. The Calumet, operated from the Hector workings, with which it is connected by a 650-foot drive, and the Elsa, at the main camp, were later brought into production.

In order to treat tailings carrying high silver values, a cyanide plant was installed in 1952 and operated for two or three years, but as the efficiency of the flotation circuit increased the need for it became less, and it was finally discontinued. During the year ending September 30, 1955, the concentrator operated 96.70 per cent of the time, handling 162,307 tons of ore at a daily rate of 444.7 tons. Sales of concentrates for the same period amounted to \$9,549,603, showing a profit of \$2,601,511.

The United Keno management faces a combination of difficulties which is not to be found in any other mine in Canada. The ground is very soft, making heavy timbering necessary. Because of the camp's height above the valley level, water is scarce, requiring recirculation of that used in the concentrator; yet the workings, in most cases, are wet. The inconveniences of permafrost, underground and on the surface, render the operation more complicated. Short winter days (Keno Hill being

less than three degrees south of the Arctic Circle) and long periods of extreme cold further complicate an already difficult situation, and it is a tribute to Conwest that the enterprise is so successful. A first mortgage bond issue, placed after the concentrator had burned, was fully paid at maturity (1953), and in 1954 the payment of dividends, regular and extra, began.

United Keno Hill, rated as the largest silver producer in Canada and the third largest in the world, will doubtless not do much more to change its relative position unless a considerable improvement in transportation facilities occurs. Owing to the difficulty of drilling because of poor coring, and for other reasons, the company has not set out to build up ore reserves greatly in advance of present needs.

The first power at Keno Hill was derived from wood-burning boilers, which rapidly consumed all the timber within reach. In 1947, the company bought control of coal deposits near Carmacks, on the Yukon River, which it operates under a subsidiary, the Yukon Coal Company Limited. Trucks returning empty from Whitehorse load coal at Carmacks for delivery at Elsa, accounting for slightly more than one-half of production, the balance being sold in Whitehorse and Dawson. United Keno also owns a sawmill on the Stewart River, near Mayo, with timber limits about twenty-five miles farther up the river.

Since June 1953, Clare E. White, who succeeded H. Brodie Hicks, has been general manager. His many years' experience with Cominco, at the Sullivan mine and later as manager of Cominco's Northwest Territories operations at Yellowknife, are of great value to him in the position. With C. N. D. Taylor as assistant manager and construction superintendent, and A. E. Pike, who joined the staff in 1954, as mine manager, United Keno has a capable team.

Although Northern Airways Limited had operated locally out of Carcross, Y.T., since 1931, and the White Pass and Yukon Route between Whitehorse, Mayo and Dawson had operated since 1935, Yukon aviation history really began in 1937 when Grant W. McConachie, a young Edmonton flyer, charted a course through the wilderness and in July of that year began a regular

weekly mail and passenger service (originally known as United Air Service and later as Yukon Southern Air Transport) between Edmonton and Whitehorse, connecting with Vancouver by way of Fort St. John, B.C.

Except for a well-equipped airport at Edmonton and a much more primitive one at Whitehorse, McConachie operated during the early years without even rudimentary aids to navigation, using improvised landing fields. When, after the outbreak of war, the Department of Transport established the Northwest Staging Route along the line McConachie had blazed, Yukon Southern was able to improve its service considerably. Between 1939 and 1941, the Canadian Pacific Railway acquired ten northern airlines, including Yukon Southern; and in 1942 these were consolidated into Canadian Pacific Airlines, of which Grant McConachie soon became president. While, in the interval, C.P.A. has grown into an outstanding international air service, the mining regions of the north have in no way suffered.

It is likely that many mines will be opened up in the Yukon as soon as transportation facilities improve. Yukoners are hopeful that when Alaska attains statehood the people of that new state will no longer tolerate being so isolated from the rest of the United States. The Alaska Highway, built by the United States Army during World War II between Dawson Creek, B.C., and Fairbanks, offers (aside from air service) the only alternative to the sea trip between Alaska and the main part of the United States. The Premier of British Columbia hopes to make some arrangement for the extension of the province's Pacific Great Eastern Railway, now reaching part way. If this should happen, mining in the Yukon would greatly benefit.

Two prospects, on each of which considerable development work has been done, would most certainly become producers if a railway should ever tap the Yukon. One of these, a lead-zinc-copper-silver deposit on Vangorda Creek, a tributary of the Pelly River, 125 miles northeast of Whitehorse, is controlled by Prospectors Airways. The other, owned by Hudson Bay Mining and Smelting Co., is on Quill Creek, 200 miles west of Whitehorse and ten miles south of the Alaska Highway. It consists of a nickel-copper deposit which almost anywhere else

might have made a mine. Concentrates could, even now, be trucked to Haines, Alaska, but whether this will be done or not will probably depend upon the extent to which the company is occupied with the development of its apparently more important new properties in Manitoba, within easy reach of its plant at Flin Flon.

Although several gold discoveries had previously been made near the mouth of the Yellowknife River, which flows into Yellowknife Bay, a small indentation on the east side of the North Arm of Great Slave Lake, the Yellowknife gold camp owes its origin to the finding of pitchblende and silver at Great Bear Lake by Gilbert LaBine in 1930. (That momentous event is dealt with in a later chapter.)

LaBine's discovery was followed by a considerable amount of staking in nearby territory, and a number of companies were formed to take over properties so staked. One of these, Bear Exploration and Radium Limited, incorporated in Ontario in 1932, secured twenty-nine pitchblende claims at Contact Lake, nine miles from LaBine's prospect at what later became known as Port Radium. After the price of gold had been advanced in January 1934, the Bear company moved its prospectors, C. J. Baker and H. M. Muir, to Yellowknife Bay, where in September 1934, on the east side of the bay, they staked a tract of ground upon which such extremely highgrade gold quartz was discovered that the claims were called the "Rich" group. When samples reached Toronto they created a furore in mining circles and Bear had a choice between several prominent mining concerns in making a deal.

Bear was the product of two Toronto men, each a personality in his own way. The idea of the company originated with J. J. Gray, a lawyer, who succeeded in persuading a client, W. H. Wright, formerly an associate of Harry Oakes at Kirkland Lake, to finance the enterprise. Major Lockie Burwash, a well-known geologist, was engaged as field manager. Gray's plan was to maintain the Bear as the parent organization, forming subsidiaries to take over various groups of claims as they were staked. Thus the Rich claims were transferred to Burwash Yellowknife

Gold Mines Limited, on whose shares F. M. Connell was given an option based upon an undertaking to drill. Within weeks, Charles L. Coleman, Connell's engineer, was on the ground, examining the showing and staking additional claims for Connell, which included territory later to become the Yellowknife town-site. Incidentally, the Rich claims did not make a mine; Coleman's report was unfavourable, and it was later found that the very high-grade surface showing had pinched out within seventy-five feet.

The thought of such rich ore, however, stirred prospectors to action, and in the dead of winter Murdock Mosher of Cobalt and Haileybury, who had staked the Central Patricia in the late twenties and in the early thirties had staked the mine in the Geraldton area named after himself, flew in with Leigh Brintnell of Mackenzie Air Service to stake some claims, arriving about Christmastime. When the plane set him down on Yellowknife Bay, the only sign of habitation was Coleman's tent on the east shore, and he pitched his own alongside. The Rich claims extended westward beneath the lake; and in order to tie on to their western boundary, Mosher crossed to the opposite side of the bay and staked nineteen claims there. Remaining no longer than necessary, he flew south before the end of the month, coming down momentarily at Fort Smith to record his claims.

Baker and Muir continued staking for Bear and its subsidiaries, and during 1935 they staked a large area on the west side two to four miles north of the future site of Yellowknife town for Burwash Yellowknife. This property was in time transferred to Giant Yellowknife Gold Mines Limited, another subsidiary, incorporated in 1937. (In 1939 Burwash Yellowknife was absorbed by Yellowknife Gold Mines Limited, another Gray company.)

During the 1935 season the Geological Survey of Canada made an examination of the Yellowknife region. In September, members of the survey party discovered visible gold in the greenstones on the west side of the bay on what was later known as the AYE group belonging to Kamcon Mines Limited, controlled by Cominco through Kamlac Gold Mines Limited. Its

report recommended as favourable prospecting ground an area three thousand square miles in extent.

Yellowknife was too inaccessible to attract many prospectors who did not have a mining company or syndicate behind them. On the other hand, it was a region that had a considerable amount of appeal for the large companies, and most of them, in one way or another, were represented in the district. The principal of these was Cominco which, after a vain effort at becoming established in parts of Canada other than British Columbia, had some time previously withdrawn from most of its outside ventures. Yellowknife succeeded in luring the big company back into the exploration field; and in 1935 its geologists located and began preliminary work on a large area on the west side of the bay south of the principal Bear holdings. This became the Con mine.

Trenching on the property began in 1936, and during the following winter a prospect shaft was sunk to a depth of sixty feet. W. M. Archibald, Cominco vice-president in charge of exploration, had taken the development of the Yellowknife properties under his personal supervision and he gave the signal for full speed ahead.

The Con claims adjoined those still lying idle which Murdock Mosher had staked. Mosher had been employed by the Kenogamisis Syndicate which included Fred G. MacLeod, Arthur Cockshutt, "Hardrock" Smith, J. M. Macintosh and others jointly interested in mines in the Geraldton (Ontario) area. The syndicate was offering a ninety-per-cent interest to anyone who would agree to drill, but those who might otherwise have taken a chance were awaiting results on the Rich claims. According to regulations in the Northwest Territories, Mosher was safe for a year from the date of recording, providing a certain amount of work was done. If for any good reason it had not been done, an extension of six months, and perhaps longer, could be secured. Such an extension had, in fact, been received, advancing the expiry date to August 16, 1936.

Early in the summer of 1936, Thomas Payne, an Englishman of good education who had already spent some years in Canada; mostly in the west and north, had drifted to Yellowknife, where

for a while he was employed by Burwash Yellowknife. As the time drew near for the expiration of Mosher's staking rights, Payne decided to re-stake the ground, and in the early morning of August 17, with the assistance of a friend, he secured a number of claims. Chief of these were the four known as the P.&G. group; these were staked in the names of Gordon Latham, an Edmonton school-teacher who was spending the summer prospecting, and Latham's fiancée, Peggy, the licences having been supplied to Payne by Latham. Some time before, Payne had received money on a grubstake basis from Micky and Pat Ryan, who operated a transfer business across the portage between Fort Fitzgerald and Fort Smith on the Slave River, and they were thus entitled to a share in Payne's stakings.

Payne became very sick and was taken to hospital in Edmonton. In the meantime, Archibald had become obsessed with the desire to get possession of the P.&G. claims for Cominco and made an offer of thirty thousand dollars which, in the circumstances, seemed a good price for unproven ground. Micky Ryan, who acted as spokesman for Payne and associates, spurned the offer and proceeded with the incorporation of Ryan Gold Mines Limited, under which drilling was begun. After a suitable interval, Archibald advanced his price to \$159,000 for a seventy-per-cent interest, but this also Ryan turned down. Finally, in an Edmonton hotel room, Archibald bluntly asked Ryan to state his price. Ryan replied that the price was half a million dollars for a sixty-per-cent interest, and Archibald, having met his match, closed the deal.

Until eight years later, when the big orebody was located at the Giant, this was the greatest event in the history of Yellowknife. It was felt that if Cominco, whose hard-bargaining proclivities were well known, and whose engineers and geologists were of the best, was prepared to pay such a price for four claims, the most optimistic statements concerning the future of the camp seemed justifiable. Comparisons were made with Porcupine and Kirkland Lake, and mining companies not yet represented in the camp made determined efforts to get a foot in the door.

In the flurry that followed the Rich staking, Charles McCrea,

former Minister of Mines for Ontario, had sent prospectors to Yellowknife who had located a group of claims for him, south-east of the Con. Archibald's decision to sink a shaft on the Con during the fall of 1936 caused McCrea to invite his friend Joseph Errington to help finance his claims; and when drilling on these disclosed a number of narrow but high-grade quartz veins, Negus Mines Limited was incorporated (1937) and a shaft was collared. J. G. McNiven, later to become mayor of Yellowknife, was the mine manager. Production began in 1939, continuing throughout the war except for the period from October 1944 to July 1945. Operations ceased in September 1952 and the property was subsequently purchased by Cominco, whose ground it adjoins.

Glyn Burge's G. B. Explorers was responsible for a great deal of prospecting and development in the Yellowknife region. Burge also organized the Thompson Prospecting Syndicate, with Fred Thompson of Haileybury as manager. Thompson, English-born like Burge, had become a prospector shortly after coming to Canada in 1907 and had spent the interval in northern Ontario and Quebec, where his efforts had met with considerable success. Early in 1938, he arrived at Yellowknife, accompanied by his younger brother Bob, and did his first staking on the Beaulieu River about ninety miles northeast of Yellowknife settlement. A few weeks later, with Roy Lundmark, a young Ontario prospector, and Murdock Mosher, both also associated with Burge, Thompson was set down by plane on a small lake soon to be known as Thompson Lake, thirty miles northeast of Yellowknife. On a little island, which they named Treasure Island, they made a sensational gold discovery in a quartz outcrop sixty feet long by about thirty feet wide, where ninety-seven claims were staked. When the news reached Yellowknife, a rush began which drew prospectors, speculators and many others to the spot from all over the continent. Burge dashed off to Toronto and brought Thayer Lindsley back with him; and Lindsley, pleased with what he saw, pledged fifty thousand dollars for drilling.

Thompson-Lundmark Gold Mines Limited was incorporated in 1938, with Fred Thompson as president and Murdock Mosher



George Hunter Photo

Giant Yellowknife mine and concentrator



Departure of truck convoy, United Keno mine



Courtesy Ontario Department of Mines
Cyril W. Knight



Courtesy The Northern Miner
Clare E. White



International Press
John J. Byrne



Ashley & Crippen Photo
Allan J. Anderson

Mining asbestos on a mountain-top, Cassiar, B.C.

Courtesy International Harvester





International Press
Alfred L. Penhale



Gilbert A. Milne Photo
Bryan W. Newkirk



Oliver Hall



Canadian Newspaper Service
M. J. Boylen

as vice-president; and among the directors were the Robert Hoffman who had performed an errand for Thayer Lindsley in the securing of his Falconbridge property, and Hoffman's brother Arnold, later to become the author of *Free Gold*, a book on Canadian mining. Ken Muir was mine manager and E. V. Neelands, consulting engineer.

When the drills confirmed the surface showings, two inclined shafts were sunk, one on the Kim vein, the original discovery, and the other on the Fraser vein, located in 1939 by Hugh Fraser, the geologist. While the veins were narrow, the ore was rich; and the break extended for over a mile.

On the Giant property a number of promising shear zones and veins had been found and a small shaft had been sunk on the high-grade Brock vein from which Charles Hershman, the engineer in charge, had hand-picked seventy-five tons for shipment to the Trail smelter. The return from this was approximately one thousand dollars a ton, but the operation was nevertheless unprofitable. Despairing of getting enough money from Bear to carry on development on a scale commensurate with what he believed the property deserved, Hershman resigned, and for some years the Giant lay mostly idle.

Production had begun at the Con in 1937 with a 100-ton cyanide mill which in August 1938 poured its first gold brick—the first in the history of the Northwest Territories. The Negus mill first turned in 1939. The Ptarmigan, four miles east of the north end of Yellowknife Bay, and the Ruth, fifty-five miles east of Yellowknife, both Cominco properties, began production during the war, the Ptarmigan in 1941 and the Ruth in 1942. The Thompson-Lundmark also began producing in 1941. At first, the war did not seriously hamper operations, but it did discourage prospecting and exploration. As the war continued, however, shortages of labour and equipment imposed such difficulties that, one by one, the mines closed down.

Meanwhile Glyn Burge had had his eye on the Giant. His interest was heightened when Don W. Cameron, a veteran prospector with experience in various parts of Canada, from British Columbia to Porcupine, who was now operating his own explor-

ation company in Yellowknife, informed him of a promising quartz occurrence he had observed in 1938 near the southeast boundary of the Giant property, and had re-examined in 1941. Burge made definite efforts to gain control of Giant in 1942, but was unable to persuade Gray to part with it.

A Toronto lawyer, J. H. Greenberg, had succeeded in making a deal with Gray in connection with Bear's Contact Lake claims, which were transferred to the newly organized International Uranium Mining Company Limited. Burge therefore retained Greenberg in the hope that he might be equally successful in conducting the Giant negotiations on behalf of Frobisher Exploration. Greenberg did succeed; and on June 4, 1943, the agreement was signed. In consideration of Frobisher's undertaking to buy 100,000 shares of Giant stock at ten cents a share, payable June 15, 1943, Frobisher was granted an option on 1,115,000 additional shares at prices ranging from ten to thirty cents a share, the final payment to be due on March 15, 1945. This was to prove a marvellous deal for Frobisher.

Dr. A. S. Dadson, one of the geologists in the Ventures organization, to whom was assigned the task of working out the complex geology of the region, evolved the hypothesis that underlying Baker Creek—a well-marked, drift-covered trench extending the length of the property east of what was known as the West Bay fault—a major gold-bearing shear-zone system might be found. A drilling program was outlined, having as a starting-point the outcrop previously noted by D. W. Cameron. Drilling began in February 1944 under the direction of A. K. Muir, who had been appointed manager, and within a few weeks a large orebody was disclosed, with values close to half an ounce in gold per ton. Giant stock shot up from a few cents to two dollars a share. The long-deferred Yellowknife boom was on, fed by a succession of sensational reports as one major ore-shoot after another was cut by the drills. With Giant stock at \$11.50 a share, all other Yellowknife issues basked in its reflected glory. New companies sprang up almost overnight and the speculating public went on a Yellowknife "binge." In 1945, despite previous staking, over nine thousand claims were recorded

in an area which extended northward about one hundred and thirty-five miles, and eastward some seventy-five miles.

In the next two years, the accuracy of Dr. Dadson's hypothesis was definitely demonstrated; three million tons of ore averaging 0.41 ounces in gold per ton were indicated in a series of shoots, some of them exceptionally high-grade, over a surface distance of about two miles. Giant's capitalization was increased from three million shares to four million, and stockholders were given rights to buy shares at \$5, which placed \$5,310,000 of new money in the company's treasury.

Giant's subsequent history has continued to justify the high hopes raised by the drilling. Plans were adopted in keeping with the idea of a big mine. The first shaft, a prospect opening, was sunk to a depth of 793 feet; B shaft, approximately 5,700 feet farther north, is about the same depth; C, the main shaft, consisting of five compartments, 1,350 feet south of B, has been put down to a depth of 1,530 feet. The three are connected at the 750-foot level by the main haulageway, approximately 7,600 feet long.

Production started in 1949 with a mill which averaged in that year 232 tons a day; by 1955 the average had been increased to 789 tons, with plans for further expansion. The Giant ore, while high-grade, is complex and presents metallurgical problems. At first, an over-all recovery of better than 85 per cent was achieved by the use of amalgamation to recover up to twenty per cent of the free gold, followed by flotation and roasting and cyanidation of the concentrate. As underground development proceeded, it became evident that, while the over-all gold content had not materially changed, the proportion of free gold was decreasing, with a relative increase in the proportion of more complex ore. For this reason, in 1955, the rate of recovery was only 79.2 per cent; but the problem was under continual study, with good prospects of eventual solution.

Following the death of Glyn Burge in 1947, Thayer Lindsley became president with Allan J. Anderson as vice-president; A. C. Callow, who had been secretary since the company's inception, continued as such. Peter N. Pitcher, one-time manager

at Cariboo Gold Quartz, became general manager of Giant in 1949, remaining, except for an interlude in 1950, until he resigned in 1956 to become general manager of Copper Rand Chibougamau. He was succeeded by Murray Pickard.

Of the mines staked during the flurry that followed the rich discoveries at the Giant, the only one that has continued as a producer is Discovery Yellowknife at Giauque Lake, fifty-two air miles north of Yellowknife town. The claims were staked in the late summer of 1944 by A. V. Giauque and his sons for the Jakeway Prospecting Syndicate and transferred by the latter to Discovery Yellowknife Mines Limited, which was incorporated in 1945. (The name was changed in 1952 to Consolidated Discovery Yellowknife Mines Limited.)

Following preliminary work by the Jakeway Syndicate, J. J. Byrne and his sons, J. C. and N. W., both mining engineers, assumed the management and undertook to develop the mine. J. J. Byrne's mining experience had begun at Cobalt, and he and his associates had been active in exploration, operating through New Athona Mines Limited and its predecessors. Their most extensive operation had been at Goldfields, Saskatchewan, on the north shore of Lake Athabasca, where they sank two shafts and did considerable underground work on the Lucky-Willy group of twenty-four claims; but they were not rewarded by values of ore grade sufficient in quantity to justify production.

At Discovery Yellowknife, shaft-sinking started in October 1946, but was interrupted by lack of finances. The ore is the richest of any mine in Canada, running in spots as high as ten ounces of gold to the ton. The vein structure consists of a horseshoe-shaped dragfold with gold values concentrated toward the nose of the fold. Up to the time of writing, the orebody has been found to extend but a short distance from the shaft, and consequently increase in production depends on greater depth.

Early in 1948, when the shaft had reached a depth of 250 feet and some lateral work had been done, the management decided that production might begin. A small mill was bought in Montana and shipped by rail to Waterways, Alberta, which is 304

miles north of Edmonton. At Waterways, terminus of the Northern Alberta Railways branch, it was loaded upon a barge and towed down the Athabasca River to and across the west end of Lake Athabasca into the Slave River. A hundred miles below the outlet of the lake, the river is interrupted by a drop of 109 feet in a series of cataracts, making necessary a portage of sixteen miles, from Fort Fitzgerald to Fort Smith, which cuts across the boundary between Alberta and the Northwest Territories. Below the portage, barges are again taken in tow for the final lap across Great Slave Lake to Yellowknife, or down the Mackenzie River.

The barge carrying the mill for Discovery Yellowknife was half way across Great Slave Lake when it sank. The short navigation season was nearing its end, but another mill was bought—this time from Cariboo Hudson Gold Mines Limited, whose mine near Barkerville, B.C., had suspended—and reached Yellowknife just ahead of the freeze-up. Only after the freeze-up could the heavy equipment be hauled over the sixty-five miles of winter road across the rough Precambrian country to the mine. Further financial difficulties, however, caused other delays during which the workings filled with water. Eventually the difficulties were surmounted, the mine was de-watered, the mill—a 100-ton cyanide plant (increased to 125 tons in 1956)—was erected and turned over for the first time in December 27, 1949. From then on, Discovery Yellowknife has not only paid its way, but since June 15, 1954, has been returning the investment in the shape of dividends.

In common with other places in the north, Yellowknife's future depends upon transportation. Besides the water routes described above, an all-weather highway connects Hay River, near the west end of Great Slave Lake, with Grimshaw, on the Northern Alberta Railways, 333 miles northwest of Edmonton. From Hay River, freight for Yellowknife must go by barge in summer and over the lake ice by tractor train in winter.

Access to Yellowknife by air was provided in the early days of its existence by Mackenzie Air Service and Western Canadian

Airways. Following acquisition of these lines by the Canadian Pacific Railway and the formation of Canadian Pacific Airlines in 1941, scheduled services have been maintained between Edmonton and Yellowknife.

The town has grown from a jumble of shacks huddled on a rocky promontory and spilling onto a nearby island into a well-laid-out community whose business and residential structures would do credit to any town of its size in Canada. Among other facilities, it has an excellent hospital. The mines' need for power provided it with electricity at an early stage in its existence. Cominco, primarily to serve its own mines, installed a 4,700-horsepower hydro-electric plant on the Yellowknife River, where water was brought through an 800-foot rock tunnel from Bluefish Lake to supply a head of 110 feet. Subsequently, the Northwest Territories Power Commission installed a plant on the Snare River, about ninety-four miles northwest of the town, which since 1948 has made power available to both town and mines.

