Frontier oil and gas

These resources are hard to find and difficult to develop, but they are vital to Canada.

The Canadian petroleum industry is engaged in the biggest, riskiest, most expensive search for oil and gas in its history. The search is going forward in areas of unprecedented difficulty: off the east coast in the fog-bound, storm-tossed, ice-bound waters of the Atlantic; and in the frozen wilderness of the Arctic. The very hazards and distances of those regions require the searchers to find reserves that are very large—they’ve got to be big to justify the immense costs of developing them.

Arctic costs will be so high that export markets are essential if the reserves there are to be developed at all. In addition, the search must be conducted with great delicacy to avoid damage to the environment, particularly in sensitive areas of the Arctic where the ecology may be easily disrupted.

So why go to all the trouble? Because hydrocarbon reserves are vital to Canada; the development of new reserves will assure their continuing supply and, in addition, allow reduction of payments for foreign supplies. For example, the Quebec and Atlantic provinces now import their crude supply—245 million barrels last year at a cost of $5.41 million. Although these imports are more than offset by exports from western Canada, discovery of oil in the Atlantic would allow reduction of these eastern imports, thus improving Canada’s overall export position.

These purchases have been necessary because energy is essential to the country’s functioning. Last year oil and gas provided 78 per cent of Canada’s total energy requirements. Canadians used an estimated 1.5 million barrels of petroleum products a day, plus an estimated 2.8 billion cubic feet of natural gas per day. Every man, woman, and child in Canada accounted for an estimated 906 gallons of petroleum products and 46,000 cubic feet of natural gas last year. It was used to run vehicles, to heat homes, offices and other buildings, to operate industries, and to make such things as asphalt for roads, petrochemicals for a host of products from food wraps to pharmaceuticals, and lubricants to keep it all running smoothly. In addition, this country exported 84,000 barrels a day of crude oil and equivalent more than it imported, as well as 2.5 billion cubic feet per day of natural gas.

And demands for hydrocarbon energy are increasing every year. Imperial Oil estimates that Canada will be consuming oil products at the rate of four million barrels a day by the year 2000, almost three times the 1971 rate.

Over the period between the discovery of large oil reserves at Leduc, Alta., in 1947 and the end of 1969, Canada’s remaining oil and gas reserves increased, making Canada by the late 1960s the only industrialized country in the western world that, on balance, was self-sufficient in petroleum. During the past two years, however, Canadian oil production has exceeded the discovery rate of accessible, new reserves.

Gas presents a somewhat similar picture. Canadian government policy is to ensure a 30-year supply of natural gas for Canadian needs before allowing any exports, but the demand for this fuel is growing so fast that no additional exports have been permitted since April, 1971.

It might appear that the best way to deal with a situation of declining reserves and increasing demands would be simply to stop exporting and retain our hydrocarbons for Canadian use. But it’s not that simple. Cutting off exports would force our customers to develop other energy sources. Once lost, these customers and the markets they represent would not easily be regained, and...
without large enough potential markets, developments in the Arctic would come to a halt. Thus, instead of making Canada's hydrocarbon supply more secure, stopping exports would endanger it.

In view of these circumstances, the prudent thing to do is to look for new large hydrocarbon deposits of the kind the industry has been producing. In Canada today, the most promising areas for such deposits are the sedimentary basins of the Arctic and the continental shelf of the Atlantic shores. These basins may hold enough oil and gas to serve Canada's energy needs for a century or more at current rates, as well as to permit considerable exports. But they are scattered over a vast area where climate, geography and location add to the normal difficulties of finding and developing hydrocarbon reserves. For example, some of Imperial's Atlantic acreage lies under water 12,000 feet deep. Because of these difficulties, reserves discovered in both the Arctic and the Atlantic will have to be very large to offset the tremendous cost of exploration and development and, particularly in the case of the Arctic, of moving them to market. A gas line out of the western Arctic, for example, will cost some $5 billion. To be economic, such a line will have to move enormous volumes – more than the Canadian market can consume. So the gas must serve export as well as domestic markets if it is to be developed at all, the cost to the Canadian consumer of developing and moving gas in amounts sufficient for Canadian needs alone would be prohibitive. Atlantic developments face different conditions. Transportation, though expensive, would not be as costly as it will be for Arctic reserves. Domestic markets alone in eastern Canada would justify the development of Atlantic reserves; surplus reserves would, according to national policy, be available for export. The nearest export customer is the United States. Here's how Eric Siewert put it last May (he is Research Director of the Advisory Committee on Energy for the Province of Ontario, and he was addressing the Montreal Economics Association): Canada, he was reported as saying, will have to develop

the energy resources of the Arctic and its other frontier areas to meet its own future energy needs. But, he went on, U.S. markets are needed to help bear the capital costs of developing them. Imperial's board chairman, W. O. Twatts, presented the matter to the Business Outlook Forum of the University of Toronto's School of Business last December in these words: 'A strong export market exists and the presence of this market will enable us in Canada to further develop our own supply potential for our own future requirements. 'For exploration and development costs,' he told them, 'and for plant and distribution systems, including Arctic pipeline construction in this decade could come to somewhere between $25 and $50 billion. Supplying the Canadian market alone would not justify investments of that size; export sales of both oil and natural gas would be needed.'

There are compelling reasons why Canada must explore for frontier reserves now. Hydrocarbon exploration is a process that requires time and money to be successful—you simply cannot turn it on and off like a tap. Imperial's own experience in a case in point: the company spent $23 million exploring Canada's western sedimentary basin for 30 years between 1917 and 1947 before it finally found the Leduc field that led to the other large reserves that were subsequently discovered. Imperial's discovery of Arctic oil at Akiton Point on Jan. 14, 1970, was the first result of a search that has been going on since 1964. Imperial has also discovered natural gas, which makes another point about hydrocarbon exploration—you can be drilling for oil, but you may just as easily find gas. The two cannot be separated at the exploration stage. So far, the search has cost Imperial Oil about $100 million, and reserves large enough to justify production have yet to be proven. Once sufficient reserves are found in this area, where a pipe line is the only feasible way to get it out, it would be another three years before the first hydrocarbons started reaching the market—a span of at least 12 years.

