The Last Drop

When it comes to oil, you can’t get it all out of the ground. But you can recover a lot more than Nature alone gives up

by Jean Martin/drawings by Eric Aldwinckle

If oilfields were people, Golden Spike would be a medical marvel — one of those multiple-transplant patients, doing very nicely thank you against all the odds. For example:

In 1949 when an Imperial Oil wildcat well brought the field in, 25 miles southwest of Edmonton, everyone said it was a beautiful baby. Not a Leduc or a Redwater as oilfields go, but certainly a major find.

But within five years it looked as though Golden Spike would never reach maturity — an acute case of weakening of the pressure, the diagnosticians said. Now, thanks to a couple of ‘operations’ (secondary recovery, to be technical about it) in 1954 and 1963, the field is alive, well, and expected to produce a phenomenal 90 per cent of its original 310 million barrels of crude.

Secondary recovery means coaxing more crude oil out of the ground than the ground really intended to give up. By means of man-made water pressure, gas pressure and other more exotic methods, it has given hundreds of old fields a new lease on life, doubling or even tripling their output. That’s a handsome bonus in these times of increasing energy demand. It’s like finding new oil deposits without having to look for them.

To appreciate secondary recovery one must realize that recovery of all the oil or natural gas from any underground reservoir is never complete. Sometimes the natural or primary recovery is as low as four per cent; rarely is it higher than 50 per cent. Throughout Alberta, for example, only about one of every three barrels of the conventional oil in place is likely to reach the surface. Alberta’s discovered oil in place has been estimated at 33 billion barrels. Of that, 11 billion barrels (including the oil produced so far) is presently deemed recoverable. But if it were not for secondary recovery, only about 7.3 billion barrels would ever be recovered.

All together, 350 projects — 2,600 injection wells shooting 1.6 million barrels of water, 136 million cubic feet of natural gas and 46,000 barrels of solvent into the oil and gas zones...
every day -- are adding to Alberta’s recoverable reserves.

Why do we need secondary recovery? Because crude oil itself has no driving force. If left to its own devices it would just lie inert in the pores of sedimentary rock. It must be pushed to the surface by pressure. The pressure may come from water underlying the oil deposit, from compressed natural gas above it, or from gas in solution with the oil somewhat like the carbonation in a soft drink.

Some oil fields are blessed with strong natural pressure; some are not. The techniques of production can make the most of that pressure -- or simply flitter it away. Turner Valley, the first significant strike in Alberta, early in this century, had an estimated one billion barrels of oil in place. But before the oil was found, much of the overlying natural gas was produced. Consequently, only about 12 per cent of the crude oil has been recovered. Secondary recovery, in effect since 1948, will contribute only about two per cent more.

Golden Spike, on the other hand, is living up to its potential, with a little help from its friends. It is an unusual field -- small but thick. Its area is about 1,320 acres, while its pay or oil-bearing section originally was 645 feet thick. The famous Leduc field nearby covers 14,500 acres, and its original pay zone averaged about 28 feet.

Golden Spike’s main drive originally came from the oil in compression. But within five years the original pressure of 2,095 pounds per square inch had dwindled to an alarming 1,386, and was still going down. At that rate Golden Spike’s production rate would soon have dropped.

Imperial scientists in the Calgary laboratory compiled a statistical history of the field, including estimated reserves and rate of declining pressure. The calculation predicted that, without man-made assistance, Golden Spike’s pressure would die with about 45 per cent of the oil still in place.

Imperial built a 12.5 million gas injection plant, began forcing 20 million cubic feet of gas from other fields into the top of the field each day and held the pressure at 1,800 pounds per square inch. This was expected to retrieve 70 per cent of the field’s crude oil.

Pressure maintenance was not new, even then. It had begun before in the 1940s, but it grew in sophistication with the bonanza of oil and gas discovery in Alberta during the 1950s and 1960s. Through research, the oil producers realized there is an optimum point for the beginning of any such program. Secondary recovery usually begins when natural pressure is seriously depleted, but the field must usually also have a few years’ history of production before a workable program can be devised. Given these ingredients, modern computer technology can build an accurate profile of an oil field’s future.