The mineral wealth of this region will not become readily available, however, until there is a railway; and it need not be much longer delayed. On the south shore of Great Slave Lake, near Pine Point, many millions of tons of lead-zinc ore have been located, but they cannot be developed without a railway. The existence of these deposits has been known since 1899. In 1928 the Atlas Exploration Company acquired the mining rights covering the area where the occurrences were first observed. In 1929 Cominco and Ventures joined with Atlas in forming Northern Lead Zinc Limited. Under the direction of Dr. J. Mackintosh Bell, approximately twenty-five thousand feet of drilling was done and two shafts and numerous pits were sunk, which disclosed half a million tons of lead-zinc ore. Subsequently, mapping by members of the Geological Survey and by Cominco geologists indicated a much larger area underlain by commercially favourable deposits, the existence of which was fully substantiated by drilling and underground development. Cominco and Ventures secured a concession granting them exclusive exploration rights over an area aggregating five hundred square miles. Several years' drilling has disclosed flat-lying deposits

about three miles in width, extending east and west for about thirty-six miles. In 1951, Northern Lead Zinc, now dominantly a Cominco concern, was taken over by Pine Point Mines Limited; the concession was terminated and the company secured 1,018 mining claims instead. A shaft has been sunk to a depth of 382 feet and a limited amount of lateral work has been done, definitely establishing that about fifty per cent of the ore can be mined by open-pit methods.

In the western portion of Mackenzie District, where the Athabasca-Mackenzie River system provides access during a part of the year, some development is possible in spite of the present limited transportation facilities; but in Keewatin District the only development so far undertaken is in the vicinity of Hudson Bay, chiefly by North Rankin Nickel Mines Limited, at Rankin Inlet, three hundred miles north of Churchill, Manitoba.

That such a mine is in existence at all is due to the persistence of Cyril W. Knight, who after a distinguished career as a geologist with the Ontario Department of Mines, organized the Cyril Knight Prospecting Company Limited in 1928 to locate and develop prospects in various parts of the country. The boom which was to end in the market crash of 1929 was then at its height and the company succeeded in raising \$450,000, of which \$200,000 was contributed by James A. Richardson.

In the spring of 1928, the company sent four prospectors, Oliver Johnston, C. R. Rumsey, Peter Radstrom and Byron Melvin, to prospect along the west coast of Hudson Bay. Noticing gossan signs near the water's edge, they landed at a point on the north side of Rankin Inlet. Melvin, a geologist, was not impressed by the appearance of the outcrop, but Oliver cut some samples which, when assayed, showed promise.

Drilling was begun in 1929, but was interrupted by the depression and not resumed till 1936. Despite the fact that cores produced values up to 4.62 per cent nickel, 1.22 per cent copper, and 0.11 oz. platinum, with lesser values in cobalt, money for further development was hard to secure. In 1951, part of the property was transferred to Rankin Inlet Nickel Mines Limited;

in 1953-54, a shaft was sunk to a depth of 331 feet and a certain amount of lateral work was done. Following a reorganization in 1954, the company's name was changed to the present one. Construction of a 250-ton concentrator was begun in 1956; in the meantime, control had been acquired by Mogul Mining Corporation Limited, a Draper Dobie and Company promotion, with assurances of sufficient funds to see the enterprise through to production.

XVI

The Maritimes

THE AREA COVERED IN THIS CHAPTER INCLUDES NOVA SCOTIA, NEW Brunswick, Newfoundland, and the whole of Quebec except the region from Noranda to Chibougamau, which has already been dealt with. So far, this area has not contributed greatly to the wealth of Canada, but recent developments suggest that it may shortly achieve a position second to no other section in productiveness.

Strangely enough, the earliest major mining activity in the area consisted of placer diggings in Beauce County, Quebec—the only notable instance of this type of mining in Canada outside of the far West. Gold was first found there in 1823, near the mouth of the Gilbert River in the Chaudière Valley, but no attention was paid to the incident. Then, in 1834, a young girl named Clothilde Gilbert, crossing a ford near the same place, found a nugget said to have been about the size of a pigeon's egg. "My father sent me on Sunday for a horse in the field, to go to mass," she is quoted as saying. "When crossing the stream I saw something shining alongside of the water, and took it up to show my father. I never thought that such a pebble would make so much noise afterwards."

Twelve years later, C. De Lery, owner of the seigniory of Rigaud Vaudreuil, obtained a patent from the Crown giving his family exclusive privileges "for ever" to mine precious metals within the seigniory. Having had no mining experience, De Lery leased the rights to the Chaudière Mining Company which began mining on the Gilbert and Des Plantes rivers. In 1847, several rich deposits were found, from which three to ten ounces of gold a day were taken for a period of several weeks. In 1851, the rights were leased to Dr. James Douglas and others, of Que-

bec City, who continued operations, chiefly on Gilbert River, until 1864. After this date mining was carried on sporadically for about thirty years by a succession of lessees, with varying success. By the end of the century, gold to the value of \$2,000,000 had been taken from the Gilbert River valley, with about \$500,000 from other tributaries.

The portion of the watershed of the Chaudière and its tributaries in which placer mining has been more or less systematically carried on extends for about twenty miles along the valley and six miles transversely, forming a block of about 120 square miles. It lies fifty miles southeast of Québec City, and twenty-five miles west of the International Boundary between the Province of Quebec and the State of Maine.

In the earliest days, gold was secured from bars in the river by panning or rocking. Subsequently, when pre-glacial channels underlying thin layers of boulder clay were uncovered, the gravel was shovelled into sluice-boxes from open pits. When, at a later date, richer gravels were found under sixty or seventy feet of boulder clay, they were mined from tunnels or shafts, brought to the surface, and washed in the usual way.

Although earlier attempts at lode mining in Quebec were made, the first important development had its inception in 1865 when the Eustis deposit was discovered six miles southwest of Sherbrooke, in the Eastern Townships. Under various owners, this property was operated until 1938, producing altogether 2,500,000 tons of ore, much of it averaging three and four per cent copper besides a high percentage of pyrite. The latter was exported for the manufacture of sulphuric acid; and in 1887 a plant for the treatment of pyrite was built by the Nichols Chemical Company at Capelton, nearby.

The Eustis occurrence was one of a number of copper replacement deposits, resulting from intrusions during the Devonian period, in the part of the Eastern Townships that extends in a belt thirty or forty miles wide from the Vermont border to the Chaudière River. The mine was named after W. E. C. Eustis, a Boston capitalist who had organized the Orford Nickel Company to operate a nickel mine near Orford, Quebec. The ore was refractory and in order to secure a fluxing ore Eustis

bought the mine at Capelton. The lawyer who made the deal for Eustis was Robert M. Thompson who was thereby launched upon a career which would lead to the invention of the Orford process for the treatment of nickel-copper ores and result in Thompson's becoming one of the founders of what later became The International Nickel Company of Canada Limited.

About three miles east of the City of Sherbrooke, in the same band of northeasterly-trending metamorphosed volcanic rocks which to the southwest contain the Eustis and Capelton ore-bodies, are the Moulton Hill copper occurrences. The Moulton Hill mine, producing pyrite, was opened in 1889 by the Grasselli Chemical Company of Cleveland, Ohio, and continued in production until 1895. In 1942, the Aldermac Copper Corporation Limited made a new find one and a quarter miles south of the Moulton Hill mine, and in the following year sank a shaft to a depth of 244 feet. The 250-ton mill from a worked out gold mine in northwestern Quebec was transferred to the property and production began in July 1944. The mine was closed in June 1945, after a total of 75,643 tons had been milled. Ascot Metals Corporation Limited was formed in 1949 to operate part of the property formerly held by Aldermac, as well as the Suffield mine and other properties. Ore from the Suffield, twelve miles away, is trucked to Moulton's 500-ton mill. In addition to these properties in the vicinity of Sherbrooke, Ascot is interested in a number of prospects elsewhere in Quebec and Ontario.

Thirty-nine miles northeast of Sherbrooke, the Weedon Pyrite and Copper Corporation Limited operates a copper-pyrite-zinc property, originally known as the McDonald mine and later operated by the Weedon Copper Corporation Limited. The present company was incorporated in 1950, with Roy Robertson of Montreal as president in association with a group of Montreal and Toronto mining men of whom Gordon F. MacDonnell is vice-president and managing director. The former owners had sunk an 800-foot shaft, opening several levels, from which over half a million tons of ore had been mined between 1913 and 1921. Beginning in 1951, the new company rehabilitated the surface buildings, de-watered the workings and resumed under-

ground operations. In 1955, a new shaft was started, working upward from the fourteenth level; and in 1952 a 250-ton mill was installed, which was later increased to 400 tons.

In the same general area the Quebec Copper Corporation Limited, incorporated in 1950, with Pierre Beauchemin as president and Bryan W. Newkirk as vice-president, had begun the development of a copper mine in Brome County, the property comprising 950 acres. Deepening the shaft from 1,110 to 1,875 feet, and opening new levels to the 1,400-foot horizon, Quebec Copper began milling in February 1954 at 450 tons a day; by the end of August in the same year, output had been increased to 800 tons. Total production to the end of 1955 had reached \$4,286,483 from 491,561 tons, averaging 1.2 per cent copper.

On an island in the Ottawa River, not far from Pembroke, there is a zinc-lead-silver-gold mine that has had a chequered career. Now the property of New Calumet Mines Limited, it was discovered in 1893 by John Lawn and the first development work was done by James and Calvin Russell. The Grand Calumet Mining Company Limited was incorporated in 1898, and between that date and 1910 occasional ore shipments were made to Belgium. The Calumet Metals Company Limited, later reorganized as the Calumet Zinc and Lead Company Limited, sank the shallow "McDonald" shaft, did a few hundred feet of drifting and crosscutting and, in 1912, put the first mill, a 150-ton gravity concentrator, on the property. The results were disappointing, and all work ceased after eight hundred tons had been milled. For many years the plant stood idle, and then was destroyed by fire, the company going into bankruptcy. During the boom conditions of 1926, the British Metal Corporation (Canada) Limited took an option; but after de-watering the shaft and doing about three hundred feet of lateral work it, too, ceased operations.

In 1937, when the depression had lifted somewhat, the mine was revived by Nesbitt, Thomson and Company who, in the next five years, were responsible for nearly one hundred thousand feet of diamond drilling which resulted in the discovery of important orebodies (including one lens, narrowly missed by British Metal, that ultimately produced well over a million tons). To

meet the wartime demand for metal, New Calumet Mines Limited was incorporated in 1942 and, in 1943, a 500-ton mill was put into operation. Further funds being required, loans were advanced in 1944 by Perron Gold Mines, by Nesbitt, Thomson, and by Frobisher, the last-named assuming management of the enterprise, with J. M. Cunningham-Dunlop as mine manager, L. J. Lichty as mill superintendent and W. B. Maxwell as consulting engineer. M. A. Thomson continued as president, but after his death in 1954 he was succeeded by Cunningham-Dunlop. To September 30, 1955, the New Calumet mine had produced 265,842,121 pounds of zinc; 75,863,414 pounds of lead; 35,442 ounces of gold; and 6,119,956 ounces of silver from 2,372,722 tons of ore milled.

At Montaubon-des-Mines, in Portneuf County, fifty-two miles west of Quebec City, lead-zinc-gold-silver occurrences have been mined more or less continuously since 1912. The discovery was made in 1910 by Antoine Lambert. Mining rights were acquired in 1911 by Pierre Tetreault, who did market some ore although his first efforts at treating the sphalerite and galena by gravity concentration were unsuccessful.

Tetreault, and later his estate, leased the property to a succession of operators. The Zinc Company Limited operated it from 1915 to 1921, and The British Metal Corporation (Canada) from 1923 to 1929. Under contract with the Wartime Metals Corporation, Siscoe Metals Limited was the operator from 1942 to 1944. In September 1948 the various properties were purchased by Anacon Lead Mines Limited, which had been incorporated in May of that year by M. J. Boylen of Toronto. The mine was worked by Anacon until 1955, when operations ceased.

In 1950, Montauban Mines Limited was incorporated to develop part of the Anacon property, and in the following year United Lead and Zinc Mines Limited acquired nearby property from United Metals Limited and joined with Montauban Mines in constructing a surface plant and in sinking a shaft near their common boundary. In 1953, these two companies were amalgamated to form United Montauban Mines Limited which has since been used by the Boylen organization as a holding company.

Many mines spread across the map of Canada have been mentioned in this book, but only an occasional one can be described as outstanding. We come now to one that can be so classed. Although it is one of the most recent to enter into production, the copper showing which it is developing was probably the first seen by Europeans in Canada, if not in all North America. In 1603, Prévert, one of Champlain's men, reporting to his chief, told of being conducted along a stream (now known as the York River) through the rugged Gaspé Peninsula to a spot near the river's source where he was shown a mountain whose bare slopes were stained a greenish hue. At its foot, pieces of malachite were strewn, some of which he picked up. These first samples of Canadian copper ore were sent to the museum at Versailles, where presumably they may still be seen.

Gaspé Peninsula is a pear-shaped, mountainous section, jutting northeasterly into the gulf of St. Lawrence, with the curving shore of the river on one side and the Baie de Chaleur on the other. Its greatest width is about ninety miles. At its seaward extremity is Gaspé Basin, one of the great natural harbours of the world. Only the shoreline is inhabited; the people, hardy fisher-folk, are descendants of Canada's earliest immigrants. A branch of the Canadian National Railways follows the coast, passing through one small settlement after another from Matapédia, on the Montreal-Halifax main line, to Gaspé, a distance of two hundred and two miles.

Two and a half centuries were to pass before Prévert's mountain would begin to give up its red metal for the benefit of the Canadian people and of the world. The modern discovery is due to the persistence of three brothers named Miller who traced copper float from the valley to the mountainside. This was in 1921, but Alfred Miller had noticed the stained fragments of rock twelve years before, although he had not followed them to their source. On that day in 1921 the brothers felt they had come upon a fortune and they took steps to secure it by staking all the claims the law allowed—in their own names, and in the names of their wives and eligible children.

As many before them had learned, the prospector's job does not end with the staking. In the Millers' case, sixteen years

were to pass before they succeeded in finding a mining organization willing to give their property a careful examination. An article by Dr. I. W. Jones of the Quebec Department of Mines, published in the report for 1935, attracted the attention of Noranda Mines Limited. This led to an examination in 1937 by Dr. A. M. Bell, Noranda's field geologist, after which Noranda took an option on the Millers' property; and the following year the Continental Drilling Company went to work. Hitherto, interest had been centred on Copper Mountain, as it was called, but Noranda's engineers, examining the surrounding territory, encountered another mineralized area on Needle Mountain, a mile to the south, which caused Dr. Bell to recommend that the drills be moved to the new showing, where drilling continued until wartime conditions forced a suspension in 1940.

Drilling on the two locations had indicated a fairly large low-grade deposit which did not encourage Noranda to embark upon immediate development, even when the war had ended; but the option was exercised in order to provide a reserve for the future, and Gaspé Copper Mines Limited was incorporated in 1947.

In the drilling on Needle Mountain, three holes had cut a bed of limestone eight hundred feet below the surface (and below two other orebodies) which ran much higher in grade than any in either mountain, but holes drilled on three sides had drawn blanks. This high-grade ore had left an unanswered question in the minds of the geologists. Consequently, in 1948, drilling was resumed in that area and the first hole encountered higher grade ore in the Needle Mountain limestone which was ultimately found to aggregate thirty million tons. It was later learned that the earlier three holes had been drilled in a nearly isolated lobe at the south end of the main orebody. When the new orebody was finally outlined the picture had completely changed. Noranda had, in a sense, found another "Lower H"; and as that famous orebody, although of higher grade, had changed the Horne mine from a small one into a large one, so did the Needle Mountain discovery convert a sleeper into a prospective mine of immense potentialities, calling for immediate development.

Once the decision to develop was made, circumstances dictated

the nature of the operation. With almost seventy million tons of ore determined without exhausting the possibilities, it was obvious—due to an average grade of only 1.72 per cent—that the capacity of the projected plant must be large, and it was eventually set at 6,500 tons a day. This, of course, was contingent upon the availability of sufficient power. Local water powers were investigated, but would not supply the mine and also the community which must soon come into existence. The problem was solved when the Québec Hydro-Electric Commission undertook to supply the need from its plant, then building, on the Bersimis River. This would necessitate carrying electricity by cable beneath the waters of the St. Lawrence estuary, thirty-two miles—the first of its kind where such a combination of distance and voltage was involved. From Metis, on the south shore, to the mine, a hundred and thirty-five miles, the current would be transmitted over the usual type of power line.

From the little town that clusters at the head of Gaspé Basin to the site of the new mine the distance in an air line is about fifty miles, but by the road which was a first requirement before any heavy construction could be undertaken it was about sixty-five miles. In the early days, when drilling equipment and supplies for the drillers provided the principal traffic, the road was little more than a track through the wilderness; but by the time that materials and equipment for the building of a town, mining plant, concentrator and smelter had been hauled in, it had become a good all-weather gravel highway with easy grades and curves.

The year of decision had been 1950; the two succeeding years saw the clearing of the townsite and the mill and smelter sites. Mining had been under way since the fall of 1951 when William Brissenden, brought in from Noranda's Hallnor mine, with a crew of thirteen, began the first adit into Needle Mountain from the valley level; and in the following May a second adit was started higher up the mountainside. Early in 1952, the contract for the erection of the mill, smelter and other surface plant was given to the Foundation Company of Canada. In September of that year, R. V. Porritt, general manager of Noranda Mines,

Gaspé Copper Concentrator and Smelter →



became also general manager of Gaspé Copper. In April 1953, John Metz, who had worked in the past at Falconbridge and at Kerr-Addison, and had latterly spent some years in German East Africa, became mine manager, with Brissenden as assistant manager. Oliver Hall, whose part in Gaspé Copper had been great, died in February 1954, but his son John was now mine superintendent.

By the end of 1954 the various operations were converging toward their end. Many miles of tunnels criss-crossed the ore-bodies in Needle Mountain. The huge mill, which with the smelter occupies the valley between the two mountains, had been completed and the smelter was nearing that stage. Unlike most mines with their characteristic headframes, Gaspé Copper has none. Instead, for the transfer of ore from mine to mill, a belt conveyor 2,300 feet long and forty-two inches wide extends from the crusher rooms seven hundred feet below ground to the top of the concentrator. The whole undertaking represented an expenditure of over thirty-five million dollars.

It had been hoped that power from Bersimis would be available before the end of 1954, as indeed it was; but less than three days after the first electrical impulse coursed through the transmission lines the underwater cables failed. Repairs could not be started till the ice was out of the river, and would take months. On November 13, 1955, the cables again came to life and this time there was no interruption. In the interval, mining and ore-treatment had proceeded under diesel power. In 1955 almost half a million tons of ore were mined which, when milled, averaged 2.06 per cent copper. Till the smelter was blown in on December 3, 1955, concentrates were shipped by rail from the town of Gaspé to the Noranda smelter, but from then on copper anodes were shipped to the refinery at Montreal East.

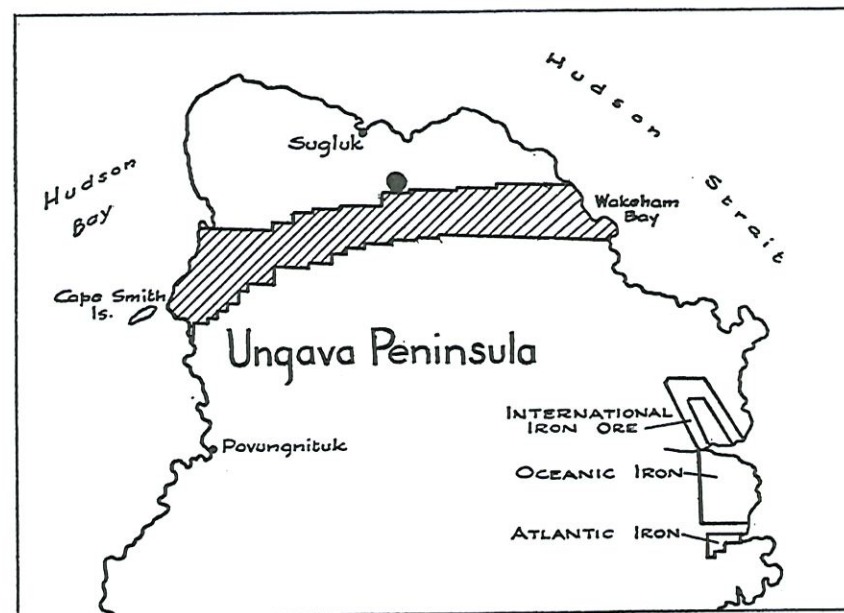
Gaspé Copper was planned from the start with an eye to economical operation, and it represents the last word in trackless mining and all that is implied by the term. Ore from its cavernous stopes is broken and removed entirely by mechanical means; in some parts of the workings, power shovels load huge diesel trucks, and in others mechanical loaders fill pneumatic-

tired transit cars, both dumping their loads into ore-passes which lead to the crushers below the valley surface.

Its site carved out of the wilderness, an essential requirement of this great enterprise was a community that would provide employees with amenities and conveniences such as they might enjoy elsewhere. Murdochville, named in honour of the man of whom the Noranda organization is so greatly a reflection, was planned for a population of four thousand, and it benefits from the experience in town-planning which that organization has gained in thirty years at Noranda.

While this mine was being established in a little-known section of southeastern Quebec, an imaginative mining engineer was setting the scene at the extreme northwestern tip of the province—in Ungava Peninsula—for what shows evidence of becoming one of Canada's most productive mining regions. Murray Watts, one of the men of Cobalt and Haileybury, while employed many years before by the Cyril Knight Prospecting Company Limited, had looked over the Ungava country and noted its possibilities; but at that time, no matter how rich its rocks might seem, it was too far away to interest the large capital needed for the development of mines in that sub-arctic region. He returned to Ungava in 1955 with a group of prospectors and they explored a strip of territory across the northern extremity of the peninsula, and for many miles found continuous evidence of nickel-copper mineralization. Back the following year, he cut samples at intervals along a stretch of some sixty miles. And then the Quebec government reserved the whole region from staking! Watts appealed to the provincial Minister of Mines, protesting that he had entered the area in good faith and had spent a great deal of money in exploration. Furthermore, much of the information he had gathered he had passed on to the Department, which otherwise could not have obtained it except at considerable expense. The Minister, recognizing the justice of Watts' contention, promised him a concession covering the area in question, but fulfilment of the promise was postponed. Watts had already transferred part of his prospective rights to Le Moyne Explorations Limited, who had organ-

ized Le Moyne Ungava Mines Limited and other companies through which to operate them; and later, the American Smelting and Refining Company had acquired a thirty-per-cent interest. In 1956, Watts and his crew devoted their time to intensive sampling; and when the assays were received the results were so promising that, despite the uncertainty of title,* Watts was deluged with offers from companies, both large and small, eager to have a share in the development of this exciting new country.



The discovery that led to the first gold-mining in Nova Scotia was made in 1858 by Lt. C. L'Estrange, who found traces of gold in the rocks while moose-hunting near Mooseland on the Tan-gier River. Other discoveries resulted, and for a few years gold-miners did fairly well. Following Confederation (but not because of it) there was a period of frenzied speculation, in the wake of which came a depression, and almost twenty years passed before the annual production of gold in the province had increased beyond the 27,500 ounces produced in 1867. Most of the time during the present century, gold-mining in Nova Scotia has been in a decline.

*The concessions were eventually granted by the Province of Quebec.

The Nova Scotia goldfields extend along the Atlantic coast from Canso to Yarmouth in a zone 275 miles long, varying from ten miles in width at the western end to about seventy-five miles at the eastern end. The area of this zone is about ten thousand square miles, or roughly half the area of the province.

Gold-mining has been mostly in the hands of small operators, but, in 1934, Cominco amalgamated two adjacent properties known as the Ross and the Nova Scotia which, as the Caribou mine, it operated until 1947. All known ore being by that time exhausted, the mine was closed down.