Another reason for the frontier search is the one articulated by William H.
What about the tar sands?

The world's biggest presently-known reserves of recoverable oil lie virtually untouched in the oil sands of Athabasca, centred around an area about 200 miles northeast of Edmonton. The Canadian Petroleum Association estimates the amount available at something like 300 billion barrels.

Could Canada's get all the oil it needs from this one source? Yes, but...

The oil in the sands is a heavy, gluey substance that has defied all efforts for years. Only recently have techniques been developed that can produce the crude from the clonging sands at costs that give any hope of being economic. A plant that has been operating there since late in 1968 had produced about 42 million barrels of oil by the end of 1971, at losses reported to be $87 million. The losses have been declining year by year and the plant promises to break even soon on operating costs. But it certainly is not a profitable enterprise.

With developing technology and expected increases in the cost of world crude oil supplies, present forecasts are that tar sands oil can be produced to compete with conventional oil. But the cost of the product is only one aspect of the question. The skilled people and specialized equipment needed to build tar sands plants are in such short supply that the plants, each with an output of 100,000 barrels a day, can be built at the rate of only one every year or year-and-a-half. At that rate, tar sands oil combined with conventional western oil would barely meet the forecast domestic demands for oil; there would be very little available for export. Furthermore, current plans are for plants that will use sands relatively near the surface, although Imperial is experimenting with methods to recover oil from the deeply-buried sands.

The search for Arctic or offshore Atlantic hydrocarbons is a risk. If the hydrocarbons are discovered soon enough, the risk will have been worth taking. It not, the Athabasca tar sands would be a hedge against declining reserves.

Even so, Imperial is one of a group of companies that have already invested $35 million in tar sands research that could lead to an extraction plant costing almost $500 million. Imperial is involved because, while tar sands oil may be expensive to produce and may be available only in limited quantities, there is no doubt of its existence. Oil from the Athabasca tar sands and from other heavy oil deposits represents Canada's long-term hydrocarbon reserve. Eventually it will be needed in large quantities. In the meantime, research and development there will increase knowledge of tar sands technology, and the resulting production will complement oil from other sources.

Even so, Imperial is one of a group of companies that have already invested $35 million in tar sands research that could lead to an extraction plant costing almost $500 million. Imperial is involved because, while tar sands oil may be expensive to produce and may be available only in limited quantities, there is no doubt of its existence. Oil from the Athabasca tar sands and from other heavy oil deposits represents Canada's long-term hydrocarbon reserve. Eventually it will be needed in large quantities. In the meantime, research and development there will increase knowledge of tar sands technology, and the resulting production will complement oil from other sources. 

The search for Arctic or offshore Atlantic hydrocarbons is a risk. If the hydrocarbons are discovered soon enough, the risk will have been worth taking. It not, the Athabasca tar sands would be a hedge against declining reserves.
Lots of Work

For every job in the petroleum industry, there are others created outside it.

Although he's only 36, Joe Gautier has been building bulk plants and service stations for the petroleum industry for the last 18 years. Six years ago, he decided he knew enough to take the bull by the horns and set up his own firm, today, GS&G Installations Ltd., employs a permanent staff of 16 and hires up to 25 more skilled plumbers, welders and carpenters for major contracts. In fact, finding skilled workers is a problem for Gautier. 'We could take on more work if we could find men to hire' As it is, business is booming for GS&G Installations - $1 million expected turnover this year, which, Gautier claims, is as big as any of its competitors without branch offices. But things aren't always so good. 'It was,' admits Gautier, 'a long way getting started.' The first year consisted of $5,000 and $10,000 contracts. Total turnover was about $37,000. A big break came in 1967 when Imperial Oil awarded the company a contract to build a bulk plant. 'We have seen 50 per cent of our dollar volume come from Imperial Oil,' says Gautier.

Once awarded a contract to build a bulk plant or service station, GS&G starts from the ground up - clearing the site, erecting the building or setting up the tanks, laying pipe line and connecting the pumps. In the last year or so, the company has been busy building marinas for the oil companies as well. After the docks and wharves have been laid by sub-contractors, Gautier's men install such inner workings as dispensing units and loading and unloading facilities.

GS&G Installations Ltd.
Surrey, B.C., Bulk plant, service station and marina contractor

Halifax Shipyards

The chance of a major oil strike off Canada's Atlantic coast is considered so strong that premier Gerald Regan began to talk in June about Nova Scotia at last becoming one of the country's have provinces. While no offshore well is yet in commercial production the intense exploration is already bringing several million dollars and several hundred jobs into Halifax.

The chief beneficiaries of the deep sea oil prospecting are Halifax Shipyards, Division, Hawker Siddley Canada Ltd., its subcontractors and the men who work for the shipyards on the shore of Halifax harbor. These days the shipyard is mostly involved in building semi-submersible oil drilling rigs. Halifax Shipyards has completed two of the huge angular platforms-on-slings now in service off the east coast. It plans to launch its third in September; it has begun construction on a fourth; and has a firm order for a fifth.

Each unit takes almost two years to build and the five of them are worth close to $100 million. Of the 1,250 men employed by the Shipyards - the biggest work force since World War II - about 800 are working exclusively on the drilling rigs. And, since the whole oil exploration business appears so bullish these days, Ernest Alderton, general manager of Halifax Shipyards, is confident the number of men working on the rigs can't help but increase by hundreds in the months to come. The annual wage bill is now about $10 million while another $4 million a year is paid to subcontractors - more than double the payroll of only five years ago.