At that point, the exact recovery technique employed depends upon the nature of the individual field. Most Alberta oil fields are underlaid by water, which contributes to the recovery in some degree. In these fields, water is injected into the underlying aquifer to supplement the water drive and maintain reservoir pressure. In other pools without naturally-occurring water, waterflooding is the commonest technique. Together, these methods account for nearly 90 per cent of the oil recovered in the province. As the name implies, it forces large volumes of water into the field at carefully selected points which in turn provide pressure to force crude oil from the producing wells. Ideally, the artificial pressure matches the original natural pressure of the field.

The water is no ordinary ditch-water either. It must be treated, and in some cases is more pure than water for human consumption. Sediments that might clog the tiny pores of oil- bearing rock must be filtered out. The water must also be chlorinated and deaerated to discourage bacteria from growing in the reservoir and clogging the rock pores and to prevent corrosion of pipelines.

At Golden Spike, solvent driven by injected gas, ‘scrubs’ oil from the rock formation, producing 90 per cent of the oil in place.

There are two common waterflood procedures – ‘peripher- al’ and ‘pattern’ -- depending on the nature of the reservoir. In Alberta’s Judy Creek field, for example, the oil-bearing rocks lie underground at an angle, or a ‘dip’ as the industry calls it, with water lying in the lowest part of the dip. Consequently, the producers have used a peripheral waterflood. The injection wells are selected at the edge of the field near the lowest incline of the producing formation. The water pressure floods in at the bottom, forcing the oil along the upward tilt of the formation, and out of producing wells. Without secondary recovery, Judy Creek would have slowed to a trickle after producing only 20 per cent of the oil in the field. It is now expected to yield about 50 per cent.

The Boundary Lake field, on the other hand, has less dip and lacks underlying water. Hence, each injection well is spaced among clusters of producing wells in a regular pattern all through the field. The waterflood forces oil to the producing wells surrounding each injection point.

But water alone cannot push all the oil that clings stubbornly within the smaller pores of underground rock formations. Hence the turn in recent years to solvent or ‘miscible’ (meaning it mixes) flooding. In 1963, Golden Spike was the first oil field in Canada to get a gravity-controlled solvent flood. This technique is effective on a formation shaped like the Golden Spike field. The solvent, a petroleum product, is injected in a layer at the top of the oil zone, and is forced down through the formation by gas injection from above, pushing the oil before it. As with other methods, this one then forces oil to the existing producing wells in the field.

Fira is yet another way to bring up stubborn oil. It was first applied in Canada near Swift Current, Sask., in 1967, when air was pumped into an injection well and an electrical igniter...
set fire to the oil formation. Combustion gases moved toward the producing wells, heating the oil (and making it flow better) and supplying additional pressure. The test produced twice as much oil, but the initial investment and operating expenses were high: about 20 times as expensive as conventional waterflooding.

Fire and water have been used in combination. In one experiment, water was flushed down injection wells after underground combustion, turning to steam when it touched the hot rock. The steam thinned heavy oil deposits. Steam is employed at Cold Lake, Alta., where Imperial's 23 pilot-project wells are producing as much as 1,000 barrels of crude per day. The Cold Lake crude is simply too thick to be recovered by conventional methods. In Imperial's project, steam at 600 degrees Fahrenheit is forced into the oil zone at a pressure of 1,600 pounds per square inch for about a month. Then, a mixture of water, gas and the hot, thinned oil is pumped out. Imperial is now building an enlarged pilot plant and drilling more wells.

Why not blast open those minute crannies of oil bearing rock? It has been tried, but so far with only limited success. The principle appears sound enough: a controlled explosion would create an underground chamber, perhaps releasing oil in the process and providing a place to pump in water, natural gas or solvents for further recovery. But conventional explosives have not been found powerful enough to do the job.

There have been controlled nuclear reactions, too, in United States experiments, and others are contemplated. This is one of the proposed methods of extracting petroleum from the vast shale deposits of the western states. (Oil shale is rock laced with a spongy paraffin called kerogen.) But even if the technique works, and leaves no radioactive materials in the oil or natural gas, U.S. officials fear that the public will be slow to accept nuclear 'explosions' in the nation's backyard, even for peaceful purposes.

Canada isn't contemplating any nuclear experiments. There is enough challenge in improving on the more conventional secondary-recovery processes. Right now the question is: how much more of that so-called unrecoverable oil might be ake out of the earth? Is it too much to hope that another four billion barrels of Alberta's supposedly unreachable 2.2 billion barrels may yet be extracted?