The situation was aptly summarized by Dr. G. Vibert Douglas, Professor of Geology at Dalhousie University, when he wrote:

Gold mining in Nova Scotia is fraught with many difficulties and disappointments. The tenor of the ores is too low and the ore shoots too widely and irregularly spaced to give confidence to the operators. When the number of grains of fine gold in the Canadian dollar is reduced or, what amounts to the same thing, when the price of gold is advanced, there will be renewed activity.

The Devonian batholith evidently did not have enormous stocks of metal to distribute to all the permeable channelways and synclines and fissures that exist. If all the gold associated with the granite magmas had been concentrated in a few veins and not in hundreds, Nova Scotia might have been able to boast of its mines. This is one of the "ifs" of geological history.*

So far as base metals are concerned, occurrences are found in many parts of the province, but few have proven of much consequence. Of these the Stirling zinc-lead-copper mine in Cape Breton is perhaps the most notable. Its history goes back to about 1895, but for many years its ore was too complex for the metallurgical acumen of the time and such efforts at development as were made were aimed at copper production only; and it was not till 1915-16 that the possibility of recovering the zinc was considered. Between 1916 and 1924, five different companies held the property in turn, control finally becoming vested in the Eastern Mining and Milling Company Limited, one of F. M. Connell's enterprises. In 1925, North American Cyanamid

*In *Structural Geology of Canadian Ore Deposits* (Canadian Institute of Mining and Metallurgy), 1948; p. 926.

Company, through its subsidiary Stirling Zinc Limited, undertook the first underground operations, sinking a two-compartment shaft to a depth of four hundred feet, from which a certain amount of lateral work was done, apparently with unsatisfactory results. Eventually, The British Metal Corporation (Canada) Limited became interested and in 1928 Stirling Mines Limited was incorporated in which British Metal held control, with Eastern Mining and Milling having the minority interest. Depending upon the vagaries of the metal markets, the mine was operated intermittently, but about the beginning of World War II production was finally suspended. The plant was sold in 1942, and the claims were allowed to lapse.

With the return of better metal prices, Evan T. Donaldson of Toronto, a former Cobalter, decided after examining a report made to the Stirling Company by James and Buffam, consulting geologists of Toronto, that the property might have possibilities. The Government of Nova Scotia was willing to facilitate further exploration by granting, in addition to the former Stirling claims, a concession covering sixty-one square miles. Donaldson and associates de-watered the old shaft and undertook extensive diamond drilling as well as a geophysical survey which resulted in the locating of new orebodies. Mindamar Metals Corporation Limited was organized in 1950, with Dome Mines holding the major interest. A four-compartment shaft was sunk, followed by the building of a 500-ton mill, which began operations in April 1952. Four years sufficed to exhaust the ore and the mine was again shut down.

Until recently, New Brunswick's contribution to Canadian mineral production had been insignificant. Occurrences of lead, zinc, iron, copper, tungsten and manganese were found in various parts of the province and small shipments of iron ore, copper and manganese had been made; but where development had been attempted, failure to produce orebodies of commercial importance had been the general experience. Perhaps the most promising discovery was that of a hematite-magnetite deposit by William Hussey in 1902, seventeen miles south of Bathurst, near the confluence of Austin Brook with the Nipisiguit River. The

ore runs about forty-five per cent iron, but it also averages from eighteen to twenty per cent silica, which limits its marketability. Acquired by Drummond Mines Limited, its ownership passed to the Canada Iron Corporation which built a railway sixteen miles long from Nipisiguit Junction on the C.N.R. main line, erected the necessary buildings on the property, and between 1907 and 1913 shipped 181,127 tons of ore to Philadelphia.

The property lay idle from 1913 until 1942, when wartime shortages provided a temporary market for the ore. Dominion Steel and Coal secured the right to operate the mine from Canada Iron Foundries Limited of Montreal, who then held the lease. From February to December, 1943, when the mine was again shut down, 127,734 tons of ore were shipped to the plant of Dominion Steel and Coal Corporation (Dosco) at Sydney.

In the meantime, through a geophysical survey made by Hans Lundberg in 1938 in the Tetagouche-Orvan Brook region, north of Bathurst, a lead-zinc-silver occurrence had been found. This deposit is near the southwesterly end of a longitudinal fault zone traceable for fifteen miles in a northeasterly direction. Trenching and drilling disclosed a length along the strike of six thousand feet of continuous mineralization, but the vein averaged less than thirty inches in width. The property was acquired by the International Mining Corporation, a United States Company operating in Canada through the International Mining Corporation (Canada) Limited and its subsidiary, Tetagouche Exploration Company Limited. The Canadian interest in these companies was represented by F. M. Connell and his associate, Arthur Cockeram, and also by Gordon F. MacDonnell.

Ventures took an option in 1941, as did American Smelting and Refining in 1945, but each dropped out after a superficial examination. Then, in 1950, control was acquired by New Calumet Mines Limited, which undertook a more comprehensive exploratory program. Drilling disclosed 150,000 tons of ore on a portion of the property averaging, zinc, 7.13 per cent; lead, 3.27 per cent; copper, 0.20 per cent; silver, 2.52 ounces; and gold, 0.012 ounces, to a depth of 400 feet. The sulphides are so finely disseminated, however, that a satisfactory method of treatment has not been found.

As elsewhere in Canada, World War II revived interest in prospecting in New Brunswick; but aside from iron ore from the Drummond mine, little was added to the production of minerals. Indirectly, however, the war was responsible for bringing into production the first base-metal mine in the province. Patrick William Meahan, a mining engineer born in New Brunswick, had spent many years in the Noranda district. During World War II he was employed as an inspector in a Toronto munitions plant where, in an explosion, he lost his right hand and three fingers from the other hand. While recuperating from this accident he returned to his native province and organized a prospecting syndicate. Viewing the local geological structures with a knowing eye, he staked a block of claims in the Elm Tree area, about fifteen miles north of Bathurst. He also secured a concession from the New Brunswick government covering the exclusive exploration rights on twenty-four square miles in the Rocky Brook-Millstream section, about seven miles south of Elm Tree.

Meahan's friends in Ontario and Quebec soon began to hear from him in connection with his various prospects. One friend was Joe McDonough who, in 1949, made a deal for Meahan's Elm Tree claims (increased by further staking), on behalf of Coulee Lead and Zinc Limited, a McDonough company then principally occupied with developing a zinc prospect in the Kenora district of Ontario. Meahan also disposed of his Rocky Brook-Millstream concession, dividing it into five parcels which he transferred to various mining companies, including Noranda Mines, The Mining Corporation, and O'Brien Gold Mines.

His hands full with other exploration projects, McDonough sought to pass Meahan's Elm Tree prospect on to someone else. New Calumet, already interested in Tetagouche, took an option, agreeing to do 2,500 feet of drilling; but the results proved unsatisfactory and the option was dropped. McDonough had tried a number of other companies before Harold T. Leslie, a Toronto mining engineer, interested M. J. Boylen, who took an option and laid out a drilling campaign. In 1952, encouraged by the first drilling, Boylen closed the deal with Coulee and incorporated Keymet Mines Limited, later sinking a shaft to 1,229 feet and erecting a 250-ton mill on the property. The mill burned

down, but a new one was built and production began in November 1954. All operations were suspended early in 1956 because, owing to the narrowness of the vein, mining could not be continued economically. The mine, however, had achieved the distinction of being the first base-metal producer in New Brunswick.

In 1951, Brudon Enterprises Limited of Montreal, anticipating the possibility of evolving a formula for the treatment of ore at the Drummond mine (now known as the Bathurst), had applied for and received a mineral reservation covering the original Austin Brook property, plus an additional area adjoining. Whatever plans Brudon Enterprises may have had in mind, no further development was undertaken; and in the fall of 1952, through a Montreal brokerage firm, Boylen acquired the property.

A magnetometer survey of the Austin Brook area had been made in 1917 by E. Lindeman of the Mines Branch of the Department of Mines at Ottawa and his map had indicated three areas with pronounced magnetic anomalies. One anomaly, comprising the Drummond pit, was known to result from a deposit of pyrite along the footwall, but its extent had never been investigated. This, Boylen now instructed his chief engineer, Robert J. Isaacs, to do. Eleven holes were drilled near the edge of the pit, and the cores showed sulphide mineralization, although not up to ore grade. A geophysical survey by McPhar Geophysics Limited had also been initiated; when the results of the first eleven holes proved disappointing, the survey was extended farther afield, and at a distance of three thousand feet north of the pit a prominent anomaly was encountered. The drills were immediately moved to this new position and the first hole intersected an orebody which was later established as one of major importance.

This orebody, known as No. 6, was found to have a length of 1,150 feet and an average horizontal width of 182 feet, assaying, zinc, 5.20 per cent; lead, 1.61 per cent; and silver, 1.98 ounces to the ton. Mainly above the 1,000-foot horizon, it was estimated as containing 28,312,000 tons; and, in addition, large areas of massive pyrite mineralization are indicated, carrying low values in lead-zinc, with some copper, but the sulphur content is about

forty per cent with a similar percentage of iron. About six miles farther to the northwest a second large orebody (No. 12) was outlined by the drills, and was estimated to contain 29,289,000 tons with the following averages: zinc, 6.6 per cent; lead, 2.4 per cent; copper, 0.5 per cent; and silver, 2.1 ounces to the ton.

Since New Brunswick was still one of the spots where drilling could be carried on without exciting undue curiosity, no word of these developments leaked out. Boylen quietly incorporated three companies: the Brunswick Mining and Smelting Corporation Limited, the Maritimes Mining Corporation Limited, and the Bathurst Mining Corporation Limited. To Brunswick went orebodies No. 6 and No. 12, while Maritimes and Bathurst were assigned adjoining ground. Sufficient favourably located ground still remained for other Boylen companies to get their share. New Larder "U" Island Mines Limited, which had been unfortunate in northern Ontario, received a group of fifty-eight claims, lying to the east of Brunswick's holdings, on which later drilling disclosed 1,173,540 tons averaging 8.2 per cent combined zinc and lead. Anacon Lead was included in the distribution, and its position as one of Boylen's chief companies was strengthened by the absorption shortly after of both New Larder "U" and Bathurst.

The ore is complex, and in order to secure the benefit of expert metallurgical experience an arrangement was made for the acquisition by the St. Joseph Lead Company (operating through its Canadian subsidiary, Leadridge Mining Company Limited) of a minority interest in Brunswick and the assumption by Leadridge of the management of the company. Francis Cameron, president of Leadridge, became vice-president of Brunswick, and Lawrason Riggs became resident manager. Another arrangement was made under which Anacon and Leadridge became joint owners of a further block of ground comprising eighty-two claims about three miles north of Brunswick's holdings.

Until Boylen's crews had staked all the ground indicated by surveys as favourable, no word leaked out, and consequently when the first announcement was made on January 15, 1953, the mining world was taken entirely by surprise. Boylen became

a local hero, and received an honorary degree from the University of New Brunswick.

A midwinter staking rush followed, which in many ways was unprecedented in Canadian mining. Almost forty-one thousand forty-acre claims were recorded. Most of the large mining companies hastened to get a foothold in the field, which soon was widely extended as other geophysical surveys were carried out. In late 1954 the American Metal Company, in association with International Nickel, announced that the presence of extensive lead-zinc-copper-silver deposits had been determined at Little River, thirty-two miles northwest of Newcastle and fifteen miles south of the Boylen discoveries. Subsequent diamond drilling proved the existence of orebodies aggregating 7,200,000 tons of ore above the 600-foot horizon. Heath Steele Mines Limited was incorporated as the operating company and plans were adopted for the erection of a 1,500-ton concentrator. The Canadian National Railways began construction of a branch, twenty-two miles in length, to connect the mine with its main line at Bartibog, about midway between Bathurst and Newcastle. Incidentally, it was the first railway construction of any consequence in the province since the early part of the century.

Other companies having considerable holdings in the area in various stages of exploration at the time of writing are: the Middle River Mining Company Limited, a subsidiary of Texas Gulf Sulphur Company; the Anaconda Company (Canada) Limited; The Mining Corporation of Canada; Conwest Exploration; and Kennecott Copper.

At Brunswick, plans were adopted to operate No. 6 orebody by open pit and No. 12 by shaft, ore from both being treated in the same mill which would be built near No. 6. In order to arrive at the most economical method of handling the ore, a pilot mill with a capacity of 150 tons a day was built, beginning operations during 1955. After completion of metallurgical tests (which, because of the complexity of the ore, have been unduly prolonged) it was planned to build a concentrator with a minimum capacity of 4,000 tons a day. Development of No. 12 orebody began with a prospect shaft, and construction was later begun on a five-compartment production shaft. At the outset, the most

modern type of trackless mining was adopted with the object of establishing a uniformly low-cost operation.

The rocks of Newfoundland cover a fairly wide geological range and contain many minerals, few of which have yet been mined commercially. The Cambrian and Ordovician rocks underlying Conception Bay, in Avalon Peninsula, are responsible for the iron ore deposits constituting the Wabana mine, which is dealt with elsewhere.* Although in former times copper was mined in a number of places on the island, the only copper produced at the time of writing comes from a mine which is primarily devoted to the production of lead and zinc. A former producer was being revived, however, with every prospect of adding considerably to the Island's copper output.

Next to Wabana, Newfoundland's most successful mine is the one at Buchans, three miles north of Red Indian Lake, about thirty miles west of the centre of the Island, producing lead, zinc, copper and lesser values in gold and silver. The occurrence was discovered in 1905 by an Indian named Matty Mitchell, and development on a small scale followed when drilling and shaft-sinking established the presence of one hundred thousand tons of finely disseminated lead-zinc ore at a spot on the Buchans River. A small mill was erected, but no method known at that time was capable of extracting the values, and in 1911 the mine was shut down.

The property formed part of a concession comprising six thousand square miles granted by the Newfoundland government to the Anglo-Newfoundland Development Company Limited, controlled by the Rothermere interests of Great Britain, who were primarily concerned with the production of pulp and paper. The mineral rights were held by Terra Nova Properties Limited, a subsidiary, and in 1925 were leased to the American Smelting and Refining Company, whose metallurgists had eventually discovered a process for the treatment of Buchans ore.

In the hope of finding further orebodies, American Smelting engaged Hans Lundberg to make a geophysical survey of the

*See, Chapter XVIII.

area, which he did in 1926. At that time Lundberg was operating from New York, but for many years since has had his headquarters in Toronto. Geophysical surveying was then in its infancy in North America and H. A. Guess, vice-president of American Smelting, was willing to try it over a limited area, contracting for only one square mile in the vicinity of the original deposit on the Buchans River. Lundberg, eager to demonstrate the new art of geophysics, grasped the opportunity. As might have been expected, the trail led beyond the confines of the square mile, but arrangements were made to extend the survey, and within a short while two large deposits of high-grade lead-zinc-copper ore were discovered, the "Oriental" 2,000 feet east, and the "Lucky Strike" 3,500 feet west of the Buchans River occurrence. This was the first major mine to be discovered by geophysics in Canada.

In early operations, about half the ore milled was taken from glory holes, but as the pits grew deeper it became necessary to go underground and for some years now all mill-feed has come from that source. Milling began in 1928 with a 600-ton concentrator which, in 1931, was increased to 1,200 tons. The Oriental and Lucky Strike orebodies produced a total of 9,500,000 tons with an average assay of zinc, 16.5 per cent; lead, 8.1 per cent; copper, 1.54 per cent; silver, 3.37 ounces and gold, 0.054 ounces to the ton.

In the late forties, when the Oriental and Lucky Strike orebodies were nearing their end, further exploration by drilling and geophysical survey disclosed two new deposits down the dip to the northwest which have become the Rothermere mine, from which the greater portion of mill-feed has since been drawn. At the end of 1955, ore reserves were said to aggregate some six million tons.

At Tilt Cove, on the west side of Notre Dame Bay, on the Island's north coast, a copper property now being developed by Maritimes Mining Corporation Limited was one of the earliest mineral discoveries. It was found in 1857 by Smith MacKay who was carrying on a survey of the west coast of the Bay. He was unable to interest capital, however, until 1864 when, in

partnership with C. F. Bennett, milling operations were begun. From then until 1917, when shipments ceased, the property was exploited by what was equivalent to high-grading, without ore-dressing other than hand-cobbing. It had a succession of operators, including the Cape Copper Company, which held it from 1892 to 1913.

These operators worked from open cuts, adits and shafts to a depth of five hundred feet, localized in two areas called respectively the West and East mines. Under construction by Maritimes Mining at the time of writing was a four-compartment shaft, designed to go to 750 feet, with the main haulageway at the 500-foot level; and plans had been adopted for a mill with an ultimate capacity of three thousand tons a day.

Another copper property in the same general area, known as Gull Pond, about fifty-two miles (by air) southwest of Tilt Cove, has recently come under the control of the M. J. Boylen organization. Discovered in 1905, it was held by a succession of owners without much development being undertaken until 1950, when it was acquired by Falconbridge Nickel Mines. Extensive diamond drilling led to plans for underground development. In 1955 the Falconbridge interest was taken over by Boylen's Bathurst and Maritimes companies, which were later amalgamated under the latter. The drilling indicated the presence of a series of large overlapping lenses of copper-pyrite ore containing to a depth of 450 feet over four million tons of 1.24 per cent copper, with a high-grade core containing an estimated two million tons, grading 1.93 per cent copper.

MOST OF THE FABRICS USED IN HOMES AND INDUSTRY, EVEN THOSE of synthetic materials, are of either animal or vegetable origin. But there is one, produced from mineral fibre, that surpasses in variety of uses any made from either of the other two classes. Its qualities are unique; it has great strength, great flexibility, is impervious to water, resists chemical action, is practically immune to decay and, most remarkable of all, it cannot be destroyed by fire.

This paragon is asbestos, of which Canada is the world's chief producer. Until recently the only important Canadian sources were in the Eastern Townships of Quebec; but, in 1949, a deposit was opened in northern Ontario; in 1950 a large highgrade deposit was discovered in northern British Columbia; and, more recently, promising occurrences have been discovered in north-western Newfoundland.

Although most people are familiar with asbestos, very few know much about it. The ancients were probably as well acquainted with it as the average person is today. It is mentioned by the Roman writer Pliny as a "rare and costly cloth," the cremation garment of kings. The Greek geographer Strabo wrote about lamps whose wicks the fire could never consume. During later times, this strange material caused awe and wonder, as when Charlemagne, at the end of a banquet, wishing to impress emissaries from hostile tribes, would throw his tablecloth into the fire and produce it again unharmed.

Marco Polo, the great Venetian traveller of the thirteenth century, tells of seeing unburnable fabrics in Tartary which the subjects of Kubla Khan assured him were woven from the hair of the salamander, mythical reptile believed to live in fire. But

Marco Polo was not taken in: he had already seen asbestos. The fabric he saw in Tartary was woven from fibre found in nearby rocks; but most of the asbestos known to the Greeks, Romans and other Europeans of a later day probably came from the Italian Alps. And it was in Italy that asbestos was first fabricated on any considerable scale. Several factories were established there between 1860 and 1875, producing asbestos thread, paper and cloth.

Asbestos is found in a tough, greenish rock called olivine; in fact, asbestos is but olivine in another form, classified chemically as magnesium silicate. But before olivine can be called asbestos it must be treated for long ages in Nature's crucible, where it is subjected to intense heat and pressure, emerging as serpentine. During this process it expands much beyond its previous volume, causing innumerable irregular fractures. This fractured mass now becomes a receptive host for hot liquids from deep within the earth which permeate the serpentine, dissolving it and re-depositing it in columnar form within the fissures. The altered serpentine is known as chrysotile asbestos, and it is to be noted that the fibres run *crosswise* of the fissures, the length of the fibres being governed by the width of the vein. Fissures vary from microscopic cracks to veins two or more inches in width. As the columns grow they gradually force the fissure walls apart.

Almost alone in nature, asbestos is both crystalline and fibrous in structure. Fibres can be divided almost indefinitely. No device has yet been invented delicate enough to split a fibre into its ultimate parts, but it is possible to get 3,300 fibrils from a single square inch. Yet its tensile strength is equal to 100,000 pounds to the square inch—as strong as some mild steels and twice as strong as wrought iron.

The Canadian asbestos industry began in a small way. The substance was first discovered near St. Joseph, Quebec, in 1860, and was called *pierre à coton*. Two years later, specimens of this silky material were exhibited in London. In 1874, two brothers at Thetford, Alfred and Robert Ward, learning that the fluffy *pierre à coton* was asbestos for which there was a demand in the United States, began to mine it. Pits were sunk and the

rock was hoisted by hand winches, later operated by a horse which plodded in a circle around the windlass, winding the cable on a drum. Not till 1887 was steam used. The first ore was shipped by ox-cart; the railway did not come until 1878.

At Danville, about forty miles in a direct line southwest of Thetford, Charles Webb owned a farm so rocky that it was not good even for pasture. He offered to sell it for fifty dollars, but could not find a buyer. A Welsh slate-miner named Evan Williams noticed the strange fibrous rock and discovered that it was similar to that which he had heard the Ward brothers were mining at Thetford. Having no money, he persuaded a farmer named Jeffrey, who had some spare cash, to finance development. That was in 1881, when three small pits were opened. The farmer gave his name to what one day would be the largest asbestos mine in the world.

In 1885 seven pits were in operation, and in that year a production of about 1,400 tons was reported. Since the market for the fibre was still limited, the highest grade sold for only eighty dollars a ton, which by 1900 had advanced to three hundred dollars. Costly methods of hand-mining and ore-dressing kept the industry from making headway, and it was not till the introduction of mechanical means of fibre recovery that a measure of stability was gained.

The industry received its greatest impetus in 1901 when H. W. Johns of New York and Charles B. Manville of Milwaukee, who had been experimenting with various substances for pipe coverings, joined to form the forerunner of the Johns-Manville Corporation, of which the Canadian Johns-Manville Company Limited is a wholly-owned subsidiary. Johns and Manville had previously been importing asbestos from Quebec and they eventually became owners of the Jeffrey mine.

The asbestos-producing area of Quebec extends in a northeasterly direction between Danville and East Broughton, for about seventy miles, with a maximum width of five or six miles. Within this area are five presently producing centres—East Broughton, Thetford Mines, Black Lake, Coleraine and Asbestos. At the time of writing, eight companies control the eleven mines;

nine are in the general region of Thetford Mines, one in Asbestos and the other five miles distant.

The Asbestos Corporation Limited operates four mines in the Thetford Mines neighbourhood—the British Canadian, the Beaver, the King and the Normandie, with a total capacity of 17,200 tons of ore a day. The company, with A. L. Penhale as president, is controlled by Canadian capital and is one of three in the Eastern Townships asbestos area which do not operate so-called "captive" mines. Johnson's Company Limited and Johnson's Asbestos Company, associate companies of which A. S. Johnson is president and W. J. Johnson is general manager, are also independent. The former company's property is at Thetford Mines and has been producing since 1875. Johnson's Asbestos Company operates a mine and a 4,000-ton mill at Black Lake, five miles southwest of Thetford Mines.

Flintkote Mines Limited, a subsidiary of Flintkote Company Incorporated of New York, operates an open pit and a mill with a capacity of 2,000 tons a day. Bell Asbestos Mines Limited, a subsidiary of Turner-Newall of London, with a mill treating 1,800 tons a day, works part of the same orebody that is also owned in part by Asbestos Corporation and Johnson's Co. The Quebec Asbestos Corporation, at East Broughton, handling 1,000 tons a day, is a subsidiary of the Philip Carey Manufacturing Company of Cincinnati, Ohio.

In the Asbestos area, Nicolet Asbestos Mines Limited, whose property is situated at Norbestos, five miles northeast of Asbestos, has an open pit about 1,500 feet long, 125 feet deep and 300 feet wide at the top, producing 3,000 tons a day. It is controlled in New York. The Canadian Johns-Manville Company Limited produces 17,000 tons a day from its Jeffrey mine, more than seventy-five per cent of which now comes from underground. As this was written, the company was completing a mill which would provide for an eventual annual production of 625,000 tons of asbestos fibre. In addition to its mining operations, with factories at Asbestos and Port Union, Ontario, the company manufactures and supplies to the trade various lines of building materials.