To take advantage of whatever opportunities arise from further oil exploration off Canada's east coast, the shipyards announced in May it will spend $3 million in the next three years upgrading its facilities.
Corod Manufacturing Ltd., Edmonton, Alberta, Manufacturer of continuous sucker rods

One December day in 1963 engineering consultant Al Palychnuk and an associate were in Imperial's Edmonton office discussing the reasons for sucker rod failure. The 25-foot-long solid rods, joined by threaded couplings, provide the push-pull motion that lifts crude oil to ground surface after a well has outgrown its flowing potential. The chief problem was with the threaded couplings - the threads would wear, break or corrode. The problem wasn't solved that day but Palychnuk didn't stop thinking about it.

Somebody had suggested welding the rods together. Despite the fact that nobody, but nobody, put 'welded stuff down an oil well' Palychnuk took the suggestion seriously. He came up with another, and to many people, even more bizarre idea. Besides welding lengths of rod why not coil them onto reels for easy transportation and storage? Palychnuk figured that if he stayed within the elastic limit of the steel and made his rods elliptical instead of round, coiling would be no problem.

After two years of experimentation - a time Palychnuk describes as 'not exciting or thrilling as they make inventions out to be in the movies - it was just a lot of hard work' - it was time to put the continuous sucker rod on the market. Palychnuk found 12 Canadian backers (including himself) and Corod Manufacturing Ltd. was born. The company, which employs 15 people, is the only manufacturer of continuous sucker rods in the world.

The first commercial order Corod got was in 1968 for Imperial's Redwater field in Alberta. Imperial is still the company's largest Canadian customer, although Palychnuk says 'we have gained acceptance with most of the companies within the industry now.' Besides lengths of the black, spaghetti-like sucker rods, some of them nearly two miles long, Corod developed the servicing equipment for transporting and installing the rods.

The firm owns 85 per cent of a subsidiary in Texas - an important coup because of the greater potential market in the oil-hungry U.S. The Texas factory has a staff of 12.

P. Hamelin Limitée
Montreal, Quebec
General contractor

The Hamelins of Montreal have been general contractors for three generations - ever since grandfather Hamelin 'got a little gang together and went into business' back in 1914. His son, Philias, took over in the 30s and shifted from interior plaster work to general building construction. Then Philias' son, Oscar, who joined the company at age 15, became president in 1962 and switched to heavy construction. 'It's in the blood,' says Oscar, whose sons André and Marcel are in the business with him.

Although the company did jobs all over Montreal island in his father's time, Oscar, who lives in Montreal East, prefers to concentrate his efforts in his own neighborhood, one of the most densely-populated, highly-industrialized areas on the island.

Currently, some 85 per cent of his work load comes from the cluster of oil companies located in Montreal East. The firm has been classified as a 'number one' contractor by the oil companies. 'That means,' says Oscar, 'that we can be trusted to go in and do a quality job, efficiently and safely, without being supervised.'

 Anything in the line of construction is what P. Hamelin Limitée does. This includes wood, cement, brick and foundation work, plus miles of digging. It involves building, repairing and demolition of just about anything. The company is run out of an office in Hamelin's bungalow - a stone throw away from the refineries he literally knows inside out. A warehouse and garage a few blocks away houses a half-ton and a one-ton truck.

Hamelin's permanent staff is small: five key people capable of managing the temporary workmen - up to 15 on a big job - who are hired by the hour when necessary. At least 50 per cent of the work is subcontracted out to 'skill specialists' - small companies with men and equipment to do a specific job like brick laying, form work or painting.

O. Hamelin, back left, and Imperial's Hodgson, front, sons M., A. Hamelin

Oscar admits he could 'push a lot harder' but at 62 he's beginning to feel he has earned the right to relax a little. 'One of these days I'll turn the business over to the boys - like my father did,' says. 'But not just yet. There's still too much to do and they still have some things to learn.'
Waterways Enterprises Ltd. Selkirk, Manitoba, Bulk oil and gasoline contractor

For the past three summers Ed Price of Winnipeg and a two-man crew — this year his 17-year-old son David and Kris Bjorson — have been sailing Lake Winnipeg with freight for settlements like Berens River, Princess Harbour, Nelson Island and Norway House. Ed’s barge, the Poplar River, brings them groceries, building materials and such appliances as refrigerators and stoves. On one trip he also had a bicycle wheel for a girl in Berens River and an outboard motor crankshaft for the same destination. Some of his cargo is for the government — hauling building materials, especially to hydro sites. Then there is the return trip to “civilization,” Selkirk, 20 miles northeast of Winnipeg, with faulty hydro generating plants, empty drums, cars, trucks and other machinery needing repair.

But Ed’s biggest cargo is oil and gasoline — generally 120 tons of the barge’s 180-ton capacity. Bulk oil is the money-maker, he says. It is 10 cents a gallon cheaper to ship than barrelled oil because there are no empty drums to return. He is trying to convince more people in the settlements he serves to put in tanks. And he is making progress. This summer he hauled a 4,000-gallon tank to Sigurdson Fisheries Limited, in Berens River and a 3,000-gallon tank for Princess Harbour. There are eight to 10 families in Princess Harbour and that tank will hold enough oil to last them through the winter. The Poplar River makes the round trip of 500 miles about 22 times a year. Powered by two 125-horsepower diesel engines, the barge travels at a top speed of five to seven knots and costs $600 a day to run.