Some Alberta experts think it is a real possibility. To recover this oil, exotic methods of recovery will likely be needed, and they will be expensive. High oil prices are necessary to make them economic. Yet four billion barrels represents about seven years' supply at Canada's current rate of consumption. It's equivalent to 1.3 Golden Spike fields—a target well worth aiming for.
Newfoundland’s Miracle Medical Mission

The 82-year-old Grenfell Mission brings sophisticated health care to Canada’s stony, stormy Labrador coast

by Steve Lynett/photos by Barry Dursley

Tom Green leaned awkwardly against the radio transmitter at Charles S. Curtis Memorial Hospital and stared intently at the icy waters that encased St. Anthony. A light rain had fallen steadily for 18 hours and showed little sign of stopping. For an hour, visibility had been decreasing sharply as fog drifted into the cradle of rock that protected the northern Newfoundland fishing village.

The mixture of freezing temperatures, rain and fog made travel by boat or car difficult. But for Tom Green, pilot, the combination put flying out of the question.

‘You’d be a chunk of ice on top of the water,’ he said, turning away from the window. ‘No one flies today.’

It was a common enough pronouncement but its frequency offered little comfort. Green and the half dozen men gathered in the hospital’s radio room knew all too well that bad weather was one of the major obstacles facing the Grenfell mission – the world’s most advanced frontier medical network.

The Grenfell mission no longer has any religious affiliation. It is a hospital organization, paid for largely by the government with some support from private endowment funds, and its main responsibility is the medical care of most of the people of northern Newfoundland and Labrador. But it is more than that: in addition it operates school dormitories, and aids the local economy with a handicrafts enterprise and a facility for building and repairing fishing boats.

Throughout its history, geography and climate have been its most formidable adversaries.

In the 82 years since it was started by a young English doctor who sailed a tiny hospital ship along the Labrador coast, the mission has evolved into a complex medical organization. Today, snowmobiles and aircraft have replaced the yelping dog teams that carried doctors and
nurses along the rock-strewn shorelines; faster transportation and advanced medical technology have made professional help more widely and quickly available.

Yet despite the technological advances, the mission's operation is not without snags. Take the weather for instance. Like rugged Labrador itself, the wind and rain pose special problems. Significantly, it is the obstacles that have preserved the spirit of the mission, a force that has lured an army of men and women from gentler climates and more comfortable cities to a life of frequent hardship and often intangible rewards.

It all started in 1892 when Wilfred Grenfell, a 27-year-old doctor with unruly hair and a scruffy mustache, left England to further his career as a medical missionary. As a representative of the Royal National Mission to Deep-Sea Fishermen, he sailed to Labrador to help the families of the thousands of cod fishermen who went there each summer. When he arrived, he found conditions far worse than he expected. Among the natives of Labrador — the Eskimos and Indians, its historical inhabitants, and the white families who had lived on the barren coast for a century — Grenfell found rampant poverty, ignorance and ill health. In this demanding region there were few priests, no hospitals and rarely a doctor.

Immediately Grenfell started a move to alleviate poverty and disease. He built hospitals and set up nursing stations with money raised from donations. A master of many talents, he showed special prowess as a money-raiser. Newspapers found him colorful copy and, as his reputation spread, thousands donated to his cause. In 1912 the International Grenfell Association was formed in New York when the modest resources of the Royal National Mission and his own efforts were no longer enough. St. Anthony became his headquarters.

Perhaps the greatest gift that Grenfell provided was the inspiration that brought hundreds of men and women to the wilds of Canada's eastern border.

Doctors and nurses from Canada, the United States and Britain worked for almost no money and a great legion of "wepes"—workers without pay—put their own money down to take a ride on Grenfell's glory road.

Grenfell took chances and faced death a number of times in his life but in 1940 the Labrador Doctor died in his sleep. His passing did little to disturb the progress of the mission. Already, Charles Curtis, Grenfell's protégé, was continuing the battle for better health care.

Confederation in 1949 probably had the most significant effect on the mission. With it came increased government assistance and eventually, in 1967, prepaid medical care for the province. Historically, all financing had come from the various agencies of the International Grenfell Association but now, as an agent of the Government of Newfoundland, the mission had a new source of support. But although it came under the wing of the government, the mission retained the spirit that had kept it alive.
throughout its early days.

Today, St. Anthony remains the nucleus of medical operations. All major surgery and specialized treatment is performed at the modern, 150-bed Charles S. Curtis hospital. Three smaller hospitals operate in the interior of Labrador at Happy Valley, North West River and Churchill Falls, site of the mammoth, $946 million hydro-electric power project. For the rest of the scattered towns and villages along the 2,000-mile coastline of Labrador and northern Newfoundland, medical care is dispensed from 13 nursing stations and community health centres.