For many years all mining operations in the area were by open pit, the ore being hoisted by overhead cableways. About 1927 came the introduction of cranes or power shovels for loading, locomotives for tramping on the pit floor, and cable cars for transporting the ore from the pits up inclined planes or tunnels. The higher grades, called "crudes," were hand-cobbed on the pit floor or taken from picking belts after the ore was crushed. The pit at the Jeffrey mine, roughly elliptical in shape, was 3,200 feet long by 2,800 feet wide, its bottom 295 feet below the local surface. The original outcrop projected as high above the general level as the pit now extends below it. Spiral benches, thirty-five feet in height with a two-per-cent grade, provided a continuous route four miles in length over which trains of cars were hauled by locomotives to the mill.

When the limitations of the open pit had driven operations underground, shrinkage mining was tried in stopes forty feet wide and about two hundred feet long. The broken ore was drawn through steel chutes into cars trammed along drifts to the pit and from there hoisted to the surface by high-speed cableways. This was a relatively expensive way of mining, and in 1932 the Asbestos Corporation introduced block-caving at its King mine. This procedure consists of the installation of a haulage system five hundred feet below the surface. The orebody is worked in blocks 160 feet square, each block traversed by four grizzly drifts, 40 feet apart, driven forty feet above the haulage level. The ore is then undercut and is broken in falling by its own weight. Canadian Johns-Manville also developed a block-caving system at the Jeffrey mine in which the blocks are 200 feet square, the crushing plant 816 feet below surface and the loading facilities at 950 feet. The Johnson's Co. has adopted modifications of these systems.

Since its fire-resistant quality is the greatest asset of asbestos, every effort is made in mining and subsequent processes to prevent any wood from becoming mixed with the product. Tramp iron can be removed by magnetic devices, but no mechanical means has yet been invented by which fragments of wood can be removed. Matches are therefore prohibited in mines and mills;

steel or concrete is substituted for wood wherever there is a chance that splinters of wood might get into the fibre.

Asbestos mills differ in nearly every respect from those used to treat gold or base-metal ores. Asbestos ore is crushed as a preliminary, but not as fine as in metal ore-dressing, and, of course, no grinding is done at all. Every effort is made to avoid injuring the fibre; the objective is to release it from its rocky matrix, and in this its tendency to clean cleavage is a help. No chemicals are used and the entire process is absolutely dry, although the ore (especially when taken from pits) is often far from dry. While an asbestos mill seems to contain a great deal of equipment, which at first glance appears to be quite complicated, the operation is really very simple, consisting only of the repetition of a single sequence: crushing, drying, shaking, and suction. As cyanide is to the milling of gold, and sulphuric acid, or some other chemical, to uranium, so is air to the extraction of asbestos. The principal equipment consists of a series of screens of various sorts and sizes which are kept continually agitated. As the fluffed fibre passes through the various stages it is drawn upward by suction fans through "fish-tail" hoods, to be either removed from the circuit or returned for further treatment. At each stage, hammer or impact mills serve to free more fibre from the rock that still adheres.

As it passes through the mill the fibre is graded, chiefly by length. Crude No. 1 includes fibres three-quarters of an inch and over; Crude No. 2, three-eighths to three-quarters of an inch. Five other grades are recognized: Spinning grade No. 3; Shingle fibre No. 4; Paper fibre No. 5; Waste (for plaster and stuccos) No. 6; and Shorts (for cements) No. 7. In 1955, prices ranged from \$1,100 to \$1,500 for Crude No. 1, down to \$37 to \$70 for Shorts No. 7.

When the fibre has been separated from all adhering rock, it goes to dry storage where it is allowed to remain for as long as possible before being shipped or processed. It usually reaches the market in bags containing a hundred pounds.

After three quarters of a century of continuous operation, the asbestos mines (especially those at Thetford Mines) had reached the point where major rehabilitation was long overdue. In ad-

dition to the complications associated with the operation of a single deposit by three companies, a city had grown up around the orebody and as the pits grew larger they encroached upon the townsite itself. Consequently, before mining operations could extended further, it was necessary to move a hundred houses, a church, the office of Johnson's Co., several streets, and some miles of highway and railway track. The program, planned in 1951-52, was initiated in 1953 and completion was expected by 1957. The cost—five and a half million dollars—was to be borne by the three companies involved, but it was believed that the ore released for mining would more than repay this amount, to say nothing of greater convenience for all concerned.

This constituted only a portion of the development and expansion which the asbestos community undertook. Canadian Johns-Manville's share consisted of a new plant, as mentioned. Johnson's Co. built its new mill at Black Lake; the Asbestos Corporation completed its Normandie mill of 5,000 tons capacity; and Quebec Asbestos had begun construction on a 2,000-ton mill at its Carey mine, nine miles from East Broughton.

Most spectacular of all, United Asbestos Corporation, by arrangement with Lake Asbestos of Quebec Limited, subsidiary of American Smelting and Refining, was proceeding with the diversion of Bécancour River, which empties into Black Lake, in order to begin draining the lake to admit of open-pit mining under its bed. This program also included the building of a 4,000-ton mill at Black Lake.

Johns-Manville, with estimated reserves sufficient to last a century, might well have been content to centralize its mining activities in Quebec, but in 1949 a protracted strike caused it to look elsewhere for sources of fibre and it succeeded in locating an extensive deposit of chrysotile asbestos in Munro Township, Ontario, about fifty-five miles east of Timmins and twelve miles from Matheson. It was mined at first by open pit; underground development began in 1954, and production from a 2,200-ton mill began in 1950.

In the sixties and seventies of the nineteenth century, prospectors had flocked to the Cassiar district of northern British

Columbia where they found placer gold in a number of places, one of which was McDame Creek, a tributary of the Dease River. McDame Mountain, at the head of the creek, seemed to wear a white plume which some of the prospectors recognized as weathered asbestos. But only placer diggings could be worked profitably in a country hundreds of miles off the beaten track, and when the diggings gave out the prospectors moved on.

Then, during World War II, the United States Army built the Alaska Highway which passed within ninety miles of McDame Mountain. This rendered that part of the country much more accessible than before, and prospectors again began to examine its rocks. Four trappers who were also prospectors—Robert and Ron Kirk, Hiram Nelson and Vic Sittler—decided that the time had come to do something about McDame Mountain's white plume. They discovered that the white plume was indeed asbestos which had gradually crept down the mountainside from a dike, 200 to 600 feet wide, which cuts across the top of the 6,400-foot mountain. Staking thirty-eight claims, they turned to Conwest Exploration, familiar to them as the operator of United Keno Hill at Mayo. Conwest lost no time in securing options on the claims. That was in the fall of 1950.

Preliminary investigation disclosed substantial ore reserves in sight. When drilling later established over seven million tons, confirmed also by an adit at the 6,028-foot level, the Cassiar Asbestos Corporation Limited was incorporated in May 1951, and plans for development were vigorously proceeded with. A road of sorts already existed for the first sixty miles south from Mile 648 on the Alaska Highway, but it required considerable improvement before it was capable of withstanding heavy truck traffic, and the construction of twenty-six miles of new road was necessary in order to reach the mine.

By the end of 1952, the roadwork had been completed, the first unit of the diesel plant had been installed, a townsite had been laid out (surrounded by beautiful mountain scenery), and the construction of a temporary mill was well in hand. The mill began operations in July 1953 at 150 tons a day; its capacity was later increased to 250 tons and then 500 tons. In practice it was

found that it could handle 700 tons a day regularly and on occasion as much as 900 tons.

To secure money for mill and other still-needed construction, the company's authorized capital was increased in 1952 from 2,500,000 shares to 4,000,000 (no par value, in each case). Of this increase, 1,100,000 shares were sold at four dollars a share, 600,000 to Turner-Newall (Bell Asbestos, who became sales agents for Cassiar) and Raybestos Manhattan Incorporated which, in addition to supplying the needed capital, made available to Cassiar their many years of experience in the asbestos industry.

Since it was already on the surface and relatively easy to secure, the talus ore constituted the first mill-feed. After being pushed into windrows by a bulldozer, it was loaded into a truck, hauled a few feet to the edge of the bench and dumped into a hopper at the head of a metal chute which conveyed it part way down the slope to a loading-hopper. From there it was trucked down a breath-taking switchback to the mill in the valley below. The chute was not a complete success, however, since it was too greatly influenced by the weather, and the management decided to supplant it (and the trucks) by an aerial tramway, capable of handling a hundred tons an hour, reaching from the workings near the top of the mountain to the dry rock storage building adjoining the mill.

Cassiar asbestos is the only non-ferrous fibre produced in quantity in North America, and as such is in demand for electrical insulation. Aside from a certain amount of hand-picked crudes, the company's product at first consisted chiefly of Spinning grade No. 3 (K) and Shingle grade No. 4 (K), but later two new grades were introduced, known as AAA. and AC. The former, a super-spinning fibre, had a market price of \$750 a ton f.o.b. Vancouver, and the latter, a high-grade asbestos cement fibre, brought \$300 a ton.

Since Cassiar is operated by Conwest, it has had the advantage of the transportation system already established to handle concentrates from United Keno Hill. Nick Gritzuk, the transportation manager, merely had to extend the area of his operations to include Cassiar. Here the traffic is northward, rather than

southward, as is the case with United Keno Hill. Furthermore, there are no rivers to ferry in summer and build ice bridges across in winter. Asbestos fibre is relatively much lighter than the silver-lead-zinc concentrates from United Keno Hill and consequently specially designed trailers (miniature boxcars) are hitched to the trucks. These travel northward eighty-six miles to the Alaska Highway and two hundred and sixty-five miles northwestward to the nearest siding of the Yukon and White Pass Route, providing connection with Skagway, Vancouver and the markets of the world.

Cassiar's first mine manager was T. T. Tigert, and his was the task of establishing a new community in the wilderness of northern British Columbia; J. D. Christian was consulting engineer, and W. V. Smitheringale, consulting geologist. Later, Tigert became consulting engineer and Christian, general manager. Norman F. Murray, with many years' experience in mines in northwestern Quebec, became general superintendent in 1954. These were the men whose particular task was the day-to-day operation of the mine; overall supervision was supplied by Conwest Exploration Company.

For three-quarters of a century, by far the greater part of the world's asbestos had been secured from a small area in Quebec. Then, in 1949, although not generally considered to be much of a threat to the ascendancy of Quebec as the dominating factor in the asbestos industry, a deposit of chrysotile asbestos was discovered in northern Ontario. In the following year, development of the Cassiar deposit began, and while its product is generally higher in grade, in point of production it could not be compared with its giant eastern competitors. However, Cassiar did demonstrate the fact that the near-monopoly of Eastern Townships mines could be broken. More recently, at the opposite extremity of the continent, in Newfoundland, Advocate Mines Limited, an M. J. Boylen promotion, has come up with a prospective asbestos field that may prove to be of major importance.

This occurrence is in the Burlington Peninsula between Notre Dame and White bays, in the northwestern part of the Island. It was discovered by George McNaughton of Timmins and Norman

Peters, a resident of Newfoundland, employed as prospectors by the Boylen organization. At the time of writing an extensive drilling program was underway, and the favourable structure was said to have a strike length of thirty-nine miles. The company's geologists had published an estimate claiming more than 40,000,000 tons of asbestos ore which mill tests had shown to be predominantly of the type used in the manufacture of asbestos cement pipe and building products.

Once more it has been demonstrated that in order to increase mineral production, the first step must be taken by the prospector, either the man on foot or his scientific prototype. For seventy-five years it has been assumed that the occurrence of asbestos ore in quantity was peculiar to a small section of Quebec, and it was not till 1955 that the annual production of asbestos fibre in Canada had reached a million tons. To attempt a prediction as to when the second million-mark might be reached would be futile, but it is a safe assumption that the rate of increase will be much greater in the future than in the past.

XVIII

Iron Ore

ALTHOUGH THE FIRST BLAST-FURNACE IN NORTH AMERICA, THE Forges du St. Maurice, was blown in to smelt bog iron near Three Rivers, Quebec, in 1736, and similar furnaces were later set up at other places in what then constituted Canada, it was not till after World War II that this country could be considered a significant factor in the iron and steel industry of the world.

It had long been known that in what was called Ungava (now New Quebec) and in Labrador there were large areas favourable to the concentration of iron ore; and it was also suspected that beneath the waters of Steep Rock Lake, in northwestern Ontario, rich and extensive deposits of iron ore might be found; but the Mesabi Range, near the head of Lake Superior in the United States, came into full production in the 1890's and provided a ready supply of cheap ore for Canadian iron and steel manufacturers. To develop either Ungava-Labrador or Steep Rock in those days would have required an investment many times greater than existing markets would have justified.

The first integration of Canadian iron and steel mills with nearby iron ore was undertaken in the District of Algoma, at the eastern end of Lake Superior. In 1894, Francis Henry Clergue, an American of French descent, gazed for the first time upon the tumbling waters of the St. Mary River and realized the inherent possibilities of that wasting power. In his mind's eye he saw, rising above the foundations of the existing wretched little town of Sault Ste. Marie, a great industrial city based upon cheap power. His schemes would require much money, at that time the scarcest commodity in Canada; in fact, Sault Ste. Marie's bonds were even then in default.

Returning to his own country, he found in Philadelphia a

group of moneyed men who became impressed by his picture of the industrial empire he proposed to create amidst the Canadian wilderness. Securing, as a first step, the \$225,000 needed to redeem the town's financial honour, and with assurances of further support, Clergue proceeded to translate his dreams into realities.

The man of the hour in Sault Ste. Marie, Clergue secured from the Ontario government concessions of water-power rights and pulp lands, as well as various railway charters, and organized the Lake Superior Power Company, the Sault Ste. Marie Pulp and Paper Company, the Algoma Commercial Company, the Algoma Central Railway Company, the Consolidated Lake Superior Company, and several others.

Harnessing the rapids, he built a plant for the manufacture of mechanical and sulphite pulp. Requiring sulphur for his chemical pulp, he bought the Elsie and Gertrude nickel-copper mines at Sudbury; and to take advantage of the surplus sulphur, he built a plant to produce sulphuric acid by a process then new. The nickel he planned to use in the manufacture of ferro-nickel, the highest grade of steel, but this did not materialize.

In the summer of 1897, prospectors rushed to the south shore of Wawa Lake and the Michipicoten River, not far from Sault Ste. Marie, on an unfounded report of placer gold. Two of them. Benjamin Boyer and Alois Goetz, continued their prospecting and in the following year found outcrops of iron ore on the north side of the lake. Boyer staked what became Clergue's Helen hematite mine; Goetz staked the future Josephine hematite mine and the Ruth and Lucy siderite properties.

Operation of the Helen began in 1900, ore being shipped over a branch of the recently built Algoma Central Railway to Michipicoten Harbour and from there by steamer to the United States market. After completion of the steel mill at Sault Ste. Marie, part of the output went there. Mining ceased in 1918 when the hematite was bottomed, but was resumed in 1939 when, on the initiative of Sir James Dunn, then president of the Algoma Steel Corporation, it was decided to process large adjoining deposits of siderite carrying thirty-five per cent iron. This mine, called the New Helen, and other iron properties owned by Algoma Steel,

are operated by Algoma Ore Properties, a wholly-owned subsidiary of which George W. MacLeod is president.

The Josephine mine, owned jointly by Sheritt Gordon and Frobisher Limited, was operated by them from October 1945 to November 1946 through a subsidiary, Michipicoten Iron Mines Limited. The orebody lay beneath a lake, which had been pumped out. Operation was not by open pit, however, but by underground workings. Although six hundred feet of capping had been left as a protection, ooze from the lake bottom made its way downward into the workings and flooded them. Cost of rehabilitation was then estimated at a million dollars, an expenditure which, at the time, did not seem to be warranted by the value of known ore reserves.

It is estimated that the Michipicoten iron ranges contain upwards of a billion tons of ore of various grades. To render it acceptable to the trade, Algoma Ore Properties maintains a plant at Jamestown, three miles from the New Helen mine, with an annual capacity of 1,500,000 tons of sinter grading fifty-three per cent combined iron and manganese. When the Sir James mine comes into operation, total production will amount to two million gross tons of sinter a year.

The general tendency in the iron and steel industry is toward the integrated operation of mine and mill, as in Algoma, but Steep Rock Mines Limited, at Atikokan, 140 miles west of Port Arthur, Ontario, is solely engaged in mining and marketing iron ore, although a portion of its properties is leased to a company primarily concerned with securing ore for its own blast furnaces.

Lake Superior, the deepest of the Great Lakes, lies in a vast depression gouged by glacial ice out of the southern extremity of the Canadian Shield which, in the region of the upper lakes, crosses into the United States, comprising parts of Minnesota, Wisconsin and Michigan. That southwestern corner of the Shield is the watershed from which streams flow eastward to the St. Lawrence, westward and northward to Hudson Bay and southward to the Gulf of Mexico. The fur trade route traversed the gap between Lake Superior and Lake of the Woods. Ascending the Kaministiquia River from Lake Superior, it crossed the

portage to Lac des Mille Lacs, out of which the Seine River flows westward to Rainy Lake.

This is typical Precambrian country, strewn with irregular rocky lakes, most of which are merely wider stretches of the rivers that connect them like beads on a string. Steep Rock Lake is an expansion of the Seine River, the master-stream of the area, sprawling somewhat in the shape of a letter M; it is about thirteen miles from one end to the other. Between Marmion Lake, next above in the Seine system, and Steep Rock, the difference in altitude is a hundred feet.

Hematite float, consisting in part of large boulders, was scattered along the south shore of Steep Rock Lake. A generation of prospectors had wondered about this float, and many believed that its source might prove to be under the lake. In fact, the Geological Survey of Canada, in a marginal note on a map published in 1897, reported that "an iron-bearing horizon with hematite of good quality appears to be generally covered by the waters of the lake." But with the Mesabi Range in flush production only seventy-five miles away, its ore as available to Canadian mills as to those in the United States, the question whether iron ore was hidden at the bottom of this lake was a matter of idle speculation; no one was interested in spending much money to find out. Nevertheless, from time to time, claims were staked, and some were brought to patent.

One of the first to consider seriously the possibility of recovering ore from beneath the lake was Julian G. Cross, a mining engineer living in Port Arthur. In the winter of 1926 he made a magnetic survey of the Middle Arm with a dip-needle. The results having strengthened his conviction that ore was there, he secured options on rights held by certain patent-holders and staked some additional claims.

In the spring of 1931, Cross succeeded in interesting James Richardson who sent his engineer, John Drybrough, to look over the ground. Drybrough staked fifteen claims along the East Arm and took an option on Cross's rights. In reporting to Richardson, he recommended that fifteen thousand dollars be spent in drilling, but because of the deepening depression Richardson did not feel justified in putting up the money. Instead, he sug-

gested that Drybrough try other sources, which he did, approaching the Steel Company of Canada and a number of the leading iron and steel companies in the United States, but without success.

Cross persisted in his efforts and finally, in the fall of 1937, persuaded Joe Errington to contribute twelve hundred and fifty dollars which, with an equal amount put up by himself, he proposed to spend in drilling through the ice. As an agency through which to work, Errington and Cross incorporated the Steerola Exploration Company Limited on January 6, 1938, and transferred to it the properties held by them. The company had an authorized capital of 100,000 shares, of which Errington and Cross each received 25,000 in payment of their holdings. The remaining 50,000 shares were sold from time to time during the following year for a total of \$87,495.50, chiefly to Donald M. Hogarth, Russell D. Bradshaw and George G. Blackstock, although a considerable number were bought by Errington himself. Errington was president and managing director; the other directors were Cross and W. S. Morlock, a Toronto lawyer who was the company solicitor.

When the ice was firm enough to bear the weight of the equipment, drilling began on the middle bay. Five holes were put down without encountering ore. Cross wired Errington to inquire whether he was willing to continue, and Errington, not one to give up easily, immediately replied that the drilling must not stop. It was then that he persuaded his friend Hogarth to join him in the enterprise. Errington's faith was soon justified, for the sixth hole found ore in what became known as the "A", or Hogarth, zone. Later, at the bottom of the middle section, the "B" or Errington zone was located.

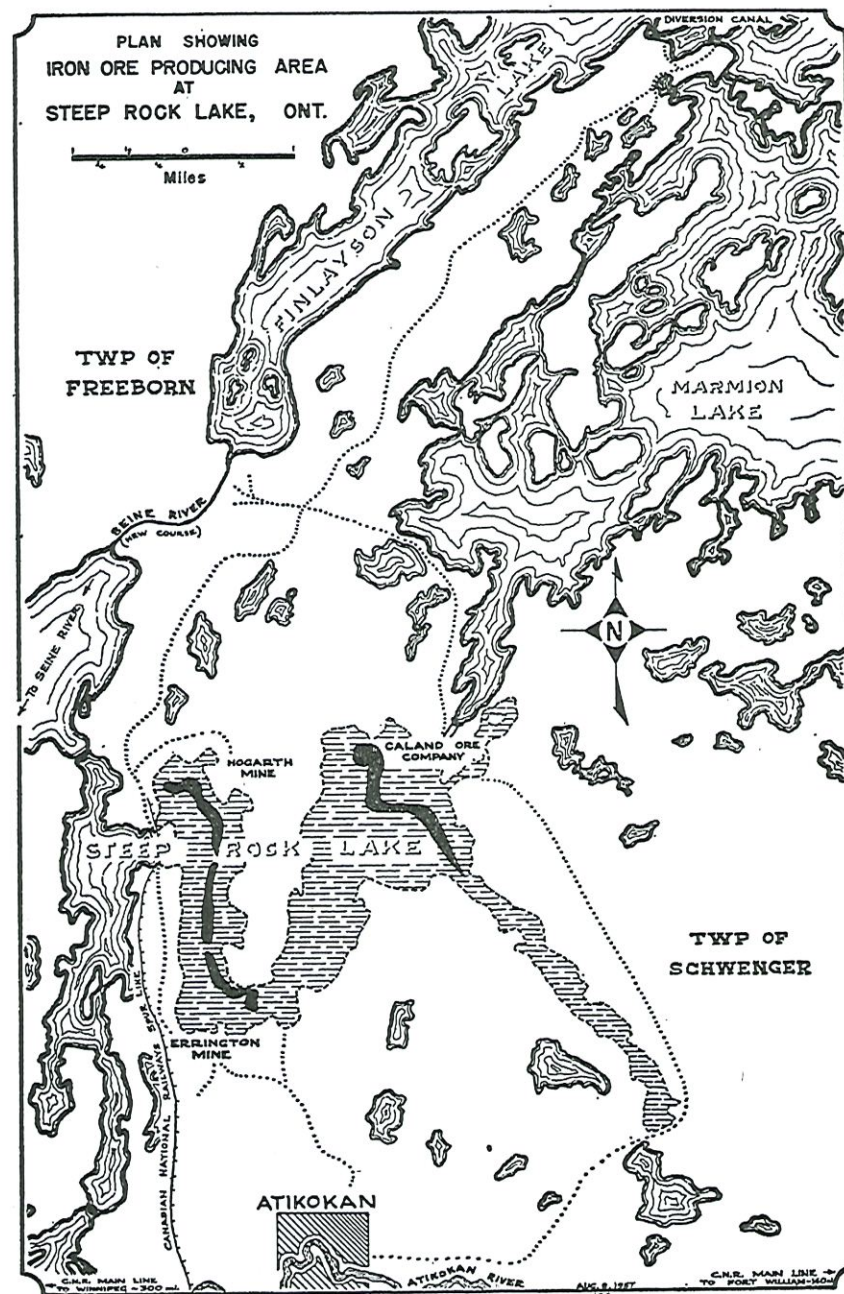
The time had now come to put the enterprise on a more substantial footing; and on February 24, 1939, Steep Rock Iron Mines Limited was incorporated with an authorized capital of ten thousand preference shares of \$100 par value and five million common shares of no par value, half of which were issued to Steerola in payment for its interest and entered in the Steep Rock books at a value of \$2,500,000. Joseph Errington became president; Julian Cross, vice-president; G. G. Blackstock, secretary

and, later, treasurer. The three directors were Errington, Cross and Hogarth.