Linwo Industries Agincourt, Ontario, Packaging firm

They each pooled $2,000, borrowed $14,000 more from the bank and Linwo Industries opened for business on Oct. 1, 1967 with seven employees and one customer. Today there are 70 employees working on packaging orders from 25 different companies. Imperial still accounts for 30 per cent of Linwo’s business, though the oil industry in general makes up 80 per cent. Besides Fire-}

Ed Price (right) and his two-man crew load the Poplar River

starter, Linwo packages such things as petroleum additives, windshield washer anti-freeze, hand cleaner and Fiz Weed and Bug Killer for Imperial. As well as at the 30,000-square-foot plant in Agincourt, Ont., the company owns a plant in Buffalo, N.Y., set up a year and a half ago to package another Esso product, Stretch ‘N Seal. Imperial wanted to market the food wrap in the United States and needed production facilities in a fast four weeks. Linwo took on the challenge and not only met the deadline but had packaged 24 million rolls two weeks ahead of schedule. The Buffalo plant employs 63 persons and Linfo and Woronowsky put the net worth of the two companies at close to a million dollars.

Kenaston Drilling (Arctic) Ltd. Inuvik, N.W.T., Drilling rig contractor

George Yelich was 23 when he left his farm in Kenaston, Sask., to seek the excitement of the Alberta oil patch. The year was 1949. In the 23 years since, he has stayed in the business but, like the industry itself, Yelich has shifted his interest north. Yelich’s company, Kenaston Drilling (Arctic) Ltd., employs 80 to 100 men in the winter when the drilling rigs are in full operation and about 30 in the summer when the fragility of the tundra limits the activity. Although he likes to hire native Indians and Eskimos, most of his employees are from farms in the Peace River district, southern Alberta and Sas-katchewan. They buy farm machinery and then find themselves short of money so in the winter they have to go out to work,” explains Yelich. ‘They make a good salary in the North — average about $1,000 a month and double that on some jobs.’ Kenaston’s work is mainly shot hole drilling for seismic crews and laying foundations, or putting in pilings for drilling rigs, equipment, storage facilities and camps. Because oil company contracts are seasonal Kenaston Drilling has expanded its services. In the summer months it takes on jobs like piling foundations for a 50-suite apartment block in Inuvik for the department of public works and drilling and placing steel foundation for a CN Telecomunications’ building at Arctic Red River.

‘We’re not a very big company,’ says Yelich, ‘but, including all our operations we have grown to a volume of about $1 million a year. Then we have about another $1½ million tied up in equipment and other assets such as buildings. We hope to increase our volume to $2 million this year.’

George Yelich with some of his crew and equipment in Inuvik. The firm employs up to 100 men in the winter

Five years ago Imperial Oil was seeking someone to package its new product, Firestarter. Bill Lindo, then plant manager of a chemical specialty firm that had done other business with Imperial heard about the search. He called a friend named Joe Woronowsky and together they decided to take on the packaging job.
GOLD AND WHITE QUARTZ
Actual size of this specimen 2 1/4 x 3 1/2.

This magnificent specimen of gold foiled with white quartz is from Schumacher, Ont. Found in all provinces and territories except Prince Edward Island, gold is the metal primarily responsible for establishing Canadian mining, and for many years was the leading product of the industry. Since 1934 Canada has ranked third in world gold production. Highly prized for jewelry and the decorative arts, gold is also important in such fields as optics, atomic energy, heat control and measurement, medical therapy, chemical manufacturing and brazing.

DAZZLING
by Barbara Rutledge photos by Ron Cole

The minerals that have made Canada prosperous come in forms of astonishing beauty

There's a small rock quarry 25 miles east of Montreal at Mont St. Hilaire that has captured the interest of people from all around the world. What makes the place so fascinating is that amid all the rock it produces for road fill and cement are 120 different minerals, 20 of which have never been reported found anywhere else on earth. Mont St. Hilaire is a mineralogist's dream - scientists from more than 50 countries have visited the quarry. And besides the professionals it attracts hordes of eager amateurs who collect minerals as a hobby. On the last weekend of May there were so many people scrambling around the place that the quarry's operations manager, Jean Lemeux, was thinking of closing it except for a few weekends a year. "Otherwise," he said, "some of our employees will be working seven days a week."

Minerals have always been important to Canadians, in different ways. This country is unusually fortunate in the number and quality of its natural resources - over 60 different mineral commodities. Its position as the nation with the highest mineral output per capita has given it one of the highest standards of living in the world. Canada is the leading producer of asbestos, molybdenum, tungsten, nickel, copper, silver and zinc; second in beryllium, molybdenum, selenium, sulfur, and uranium; third in cobalt, lead and gold, and fourth in gold. Mining was a $15.9 billion business in the country last year. Minerals help provide us with our shelter, transportation
STILbite ON CHABAZITE Actual size of the stone 1.5" - charming.

Looking like a sea anemone freshly plucked from the ocean, this pale brown stilbite was found in a rock cavity at Wasson's Bluff, N.S. It derives its name from the Greek "stilbite", meaning to glitter or shine.质押 the stilbite flower are pinkish crystals of chabazite. Minerals similar to these two are produced synthetically. Called zeolites, one of their uses is for softening water.

and communication. They fertilize crops, bring radio and television to millions, heal the sick and make possible such feats as going to the moon. Many of them are also beautiful and, for this quality alone, they are sought by collectors.

Only a few years ago mineral collecting was largely the preserve of the scholar. Today it is the fourth largest hobby in North America, following photography, stamp and coin collecting. In Canada there are more than 80 mineralogy clubs, most with their own newsletters or magazines. Members field trips to quarries and mines, backpacking, building excavations, road trips or other nearby mineral locations, to get together to talk about their collections and trade specimens. Twice a year, for example, The Walker Mineralogical Club of Toronto, the oldest in Canada, holds an auction. Members bring in unplayed minerals and there's brisk bidding for an hour or so while everyone tries to acquire desired additions to his collection. Bids range from a few cents to a few dollars at most.

Actually, cost is probably one of the reasons mineral collecting is so popular. It's an inexpensive hobby to start. A two-pound hammer, a geologist's pick, some cold chisels, safety goggles, newspapers wrapping the finds and a collector's bag will put the amateur in business. A field guide, magnifying glass, magnet and pocket knife are useful to identify minerals.