What turns this collection of hospitals, nursing stations and health centres into a workable operation is a technologically advanced network of communications and transportation. A radio-telephone system puts all 13 outport stations in contact with St. Anthony. And standing by on 24-hour call is a trio of ambulances, ready to respond to any emergency. A hospital ship the 98-foot-long Strathcona III makes regular visits to outport stations. She carries a complete dispensary, an X-ray unit and a full range of dental equipment.

Grenfell headquarters the Charles S. Curtis hospital dominates the St. Anthony landscape, a ring of dark hills that fall sharply to a small harbor. With 400 salaried staff, the hospital is the largest employer in the area. Among its professional staff are 14 specialists, a number that few other hospitals its size can boast. Its medical facilities, the doctors believe, make it one of the best-equipped hospitals in Canada. For instance, the hospital can perform any operation with the exception of open-heart surgery and kidney transplants.

There is a wide range of backgrounds among the professionals and volunteers who come to St. Anthony, but almost all of them are pursuing an ideal. Although the country is beautiful at any season, winter is temperamental and cold; and mosquitoes and black flies are summer's constant pests. Clothes and food are expensive and night life is something the individual creates himself. But still, people come.

'Like my job and I really feel needed here,' says Sargent Horwood, 'I feel that if I left the job they'd have a hard time finding someone else.'

Horwood is 43, the father of two children and the mission's only full-time paediatrician. In May, 1972, he and his family left the affluent community of Los Alamos in the foothills of New Mexico's Sangre de Cristo mountains. For Dr. Horwood, a poised and articulate man, it meant leaving a lucrative private practice to live in a region where personal wealth is rare.

'In Los Alamos I was one of five paediatricians looking after a population of 25,000,' said Dr. Horwood. 'Now I'm the only person responsible for 50,000. It's a tremendous responsibility but it's also very gratifying. And people really appreciate you when they see you.'

Like Dr. Horwood, 37-year-old Gordon Johnson is one of a kind. The mission's only ophthalmologist, he and his wife Ann rejected a comfortable life in Toronto to join the Grenfell Association.

'I want a change from the city and a chance to do something useful,' he said. 'Unfortunately, you give up contacts with university and colleagues in the same branch of medicine. You must do all the work yourself so that there is little room for specialization. From an academic standpoint it can be quite unrewarding. But there are other rewards - like going to work in a place over magnificent landscape instead of riding a stuffy subway.'

At 21, Sharen Madden is one of the youngest professionals on the mission staff. She lived in Windsor, Ont., before she became a staff nurse in the intensive care unit.
care ward at St. Anthony. After hours she leads a girls’ guide group and teaches figure-skating.

‘There isn’t a lot of entertainment and the region is just so isolated,’ she said, ‘but the thing that saves it, is that it’s so beautiful.’

Why did she choose the Grenfell Association? ‘It was from a desire to know a different way of life,’ she explained. ‘I wanted to change what used to be a narrow outlook on life.’

In the Grenfell organization, it’s the outpost nurses who hold the front line. Gordon Thomas, 34, the executive director of the International Grenfell Association and its chief surgeon, says: ‘These women are highly qualified and extremely dedicated. Many of them are as good as a general practitioner – they have to be because they’re on their own if a doctor can’t get in to help them.’

And the pressure is on the outpost nurses when weather locks them in. Especially in Labrador, where the road system is all but nonexistent, evacuation is highly dependent on aircraft.

Tom Green, 32, and his 27-year-old companion Tom Vlaming, are full-time mission pilots. Between them they have ferried patients suffering everything from heart attacks to broken legs and landed on an assortment of lakes, ponds, paved runways and cleared fields. Their common bond is a love of flying and a dislike of St. Anthony airport.

‘The runway isn’t in the direction of the prevailing winds,’ says Vlaming. ‘You’re grounded by a strong crosswind.’

Vlaming’s aircraft, the mission-owned, eight-seater, twin-engine Navajo, is restricted to smooth, solid runways, but Green’s plane, an eight-seater, single-engine Turbo Beaver is more versatile. The Beaver can get airborne even if it has to bump across an open field.