Watkin Samuel, exploration engineer for Errington at Little Long Lac, was employed as chief engineer from the start, with Hugh Roberts of Duluth as consulting geologist. Samuel, who supervised the drilling, maintained his home at Geraldton, visiting Steep Rock as need arose, but shortly after the company was formed, M. S. Fotheringham, a young engineer previously with Teck-Hughes at Kirkland Lake, was engaged as resident engineer.

The first plans were based upon the expectation of underground mining, and a shaft was sunk to a depth of 800 feet in the hanging-wall greenstones, southwest of "A" orebody, from which a crosscut was run 1,000 feet toward the ore. Charles D. Kaeding of San Francisco, an engineer who had had experience of Canadian mining at Porcupine, Red Lake and elsewhere, became a director in October 1939 and was responsible for the appointment as consulting engineer of Eldon L. Brown, president and managing director of Sherritt Gordon. About this time some doubts, probably latent from the beginning, concerning the feasibility of underground mining, came to the fore, and Brown suggested that a hole be drilled into the orebody ahead of the drive. This was done through a valve, but as the drill neared the ore the rods were shot back and, before the valve could be shut, silt and broken rock to a depth of three feet had been forced from the hole into the crosscut.

It was now obvious that any attempt at underground operation while the lake and its accumulation of silts remained in place could only end in disaster. A change of plan became imperative; and diversion of the Seine River, isolating the eastern and middle sections and de-watering them, was decided upon. This would cost upwards of eighteen million dollars, most of which must be spent before success or failure could be determined. It was estimated that the portion to be de-watered contained over 118 billion U.S. gallons of water, of which some 70 billion, plus an annual inflow from rainfall of five billion gallons, would need to be pumped before mining could begin. After the water had been removed, a much more difficult job would remain. From a few feet to a depth of three hundred feet of glacial silt

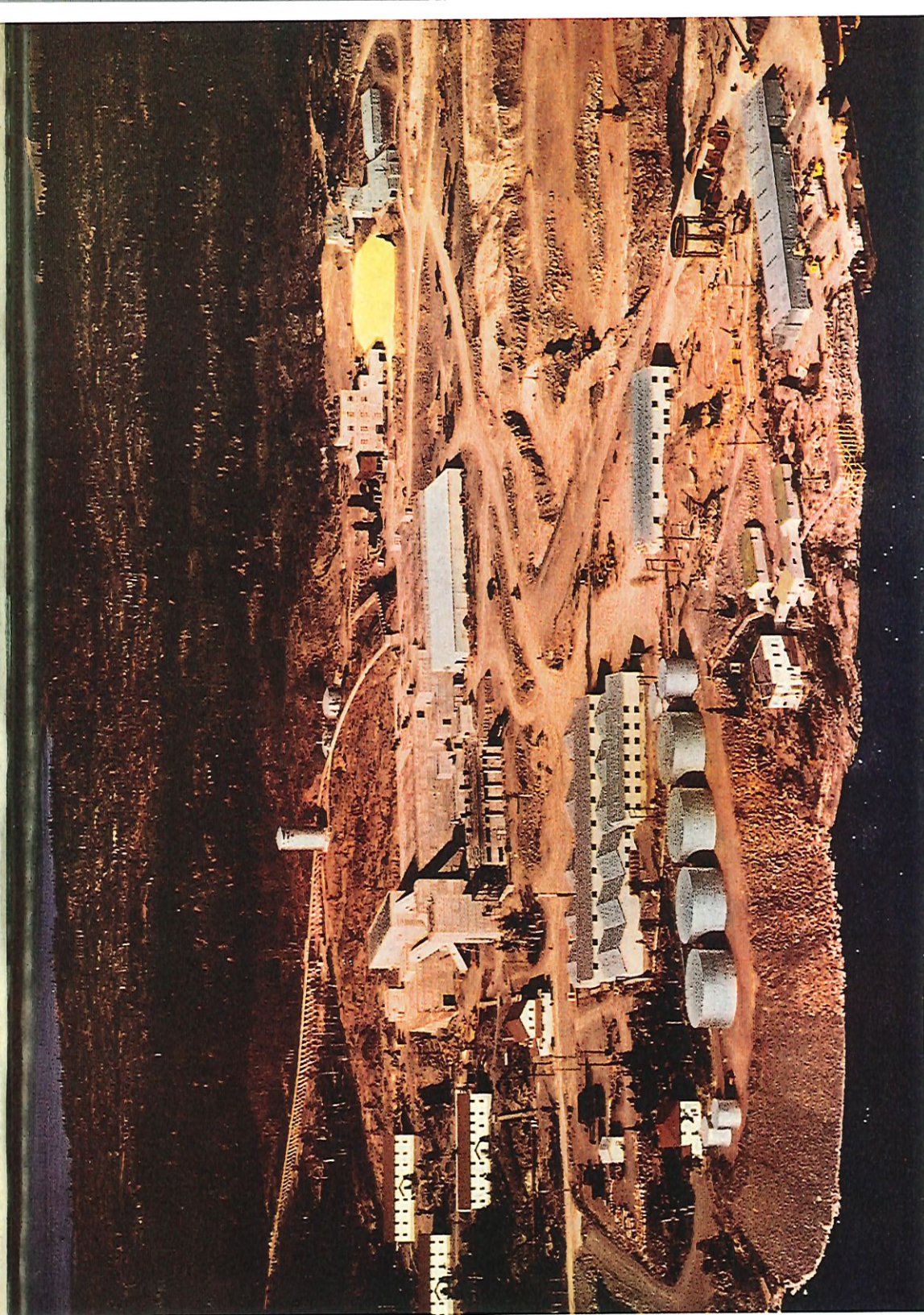


and up to a hundred feet of boulder clay would still overlie the orebody and must also be taken out.

The times were not propitious for such an undertaking. Besides the many difficulties to be faced because of the war, engineering opinion was far from unanimous concerning the feasibility of the whole enterprise. Nevertheless, the promoters did not falter.

Five different diversion routes were explored. The one finally chosen consisted of cutting a new channel from Marmion Lake through the much smaller Raft Lake to Finlayson Lake, five miles long, lying parallel to Marmion on the west, and returning the water to its original course at the head of the West Arm. The channels from Marmion to Raft and from Raft to Finlayson would be in rock, 100 feet wide and from 60 to 90 feet deep. Raft Lake, at the same elevation as Marmion, could be lowered the requisite amount by pumping with diesel and gasoline equipment. But Finlayson lay at a higher elevation and must be lowered fifty-five feet. The plan adopted here was to run beneath its bed a ten by twelve-foot tunnel 1,400 feet long, and thus draw off the excess water. Finlayson's future outlet at the "Escher Cut," 140 feet deep and 200 feet wide, led to a channel, mostly in gravel, averaging 300 feet wide for a distance of four miles and discharging into the north end of the West arm, where two dams walled off that portion of the lakebed which it was proposed to mine.

Since the 100-foot head between Marmion and Steep Rock lakes had been used for power by the Ontario-Minnesota Paper Company, it was necessary for the Steep Rock company to arrange with the paper company to convert its plant into a transformer substation and supply it with an equivalent amount of power from the Ontario Hydro-Electric Power Commission which, in 1943, built a high-tension line from Port Arthur (130 miles) to the mine. The spillway at the old outlet of Marmion Lake was raised to prevent the possibility of water again flowing into Steep Rock Lake at that point, and a 900-foot spillway and control works were built in Raft Lake to regulate the level of Marmion for the benefit of power installations in the Seine River below Steep Rock Lake.



Just when the success of the great undertaking seemed assured, Joe Errington, who had taken the lead in the heavy financing already required, died suddenly on February 8, 1942, in the Toronto Union Station. He was on his way to a meeting in New York, at which an address was to be delivered concerning Steep Rock. Direction of the enterprise now devolved upon Donald Hogarth, a worthy successor to Errington, with whom he had been associated for many years. Charles McCrea, a director since 1941, became vice-president. Hogarth was a man of many parts, but his chief characteristic was his faith in the possibilities of Canada. Having attained the rank of Major-General in World War I, he had become an original member of that group interested mainly in mining and exploration whom Thayer Lindsley had gathered about him in Ventures Limited, which also included Errington.

Not the least of Hogarth's contributions to the success of Steep Rock was his securing of the support of Cyrus S. Eaton, Canadian-born financier of Cleveland, Ohio, through whose influence the project was financed when money was hard to get, and Hogarth's death in June 1950 was Steep Rock's second serious loss. M. S. Fotheringham, who had gone to Steep Rock as a junior engineer in its earliest days and had risen to the post of vice-president and general manager, was now selected to succeed Hogarth as president—a choice which the company's subsequent progress amply confirms.

When Hogarth took the helm in 1942, six days after Errington's death, the diversion plans had not been finally adopted, and it would be almost a year before that vital project could begin. In some ways, it was not an exceptional undertaking. Twenty years previously, Canadian engineers had diverted a stream along channels blasted through granite on the Saguenay for the Aluminum Company of Canada, and the Welland Canal had already won high honours for Canadian engineers, but the Steep Rock development, requiring co-ordination and timing of no mean order, was begun and completed while both men and materials were in short supply. The diversion was successfully carried out during 1943; on schedule, the plug was blasted from the bottom of Finlayson Lake, and when the water had reached

the required level, the temporary dam blocking the Esker Cut was removed and others elsewhere completed so that the Seine River, which even the glaciers had been unable to budge from between the perpendicular walls of Steep Rock Lake, was now prevailed upon, for a distance of eight miles, to follow an unfamiliar course, by-passing its ancient channel.

The diversion completed, the next step, begun in December 1943, was to pump out the Middle and East arms. Seven steel barge hulls had been built, each equipped with two 24-inch electrically driven centrifugal pumps. But before they could begin to operate, a pumping forebay, or pool, must be excavated and a 300-foot tunnel, eight feet by twelve, driven through the solid rock of Narrows Island to connect the forebay with the West Arm, into which the water could be discharged.

Between December 1943 and May 1944 that portion of the lake east of the dam separating the West Arm from the rest of the lake was lowered eighty feet at the rate of six inches a day. The level had thus been reduced sufficiently to expose a formerly submerged extension of Mosher Point (at the junction of the two lines forming the middle portion of the M) which divided the part being de-watered into two separate lakes. By now, the fourteen pumps were more than was necessary to maintain the schedule in the western section. Four, and later four others, were moved to the eastern one.

After the bulk of the water had been pumped from the lake, and the "B" ore zone exposed, the removal of the heavy overburden, including clay-silt, boulder clay and rock, came next in order. The depth of overlying silt varied from a few feet to a maximum of a hundred feet. How best to remove it was a nice problem. It was finally decided, because of the clayey nature of the material, to disintegrate it by hydraulic monitors supplied by water under high pressure from pumps still de-watering the eastern section, and to use suction dredges to pump the resulting slurry into the selected disposal area at the head of the West Arm. Owing to the specialized nature of this operation, the Steep Rock directors decided to have the work done by contract and employed the Construction Aggregates Corporation of Chicago for that purpose.

The silt was removed from "B" ore zone by two fifteen-inch suction dredges, the operation requiring seven years—from 1944 to 1951. But when the time came to remove the silt from the "A" zone, the greater depths and larger quantities involved posed problems never before encountered anywhere. Larger and more efficient equipment was required, for which Construction Aggregates, on behalf of the Steep Rock company, began a search. Late in 1949, they located in Boston a thirty-inch, all-electric dredge called the "Nebraska." It had been built for use on the Kingsley Dam in Nebraska, after which it was dismantled and moved to New York, where it was put to work enlarging the Idlewyld Airport, and was later towed to Boston. Again dismantled, it was transported to Steep Rock Lake and renamed the "Steep Rock," going into operation in January 1951. When later a second unit was required, the steam dredge "New York" was bought in Chicago and transformed into a mate for the "Steep Rock." Named the "Marmion," it began operations in October 1952.

Working without a stop till December 1954, deterred by neither darkness nor cold, these two leviathans removed approximately fifty-five million cubic yards of material, thus exposing the ore so that power-shovels and trucks could begin stripping and mining the Hogarth pit.

Disposal of the silt involved many problems that were inherent, but when the ice went out of the Seine River in the spring of 1951 it was discovered that water below Steep Rock Lake, and in a considerable area of Rainy Lake, was markedly discoloured. With a view to the eventual development of orebodies believed to exist under the West Arm, plans had been prepared for the by-passing, at some future time, of that section of the lake. It was now decided to proceed with these plans, and between January and May, 1952, the channel from Finlayson Lake was extended from Barr Lake through a number of smaller ones to a new junction with the Seine a short distance below the outlet of the West Arm, and the latter was sealed off by an earth fill. This was completed at a cost of \$1,221,000, and the waters of the Seine River were restored to their pristine purity.

In the meantime the discovery of another major orebody ("G")

between "A" and "B" made necessary the transfer of the dredges "Steep Rock" and "Marmion" two miles and a half overland to new locations above the "G" orebody, thus creating further engineering history. During the winter of 1954, the unprecedented operation was successfully carried out; and by June 1955 the dredges had begun excavating fifty million cubic yards of silt overburden covering that orebody.

A crushing and screening plant was built at the terminus of the Canadian National's three-and-a-half-mile spur from Atikokan (put through in 1944), and a 30,000-ton oredock (later increased to 60,000 tons) was constructed by the Government of Canada at Port Arthur, in preparation for the first Steep Rock ore shipment. The first one, however, at the beginning of October 1944, was to the oredock at Superior, Wisconsin, instead of to Port Arthur.

Open-pit mining is the most economical means of producing ore, until depth invokes the law of diminishing returns. Then, if circumstances permit, resort must be had to underground operation — to which, fortunately, the Steep Rock orebodies, being deep-seated, are well suited. As the Errington pit neared the end of economical operation in 1950, work was started on a shaft ("B-1") to mine the underlying ore. Collared on Float Island, a quarter of a mile south of the orebody, it was sunk to a depth of 1,200 feet. From levels at 700, 900 and 1100 feet, drifts were run into the orebody. As the other open pits reach the same stage, similar underground workings will be opened up. The form of mining employed is called "induced caving": in large stopes, the ore is undercut ahead of the face; blastholes are drilled upward, charged with explosives sufficient to bring down a large mass of ore which by the force of its fall will break into fairly small pieces. In order to break the ore further, underground crushers have been installed, from which belt conveyors carry it to loading terminals on surface.

Steep Rock ore is marketed in two principal grades, an open-hearth lump, containing pieces four to ten inches in size, called "Steep Rock," and the "Seine River" grade consisting of the finer material, each piece not exceeding two inches in size. Open-hearth furnaces, in which pig-iron is converted into steel, use

considerable quantities of lump and intermediate ore. For this purpose, the low silica and phosphorus content and the lumpy nature of these sizes make Steep Rock ore very desirable.

The first trainload of ore from the Errington underground mine was dispatched on March 2, 1956, and it was estimated that about 750,000 tons would follow from the same source during the year. The balance of the estimated production of 3,250,000 tons for 1956 would come from the Hogarth pit. From mines under development, the company envisaged annual shipments of 5,500,000 tons, but since these are only part of the area known to be ore-bearing, it is likely that the ultimate yield will be many times this amount; and because the orebodies are deep-seated, the mines can count on a long productive period.

In addition to Steep Rock's own mining operations as described above, a second gigantic operation is under way in connection with the "C" orebody, located in the Falls Bay section, or east limb, of Steep Rock Lake. This section, comprising 1,200 acres and estimated to contain a minimum of 100,000,000 tons of equally high-grade ore, was leased in January 1953 on a royalty basis, for 99 years, to Caland Ore Company Limited, wholly-owned subsidiary of the Inland Steel Company of Chicago. Preparing the ground for production, scheduled for 1960, is a task second only to that which Steep Rock has already carried out. Before the ore can be mined, it will be necessary for Caland to de-water its section of the lake, a hundred feet at its greatest depth, and then remove an estimated 160 million cubic feet of clay.

Mining men speak of Steep Rock with respect because they can appreciate the job that has been done with such marked absence of fanfare. Yet to the great majority of Canadians, Steep Rock is little more than a name; on a quiz program it would draw a blank. Because iron, the drudge of industry, is not one of the spectacular metals, like gold or silver or uranium, and is content to supply people's everyday needs, it is taken for granted.

It is no disparagement of the way the Quebec-Labrador iron ranges were developed to suggest that, although bold of concept and brilliant in execution, it was much less spectacular than that

at Steep Rock. Ore in Quebec-Labrador is on or near the surface, not hidden beneath hundreds of feet of water, silt and clay, and no large river had to be diverted before it could be mined. On the other hand, the Steep Rock deposits lay only three or four miles from the railway and 140 miles from the head of the Great Lakes, centre of the world's largest iron and steel mills. But Quebec-Labrador was 1,750 miles from that market and 360 miles from tidewater, a gap that must be bridged by a railway traversing a terrain as rugged as any that could be imagined. Building railways in difficult territory holds no terrors for Canadians; but this was the first in which a large part of the matériel needed was transported entirely by air. In addition to what was required for the railway, matériel for a 12,000-horsepower hydro-electric plant, a dozen airfields and strips and a railway terminal and assembling yard must be flown in.

The original source of the ore is shrouded in the mists of time, but the record of the last million years is easily deciphered by the geologist. Most of what is called New Quebec, and Labrador as well—except that part along the Atlantic—is from 1,500 to 2,500 feet above the sea, but an arm of the ocean once occupied a depression, about a hundred miles wide, stretching north-westerly across the area for about five hundred miles. What remains of this depression is known to geologists as the Labrador Trough. Streams flowing for ages from high ground on either side carried billions of tons of sediments into the trough, spreading them along its bottom in horizontal layers. One such layer, averaging about four hundred feet in thickness, consisted largely of silica containing from thirty to forty per cent iron. Such deposits as this are generally referred to as "iron formation."

The land eventually rose to an altitude probably several hundred feet higher than at present; and (just when is not clear) it was subjected to a thrust from the northeast which caused the rocks to buckle into folds and faults, leaving the formation open to the action of seeping water. This seepage dissolved out a large part of the silica, leaving concentrations of iron oxide at various places along the trough. Such concentrations, contain-

ing from fifty-five to sixty-five per cent iron, constitute ore of commercial grade.

The final stage was reached in the Glacial Period when ice planed off the surface of the land, leaving the aspect very much as it is today: a region containing myriads of sprawling lakes of all shapes and sizes, connected into chains by short, twisted bits of streams which tumble down falls or over cataracts in channels so new that the rocks still have sharp edges. In places the surface is swept clean, but generally it is littered with gravel and sand—where it is not covered by that mixture of water and vegetation known as muskeg.

This region was first explored in 1892 and subsequent years by Dr. Albert Peter Low, one of the most brilliant of that group of men who have achieved for the Geological Survey of Canada a record of exploration unexcelled in any other land. From 1892 to 1895, inclusive, Low travelled 7,100 miles in that country—a thousand miles on foot, and the rest by canoe, boat and dog sled. Almost half a century was to elapse before the modest records of his remarkable journeys would attract the attention they deserve, but many prospectors and promoters had meanwhile become aware of their significance.

Reuben D'Aigle, having narrowly missed becoming the discoverer of the great Hollinger mine in Porcupine, was in New Quebec—then known as Ungava—as early as 1914, and was the first to stake (and record) claims in that region. Sir Donald Mann, the railway-builder, backed him to the extent of \$22,000; but that financier's influence was not equal to the task of securing large capital for the development of iron mines in such an out-of-the-way place.

Partly owing to D'Aigle's efforts, a group of Toronto men became interested, and in 1929 Fred M. Connell organized The New Quebec Company Limited. It comprised three groups of investors: one, including Connell and represented by J. Y. Murdoch, consisted of men associated with Noranda; the second represented by Richard S. Dening, consisted of the Huronian Mining and Finance Company Limited (which after various amalgamations became Anglo-Huronian Limited); and the third group consisted of New York interests, represented by Cornelius

V. Whitney. Murdoch was president and Kenneth A. MacFadyen, manager.

The company obtained a concession from the Quebec government granting it exclusive exploration rights covering five blocks of territory along the Trough; and a similar concession was secured from the Government of Newfoundland covering thirty-six Mining Locations in Labrador.

In the same year (1929) the company sent two geologists, W. F. James and J. E. Gill, to make an exploratory reconnaissance of its concessions; but, although they made the first discovery of commercial-grade iron ore in the region, the depression soon put an end to any hope of securing capital for development. The company had spent approximately \$75,000; but when efforts to interest likely purchasers had failed—Bethlehem Steel had considered the proposition in 1931—the leases were allowed to lapse, and eventually the company was wound up.

The next move was made by John H. Colville, a Toronto mining engineer, in association with Weaver (Minerals) Limited, a Montreal company headed by Lovell G. Mickles. Early in 1936, Colville proceeded to St. John's, Newfoundland, armed with an application addressed to Sir John Hope Simpson, Commissioner for Natural Resources in the Newfoundland government, requesting on behalf of the Weaver company a ten-year concession on an area comprising some 20,000 square miles in Labrador south of Lat. 55° N. and west of Long. 61° W.

With the assistance of Hans Lundberg, then living in St. John's, Colville secured the concession. It was granted on condition that (among other things) the concessionaire should spend \$50,000 a year in exploration or mining; that the area should be reduced each year after the third; and that at the end of the tenth year the holder should be entitled to receive a Crown grant of the mineral rights covering such portion of the remaining area as might be selected for retention.

To operate the concession, the Labrador Mining and Exploration Company Limited was incorporated under Newfoundland law, and its management was vested in McKay (Quebec) Exploration Limited, of which Addison H. McKay of Montreal was the manager and principal shareholder. A second company,

Newfoundland Skyways Limited, was organized to supply aerial transport for the enterprise.

Dr. J. A. Retty, a geologist formerly in the employ of the Quebec Department of Mines, was given charge of exploration, establishing his base at Ashuanipi Lake, in the upper Hamilton River system. It is significant, however, that although a deposit of pure hematite was discovered in 1937 through the help of an Indian, and six orebodies were located later, the quest was still for gold, with much less emphasis on base metals.

McKay was required to find most of the money to keep the exploration effort going, but without evidence of rich mineral deposits the proposition did not appeal to the speculating public. It was obvious that the most likely source of capital was among the large iron and steel manufacturers in the United States, and Mickles approached the M. A. Hanna Company of Cleveland, Ohio. He discussed the matter with George W. Humphrey and J. H. Thompson, officers of the company, but they did not care to assume the leading part in such a large project.

Meanwhile, in 1939, McKay had applied to the Quebec government for a concession in New Quebec, adjoining Labrador Mining and Exploration's concession in Labrador, and this was granted. It covered 3,900 square miles and was to run for two years at a rental of \$1,000 for the first year and \$2,000 for the second, renewable at \$3,000 a year.

Owing to lack of money, operations were suspended in 1940 and 1941, but shortly after, the interest of Jules R. Timmins was enlisted in the enterprise. Mickles and he had met casually a couple of times, and the conversation had turned to iron ore in Labrador, but no definite deal had been discussed. Timmins had intimated that he was on the lookout for some suitable project to perpetuate the family name. He had visited Labrador and had been impressed by what Retty had shown him. Eventually he admitted that the project appealed to him and that he might be willing to consider it, but he stipulated that Hollinger should have control, preferably with the minority interest held by some company with experience in the iron trade. His first definite move in achieving this end was the acquisition, after a memorable proxy-battle, of control of McKay (Quebec) Explo-

ration, leading, in 1942, to control of Labrador Mining and Exploration.