The hobby gets more expensive as the collector begins purchasing pieces. There are some 85 mineral dealers in Canada with bulk outlets where you can buy beautiful minerals from around the world at prices ranging from a few cents to hundreds of dollars. While this hasn't happened in Canada yet, big auction houses like Sotheby's in London and Parke-Bernet in Paris and New York have held mineral auctions. At one such sale - at Parke-Bernet last year - a fine piece of quartz brought $193.50; at Sotheby's in 1970, 108 lots of minerals were sold for $18,442. The bargain of the sale was a large and colorful amethyst group from Brazil at $826. On the other hand, at The Walker Mineralogical Club auction last spring an attractive piece of rose quartz sold for five cents.

Besides the cost, there are other reasons why mineral collecting is becoming an increasingly popular hobby. H. R. Steacy, co-curator of Canada's National Mineral Collection in Ottawa, believes that the moon shots of last few years and the subsequent publicity given to rocks brought back to earth have sparked an interest in amateur mineral collecting. Along with such other stimuli as guided tours publicizing localities yielding unusual or especially fine specimens, more and more leisure time and the current return-to-nature desire, Dr. Steacy points out that people are becoming interested in minerals at an earlier age because earth science courses are being taught in lower grades at school.

Perhaps another reason for the growing fascination is because the hand, geometric, highly-polished lines of some rocks and crystals correspond to many developments in art and architecture. French painter Edouard Pignon has a theory that in an age when many sculptors have taken their inspiration from natural forms like unheated rocks and boulders, people have become sensitive to such shapes and learned how to look at them with concentration.

Whatever the reasons, it's happening. And although Canada has never been regarded as a prolific source of gem minerals, it has produced many popular ornamental stones. Labradorite (photographed on the cover) was discovered in 1770 on an island off the coast of Labrador; it's so identified with this country that it has been called the 'gem of Canada.' The Eskimos call it 'fire rock.' Bright blue sodalite, handsomely mottled with white comes from a quarry near Bancroft, Ont. In 1906, 130 tons of it was shipped to England to be used as ornamental stone trim for the interior of Sir Ernest Cassel's house in Park Lane, London. Other beautiful minerals include jade from British Columbia, multi-colored agate and bright green amazonite from Ontario and Quebec, fresh-red garnet and rose quartz from Ontario, and little chalcedony and jasper from various localities in British Columbia, Ontario and Nova Scotia. Then there's Amethyst Mountain near Thunder Bay, Ont. - about which an enthusiastic mineral collector says: 'It's not really big enough to be called a mountain, but it is a whole tremendous hill of solid amethyst.'

There are others as well, some of them economically significant, that are beautiful to look at. The photographs on these pages were taken at the Royal Ontario Museum in Toronto where Dr. J. A. Mandarino heads a mineralogy department of 150,000 specimens from all over the world. These minerals would be prime pieces in anyone's collection.

GYPSUM Actual size of the stone 3" x 2 1/2".

It's hard to believe that the mineral that goes into making wallboard and plaster, cement and paint, self-conditioner and paper can also be a collector's item like this amethyst rose of gypsum crystals from Winnipeg, Man. But it's true. Canada is the world's second largest producer of gypsum and the leading exporter of the mineral.
FLUORITE

Shades of mauve and gray, these crystal cubes of fluorite with their glassy luster were unearthed in Charlotte County, N.B. Fluorite can be clear or range in color through pink, yellow, brown and nearly black — even banded in different colors. Its uses in metallurgy and the manufacture of hydrofluoric acid constitute about 90 per cent of total consumption but clear optical grade fluorite is valuable for making lenses.

RHODOCHROSITE

Topped with prismatic black crystal spikes of aspirin and iced with white feldspar this 1½ inch square semi-transparent chunk of rhodochrosite whose color typically ranges from pale to deep rose red comes from Mont St. Hilaire, Que. The rock quarry at Mont St. Hilaire is a small one — producing only 600,000 tons of crushed stone a year — but it is world famous because of the wide range of minerals found there.
ASBESTOS
Wispy enough to look like they could be swayed by the merest breath, these chrysotile asbestos fibers from British Columbia were contained in rock that had been twisted, shredded, squeezed and superheated by primeval convulsions of the earth's crust. Therefore, although seemingly silky and fragile, they are fireproof, resistant to ordinary acids and, when twisted, have the tensile strength of steel. Canada is the leading asbestos producing country in the western world. The major end uses of the mineral are in construction, cement products, floor tiles, paper products, textiles, highway asphalt, and insulation.

OLIGOCLOSE
Actual size of this sample: 2" x 1".
A pale, foamy blue-green, this oligoclase from Baffin Island, N.W.T. seems to typify the cold precociousness of Canada's North. This particular specimen is highly unusual because of its transparency. Most oligoclase, especially big pieces of it, is opaque. As a member of the feldspar family oligoclase is related to amazonite and labradorite. It has no value, except as a collector's item.

SYLVITE IN CARNALLITE
White sylvite crystals and the orangish carnotite are commercially known as potash. Canada is the world's largest producer of potash. It's mined in Saskatchewan - this sample comes from Estevan - but there are known reserves in Manitoba, Alberta and Nova Scotia. While it is a vital component in the production of batteries, soap, television tubes, vitamin pills, fire extinguishers and astronaut breathing gear, it is also used in the manufacture of glass, ceramics, textiles, dyes and explosives. However, 95 per cent of potash production is used for fertilizer. It is necessary for plant growth and regulates the intake by plants of other minerals and elements.