At the Harbour Deep nursing station, 80 miles south of St. Anthony, Green gets his toughest ride. Early in winter, when the aircraft has been converted from floats to skis but the harbor ice is not yet solid enough to support the plane, Green must land on a quarter-mile-long pond atop a 1,500-foot hill. Because the pond’s surface is more shallow than ice the plane must taxi gingerly to an island made of cut tree tops.

But the patient too, must be brought to the top of the 1,500-foot hill – often aboard a dangling stretcher. A group of the town’s men pull the stretcher with long ropes along a steep and narrow path to the crest of the hill.

How does Green get out? ‘The same way I come in,’ he says. ‘You just have to be quick.’

The ship is the Imperial Quebec.
Kerosene lamp and spinning wheel recall pioneer days at Ontario’s Sharon Temple, 2.1 miles north of Toronto.

Logging locomotive is part of British Columbia Forest Museum at Duncan.

Animated penny banks are in the Bank of Montreal’s head office, in Montreal.

Canada’s Roadside Museums

They provide informal glimpses into little-known aspects of our past

by Elizabeth Kimball

All across Canada, on pleasant side-roads and even, occasionally, hidden within great cities, small museums describe chapters of Canada’s past that more famous museums often scarcely mention.

Alberta has a Ukrainian Village and Prince Edward Island a Car Life Museum and a French Acadian Museum. There is Nova Scotia’s Barrington Woolen Mills, Vancouver’s Hastings Mills; Ontario’s Mining Museum at Porcupine; Joseph Brant Museum at Burlington and Hydro Museum at Toronto. Montreal has a Telephone Museum. For instance, 2.1 miles north of Toronto, about one mile west of Don Mills Road near the Holland Landing cut-off, stands Sharon Temple. Unlike any other structure in the surrounding...
district, the three-tiered, white frame temple, sits back from the road in the
centre of a finely trimmed lawn.

The temple commemorates the Chil-
dren of Peace, a religious sect founded
by David Willson, an Irish-American
who settled a 200-acre Crown patent in
what is now Sharon Village. A minister
of the Society of Friends, he broke away
and, with six followers, formed the Chil-
dren of Peace in 1812. He designed the
temple and was minister of the sect. He
died in 1866, and is buried in Sharon
Burial Ground.

The temple at Sharon was the sect’s
second building. Despite its splendor, Sharon Temple was normally used only
once a month during ritual services at
which church members contributed to a
charity fund that provided money for
the needy of the area. One of the first
credit unions, the fund was also used by
sect members if they were in need.

Regular services and meetings were
first held in Willson’s house; later in a
one-storey structure that became the
sect’s music hall after they completed
their second meeting house in 1842.

Construction began on the temple in
1825 and it was used by the sect until
the late 1890s. David Willson was the
architect, and Ebenezer Doan was the
master builder. It took seven years to
build, with the men of the congregation
each contributing his own kind of work
toward it. One cut lumber, another
hauled stone; the windows are said to have
been built at several homes; and
Ebenezer’s son, John Doan, spent a full
year making the elaborate ark.

Every aspect of the structure is
symbolic. The building’s three tiers
represent the Trinity. The columns sur-
rrounding the ark are inscribed Faith,
Hope, Love, Charity. Twelve lanterns –
one at each corner of each storey –
represented the 12 apostles. At the time
of the Illumination, the first Friday in
September, the lanterns and one candle
behind each of the temple’s 90 win-
dows were lit.

Many children visit the temple. And
the question they ask most often upon
entering through the temple’s towering
east doors is, ‘What’s upstairs?’ Con-
fronted with Jacob’s Ladder, an extre-
emely steep, 24-foot arching staircase,
the young eyes slide along its polished
surface to the second floor, a music gal-
ery where, long ago, the band played.

The barrel organ, one of five organs in
the temple, was the first ever built in
Upper Canada. It produced 20 different
hymn tunes when operated by a big
hand crank. And in the driving snow the
children crave to climb aboard Ebenezer
Doan’s wooden buggy, driven from
Pennsylvania in 1808. Its is suspended
on wooden springs.

Manitoba preserves its Mennonite
heritage, and portrays pioneer life in the
province and Western Canada, with a
Mennonite Village Museum. 1 1/2 miles
north of Steinbach on Provincial Trunk
Highway No. 12. Begun in 1964, its
plans call for additions as each genera-
tion preserves the history of the preced-
ing age.