Timmins was now in a position to offer the Hanna company a suitable deal. There are several claimants for the honour of having brought the two together, and doubtless more than one had suggestions to offer, but the person who probably did most to bring matters to a head was John Knox, at that time general manager of both Hollinger Consolidated and Labrador Mining and Exploration. Hanna and Hollinger had previously investigated jointly an iron anomaly at Milton, Ontario; and it was this association, together with the earlier acquaintance of Knox and Humphrey, that led to the eventual partnership.

In 1942, the licence secured from the Quebec government in 1939 by McKay was replaced by another covering the same territory for a period of five years at a rental of \$2,000 a year, and requiring an annual disbursement of \$10,000. It was renewable for a further period of five years at a rental of \$1 and an annual disbursement of \$10 a square mile. The new licence was taken out in the name of the Hollinger North Shore Exploration Company Limited, which had been incorporated as the vehicle for operations in New Quebec.

Also in 1942, geological work suspended two years before was resumed. This was under the direction of J. K. Gustafson (then in the employ of Hollinger Consolidated), with Retty, A. E. Moss and A. T. Griffis as assistants. By now the existence of profitable iron-ore deposits seemed practically certain, but there was not sufficient evidence to justify the expenditure of the large sums needed to bring the ore to market. The minimum requirement before development could be undertaken was set at 300,000,000 tons, later advanced to 400,000,000 tons.

Previous exploration had established promising locations for testing, but drilling in a region where all supplies and equipment must be transported by plane was expensive and hedged about by difficulties. To handle air transport, Hollinger-Ungava Transport Limited was incorporated in 1948. By 1949, more than the specified tonnage had been outlined by the drills, approximately two-thirds of it in Quebec and the rest in Labrador. The ore is direct-shipping, high-grade, with an average iron con-

tent of sixty per cent, approximately ten per cent being "manganiferous"; it is free from impurities such as sulphur and phosphorus.

In 1949, the Iron Ore Company of Canada was incorporated under a Delaware charter. Its authorized capital was six million shares of \$10 par value, the stockholders being the Hollinger North Shore Exploration Company, the Labrador Mining and Exploration Company, Hollinger Consolidated Gold Mines, the M. A. Hanna Company and a group of United States steel companies including Armco Steel Corporation, Hanna Coal and Ore Corporation, National Steel Corporation, Republic Steel Corporation, Wheeling Steel Corporation and the Youngstown Sheet and Tube Company.

Up to the end of 1955, Iron Ore of Canada had issued bonds amounting to \$140,000,000 which were bought by fifteen United States and four Canadian insurance companies. In addition, debentures to the extent of \$73,600,000 had been issued.

George W. Humphrey became president, Jules Timmins, vice-president, and W. H. Durrell, general manager. When Humphrey resigned in 1952 to become Secretary of the Treasury in the Eisenhower administration, he was succeeded by J. H. Thompson; and when Durrell shifted to another position in the organization, his place as general manager was taken by C. E. McManus. Actual operation of the company's affairs is controlled by a Canadian company called Hollinger-Hanna Limited, jointly owned by Hollinger Consolidated and Hanna Coal and Ore Corporation, of which Jules Timmins is president and W. H. Durrell, executive vice-president.

Since most of the ore is at or near the surface, some in ridges above surface level, the company's chief task was to get it to tidewater at the lowest possible cost. Thus a railway became the key factor, and for this purpose a charter was secured under the name Quebec North Shore and Labrador Railway. Construction began in 1951, and the single-track line was completed in 1954, covering a distance of 356.7 miles from tidewater at Seven Islands, on the north shore of the Gulf of St. Lawrence, to the assembly yards at Silver, near the mines. About forty

per cent of the line consists of curves, of which there are seven hundred.

Seven Islands (Sept Iles), given its name by Jacques Cartier in 1535, is a natural harbour with plenty of water for ocean shipping, ample protection behind its seven islands (one of which is but a reef), and sufficient dock space to accommodate all the ships that have occasion to call. The coastal terrace upon which the town is building can supply space for a city. The dock is equipped with the most efficient means of unloading ore-trains, loading ships, and storing ore to ensure a continuous supply.

Beyond the six-mile terrace and a fringe of foothills, the rugged Laurentians, which there rise to a height of 3,200 feet, provide the plateau's beetling brow. Once past this, the altitude decreases until at a distance of about a hundred miles inland the terrain becomes typically Precambrian, the average elevation being about 2,000 feet. Water predominates; in the southern portion the land is timbered; but as the iron region is approached the country becomes a series of bare, ridged uplands, the whole brick-red owing to the presence of iron oxide.

The route follows generally the main drainage system. At about Mile 12 it strikes the Moisie River, the approach to which is a 2,206-foot tunnel through a buttress of the Laurentians. The tunnel debouches directly upon a 705-foot steel trestle strung 155 feet above the turbulent waters of the river. The Moisie, at Mile 28, leads to the Nipississ, and this in turn, at Mile 57, to the Wacouno, which the railway follows to the height of land at about Mile 150. From Ashuanipi Lake, one of the sources of the Hamilton, the drainage is northward (and eventually eastward to the Atlantic); the railway first touches this lake at about Mile 186, and follows its eastern shore for sixty-five miles. At Mile 330, the line passes along the top of Menihék Dam, which provides water for the turbines that generate power for the mines and townsite.

Like every other feature of this remarkable enterprise, railway construction posed exceptional problems. The job was too big for any one firm, and consequently four large contractors—Cartier Construction, Limited; McNamara Construction Company Limited; Mannix Limited; and Morrison-Knudson Com-

pany of Canada Limited—joined to form a new company which submitted bids on the construction of the railway, terminal and two power projects, and was awarded the contracts. The tunnel at mile 12 was excavated by Patrick Harrison and Company Limited. The connecting link between the individual companies, and between the group and Iron Ore of Canada, was the general manager, Jack Clark.

The airlift made all possible. Under Charles Hoyt, operations manager for Hollinger-Ungava Transport, more than seventy-five pilots, most with long experience of bush flying, in planes of all sizes and designs, on wheels, floats and skis, transported anything and everything that the construction crews required, carrying upwards of three hundred tons a day. Operational base was at Mont Joli, a C.N.R. point on the south shore of the Gulf, where much of the traffic originated; but heavy goods ordered in time to arrive by water went from Seven Islands, which for a time had a record of daily take-offs greater than that of any other airport in Canada. When conditions were favourable, planes left the airport at five-minute intervals. Flying for eight years, summer and winter, through all sorts of weather, the operation was not marred by a single fatality and there were few serious accidents.

The first terminal of the railway was at Burnt Creek, but when it was found to be on top of one of the largest ore deposits, the budding town was shifted a few miles to a new site called Knob Lake. Later, at the suggestion of Premier Duplessis, the latter was re-named Schefferville, after the Bishop of Labrador, and a model town has since been laid out. While having no desire to deprive the worthy bishop of due recognition, many of those who pioneered the camp regret the change of name; the original was derived from the "Knob," a landmark familiar to all who travelled the skies in that region.

The "Last Spike" was driven by Jules Timmins on February 13, 1954, and by the end of July the first loaded trains had reached Seven Islands. One chapter had ended and another had begun. The objective for 1956 was 12,000,000 tons (which was attained), and it is expected that when the Seaway is completed the minimum yearly quota will be 20,000,000 tons. In-

cidentally, that the development of the Seaway became at last possible is due in large measure to the influence of U.S. steelmen, vitally interested in securing Quebec-Labrador iron ore.

In view of the terrain it traverses and the difficult conditions under which the railway was built, it is a tribute to the skill of its builders that they have produced in this unpropitious land a road that has won the admiration of every railway expert—and there have been many—who has gone over it. The 132-pound rails, laid on closely-placed ties, well ballasted with rock, and a grade of 0.3 per cent, southbound, provide a standard which no other similar stretch of railway on the continent has reached.

Trains of 125 cars, carrying up to 15,000 tons of ore and hauled by four diesel-electric locomotives, continue during the season in unending succession. Twenty-three passing sidings are provided, and the line is equipped throughout with automatic signals. In 1956, well-appointed passenger trains were in operation twice a week, each way, between Seven Islands and Schefferville; and when the highway between Quebec City and Seven Islands is completed the Quebec North Shore and Labrador Railway will undoubtedly carry hordes of tourists.

J. A. Little, first field manager of the enterprise during exploration days, is general manager of the railway with headquarters at Seven Islands, and A. Bybee is superintendent. Earl Farnam, attached to the mining division, is responsible for getting out the ore and making sure that it is available for loading into the holds of the ships that, one by one, slip silently in from the sea.

In 1948, the Ontario Department of Mines, in association with the Geological Survey of Canada, conducted an airborne magnetometer survey of a portion of Hastings County; maps were prepared and distributed by the Survey. One of these maps reached geologists of the Bethlehem Steel Corporation, Bethlehem, Pennsylvania, who noted the similarity between the convolutions marking an anomaly on the Ontario map and those on one of a newly discovered iron-ore deposit in Pennsylvania. Investigation followed, and as a result a tract of land, eventually comprising 1,195 acres, was optioned by Bethlehem in May 1950, near the town of Marmora. Forty holes with a maximum depth

of eighteen hundred feet were drilled, and by August 1951 the existence of more than eighteen million tons of disseminated magnetite, containing thirty-seven per cent iron, had been confirmed. The ore was buried beneath flat-lying limestone beds about 130 feet thick.

Marmoraton Mining Company Limited was organized to mine and ship the ore. Stripping of the overburden began in March 1952 and continued at the rate of thirty thousand tons a day. By 1954, a pit about half a mile long and about a quarter of a mile wide had been opened, which will be mined to a depth of five hundred feet.

Mining is by open-pit methods and presents no problem. Waste rock is eliminated by magnetic separation, but since the ore still contains a considerable percentage of gangue material it is concentrated at the mine, passing through rod and ball mills and the usual accessories of classifiers and filters. The concentrates then go to an agglomerating plant and emerge in the form of hematite pellets from half to three quarters of an inch in diameter, containing 63-65 per cent iron. These are loaded into bottom-dump hopper cars and shipped over a C.N.R. line to Picton, on the shore of Lake Ontario, where a high bank facilitates loading into carriers which pass through the Welland Canal, discharging their loads at Bethlehem's steel plant at Lackawanna, New York, 211 miles from Picton.

When Newfoundland joined its large neighbour in 1949, the latter's iron ore production doubled; thenceforth, of course, ore mined at the Wabana mine on Bell Island in Conception Bay, on the north shore of Avalon Peninsula, was counted as Canada's. This remarkable mine, which has produced fifty-five million tons of ore since it was opened in 1895, has reserves of unknown extent. The ore, containing about 52 per cent iron, 12 per cent silica and 0.8 per cent phosphorus, has not hitherto been much in demand by Canadian or American steel-makers. An exception is its parent company, the Dominion Steel and Coal Corporation, whose Sydney plant takes about a million tons a year, the rest of its output going to well-established markets in Great Britain and West Germany.

As was the case at Steep Rock, the Wabana ore is covered by two hundred feet of water, but in place of Steep Rock's silt and clay, Wabana has a cover of from three hundred to sixteen hundred feet of rock. Another difference is that the water could never have been pumped out, for it is part of the Atlantic Ocean. The ore occupies a dozen horizontal beds, three of which are of workable height. The lowest, known as the Dominion, varies from five to thirty feet in thickness; the Scotia, in the middle, lies two hundred and forty feet above; while the Upper is sixty feet higher up. The two upper beds vary from five to thirteen feet in thickness. The strata dip northwestward—that is, out to sea—at a uniform rate of about ten degrees.

When the glaciers were reconstructing the land in that vicinity they failed to eliminate a rocky ledge nearly seven miles long and about two at its greatest width, rising two hundred and twenty feet from the waters of Conception Bay; and it just happened that the gently sloping beds of iron ore underlying the floor of the bay came to surface on this island. They were first mined as open pits. The miners, following the ore northwestward and downward, soon reached a point beyond the edge of the island, but with sufficient rock in the roof to keep out the sea; and the farther north they went the thicker the rock-cap became. The farthest working face is now nearly three miles from the portals on Bell Island, under sixteen hundred feet of rock and two hundred feet of water.

While several "slopes" have been mined at times, three principal ones are being worked at present: Nos. 3 and 4, in the lowest bed, their portals about a mile apart, and No. 6, directly above No. 3. At a point 7,500 feet from the portal of No. 3, the main east-west artery extends 6,000 feet east and 7,500 feet west, giving the mine a width of more than two and a half miles.

It is a very satisfactory mine to work. The beds are thick enough to allow extraction of ore without much dilution by waste rock; both ore and rock stand up much better than is the case in many mines, and little timbering is required. The workings are completely dry. Extraction follows the "room and pillar" method; main levels are driven twenty feet wide, by from eight to fourteen feet high; main headways are twenty feet wide and





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from five to fourteen feet high; rooms are from twenty to twenty-five feet wide, the full height of the seam.

At one time or another, since mining at Wabana began, many different means of extracting ore have been followed. The mine is now completely mechanized; drills are mounted on trucks; and broken ore is lifted by mechanical loaders into self-propelled shuttle cars. Until electricity was introduced, ponies were used underground, and stalls where generations of horses spent their lives can still be seen in the old workings. In 1952-53, a complete change was made in the method of lifting ore to the surface; No. 3 slope, the main haulageway, was equipped with a three-foot rubber conveyor belt consisting of ten flights, each approximately twelve hundred feet in length, travelling at 575 feet a minute with a capacity of a thousand tons an hour. It is said to be the longest conveyor system in the world, and has also the greatest vertical lift.

On surface, previous to 1955, the ore was loaded from hoppers into trucks and hauled a mile and a half across the island to the south edge, where it was dumped over the bank to pockets from which it was taken to fill ships lying at the dock. But since then a separation plant has been built near the portal of the main slope to eliminate waste rock, and a second conveyor-belt system, 8,800 feet long, in five flights (the longest 4,700 feet) now completes conveyor-carriage from the innermost reaches of the mine to the island's farther edge, a distance of nearly four and a half miles.

Dominion Wabana Ore Limited, wholly-owned subsidiary of Dosco, is managed by Herbert P. Dickey, vice-president and general manager; the mine superintendent, H. D. Cameron, who first went on the payroll in 1928, has spent his working life in the mine.

Although most of the mines described in this chapter are in the eastern part of Canada, British Columbia seems likely to play a more important part in iron-ore production than in the past. Two companies, The Argonaut Company Limited, working deposits at Quinsam Lake on Vancouver Island, and Texada Mines Limited, operating a mine on Texada Island, between the main-

land and Vancouver Island, have shipped, since the end of World War II, increasing tonnages—principally to Japan. The completion of hydro-electric power projects now in the planning stage is likely to result in the development of other deposits.

In addition to the sources of Canadian production mentioned above, iron ore is a by-product of Inco's operations at Copper Cliff, Noranda's at Port Robinson and Cutler, and Quebec Iron and Titanium Corporation's at Sorel, Quebec; while Falconbridge and Sherritt Gordon also plan shortly to recover iron ore from their respective operations.

So far as prospective production is concerned, the most promising area appears to be that section of the Labrador Trough extending northwestward to the west shore of Ungava Bay from the area now being developed by the Iron Ore Company of Canada. While a number of companies such as Noranda and Frobisher have interests in the central portion, the most likely near-future development will probably be in the neighbourhood of Ungava Bay where immense deposits of ore requiring concentration can be mined within easy reach of tidewater. Among the companies holding concessions here are Consolidated Fenimore Iron Mines Limited, Oceanic Iron Ore of Canada Limited, International Iron Ores Limited and Atlantic Iron Ores Limited, the two latter controlled and privately financed by Cyrus S. Eaton. On the Belcher Islands, in Hudson Bay, Belcher Mining Corporation Limited has located extensive deposits of magnetite by diamond drilling. Success in marketing will be governed by conditions of navigation in Hudson Bay and Strait.

Canadian Javelin Limited holds a concession comprising 4,700 square miles in the Wabush Lake area of Labrador, where more than 900,000,000 tons of 37-per-cent ore have been disclosed by diamond drilling. A thirty-seven-mile railway, the bonds of which have been guaranteed by the Government of Newfoundland, is under construction, connecting these deposits with the Quebec North Shore and Labrador Railway, over which it is proposed to ship the concentrated product to Seven Islands and the markets of the world.

A recurrent theme in the iron ore story is that of early prospectors or explorers discovering extensive ore deposits in some out-of-the-way place and, after vainly attempting to find capital for their development, being forced to allow mining rights thus acquired to go by default. Then, when growing scarcity in world markets, especially in the United States, has created a demand, others reap the benefit. In 1947-49, W. A. Hesse, a geologist, backed by the Cleveland Cliffs Iron Company and associates, located and mapped a large area of Huronian rocks in the Mount Wright region of northeastern Quebec, where widespread showings of iron formation were discovered. Hesse and his backers acquired exclusive exploration rights by staking a large group of claims, but when the iron companies declined to spend the sums necessary to bring the project into production, Hesse was forced to relinquish his rights.

In 1952, the Mount Wright region was explored by the United States Steel Company and after a considerable amount of drilling in subsequent years the existence of immense deposits of magnetite was established. Concentration is necessary, but the project was held to be economically feasible because of the extent of the deposits and the further fact that they can be worked by open pit. In 1955, The Cartier Mining Company, a subsidiary of United States Steel, was incorporated, and plans were adopted for the building of a town, a 10,000-ton concentrator, and a railway 250 miles long to connect the iron ranges with Shelter Bay, on the north shore of the St. Lawrence River. The deadline for this program was set at 1961.

Now that Canada has at length joined the ranks of iron-ore-producing countries, there does not seem to be any limit to possible sources of supply. Here is an interesting example of the manner in which deposits are sometimes located. In the fall of 1955, Lloyd Leach, geophysicist for Lundberg Explorations Limited, flying south from the James Bay region in a company aeroplane piloted by Sten Lundberg, drew his companion's attention to the geological formation over which they were flying at a point about thirty-five miles north of Kapuskasing. Flying back in the spring, they decided to test the spot with the magnetometer and located promising anomalies. Unable to interest

any of the mining companies in their find, they raised money for drilling from among their fellow-employees, a few dollars here and a few dollars there. The drill proved the existence of a large deposit of high-grade magnetite, which was bought by the Steel Company of Canada for a million dollars cash.

All the iron ore produced in Canada up to the end of World War II came to less than forty million tons, an amount which, when projects now under way are completed, should constitute the country's minimum annual production. Canada's advance, in less than a decade, from almost complete dependence for iron ore upon outside sources to a prospective position as one of the world's leading producers is unique in history.

Canadians can take no credit, of course, for the existence of this ore, but perhaps they may be entitled to feel a certain amount of pride in the energy and efficiency which they have displayed in making it available.

XIX

Uranium

ONE SHORT AUTUMN DAY IN 1929 AN AEROPLANE WINGED ITS WAY above the Arctic tundra near Great Bear Lake. On board was a prospector looking for new lands to prospect. What he saw below was a jumbled mass of rock, overturned and twisted when the earth's crust was cooling. To almost anyone else it would have seemed a wasteland. Yet this was exactly what he was looking for, since in places where Nature has undergone such convulsions, valuable minerals are often found.

Gilbert A. LaBine had looked for gold and silver ever since as a lad he had left the family farm at Westmeath, in the Ottawa Valley. He had examined rocks at Cobalt for silver; he was at Porcupine and Kirkland Lake when those fabulous camps were in their prime. But while he had diligently searched at the foot of every rainbow, he still had to find his pot of gold; and here he was searching again on the rim of the Arctic.

In the spring of 1917, LaBine had staked a gold-quartz vein in a shear zone in granite about two and a half miles north of the eastern end of Long Lake, in the Rice Lake district of south-eastern Manitoba. It was not till 1925, however, that he was able to begin developing the property; and in that year Eldorado Gold Mines Limited was incorporated, with Gilbert LaBine as managing director and his brother Charles as president. The continent was in the midst of a boom which in 1929 would crash with disastrous consequences to people all over the world. But during the hopeful mid-twenties mining shares were easy to sell and the LaBines had little difficulty in raising half a million dollars for their mine. In 1927 they put down two prospect shafts and, later, one of three compartments which went to 500 feet, opening three levels from which a considerable amount of

underground work was done, but the ore pinched out. J. P. Millenbach, the mine manager, afterwards one of Ventures's top men, was left to dispose of the plant and equipment while Gilbert LaBine set off in the fall of 1929 to find another property.

Such organizations as Hammell's N.A.M.E. and MacAlpine's Dominion Explorers Limited had already begun aerial exploration of the far north, and in 1928 Gilbert LaBine had decided to take a look himself at the country about Great Bear Lake. With that end in view he arranged with Western Canada Airways to set out gasoline and oil caches along the route for a flight down the Mackenzie in 1929. He flew from Winnipeg, his pilot being the well-known bush flyer, Leigh Brintnell. (LaBine paid the regular passenger fare south of the Northwest Territories and \$1.75 an air mile within the Territories.) Brintnell left his passenger at Hunter Bay, near the southeastern end of the lake, and arranged that he or another pilot would pick him up a short while later.

LaBine found copper, native bismuth and cobalt which elsewhere might have been phenomenal, and staked four claims. He was picked up by C. H. ("Punch") Dickins, another famous bush flyer, and as the aeroplane flew low above the jumbled surface of the rockbound land, LaBine was greatly impressed by the formation about Echo Bay. It was too late in the season to do anything about prospecting this promising region, but he was determined to return in the spring.

He did so, flying in as before. This time he was equipped for a longer stay and was accompanied by another experienced prospector, Charles E. St. Paul. The latter was confined to camp with snowblindness, however, when on May 16, 1930, LaBine made an historic discovery. At the water's edge, on what later became known as LaBine Point, a promontory jutting into Echo Bay, LaBine located a vein which, when assayed, was found to contain pitchblende, cobalt and bismuth, as well as very rich native silver. Shortly afterwards a second vein was found lying parallel to the first, about three hundred feet away; and later, two others. The veins, from a few inches to about ten feet in width, were in a severely faulted and disturbed zone (which had caught LaBine's practised eye the previous year) and lay near

the contact of granite intruded into lava flows. All veins were found to carry silver running up to 20,000 ounces to the ton.

Even silver so rich might be difficult to mine profitably so far from market; whether LaBine had found a mine or not would probably depend on values carried by the pitchblende, for the minesite was a thousand miles by air from Edmonton and 1,500 miles from railhead at Waterways, and a 3,600-mile haul would be required to transfer the ore from the mine to a refinery.

Before any mining could be undertaken, camp buildings would need to be erected and the necessary equipment and supplies brought in over the long water-route from the end of steel. The first mining was carried on by trenching, and the ore was hand-picked in bags. The first ore shipment was made in the spring of 1932—twenty tons consigned to the ore-dressing laboratories of the Mines Branch at Ottawa. This was a crucial shipment, but the result—an average of over 40 per cent U_3O_8 —justified LaBine's expectations. Nevertheless, much scepticism existed among the mining fraternity concerning the prospects for profitable operation. In those days, of course, the end-product was radium.

The first small mining plant, diesel-powered, was brought in during the summer of 1932 and an adit was driven into the hillside the following winter, when a crew of twenty-five was employed. The next year, after considerable work had been done underground and ore reserves had been built up, a concentrator was brought in and production started.

Oil for the diesel plant came from wells of Imperial Oil at Norman Wells, on the Mackenzie River, fifty-one miles north of the mouth of Great Bear River. These wells, drilled in 1920-21, had remained capped in the interval because of the lack of a market for the oil. This market Eldorado now proceeded to supply, and Imperial Oil installed a small refinery to provide petroleum products to meet the need.

Emile Walli was mine manager during these difficult years. Much of the credit for the successful development of a mine under such exceptional circumstances is due to him, although the guiding hand and driving-force throughout were Gilbert

LaBine's. Later managers were E. J. Bolger, E. B. Gillanders, H. E. Lake and, at the time of writing, J. G. McNiven.