PLACER GOLD
Actual size of this sample: 1" x 1/2.
Left over from the gold rush days of 1896 and 1898 these tiny, water-smoothed nuggets were panned from Forty Mile Creek in the Klondike region of the Yukon. People in the North turn them into trinkets for tourists. You can get a beautiful gold nugget bracelet for $175 and rings cost $55 and up.
ROCK MAPPERS

An agency older than Confederation keeps finding new facts about underground Canada

by Robert Collins

As part of the geological reconnaissance of Canada a geologist climbs over black and white striped trachyte and anorthosite rock in Newfoundland

We'll begin with a one-minute quiz. What do these three dissimilar items have in common?

a) An Ottawa minerals expert who last year examined and identified 1,014 assorted pieces of rock, mailed to him by total strangers.

b) A $10 book on prospecting which has become a Canadian best seller (nearly 25,000 copies sold) without the aid of book reviews or a Canada Council grant.

c) An Ottawa geochemist who probably knows more about the moon surface than anyone else in Canada.

If you answered 'Geological Survey of Canada' to all this, you're either a genius or you peeked. Otherwise you might assume that 'geological survey' connotes some ancient organization of men with pickaxes, knee breeches and Mountie hats, trudging around Canada gathering rock samples and making maps for secret government files. And you'd be almost totally wrong.

The Survey is old (130 years, one of the oldest scientific organizations in the world) and it does make maps (by 1976 it will have completed the first total geological reconnaissance of Canada), but the maps are far from secret — they're available to anyone and they have pointed the way to many important mineral discoveries, including those in the current Arctic oil explorations.

And a newer and equally important role is the Survey's continuing study of Canada's natural resources: how to use and conserve them. Between or around those major tasks, the Survey gets involved in all kinds of interesting peripheral things: identifying rock samples sent in by the public (but the Survey won't assay ore for you); updating that best seller, 'Prospecting in Canada'.
which tells you everything from how to keep bears out of your car to the definition of a 'herse' (if you thought it was a U-drive, you're not Number one; it is the unit of frequency equal to one cycle per second). And the Survey means being one of the 31 scientific organizations outside the United States chosen by the U.S. National Aeronautics and Space Administration from hundreds of applicants to study material from all the Apollo moonwalks.

If a Remenyi's work force consists of degree-holding scientists, many with PhDs, specializing in such fields as geochemistry, microgeology, astrophysics and multi-spectral aerial photography. And although they still occasionally take to canoe or dog sled, most often they travel by helicopter, or in fixed-wing aircraft fitted out like laboratories.

'We are not suffering from old age,' sums up Yves Fortier, director of the Survey. 'I might be, but not the Survey! Fortier can afford to joke about his age because he looks as spry now as at 38 when he paddled a canoe around Grown- wallis Island in 1959, or when he led a helicopter mapping foray into the Arctic Islands in 1955, which won him the Massey Medal, awarded by the Royal Canadian Geographical Society.

Fortier is proud of his medal but neither he nor his colleagues regard awards or trips into the Arctic as extraordinary. Survey men have won one other Massey Medal and two gold medals from England's Royal Geographical Society. And since William Logan was named first director in 1842, Geological Survey men have been prowling into Canada's frontier - long before the other forerunners of civilization, Canada then consisted only of parts of what are now Ontario and Quebec, but as the nation grew after Confederation, the Survey's mapping responsibilities grew with it.

Today it is almost impossible to get a

Since 1859 the Survey has published 10 compilation maps, containing all knowledge of the country's geology. This section, showing parts of B.C. and Alberta, is, from the last compilation, done in 1969.

Survey men to discuss the adventure of his job, partly because aerial travel has taken most of the hardship out of it, partly because a geologist finds more romance in experimenting with such things as ionization chambers to measure the radon content of the atmosphere from ground vehicles and aircraft and are designed to sniff out uranium deposits.

Nevertheless, early field geologists were hardly types, traveling by canoe, horseback or on foot and living off the land. One of them, J. B. Tyrrell, ran out of food and lived for weeks on caribou, ducks and polar bear while he was exploring and mapping between Hudson Bay and Great Slave Lake in 1893. Another, A. P. Low, who specialized in the Labrador and Ungava regions, spent two years on one expedition, covering 1,000 miles by ship, 300 by dog teams and another 1,000 on foot. A third Survey man gashed his foot with an axe and sewed it up himself.

Gradually their map-picture of Canada grew and with it came important mineral leads. Some of these were ignored for years. In 1893 Tyrrell verified reports of oil seepages around Morinville, near Edmonton. He informed his headquarters, but no one drilled where he suggested. Oil finally was found near Morinville in 1947, much to the delight of Tyrrell who was then nearly 90.

In 1930 after reading a 36-year-old Survey report, Gilbert LaBine flew to Great Bear Lake and subsequently discovered the Eldorado mine which became a major producer of uranium. In 1932, in the course of everyday mapping the Survey discovered Canada's largest deposit of magnatite in British Columbia. Six years later in the same province the Survey found a mercury deposit, said to exceed in value all the money spent on Survey work in British Columbia to that date. Also in the 1930s, Survey maps indicated artisan water in parched southern Alberta. Wells were drilled, water flowed and a million acres of dry belt were irrigated.

As early as the 1880s, the Survey was working in the North, but most of the mapping for the first half of this century was confined to the District of Mackenzie. Then in the late 1940s, Yves Fortier led a systematic reconnaissance of the Arctic islands. At first the geologists used dog teams and freighter canoes. Then they evolved a helicopter survey method. In 1952 the Survey made North America's first helicopter geological mapping foray in the Arctic and in 1955 Fortier's 'Operation Franklin' mapped 120,000 square miles.

These were historic trips for two reasons. They proved, for one thing, that helicopter survey was fast and relatively economical method of mapping. To that point the Survey had mapped only a million square miles, roughly one quarter of Canada's land mass, in more than a century. Since then, using leased helicopters, it has mapped all but a few islands in the Arctic, northeastern Quebec, Labrador, British Columbia and the Yukon.