The village contains a house-barn ty-
pical of early Mennonite villages in Eu-
rope about 200 years ago. Transplanted
from Prussia to Russia around 1789,
this unique plan came to Canada in
1874. The construction is distinctive:
two-by-six scantlings laid flat, plastered
inside, sided outside. Inside there is a
huge brick oven in the main room, a
compact little kitchen in the centre of
the house, and a passage between the
pantry and boys’ bedroom leading to the
barn, which is attached to the house.

This museum includes an original log
house with a thatched roof, built in
1892, and a church, built in 1881. The
church, formerly used by the Old Colo-
ny Mennonites of the district, was
moved to its present site in 1868. An ar-
tifacts building, opened in 1967, houses
ear early Mennonite heirlooms, in-
cluding a wall map of the Mennonite mi-
gration, a collection of Mennonite cloth-
ing and another of old wall clocks. There
is also a library of books and documents
pertaining to Mennonite faith and histo-
ry, the oldest dating back to 1588. Out-
side stands a monument to Johann
Bartsch, an early Mennonite leader,
that is chopped and pitted by shots fired
during the Russian Revolution. This mo-
ument was shipped to Canada in

Also on the grounds is a replica of a
windmill built in 1877 by Mennonite
pioneer Abram Friesen. The replica was
built from blueprints drafted in Holland
by the Dutch Windmill Society. The
basic framework, made up of eight Dou-
glass fir poles, each 32 feet long, was as-
sembled without nails. The mill tower
stands 46 feet tall and each sail meas-
tures 32 feet. The two milling stones,

Everywhere at Sharon is symbolic: 12 corner lanterns represent the 12 apostles.
The home of the temple’s master builder, Ebenezer Doan, was built in 1819.

Willson’s study is surrounded by a colonnade, reflecting the design of the temple itself, and painted the same colors.

Tiny, sunlit study, only 8 by 16 feet, was built for the sect’s founder, David Willson, at the same time the temple was built.

The museum has a display of poachers’ paraphernalia, too; spears, jig hooks, nets, and a flambeau for lighting the pirate fisherman’s boat.

Stuffed specimens gape, glassy-eyed from their mounts, and very-much-alive young fish frisk in tanks.

British Columbia’s Forest Museum is a mile north of Duncan (or 40 miles north of Victoria) on Trans Canada High-

Each weighing 2,000 lbs., can produce as much as 800 lbs. of flour per hour.

The original mill cost $2,000; the replica cost $100,000.

The village has a large parking lot, and a place to picnic.

A former schoolhouse is now the Margaree Salmon Museum, 100 feet off the Cabot Trail at North East Margaree, N.S. The Margaree Anglers’ Association, its sponsor, claims this is the only museum of its kind in North America. Its collection of old-time fishing tackle includes rods from seven to 13 feet, home-crafted and of just about every type, many sizes and types of reel, a horsehair fishline, old-time gut casts, trout and salmon flies, fly books, gaffs and fly-tying materials.

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Part of the museum at Sharon, Ont., is this reconstructed log house.
way No. 1 on Vancouver Island. It occupies 90 acres of lakeside, through which a 1½-mile-long, narrow-gauge railway carries visitors through canyons of towering Douglas firs, over hills and under bridges, and over a trestle high above Somenos Lake. The exhibits include a steam logging locomotive, heavy old wagons and buggies, Douglas firs five feet in diameter (100 years old) when Captain Cook first set foot on the island in 1778), Indian totems, a water wheel and, in the log Museum Building, smaller tools and souvenirs of the province's logging industry. Retired lumberman Gerry Wellburn started the nucleus of the museum in 1949, with his collection of vehicles and equipment of the Canadian forest industry.

One of Quebec province's most unusual museums, right in the heart of Montreal, on historic Place d'Armes, is the Bank of Montreal's Head Office Museum at 125 St. James St. It is a reminder of how it was at Canada's first permanent bank in 1819, two years after it went into business.

Visitors almost literally step into the past when they enter; for immediately they are confronted from the cage by a smiling and mustached gent, the bank's first teller, Henry B. Stone. So warm is his smile that it may be an instant or two before they realize that he is only a dummy, and that even if they thrust their hands into his till he could...
The Bank of Montreal’s museum in Montreal contains a collection of cast-iron penny banks, many of them mechanically-actuated.

When the hunter shoots a penny into the slot, a bear pops out of the stump.

Drop a cent; the mouse becomes an acrobat.