In addition to difficulties inherent in the operation of a mine at such a remote spot, other unusual problems had to be faced. The veins strike beneath the waters of Great Bear Lake. Many mines are operated without undue trouble underneath lakes, but here the ground has been badly shattered, and numerous fissures cut the veins. Since the ground is perpetually frozen to a depth of three hundred feet, water does not penetrate into the workings above this level, but fissures in deeper ground are permeated with water under pressure, and it is necessary to seal it off before mining can proceed.

This is done by what is called "grouting," which consists of pumping a thin cement mixture into the cracks through drill-holes properly placed. From one drill-hole it is possible to treat in this way an area of from fifty to seventy-five feet in diameter, but it adds greatly to the cost of mining. Forcing the cement into the fractures requires pumps capable of overcoming water pressure as high as seven hundred pounds to the square inch.

The first mill, a gravity concentration plant, was built in 1933 and continued in use until 1952. The Mines Branch Radioactivity Division at Ottawa developed an acid leaching plant between 1947 and 1949 and a concentrator designed accordingly, built at LaBine Point and put into operation in April 1952, was the first modern uranium leaching plant in North America to treat pitchblende ores. Part of its function was to treat tailings impounded since the beginning of production which the gravity plant could not handle. The mill superintendent during this period was E. B. Spice.

The cost and labour of hand-picking were eliminated after the first concentrator began operations; and, so far as possible, all material not capable of producing uranium was discarded. The company had built its refinery at Port Hope, Ontario, in 1932, to treat the concentrates. The reason it was not built at the mine is that for every ton of concentrates refined about seven tons of chemicals and other supplies are needed; and it was therefore cheaper to ship one ton of concentrates to the refinery

than to transport seven tons of chemicals and other requirements to the mine.

Following construction of the original concentrator, shipments of concentrates and lump ore were made from LaBine Point at an average rate of two tons a day. The concentrates (consisting of a black powder) and the lump ore were packed in bags and loaded on boats for the first stage of the long journey to the refinery. Navigation on Great Bear River, flowing westward from the lake into the Mackenzie, is interrupted by an eight-mile series of cataracts about thirty-five miles above the river mouth, and here the first stage ended; everything had to be hauled by trucks over the portage for re-shipment at the other end. After reaching the Mackenzie, the course lay up that river to its source in Great Slave Lake and across the western end of the lake into Slave River, another interruption occurring just where the river cuts the sixtieth parallel of north latitude. Here a sixteen-mile portage is necessary to get around the rapids that extend from Fort Smith to Fort Fitzgerald. From Fitzgerald, water transport could continue without further interruption up the remaining two hundred miles of the Slave River to Lake Athabasca, across its western end, and 175 miles up the Athabasca River to Fort McMurray. Here the Clearwater River flows into the Athabasca, and seven miles up the Clearwater is Waterways, the northern terminus of the Alberta and Great Waterways branch of the Northern Alberta Railways (jointly operated by the C.P.R. and C.N.R.)

Five hundred tons of ore are required to provide ten tons of concentrates; from six to thirteen tons of concentrates—depending upon the richness of the ore—are required to provide one gram of radium. Extraction takes about thirty days of complicated and exacting processes. The result is a pinch of white powder enclosed in a glass tube about the size of a match, which must be kept in a heavy lead container. Not till 1936 did the company's total production amount to one ounce of radium!

In 1935, Eldorado organized a transport service, known as the Northern Transportation Company, a wholly-owned subsidiary, which has played an important part in supplying service on the Mackenzie system, not only in so far as the parent company's

requirements are concerned, but for others as well. Previously, the company had not attempted to transport its ore; the Hudson's Bay Company and others had handled it under contract. In 1935 the company also established an aeroplane service from Edmonton to the mine for the convenience of company personnel and the carrying of medical supplies and other vital requirements.

Pitchblende had been found in many parts of the world, but rarely in quantity and never before so rich as that which Gilbert LaBine found on the shore of Great Bear Lake. The principal pitchblende deposits previous to that time were at St. Joachimsthal, near Carlsbad, Czechoslovakia, and in the Belgian Congo, the world's principal source of supply. It was from St. Joachimsthal that Pierre and Marie Curie obtained the pitchblende from which in 1898 they for the first time extracted radium.

Before Eldorado got into operation in 1933, the world price of radium was \$75,000 a gram; sometimes it sold as high as \$120,000. The advent of the Canadian product brought on a price war between Eldorado and the cartel controlling the European product, and as a result the price dropped to an average of \$25,000, and even on occasion as low as \$20,000. This was hard on Eldorado, for while the reduced price enabled some clinics and hospitals to obtain radium when they might not have been able to do so, the demand did not increase proportionately. The rapid price fluctuations led many possible customers to defer buying in the hope that today's price might be bettered tomorrow. In addition, therefore, to the difficulties inherent in operating a mine near the Arctic Circle, and the consequent transportation problems, the company was faced with a sales problem of first magnitude, and one that did not come within the experience of ordinary merchandisers.

The war interfered with Eldorado's operations; wartime conditions put a limit on the supply of man-power as well as on necessary supplies and equipment. Furthermore, large sections of the world had been removed from the list of possible radium customers. Most countries were more concerned with the treatment of wounds received in battle—for which radium was of little use—than with the treatment of non-combatant stay-at-homes. Consequently, the mine was shut down from June

1940 to April 1942. Although the company showed a comfortable book-balance, the banks would not accept, as collateral, radium and uranium products valued at several million dollars; and to keep the enterprise afloat Gilbert and Charles LaBine were at one time obliged to pledge their personal securities to the value of \$950,000. In 1943 the name of the company was changed to Eldorado Mining and Refining Limited. (The reason was that in attempting to secure priorities in Washington, to which the company was entitled, it frequently had to contend with officials who, adhering to the supposed letter of the law, put obstacles in the way of a company whose name contained the word "gold.")

In the meantime, the LaBines had kept in touch with their former associates in Manitoba, three of whom, William Walton, William Quesnel and Gunnar Berg, had continued prospecting, sometimes separately but generally as a group. In 1933, Gunnar Berg discovered a gold prospect on Beresford Lake. The LaBines took an option on it, incorporating Gunnar Gold Mines Limited. James Houston, in charge of the mine, sank a 1,000-foot shaft and, in April 1936, production began from a 150-ton mill with John Botsford as mill superintendent. When the mine closed in May 1942, after nearly four million dollars had been taken from some three hundred thousand tons of ore, Walton and Quesnel were ready with another prospect eight miles away. The LaBines bought this prospect and incorporated Ogama-Rockland Gold Mines Limited, moving the Gunnar plant to the new venture. A shaft was put down a thousand feet, but the ore petered out; and with the end of this third attempt to make a mine in the Rice Lake area the LaBines and their prospector associates abandoned the hope of developing a gold mine. The LaBines invited the prospectors to join them in the search for uranium at Great Bear Lake, and Botsford became assistant-manager of Eldorado.

It was generally understood in mining circles that the reopening of Eldorado in 1942 was connected in some way with the war, but details were lacking. That such was the case became evident when, effective January 28, 1944, the Government of Canada, acting under wartime emergency powers, expropriated

the 3,905,046 outstanding shares of Eldorado Mining and Refining at \$1.35 a share. This was slightly above the market price for the day, but much less than the highest that the stock had reached in the past. At the same time, everything that had to do with possessing, mining or processing uranium ores or their products became in effect a government monopoly.

Later, the company was converted into a corporation without share capital, its assets subject to the control of the government; and, in October of the same year, the name was changed to Eldorado Mining and Refining (1944) Limited. Gilbert LaBine, who had in 1936 become president, continued in that capacity under the government.

The reason for the expropriation was given as one of vital military importance; those who sought more specific information were asked not to inquire further. The explanation came dramatically and unexpectedly on August 6, 1945, when an atomic bomb was dropped on Hiroshima, Japan, and the world learned that the explosive substance within it was uranium that had come chiefly from the Eldorado mine at Great Bear Lake.

Since everything having to do with uranium was now a government monopoly, it became the duty of Eldorado to promote the search for other uranium deposits. Starting in 1943 in the Great Bear region, parties of prospectors, geologists and geophysicists under the direction of Richard Murphy and the general supervision of Gilbert LaBine examined likely areas in the Mackenzie District, northern Saskatchewan and certain parts of Ontario. While many radioactive occurrences were found in each season, it was not till 1946 that anything significant was located. In October 1947, Gilbert LaBine resigned as president and was succeeded by William J. Bennett, already in the government service; but LaBine remained as a director until 1949.

The important developments in 1947 were in the neighbourhood of Beaverlodge Lake, a short distance north of Lake Athabasca, where evidences of uranium mineralization are widespread over a length of fifty miles and a breadth of about twenty-five, marked principally by what came to be known as the St. Louis Fault. After extensive diamond drilling, three occurrences were found to justify underground exploration, which began in

1949 and continued through 1950 and 1951. One of these, called the Ace, developed into a mine, and in the spring of 1952 the construction of a mining plant and concentrator was begun. Despite the shortness of the transportation season and the distance from the railhead, both were in operation in little more than a year's time.

It was in this general region that many claims were staked for gold in 1934. A group located by Thomas Box (after whom the mine was named) had been developed by Cominco and, in 1939, brought to production with a 1,000-ton mill. The town of Goldfields had sprung up around the Box mine, the J. D. Nicholson Mines Limited and one or two other prospects being developed; but when the Box and Nicholson ceased operations in 1942, owing to a combination of low-grade gold ore, lack of labour and increased costs, Goldfields became a ghost-town. With the discovery of uranium in 1947 and the boom following the resumption of private prospecting in 1948, the need for another town became imperative and the Saskatchewan government laid out a townsite called Uranium City, about eight miles west of Beaverlodge (the Eldorado townsite), which rapidly assumed all the typical characteristics of a boom town.

Development of the Eldorado holdings proceeded at four different points—the Martin Lake, Eagle, Ace and Verna groups of claims, stretching along the St. Louis Fault for a distance of about four miles. The Ace and Verna have developed into the chief mines, and shafts have been sunk on the Ace (an inclined one, which is the principal opening), the Fay, 4,000 feet west of the Ace, and the Verna, 7,000 feet east of the Ace. Part of the Ace group, owned by Radiore Uranium Mines Limited, was leased by Eldorado and is operated on a royalty basis. In 1955 the Verna shaft was sunk to the sixth level on Radiore property and connected at that level with the Fay shaft. Farther east, two other mineralized areas, the Bolger and the Donaldson, are expected to become mines. Thus it may be seen that the Beaverlodge operation consists of a group of mines rather than a single one.

The Eldorado mill at Beaverlodge began production in April 1953 at 500 tons a day, employing an alkaline leaching process

under pressure with sodium carbonate-bicarbonate as the leach reagent, rather than sulphuric acid. In 1954 the capacity of the plant was increased to 700 tons by the addition of an atmosphere pressure leaching circuit, thus no longer requiring additions to the battery of troublesome autoclaves necessary to pressure leaching. Plans were adopted for the ultimate increase in capacity to 2,000 tons a day in order to take care of custom milling for smaller producers in the district.

R. E. Barrett, formerly of Central Patricia, and for a while Professor of Mining Engineering at the University of Toronto, was manager at Beaverlodge from 1952 to the fall of 1954, when he was transferred to Ottawa to take charge of the Ore Procurement Division of the company and was succeeded by W. M. Gilchrist, previously assistant-manager.

Since 1948 Eldorado Mining and Refining has been the government's agent for the purchase of uranium, such purchases (with certain reservations) going eventually to the United States Atomic Energy Commission. The original price which Eldorado was authorized to pay was based on a sliding scale, depending on grade, up to six dollars a pound of uranium in an acceptable concentrate (precipitate), with a content of not less than ten per cent by weight. In addition—during the first three years of production—the authorized price provided for a development allowance of \$1.25 a pound.

It was found, however, that such an arrangement would not provide sufficient incentive for developers to invest the huge sums necessary to bring an uranium mine to production, especially since it was specified that all contracts must terminate not later than March 31, 1962. (Later, in specific cases, the deadline was advanced to March 31, 1963.) Consequently, in 1953, a new formula was agreed upon which provides for the amortization within the lifetime of the contract of capital charges and costs of production, and on this basis all contracts have since been negotiated.

The prospectors who rushed into the Beaverlodge area varied from get-rich-quick hopefuls who could scarcely recognize one rock from another, but placed their reliance upon the possession

of a brand-new Geiger counter and little else, to well-organized teams of experts employed by established mining organizations. One of the best examples of the latter was a concern called Technical Mine Consultants Limited, with headquarters in Toronto, controlled by J. H. Hirshhorn and directed by Franc R. Joubin, a consulting geologist who had moved east from British Columbia a few years before. Having secured a concession from the Saskatchewan government covering six and a quarter square miles in the Beaverlodge area, north of Black Bay, Technical Mine Consultants had in 1949 incorporated Rix-Athabasca Uranium Mines Limited, to which the concession was transferred.

Joubin and his crews were on the ground early and conducted an intensive exploration campaign. This produced two showings, the Leonard and the Smitty, which seemed to justify development; the former was worked from an adit and the latter from a shaft which was sunk to a depth of 275 feet. In May 1954, ore shipments to the Eldorado mill were begun at the rate of a hundred tons a day.

Up to the time of writing, the performance of Rix-Athabasca—aside from becoming the first post-war independent uranium producer in Canada—has not been exceptional, but it did provide for the introduction to uranium-mining of Franc Joubin, who was destined to influence it so greatly. Joubin was born of French immigrant parents in San Francisco in 1911, but two years later the family moved to Victoria, B.C., where he and his younger brother grew up. His father was killed in World War I, leaving a wife whose ill health prevented her from caring for her children, and consequently Franc spent some years in an orphanage. As soon as he could, he arranged to reunite the family in a home of its own, while at the same time striving to obtain an education. He made ends meet by working at a variety of occupations from professional wrestler to commercial artist; and without too much loss of academic time, he graduated from the University of British Columbia in chemistry and geology. Franc Joubin was no arm-chair geologist and found the life of a geologist-pro prospector strangely congenial. Some years later, after having secured his Master's degree in geology from his Alma

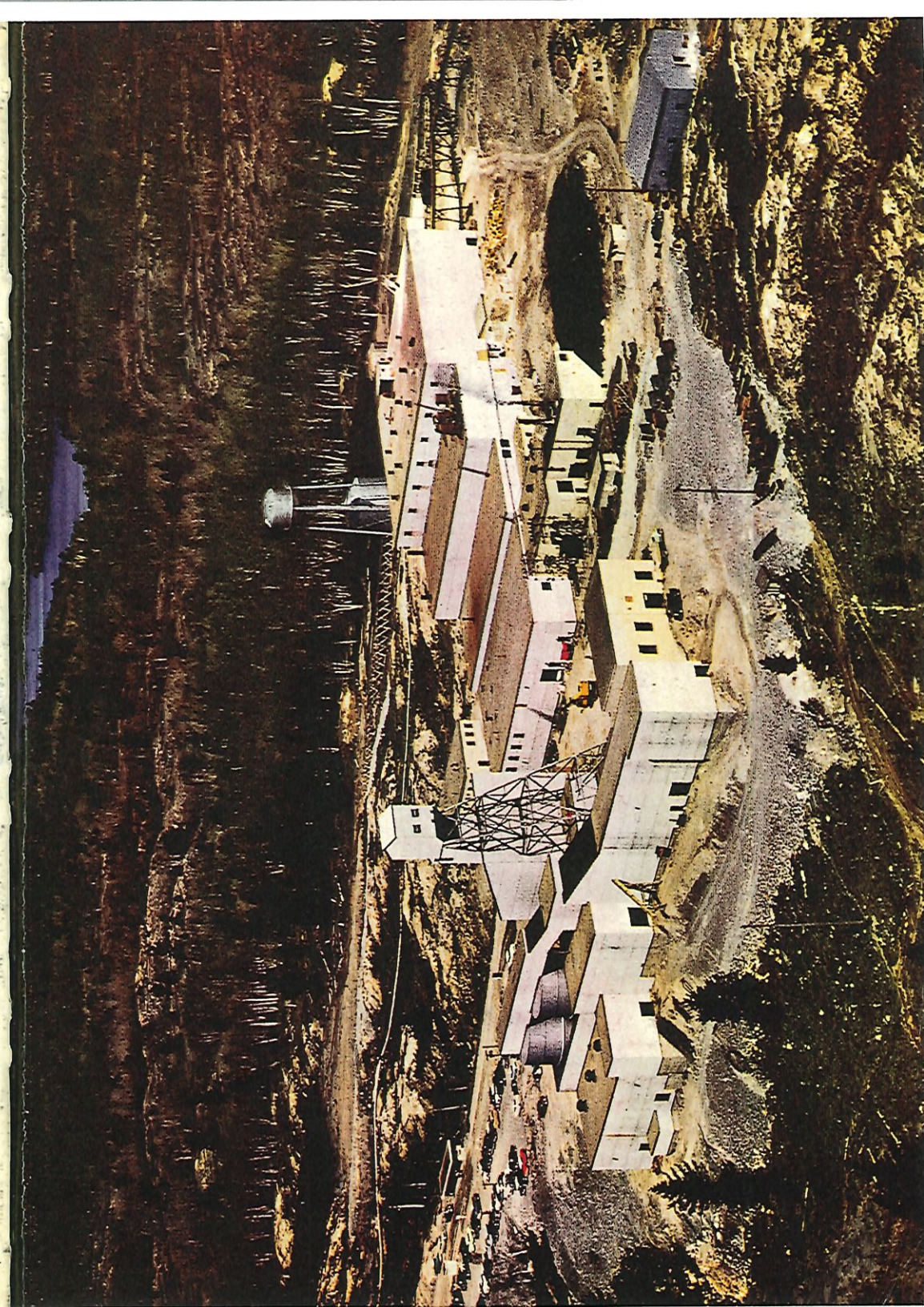
Mater he moved to Toronto in charge of exploration for Pioneer Gold Mines of B.C. Limited. Pioneer was interested in locating new mines of any sort, and Joubin did his best for the company until its curtailment of exploration in 1949. For some time his own absorbing interest had been directed toward radioactive minerals, which in his opinion held most promise for human welfare.

In 1948, with other prospectors and geologists, he had rushed to what was known as the Camray uranium field. Bob Campbell, a prospector (following the century-old tip of J. L. LeConte, an American mineralogist who, in 1847, had identified as pitchblende some specimens from an occurrence on the north shore of Lake Superior), had found veins containing pitchblende in the same region and had staked some claims. The veins could not, however, be worked profitably, and the rush had soon subsided. While attention was focused on this section of Ontario, prospectors were alerted for other signs of radioactive minerals, and one occurrence in particular, in Long Township of the Blind River area on the north shore of Lake Huron, was examined by prospectors and engineers, but assays were not encouraging.

At Bancroft, in southeastern Ontario, prospectors had more than once located radioactive occurrences in association with pegmatite dikes, but early attempts to recover radium (uranium then had no commercial value) were not successful. But the boom which followed the lifting of restrictions on prospecting for uranium caused several prospectors to re-examine the Bancroft occurrences. Among these was Arthur H. Shore, who lived in Bancroft and knew where to look. In Faraday Township, about five miles from his own home, he staked his claims and in June 1949 organized a company—Faraday Uranium Mines Limited—to which the claims were transferred. The incorporation of this company to exploit a mine in a section of Ontario which, from a mining standpoint, was not very well thought of, attracted very little attention. The first capital was raised locally and fell far short of what was needed to bring in a mine.

The company's fortunes improved considerably in 1952 when Bryan W. Newkirk, Jr., became interested in its possibilities, and

Pronto Mine, Algoma Uranium Field →
—George Hunter Photo



with his father (president of Continental Exploration Limited) and Evan T. Donaldson provided the first large-scale financing. This enabled the company to undertake a drilling program and, eventually, geophysical surveys. After further drilling, a favourable zone was disclosed for a length of 2,500 feet, to a depth of 500 feet.

Underground exploration was now decided upon, and the nature of the terrain made it relatively easy. In September 1954 work was begun on the first adit, driven into the side of the hill rising above Bow Lake, and this was followed by two others at the same level. During the following summer, an internal shaft was sunk from the central adit to permit exploration 150 feet below that level. This and further drilling made possible an estimate of 1,660,980 tons of ore grading 0.112 per cent uranium oxide, justifying a sales contract amounting to \$29,754,000. This in turn made possible the financing of a mill with an initial capacity of 750 tons a day, easily capable of expansion to 1,000 tons. It was estimated that production of the first concentrates might be expected early in 1957.

The younger Newkirk did not live to see the enterprise through to a successful conclusion, a responsibility which his father assumed in his stead. In this he was assisted by Ashton W. Johnston, vice-president, R. Massey Williams and H. Brodie Hicks, mining engineers who have directed the development, and R. D. Wilson, the mine manager.

Bicroft Uranium Mines Limited, with Robert A. Bryce as president, was formed in April 1955 by the merging of Croft Uranium Mines Limited and Centre Lake Uranium Mines Limited, the properties held by each having been transferred to the new company. The Bicroft mill, of 1,000 tons capacity, planned for expansion to 1,500 tons, was built on the property formerly held by Centre Lake, and is about four and a half miles from the highway between Peterborough and Bancroft, ten miles from the latter place. After the sinking of a prospect shaft, the main production shaft was sunk to a depth of 925 feet with stations at intervals of 125 feet. A contract for \$35,805,000 was received from Eldorado.

Four other companies in the Bancroft area—Rare Earth Mining Company Limited, Canadian Dyno Mines Limited, Greyhawk Uranium Mines Limited, and Cavendish Uranium and Mining Company Limited—were proceeding with development at various stages, so well advanced as to justify Eldorado in considering them for sales contracts.

In the meantime, Gilbert LaBine, Canada's pioneer uranium miner, had not been idle. In 1950, he had acquired property adjoining Eldorado's holdings at Beaverlodge from Nesbitt Uranium Mines Limited and Eagle Ace Uranium Mines Limited in exchange for shares in a new company called Nesbitt LaBine Uranium Mines Limited, upon which development was immediately begun. LaBine, however, believed that the geology of the region indicated the necessity for a more thorough search than had yet been instituted. In his opinion, the man to do the job was Albert Zeemel, whom he had employed for more than a dozen years as a prospector in Quebec, Ontario and Manitoba. Consequently, in 1952, he brought Zeemel to Beaverlodge and started him working in the region west of most of the discoveries already made. In August, in response to a message from Zeemel, LaBine flew to Beaverlodge, and on Crackingstone Peninsula he walked with his Geiger counter over spots indicated by Zeemel and heard such a crackling in his ears as had never before come out of a counter in his experience. "It's an elephant!" he exclaimed. That remark was to become enshrined in more than one legend, but it did graphically illustrate the magnitude of Zeemel's discovery.

The orebody, which proved to be 1,400 feet long and 600 feet wide, dips to the southwest in the direction of the St. Mary's Fault, which dips in the same direction although somewhat more steeply. In view of the immense amount of prospecting that had already taken place in the general area, it is amazing that this giant rich deposit, within twenty-five miles of Eldorado's Ace mine, should have remained undiscovered for so long. Probably because much of it was muskeg-covered, earlier prospectors had passed it by.

As in the case of Eldorado, LaBine turned his new find over to a gold-mining company whose ore in the original Manitoba properties had become exhausted. Gunnar Gold Mines, since the closing of the Ogama-Rockland mine in 1942, had continued as an exploration and holding company with assets amounting to some six hundred thousand dollars. In 1953 the authorized capital of this company was increased from 3,000,000 to 5,000,000 shares of one dollar par value; and in 1954 the name was changed to Gunnar Mines Limited.

Since the orebody was susceptible of operation by open pit, plans were made for immediate development by such means, while it was also planned to sink a three-compartment shaft from which underground workings could be conducted to supplement ore recoveries from the pit and eventually supplant it. In order to finance this program and also to provide for the construction of a mill, five-per-cent sinking-fund debentures, maturing in 1960, were floated amounting to \$19,500,00. Production began in October 1955 at 600 tons a day, and was to be increased by stages to an eventual 1,650 tons by early 1957. Considering the circumstances, it was a remarkable achievement to reach production in little over three years from the time the ground was staked.