The Arctic work was helped along by Piper Super Cub aircraft fitted with an oversized balloon tire, able to land and take off almost anywhere in the islands. Subsequently the Survey bought two planes of its own for experimental work on a long-ranging Queenair for high-sensitivity magnetometry, and a Skyvan, a high-wing, slow-flying plane that seems to have the potential to accommodate equipment set up in laboratory-bench fashion. It is used for gamma ray spectroscopy, infrared imaging and various airborne geochemical studies. Altogether, aircraft have speeded up Canada's geological mapping by two or three centuries.

The Arctic islands work also laid the foundation for the oil exploration that has been going on there since the 1960s. Survey maps have always been of interest to the oil industry; there was a particular rush on them after Imperial Oil made the big oil discovery at Leduc in 1947, and by 1960 the Survey established a Calgary office (now expanded into an Institute of Sedimentary and Petroleum Geology). But the Arctic data was valuable, adding to what the oil and mining industries knew about the high Arctic and encouraging further work there.

They've used Survey data extensively since 1960. In the eastern Arctic, Survey studies on Bath Island encouraged a mining company to stake out and explore a large lead-zinc deposit near Arctic Bay. Survey reports of widespread iron deposits helped the discovery in 1962 of the Mary River iron mine. Survey maps show thick sedimentary rock, the kind in which oil is sometimes found, under Hudson Bay.

In 1960, the Survey ran the first seismic surveys in the Sverdrup Basin of the Arctic. Archipelago, and found sedimentary rock sections more than 70,000 feet
In the 1980s geologists in northern Alberta focused on herodolium uranium

Kouchibougouac National Park site in New Brunswick.

Some are operating a laser unit, first of its kind in Canada, that can pick out a single speck of material from a rock sample, for pure analysis. Others are analyzing coal samples from British Columbia, the Prairies and the Atlantic provinces, to learn more about Canada’s coal reserves and how they might best be utilized.

The geochronologists are dating rock: some of it as old as 2,000 million years; some of it as ‘young’ as Mt. Edziza, a British Columbia volcano that has erupted at least three times in the past 1,800 years.

The lapidary laboratory saws and polishes rocks into wafers 3/1,000 of an inch thick for microscopic studies. They are also keeping busy preparing some 8,000 sets of minerals and rocks, sold to prospectors and the general public every year, or identifying yet another sample sent in by somebody. The Survey will identify a rock for you, free of charge, if you address it to: ‘Geological Survey of Canada, 601 Booth St., Ottawa’, mark it ‘for mineral identification’ and tell where you found it, plus any other pertinent details. Don’t expect to get the sample back, unless you enclose return postage.

Much of the Survey’s lab activity is a quiet form of detective work. The geochemistry section, for example, outlined the known copper deposits in the Coppermine region of the North using materials acquired by helicopters that leap-frogged quickly over the area, landing to take samples of lake sediments. The same technique can now be used to detect undeveloped mineral belts elsewhere in the Canadian Shield.

‘Glacial drift’, the bane of geologists for more than a century, is being used as a clue in the minerals hunt. Glacial drift is the overburden of soil, rock and assorted rubble that was rooted up from its original location, carried miles away by creeping glaciers, and left behind as the glaciers receded. In the past, this overburden has complicated geological work. A trace of valuable ore might

Use of aircraft fitted with balloon tires in 1956 was pioneered by the Survey.
show up in it — but where had it come from? Now the Survey and a few private companies are experimenting in ‘drift prospecting’. Using geochemistry, core drilling and other geological skills, they hope to develop a standard technique whereby prospectors will be able to trace overburden back to its pre-glacial source and, perhaps, to hidden minerals.

From a layman’s standpoint, the most exciting case on the Survey’s files is the study of moon samples from the Apollo missions. Before the first landing in 1969, NASA invited scientific organizations around the world to describe what they’d do if they had some moon rock. Dr. J. A. Maxwell drew up the Geological Survey’s proposal, involving chemical analysis, mineralogy, isotopic studies, seismic properties and electrical conductivity — really the same curious research that the Survey applies to earth rocks. NASA approved, and in October, 1969, Maxwell and two companions flew to Houston in a Canadian Forces jet to bring back 110 grains, about one quarter pound, of the precious stuff.

It was on strict loan; every grain had to be returned or accounted for. The grey-black material — some walnut-size humps, several thin slices, and some dust — was sealed in 15 containers. Like every other Canadian traveler, Maxwell had to clear with Customs before he could get back into the country, and get a permit from the department of agriculture. Then a motorcyle escort whisked the scientist to Survey headquarters where the moon rock was kept in a special vault when not in use.

‘Every mission since then has shown us more and more that the moon is very much like earth,’ says Maxwell. ‘Its geology makes use of the same alphabet, although it arranges the letters a bit differently.’

No new elements have been found, so far, but there are small quantities of new minerals, which have been given names like ‘triquilite’ and ‘triquilite’. So far, virtually no platinum, gold or silver has been found, but there are rich concentrations of titanium. Moon rocks are extremely low in sodium and potassium, and show relatively little fluorine, chlorine or carbon dioxide. The Geological Survey will examine samples from the Apollo 17 flight. That’s the last of the Apollo series, but it will not exactly leave the Survey unemployed. At 601 Booth St. the face of Canada always had higher priority than the valleys of the moon. Although this country will be mapped overall by 1976, most of the work is on the one-inch-to-four-miles or one-inch-to-eight-miles scale, which is considered ‘basic’ mapping (some maps are on one-inch-to-one- or two-mile scale). There’s enough mapping, probing and analyzing to keep the Geological Survey down to earth for a few more generations.

In the analytical chemistry lab rocks are studied to determine composition.

The Survey’s Ottawa headquarters: the rocks on the lawn are 4.5 billion years old.
The man who invented the dotted line

By David Parry

and other legends from the history of Canadian transportation

"When Mr. Biggs came out of the office, I saw him standing there with a quart can of paint in one hand and a brush in my other hand. He asked me what I was doing."