The main room of the house-barn in Manitoba’s Mennonite Village Museum with guides in period costume.

not raise the hand gun that rests on his counter. Henry B. has a quill pen and sharpener, too. The soft light from the simulated whale-oil lamps flickering on the walls, the dozy tick-tick of an ancient clock, the leatherbound custo-
mers’ ledger, lying open to show the entries in pounds, shillings and pence – all these help to create the illusion that 1914 has telescoped backwards into 1819.

The museum contains tokens, coins, notes, documents and other mementos of the Bank of Montreal’s early history including the original deed, handwritten in 1648 by de Maisonneuve. In addition, a constant crowd pleaser will be on display throughout the summer: It’s an assortment of 19th-century penny banks. These cast-iron ‘toys’ were designed to lure children to thrift: an inserted coin produced elaborate feats of movement from the finely de-
tailed human and animal figurines.

Displaying more recent history the museum has a collection of documents, souvenir programs and medals pro-
duced to commemorate the September, 1901 visit of the Duke and Duchess of Cornwall and York, later King George V and Queen Mary.

Visitors flock to the Bank of Canada’s $1,000 note often passing by a far more valuable prize – one of the two re-
main ing $3 notes issued by the Bank of Montreal in 1844.

In every part of Canada are museums as special as these five and, generally speaking, as little known outside their own province or district. Their names can be obtained by writing to the minis-
ters of tourism of the provinces. Inqui-
ries should be made well ahead of time about admission prices, restaurants, parking arrangements and visiting hours – some of the smaller museums are open only in summer or on certain days of the week. ☑️
Replanting the Tundra

Special grasses can promote the development of new permafrost over a buried arctic gas pipeline

The northland is Canada's last frontier. It is sparsely populated, largely unexplored and only marginally developed. Its abundance of natural resources has been almost untouched. Vast areas alone have held most of its secrets intact; climate and distance have kept away all but the most determined visitors. But the North is changing. Today, an expanded search for needed minerals and hydrocarbons has begun to unlock the region, revealing its treasures and shedding light on many of its mysteries.

In the last few years, gas discoveries in Alaska and the Mackenzie Delta have encouraged planning for a gas pipeline across the northern Yukon and southward up the Mackenzie Valley. Preparation studies for the line have produced some unexpected benefits. Out of a project aimed at a continued energy supply have come intensive bird, fish and mammal studies, research into the frozen ground known as permafrost and, just recently, one of the most extensive botanical investigations ever undertaken in the Canadian North. These efforts have been directed jointly by Canadian Arctic Gas Study Limited, and the universities of Alberta, Saskatchewan and British Columbia, to permit development and transportation of the region's natural gas.

But why a botanical study? Because...
After a pipeline is stitched through the forest and across the open tundra, the vegetative cover must be restored to prevent erosion. And in the Arctic there are two types of erosion to contend with—water and thermal. Water erosion is the kind common to most regions where rainfall and rivers wash away unprotected slopes and banks. Thermal erosion is unique to permafrost.

In both tundra and northern boreal forest, the existence of perpetually frozen soil requires a balance in the exchange of heat between air and ground. Where there are plants growing, they can form an insulating blanket that affects the flow of heat. If the insulating plant cover is removed and the soil happens to be laden with ice, the subsequent thaw and slumping process—called thermokarst—often creates a deep, water-filled trench.

Since 1970, Canadian Arctic Gas Study Limited has been trying to find a fast and effective way to restore the tundra’s insulating cover and so prevent erosion. The Arctic Gas group of companies, of which Imperial is a member, has spent three-quarters of a million dollars on revegetation studies and expects to double the amount before its project is done.

To reestablish a pipeline right-of-way that stretches some 1,500 miles through many types of terrain is an ambitious task that requires not only money but also large amounts of information. Researchers working on the study have detailed both the landforms along the route and the wide variety of plant life that exists in each area.

Don Dabbs, head of the pipeline revegetation studies for Arctic Gas at Northern Engineering Services Company Ltd., explains the purpose of the research effort: ‘By determining the plants that already exist in a region and then investigating their growth characteristics, we’ll be able to select the appropriate plants for revegetation.’

To this end, Dabbs and his fellow workers—a group of soil, peatland and revegetation experts—have roamed the Mackenzie Valley and northern Yukon Territory filling notebooks and file folders with a multitude of data. ‘This preparation for the pipeline, even if the line is never built, has brought more facts to light than would probably have been learned about the area in the next 10 years,’ he said. ‘The information is sound, biological data and it will be available to anyone who wants to use it.’