On October 1, 1955, Gunnar made a contract with Eldorado Mining and Refining under which the latter agreed to buy, between that date and October 1, 1962, uranium oxide concentrates valued at \$76,950,000, the first such contract to be negotiated.

Several other properties in the Beaverlodge area had reached various stages at the time of writing. Lorado Uranium Mines Limited, owning several groups of claims, had located its shaft and surface plant at the western end of Beaverlodge Lake. The shaft was down to a depth of 610 feet, and a 500-ton mill was being built to treat its own ore and that of several other mines in the neighbourhood. It had received a sales contract amounting to \$60,000,000. Lake Cinch Mines Limited, controlled by ViolaMac Mines Limited, with eight claims two and a half miles southwest of Uranium City, had a three-compartment

shaft sunk to 548 feet and development was proceeding on the 300 and 500-foot levels. Production at the Lorado mill was expected to begin late in 1957. Cayzor Athabaska Mines Limited, holding eighteen claims in the Jean Lake area, one and a half miles northwest of Uranium City, had a shaft down 350 feet and had also arranged with Lorado for the milling of its ore. National Explorations Limited, St. Michael Uranium Mines Limited and Baska Uranium Mines Limited were also developing properties in the Beaverlodge field.

Rayrock Mines Limited and Consolidated Northland Mines Limited, both promotions of J. J. Byrne and his sons, operate uranium properties on the Marian River, about 150 miles south of Great Bear Lake and 100 miles northwest of Yellowknife. At the time of writing, Rayrock was proposing to build an acid leaching plant to treat its own ore and that from Consolidated Northland on a custom basis. A sales contract with Eldorado for \$15,792,000 had been negotiated by Rayrock.

Eldorado at Great Bear Lake gave Canada a foothold in the uranium industry; Eldorado at Beaverlodge went on to establish Canada as one of the world's most important uranium producers; but with the advent of Algoma, Canada's primary position became assured. It is natural to suppose, in considering the possibility of new mineral discoveries, that they will be in some remote spot—such as Great Bear Lake and Athabasca. Nevertheless the greatest mineral strike in Canadian history was to be made in a part of the country that had been settled for more than a century and is traversed by a paved highway and a railway.

Discovery of the mine at Great Bear, and of Gunnar, was due in each instance to a competent prospector; but in Algoma the country had been overrun for years by competent prospectors, many claims had been staked, and nothing had come of it all. What was needed here was the intervention of a man who would apply more than the usual degree of perception. Franc Joubin was the man. He had been reading, talking and dreaming

about uranium for twenty years; and now he would be in the right spot and at the right time.

The Camray rush was tapering off, but Joubin was still in the neighbourhood, as consultant for a number of exploration companies. His quarters in a tent "motel" attracted prospectors who had a claim to sell or who just wanted to talk about rocks. One such prospector, named Karl Gunterman, dropped in one evening in May 1949 to see if he might interest Joubin in some claim he had staked on a nearby stream flowing into Lake Superior, but Joubin was not interested. During the course of a conversation about prospects and many other things, Gunterman mentioned a radioactive sample which his partner, a Sault Ste. Marie hotel-owner named Breton, knew about. It appears that Breton had passed his Geiger counter over a collection of specimens in the mining recorder's office and one had responded with a characteristic buzz. Fastened to this specimen was a label containing the partially obliterated word "Long" or "Lang," which might mean the name of the prospector who had found it, or might refer to Long Township in the Blind River area, about seventy-five miles east of the Sault.

Gunterman informed Joubin that Breton had been attempting to discover the source of the specimen, but apparently had not succeeded. On different visits to the Sault, Joubin dropped in to see Breton and inquire how the search was proceeding, but was told that it was slow and difficult. As a matter of fact, Breton and Guntermen had located the spot in Long Township from which the sample had come, but found that someone else had staked the ground a few days before their visit. They, however, staked claims adjoining. Eventually, Breton took Joubin to the location. Driving eighty-seven miles eastward along the highway, they stopped beside Lauzon Lake, where they left the car and walked two miles into the bush. There, on ground staked by René Audette and Alex Fisher, they found several shallow pits which someone, many years before, had blasted out of the rock. Joubin was puzzled when he saw the sort of rocks in which the pits had been dug. While rust stains denoted the presence of oxidized pyrite, the pits had been sunk mainly in a quartzite pebble conglomerate, an unusual host rock

for uranium, in Joubin's experience. However, he tried out the counter and secured a surprisingly marked response from each of the pits. Joubin carried away several samples and, when he returned to town, sent them to the assayer.

The assayer's report read: "Only trace quantities of uranium present."

Nevertheless, Joubin persuaded a number of mining companies to send geologists or engineers to examine the property. The results were invariably the same; and since thorium is the only element besides uranium likely to affect a Geiger counter, he and the others who examined the pits came to the conclusion that thorium must be responsible for the behaviour of their counters.

Three years passed, during which Joubin's uranium prospecting led him to other fields. But he could not forget Long Township. Finally, in 1952, he approached J. H. Hirshhorn, with whom he was already successfully associated in the uranium hunt (Rix-Athabasca, Rexspar), and it was agreed that additional prospecting should be undertaken and property staked in Long Township to include the Audette-Fisher-Gunterman-Breton claims, all of which had been allowed to lapse. A company called Peach Uranium and Metal Mining Limited was incorporated, with Joubin as president.

Joubin had not been satisfied with the thorium explanation, yet he could give no other. He had continued to ponder the problem; and then, one day in 1952, he came across an article in a scientific journal which discussed the solubility of surface uranium ores containing pyrite or iron sulphide. He had some of his Long Township samples analysed for thorium and learned that they contained little or none of that element, and at once the truth flashed upon him. Most of the radioactive agent in the samples had already been leached out by the action of sun, wind and rain; and the *radioactive element must be uranium because thorium was practically insoluble*. Water, acting on the pyrite, had formed sulphuric acid; this had dissolved the uranium and the rains had flushed it away. To prove his theory it would therefore be necessary to drill below the range of oxidation.

For a thorough test, Joubin estimated, about \$30,000 would be required, and Joe Hirshhorn agreed to find the money.

Early in April 1953, drilling began quietly on the Peach claims. Joubin directed operations, assisted by Paul Young, as chief engineer, and Don Smith in charge of the actual drilling. The cores were shipped to a fluorimetric laboratory in Vancouver for assay, but as time passed without any report it was with almost a feeling of relief that Joubin eventually learned that the delay had been caused by a fire which had destroyed the assayers' premises. He was assured, however, that the assay results would be forthcoming in due course. When the report did arrive, his patience was rewarded by the information that out of fifty-six samples assayed, fifty indicated a commercial content of uranium: the average grade was 0.11 per cent uranium oxide.

The next step was to discover the extent of the mineralized area. The uranium seemed to be associated with the contact of what was called the Mississagi quartzite with the basement granite complex; and here the Geological Survey of Canada, as in many other cases, was able to come to their assistance. In 1922 the Survey had published the result of a geological reconnaissance in which W. H. Collins had mapped the rocks of that particular region. The map was out of print and copies were scarce, but after a frantic search one was found and the story it told filled Joubin with awe and its explanation set Hirshhorn dancing a jig. According to Collins's map, the line of contact described a gigantic Z, each stroke of which covered a distance of about thirty miles—a total of nearly a hundred miles!

Now that they had some intimation of what might be the outcome, they were almost overwhelmed by the prospect. Naturally, they wished to secure as much as possible of the ground along the zigzag lines of that giant Z; but they feared that long before they could get much staking done their secret would be out, and they might even be left holding the bag. The staking law of the province allowed them only thirty days between staking and public recording, and it was evident that the first recordings would reveal the secret. They had therefore only thirty days in which to accomplish their entire staking program.

In this extremity they weighed several companies in which they were interested. Joubin's recommendation of Preston East Dome was endorsed by W. H. Bouck, its president, and agreed to by Hirshhorn. That Porcupine gold mine was shut down at the moment by a miners' strike, and this meant that the office and technical staffs would be enjoying an involuntary holiday, and would be free to join in a staking bee. Furthermore, the company had money in its treasury and was interested in outside ventures. An agreement was quickly reached under which the company would furnish the men and money to do the staking, receiving in return a half interest with Hirshhorn's Technical Mine Consultants in the proceeds.

The operation was supervised in the north portion of the field by Robert Hart, Preston's chief geologist, and W. A. Hutchison, the mine manager. Harry R. Buckles had charge of staking the southern portion. Joubin directed the general program from Toronto. Seventy-five Preston personnel and others were flown from South Porcupine into the country behind Blind River and landed on some of the many lakes which spatter the area. Also landed were camping equipment, supplies of all sorts, and Geiger counters. The counters were indispensable to strangers in a strange land who must work against time in their attempt to follow an imaginary figure sprawled across fifty townships. A lawyer, supplied by William Bouck, the legal partner, went into the bush with the stakers to see that the essential paper-work was well and truly done. In thirty frantic dawn-to-darkness days the greater part of the Z was staked; and on the morning of July 11, as soon as offices were opened, the lawyer, engineers and others presented themselves at a number of recording offices to register a total of 1,400 claims covering about 56,000 acres. No staking rush like this had ever happened before.

The secret had been well kept. The news was met, at first, with incredulity, and then by a concerted rush to get stakes into the ground somewhere in the region. Before the summer was over some eight thousand additional claims had been staked—and despite the advantage that Joubin and his associates had enjoyed, some of the late comers did very well indeed.

Collins's map, by indicating the line of contact, suggested those parts of the area in which uranium mineralization might be found; but, of course, the final criterion would be the drill. And every drill in the country was soon on the way to Algoma. As the orebodies were outlined, claims were grouped by Joubin, Hirshhorn and associates into convenient parcels, and transferred at only the actual cost of staking to the many companies under Technical Mine Consultants direction. In the southern part of the region, 139 claims, including those belonging to Peach, were allocated to Pronto Uranium Mines Limited. Within two miles of the railway, Pronto was able, under the direction of Paul Young, to begin development immediately. A three-compartment shaft was sunk to a depth of 591 feet, followed by underground mining at five levels. The mill, with a capacity of 1,500 tons a day, was ready for production in September 1955. The milling process employed (as was later the case with all mines in the district) was leaching by sulphuric acid.

In the northern portion, 634 claims, in four separate groups, went to Preston East Dome and then to Algom Uranium Mines Limited, under which two mines of about equal size are operated. The Quirke mine, near the lake of the same name, was the farthest north; and near Elliot Lake, about midway of the field, the other mine, called Nordic, was located. At Quirke a six-compartment shaft was put down to 861 feet, opening six levels, and at Nordic a similar shaft went to 889 feet, with five levels. At both mines construction of concentrators, each with a capacity of 3,000 tons a day and planned to reach production in 1956, was quickly got under way.

Unable to wait until the provincial government realized completely the importance of the undertaking, Joubin, then president of Algom, instructed R. C. Hart, Algom manager, and M. S. Stevens, general superintendent, to build their own access road and select a central townsite. These men, on foot, marked out a track through the bush, climbing over rocky hills and bypassing frequent lakes. They began their road near Spragge station, fifteen miles east of Blind River, and continued northward to Quirke. Merely to provide a means of access, Algom spent nearly \$300,000, part of which was later refunded by the govern-

ment. In that first year, this narrow track, bearing an almost impossible traffic load, seemed always on the verge of breaking down completely, but somehow the endless procession of vehicles always managed to struggle through. Then, amidst the general confusion, and despite the crowded condition of the road, crews of the Ontario Department of Highways, with bulldozers, power shovels and dump trucks, attempted to convert it into a highway.

Drilling was the first concern of everyone; only by this means could the extent of ore reserves be determined; and the determination of ore reserves was essential to the securing of a contract to purchase, or a "letter of intent," from Eldorado. Algom could show reserves of tens of millions of tons, and consequently was awarded a contract amounting to \$206,000,000; Pronto, with more modest reserves, received one for \$55,000,000.

Never before had mines found financing so easy. In February 1955, Rio Tinto Limited of Great Britain, in association with Sogemines Limited, representing Belgian capital, acquired control of Algom by stock purchases, and through loans supplied the company with adequate money for development. Control was exercised through Rio Tinto Exploration Limited, a Canadian company, of which Dr. D. R. Derry, formerly chief geologist for Ventures, was president. Dr. E. B. Gillanders, who had had five years of uranium-mining experience with Eldorado at Port Radium and Beaverlodge, was vice-president of Rio Tinto Exploration, and also managing director of Algom.

Rio Tinto seems likely for some time to have in Northspan Uranium Mines Limited the largest operation in the Blind River field, if not in the western world. This company grew out of a merger of the Joubin-Hirshhorn-directed Lake Nordic Uranium Mines Limited, Panel Consolidated Uranium Mines Limited, Spanish American Mines Limited and Buckles Algoma Uranium Mines Limited. Northspan has received a sales contract from Eldorado amounting to \$275,000,000, and plans have been adopted to provide for a daily production of 9,000 tons. Another Joubin-Hirshhorn-directed company that has come under Rio Tinto control is Milliken Lake Uranium Mines Limited, owning property in both the Beaverlodge and Algoma fields, with ore

reserves in the latter estimated at upwards of 15,000,000 tons. Milliken Lake has a sales contract amounting to \$94,500,000 and plans are underway to build a plant capable of handling 3,000 tons a day.

Early in 1956 the Rio Tinto interests in Canada were merged with those of J. H. Hirshhorn in the Rio Tinto Mining Company of Canada Limited with Hirshhorn as chairman of the board. About the same time Franc Joubin resigned from most of the managing directorships he had held in the companies he had helped to bring into existence. This he did in order to devote his full time to the position of consulting geologist, on a worldwide assignment, for Rio Tinto. Thus the two men who were most responsible for the discovery and first development of the Algoma uranium field have both retired from direct participation in its future development.

New names and new faces have succeeded them. When Joubin and his aides were doing the original staking in 1953, they were forced, largely through lack of time, to avoid the deeper ground on the flanks of the folds. Those who rushed in after word of the first recording got out had no alternative but to take what was left and they staked under the pressure of intense competition. Among these were Arthur W. Stollery, James Kenney and Fred Jowsey. These men pooled their claims and gave an option on the large resultant area to Stephen B. Roman.

Roman had come to Canada from Czechoslovakia in 1937 and in the interval had made several unsuccessful attempts to develop a mine. In 1953 he was the president of North Denison Mines Limited which had passed through several reorganizations, in 1954 undergoing a further change of name to Consolidated Denison Mines Limited. When he began drilling for the down-dip extension of the proven Algom Quirke orebody, there were headshakings; but when the results of the first drilling were announced, Denison stock began to rise and continued to do so as further results were given out. The extent of Consolidated Denison's ore reserves may be gauged from the fact that its sales contract calls for payments amounting to \$182,250,000. Having found a mine, Roman proved that he was capable of big

ideas. Two shafts sunk under contract by the Patrick Harrison company were begun—one of five compartments and the other of seven. Construction was also begun on a mill with an initial capacity of 6,000 tons a day, with production scheduled for mid-1957. John Kostiuk was appointed general manager, John Bracken, assistant-manager, and R. W. Mancantelli, mill superintendent.

Not content with this, Roman organized a second company, known as Can-Met Explorations Limited, holding thirty claims adjoining the Consolidated Denison property in the Quirke Lake section. There he has developed a mine on which two shafts have been sunk and plans have been adopted for a 3,000-ton mill. To complete the picture, a sales contract has been secured amounting to \$75,852,000.

At the time of writing, two other companies in this area had received sales contracts and were proceeding with development. Stanrock Uranium Mines Limited was sinking two shafts to approximately 3,000 feet, with plans for a 3,000-ton mill. It had received a contract for \$95,200,000. The company is controlled in New York, and C. H. E. Stewart of Toronto is vice-president in charge of production. Stanleigh Uranium Mining Corporation Limited is also controlled in New York, with H. S. Strouth as president and general manager. It holds 108 claims in the Elliot Lake section; two shafts were being sunk to 3,600 feet, and a 3,000-ton mill was planned. A sales contract for \$72,981,000 had been secured.

The model town of Elliot Lake was planned to serve the mines, especially Algom, Pronto and Consolidated Denison. Hart and Stevens selected the site; Joubin was the first chairman of the board of trustees; and Algom spent the first \$250,000 in land-clearing and community preparation. The mines concerned, in co-operation with the Ontario Department of Planning and Development, have continued with the project which, like everything else in the camp, has been rendered difficult by the need for use during construction. The town is expected to have a population of 25,000 by late 1958, and facilities are being provided accordingly.

To supply sulphuric acid for the uranium mines, and also to provide an outlet for its own pyrite, Noranda Mines has built a plant for the manufacture of sulphuric acid at Cutler station, fourteen miles east of Blind River. With a production rate of 1,000 tons of acid daily, it ranks among the larger acid plants on the continent. Other chemical plants to serve the uranium mines are planned for the near future by various companies, and the prospects are good for the development of a local chemical industry on a fairly extensive scale.

Geologists believe that the most likely place to look for uranium is along the southern (or southwestern) edge of the Canadian Shield, and it is true that the principal occurrences found to date are in accordance with this theory, but there is one deposit which does not fit into the pattern. It is that of Rexspar Uranium and Metals Mining Company Limited whose property, consisting of 110 claims and fractions, is near Birch Island, about eighty miles east of Kamloops, B.C. The property, developed by Francis Joubin during 1950-52 while directing Technical Mine Consultants, and turned over to the present owners by Rio Tinto, is situated on a mountainside at an elevation of 4,000 feet above the valley in which the mill is located. It will be worked by open pit and the ore transported from pit to mill by aerial tramway. The leaching process is a radically new one devised by Professor Frank Forward and is used by arrangement with Sherritt Gordon Mines. The process involves the use of seventy-foot-high pressure towers, four feet in diameter, which were designed by R. M. Way and Company Limited, builders of uranium mills. The president of Rexspar is Dr. Philip Joseph of Montreal, and the mine manager is J. W. Scott.

This book is being written at a time when a number of relatively new metals are making their appearance, some so new that very little is known about their possible uses. Future writers on Canadian mining may have a great deal to say about some of these, but their present field of usefulness is still too indefinite to warrant much space in this book. One such metal is lithium; silvery-white in colour, it is the lightest of all solids, exceeded in lightness by only two elements—hydrogen and helium. Some of

its recently discovered uses are still on the secret list but have given it a definite place in Canadian mining. The chief producer of lithium is the Quebec Lithium Corporation Limited, one of Pierre Beauchemin's enterprises, controlled by his Sullivan Consolidated, with East Sullivan and Ventures also participating. Quebec Lithium, incorporated in 1952, holds 13,531 acres twenty-five miles north of Val d'Or. In July 1954, a five-year contract was entered into for the sale of lithium concentrates with the Lithium Corporation of America. In December 1955, a 1,000-ton mill went into production, which was expected to reach capacity in mid-1956.

The future of titanium, which has been known to industry for a much longer time than lithium, is still indefinite. At Allard Lake, twenty-two miles inland from Havre St. Pierre on the north shore of the Gulf of St. Lawrence, a large deposit of ilmenite, a titanium-bearing ore, is being developed by the Quebec Iron and Titanium Corporation Limited, a subsidiary of Kennecott Copper Corporation. A railway has been built between Allard Lake and Havre St. Pierre and the ore is shipped to the company's smelter at Sorel, fifty miles below Montreal, which has a capacity of 1,500 tons a day. The ore is fused in a battery of electrical furnaces, separating the iron, which is recovered as pig-iron; the titanium is then concentrated in a slag carrying about seventy per cent titanium.

Titanium metal (not yet produced commercially in Canada) has many uses, especially where light weight, great tensile strength, and resistance to high temperatures are concerned, and it is already being used as an alloy. Up to the present, the chief product derived from the ore (in addition to iron) is titanium oxide pigment. This, in the form of titanium white, is used in the manufacture of paint, to render paper opaque, to whiten rubber, and to de-lustre artificial silk. It is also used in the manufacture of ceramics, printing inks, linoleum and cosmetics.

Columbium is another of the new metals about which very little is yet known but of which much is hoped. In 1952-53, a great deal of excitement was caused at North Bay, Ontario, when a deposit of columbium-uranium was discovered on an island in Lake Nipissing, and many claims were staked in the

vicinity. The principal occurrence was controlled by the Inspiration Mining and Development Company Limited, which incorporated Beaucage Mines Limited to operate the property and institute research in connection with finding markets for the product, which at the time of writing was still in the experimental stage.

The best established of these new metals is magnesium which, as an alloy, is capable of an endless variety of combinations with metals old and new. It is easily worked; it can be cast, rolled, drawn or extruded. It is a good conductor of heat and electricity, and has what engineers call "good fatigue resistance," or ability to absorb vibration.

In 1937, with a view to possible commercial production, General A. G. L. McNaughton, then director of the National Research Council, assigned Dr. Leslie M. Pidgeon, Professor of Metallurgy at the University of Toronto, to the job of finding an economically practicable method for the production of magnesium. After a considerable amount of investigation, Dr. Pidgeon concluded that the reduction of calcined dolomite by ferrosilicon in a vacuum was the most practicable process. It was still in the laboratory stage when World War II rendered the need more urgent. The first magnesium by the Pidgeon process was produced in January 1941. In the same year, Dominion Magnesium Limited was organized, chiefly by Walter Segsworth, J. D. Barrington and R. J. Jowsey, associates in Moneta Porcupine Mines Limited, who were looking for an outside interest for their company, then nearing the end of its ore. Finances were supplied by Ventures, Bobjo and Moneta, with assistance from the Government of Canada. Dominion Magnesium, having the exclusive rights for Canada in the Pidgeon process, acquired large deposits of high-purity dolomite at Haley, Ontario, about eighty miles northwest of Ottawa. A reduction plant with an initial capacity of five thousand tons of magnesium a year was built by the government and operated by Dominion Magnesium until 1945, when the entire enterprise was sold to the company, which then turned its attention to the creation of commercial outlets for magnesium.

Additions to the main plant have since been made, and a 2,300-ton extrusion press has been installed, which greatly extended the variety of magnesium shapes available to the trade. In 1952, a foundry, financed and owned by the government, was constructed at Haley. This foundry, on which Dominion Magnesium holds an option, is operated by Light Alloys Limited, a subsidiary of Dominion Magnesium, and produces jet engine and airframe components.

Until 1952, the company bought its ferrosilicon on the open market, but in that year Electro-Reagents (Quebec) Limited began the building of a plant at Beauharnois, Quebec, capable of producing an eventual 12,000 tons a year of 75-per-cent ferrosilicon. The plant is operated on a fee and profit share arrangement by Chromium Mining and Smelting Corporation Limited.

At present, Dominion Magnesium has an annual production of eight thousand tons of magnesium and its alloys, comprising strontium, barium, titanium and zirconium alloys; in addition, it produces calcium, thorium and zirconium metals. Except for Aluminum of Canada Limited, which produces two thousand tons a year at Arvida, Dominion Magnesium is the only producer of magnesium in Canada. The domestic market is growing fast, and since the war the company has developed a rapidly expanding export market. From the inception of the company, R. J. Jowsey has been its president; also with the company from the beginning, John Thomson is the present general manager, and H. B. Clearihue, the treasurer.

The mining described in earlier chapters of this book was relatively simple; amateur miners went forth in a spirit of high adventure to find gold in river gravels and recover it by primitive methods. Others burrowed into shallow gold-copper or silver-lead workings, and were easily balked by metallurgical difficulties. With nickel, they started pretty well from scratch; and the nickel industry is largely a Canadian creation. Not till past mid-century did Canada rate as primarily a metal-producing country, because formerly it had little iron. That this limitation no longer applies has been abundantly demonstrated in the interval. And now, as the book comes to an end, a new metal age is dawning,

one toward which Canada can contribute in even greater measure than in the past was believed possible. But whether it shall be to supply the means of self-destruction for mankind or to help provide the possibility of peace, plenty and some release from toil is the question with which humanity for the first time in its history is confronted.

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