The man with the question was Frank C. Biggs, Ontario's Minister of Public Works and Highways from 1919 to 1923. The man with the paint brush was Robert Hunter, an employee of the City Parking Garage at 34 River Street in Galt, Hunter had possibly just inspired the world's first road markings.

The story is spring of 1918. Two doctors who rented space in the garage had frequently complained of finding their cars blocked when they had emergency business to make. Hunter's brainwave was to paint lines marking off each motorist's quota of the floor. When the hon. Mr. Biggs walked in, Hunter explained what he was doing, then suggested to the minister that the idea might also work on the new pavement in front of Mr. Biggs' farm. On a foggy night, Hunter pointed out, it was difficult to see the road.

In a letter to the Historical Society of Wentworth County, Hunter details the minister's reaction to the idea: "He thought for a moment, then said he had had trouble locating the two curves at Clarkson when he was returning home Friday night after a late session of the House. I thought no more of the matter until about two weeks later. I was on my way to Hamilton and there was a white line painted on the pavement in front of his (Mr. Biggs') farm where the road curves sharply towards Bullock's Corners. A few weeks later, Bullock's Corners and also the two sharp curves at Clarkson were marked by the lines."

Hunter concludes his note, "May God bless Mr. Biggs."

Present-day officials at Ontario's ministry of transportation and communications can neither confirm nor deny Hunter's account of the origin of the line in the road. There is, however, a strong feeling that the idea of marking dangerous curves originated somewhere in Canada.

Transportation historian Edwin C. Guillett believes the dotted line started here, too. In his Story of Canadian Roads, Guillett places this date at 1930, and credits J. D. Millar, an engineer in charge of construction on Ontario's Highway 2, not far from the Quebec border. Millar noticed that when fog blew in from nearby Lake St. Francis it was difficult for motorists to see the road. He had lines painted at 300-foot intervals down the centre of the road. But when his supervisor arrived he ordered the lines removed and snapped to Millar, "What do you think you're going to do? Paint white lines on all the highways of the province?"

However, within three years dotted lines appeared on roads all over North America. Millar went on to become the province's deputy minister of highways. Other Canadian highway firsts include the original plank road (Kingston Road east of Toronto, a model later copied in other provinces and states), the first numbered highways (credited to A.C. Emmett of the Manitoba Motor League), the 12-inch diameter traffic light, and North America's first super-highway (Ontario's Queen Elizabeth Way which officially opened in 1939). Credit for devising the first streetcar fare box goes to Sir Frank Smith, senator, banker, railwayman, and owner of the Toronto horsecar system. But the Canadian Railroad Historical Association believes Montreal developed the world's first pay-as-you-enter streetcar. Until 1905, fares were collected by a conductor who waited for everyone to sit down, then walked through the car and sold tickets. During rush hour, when the size of the crowd made it difficult for the conductor to get around, passengers frequently escaped without paying. In those days Montreal built all of its own streetcars, so there were adequate facilities to perform an experiment on number 890, which was given an extended platform, large enough to hold an average load of passengers from any one stop. This allowed the driver to move on while the passengers trooped inside one at a time, paying their fares as they entered.

Canadians didn't invent the electric streetcar, but they did come up with the efficient design. Early models drew power from electric rails buried in the ground. Often, heavy snow or rain short-circuited these systems, bringing the streetcars to a halt. John J. Wright of Toronto thought of using overhead wires in conjunction with a roof-top trolley pole that had a wheel on the end to lessen the friction. The new system was introduced at the Canadian National Exhibition in 1884, and was later adopted in major cities all over the world. But eight chilly winters passed before Thomas Ahearn of Ottawa invented the first electrical heating system to keep streetcar passengers comfortable. Ahearn is also remembered as the man who came up with the apparatus for the first electrically-cooked meal.

In 1949 when Newfoundland entered confederation, the Newfie Bullet was turned over to the CNR. The Bullet was the province's affectionate (and ironic) nickname for the Newfoundland Railway. Amid the regular staff of railway employees, CNR officials were puzzled to find on the payroll a wind sniffer. They learned that winds at the foot of Table Mountain reach 150 miles an hour and just a few years earlier a 14-car freight train had blown off the track into a brook. A trapper and farmer named Lauchie MacDougall of Wreck House possessed the unusual ability of being able to sniff the wind and anticipate what it might do. So the Bullet paid him $140 a year to walk the tracks a few times a day and phone in his appraisal. If it were safe the trains would pass. If not, they'd be chained to the tracks.

The CNR, after some hesitation, elected not to tamper with fate. They carried on the tradition, and when Lauchie MacDougall died in 1965 his wife Emily, took over his duties. In 1869 a Toronto dentist named J.W. Elliott took out a patent on a rotary snow plow for locomotives. Elliott called his machine a "compound revolving snow shovel," and it was designed to replace the old wedge-type plow which didn't work well in very deep snow, and didn't work at all in deep drifts or avalanches. But Elliott was unable to raise the interest of the railways and eventually returned to pulling teeth. His idea was later modified by another Canadian named Orange Julli who, along with the Leslie brothers of Orangeville, Ont., developed the basic rotary plow now used from Siberia to South America.

Until the early '30s, all railways were baffled by the problem of rail breakage. Often, with no visible warning, rails would snap completely in half. A young metallurgist from the Maritimes named J. Cameron Macklin linked the problem to minute cracks formed during the cooling of the metal. Macklin developed a controlled-cooling process and as a result of his work, the world's first shatter-free rails were turned out in Sydney, N.S., in July, 1931. Today, most of the rails produced in the world are made by the Macklin method.

Other Canadian firsts in railroad ing include the world's first sleeping car, developed by the Great Western Railway (now part of CN) in 1897 — six years ahead of the first Pullman. The dome car was devised in 1902 by the Canadian Pacific Railway.®