Over the next two years all of it will be published in one form or another and some of it is already in print. ‘I think it’s fair to say,’ he adds ‘that Canadian Arctic Gas has made possible one of the most comprehensive ecological research projects in the Canadian North.’

Dr. Lawrence Bliss, professor of botany at the University of Alberta, believes the research project has added significantly to botanical knowledge of the North. ‘Past efforts provided a base for this recent study,’ he said, ‘but much of the work carried out before was done in bits and pieces. The ability to study large areas and relate plant communities to topography, soils and animal use would not have been possible without industrial impetus.’

But what about the major aim of the study? Can the pipeline route be revegetated?

‘We’re certain it can,’ says Dabbs. ‘The tool for the task is a heavily fertilized mixture of well-known farm grasses, many of them relatives of grasses blanketing southern Canadian lawns. Creeping red fescue, Kentucky bluegrass and timothy are a few familiar names to be used in the seed mix. Right now seed merchants in the Peace River country of Alberta as well as Minnesota, Oregon and Washington are busy producing the one-and-a-half million pounds of seed needed to replant the entire route. ’

‘The rationale for spreading the work around,’ Dabbs explains, ‘is to avoid a complete catastrophe in case disease or drought hits one of the areas. Using this method, there’ll be enough seed to meet our needs when it comes time for the pipeline to go through.’

The farm grasses are the mainstay of the program and have proven themselves in mass seedings at abandoned drill sites, on old haul roads on the tundra and at separate test plots established by Dr. Bliss and Northern Engineering. While some of the grasses grow well for only one or two years, there are plans to include others in the mix that don’t really catch on before one or two season’s growth.

But the people at Northern Engineering agree that nothing would help the project more than some home-grown grass— the kind that is native to the tundra. Researchers have been working on two promising varieties that have shown...
the desired qualities for revegetating disturbed surfaces. Says Northern researcher Walt Younkin: 'These two grasses, called polargrass and bluejoint, are the first to get into exposed soil, whether it’s from a natural frost heave or a man-made disturbance.'

Until recently, Younkin’s work was part of the study being directed by Dr. Lawrence Blin at the University of Alberta in Edmonton. The university’s biological sciences building contains the most up-to-date facilities for controlled environment studies in Canada. Speciality-built plant growth chambers can be set up to simulate the climate conditions of almost any region on earth, from the tropics to the Arctic. During experiments, both in the northland and at the university, Younkin and fellow researchers identified polargrass and bluejoint as the most suitable for revegetation.

The problem with the grasses lies in finding enough of the seed to revegetate any significant area. The aim is for 100,000 pounds of the native stock to go into the mix and Dabb’s thinks it’s possible that this amount can be produced in the Peace River country. It will require much more basic research,’ he said. ‘And for the project to be practical we must be able to produce the seed on an agricultural scale.’

What makes these grasses so attractive is their fitness for the harsh Arctic environment. They are a natural part of the region’s ecosystem and flourish as a result of thousands of years of selection. ‘It is unlikely,’ says Dabb, ‘that these species will be wiped out by disease or unusual weather conditions once they have become established.

‘Though we hope to be able to use native grasses in the seed mix, it will be possible to maintain an adequate plant cover using only farm varieties,’ says Dabb. ‘The native grasses will help reduce the amount of maintenance we have to do along the route. If we can’t put together enough native seed by the time the pipeline is ready, we’ll make up the difference with farm varieties. If some of the grasses in the mix die off, we’ll simply go in and re-seed.

‘By the time a pipeline is approved,’ Dabb said, ‘we’ll have enough seed to do the job. We’ll also have enough for a second seeding in areas that don’t take.

‘In places that present re-seeding problems, like critical side slopes, we will help the grasses control erosion by hand-cutting and replanting. On slopes that erode easily, we intend to use soil-binding mats, staked down to hold things in place. In addition we’ve found that the tundra’s vegetation can sometimes be stripped off, then replaced after the pipe is in the ground. With fertiliser and some extra seed a reasonable amount of it will re-establish itself.’

But for all their studies, the botanical influence of the Canadian Arctic Gas people will be temporary at best. Nature will evens regain control.

‘Our work,’ says Dabb, ‘is just a Bandage to help nature heal itself. The vegetation program will keep things together until natural cover has returned.’