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Oil from Alberta's tar sands – NRC process may be the answer

For Canadians, one of the most important factors in the equation balancing future energy supplies and needs is the bitumen locked in the vast tar sand tracts of northern Alberta. The total reserves of synthetic crude oil that lie under these forested plains has been estimated at 1,000 billion barrels, of which 250 billion barrels (or 70 per cent of the Middle East reserves) are recoverable by today's extraction technology. The problem, at least for the present, is in the expense of removing the sand from the bitumen, a task made more difficult in many areas of the beds by the presence of clay, which tends to bond the two materials together.

Spherical agglomeration

One attractive alternative to the existing technology that has received attention in the last few years is a process developed by the National Research Council of Canada's Division of Chemistry called spherical agglomeration. Dr. Ira Puddington, who recently retired as director and now acts as a consultant to the Division, is one of the principal scientists involved in the work. According to Dr. Puddington, spherical agglomeration is a general technique for separating the components of many

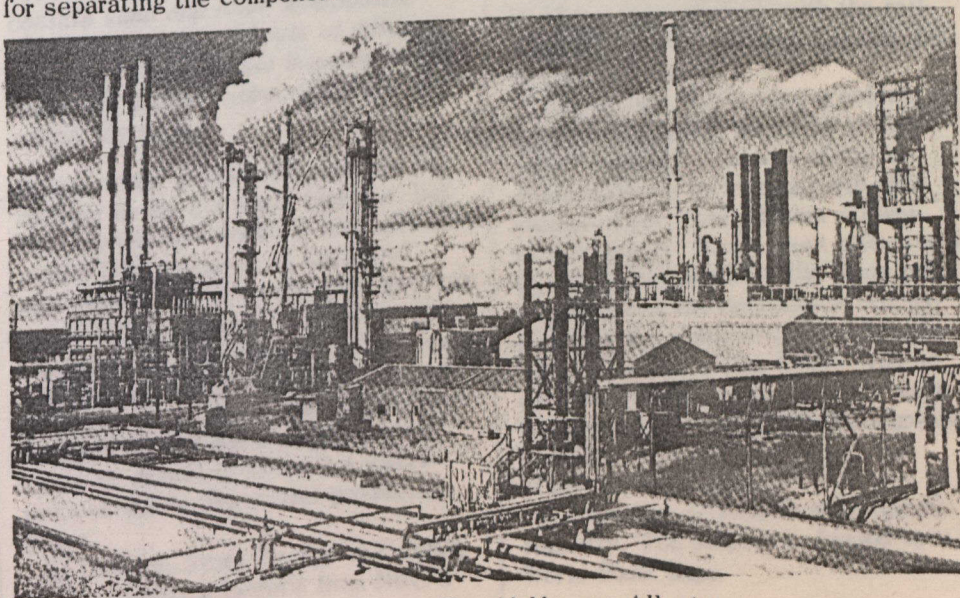
kinds of mixture, with tar-sand extraction currently one of its more visible applications.

The name of the process describes its essence. When a mixture is suspended in an appropriate liquid and the right experimental conditions introduced, one or more of its components agglomerate or "pelletize" into spheres that separate readily from the remaining material.

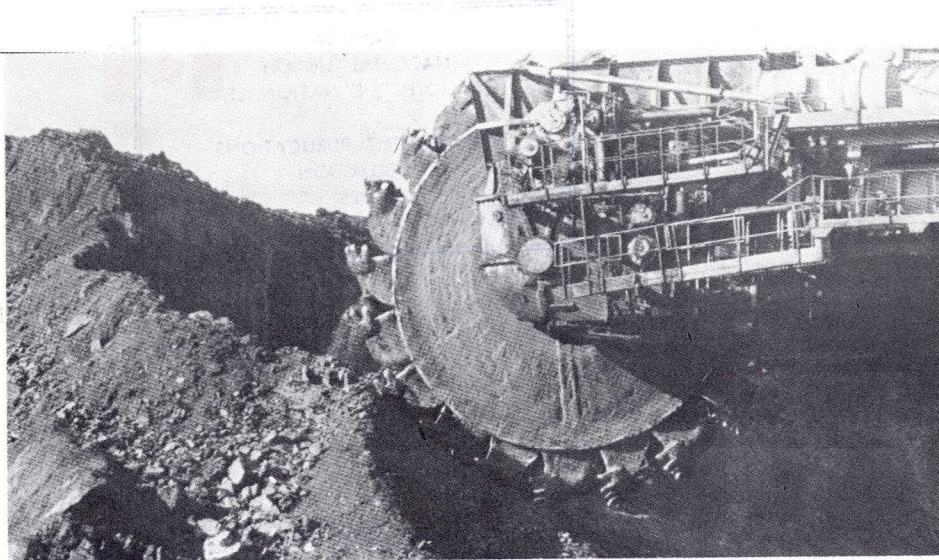
"If the technique is used to upgrade ore, it is often the formed spheres that contain the valuable material," says Dr. Puddington. "In other instances, such as the upgrading of coal, it can be the unwanted impurities that pelletize, leaving the coal behind. This is the case with tar-sand extraction, where sand and other undesirable substances are agglutinated into spheres, leaving the valuable hydrocarbons that make up bitumen behind in solution."

New method

As Dr. Puddington describes it, the process begins with the dispersion of untreated tar sand in a tank containing kerosene, followed by agitation of the system: The bitumen hydrocarbons dissolve because they are hydrophobic (literally, "water-hating"), while the sand and other hydrophilic (water-



Great Canadian Oil Sands refinery, Fort McMurray, Alberta.



John McAulay

This giant bucketwheel, part of one of the 1,700-ton machines used to mine the Athabaskan oil sands, is capable

of scooping up over 50,000 tons of oil sand a day.

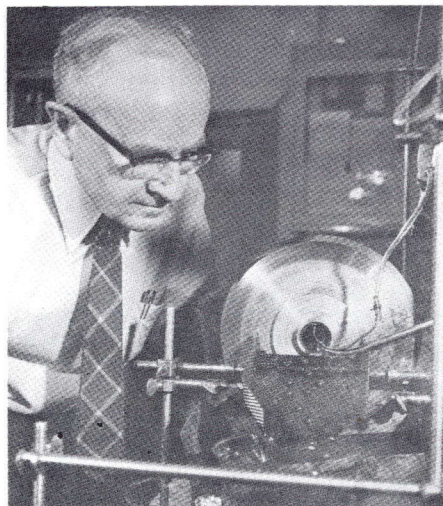
loving) materials remain in suspension. A carefully controlled volume of water is then sprayed into the rotating system, which preferentially wets the surfaces of these hydrophilic solids. On collision during agitation, these wetted surfaces adhere because of the surface tension that exists between the kerosene and water, thus building up dense, spherical particle clusters.

"It is the interfacial surface tension between these two immiscible liquids (kerosene and water) that acts as the bonding force holding the agglomerates together," explains Dr. Puddington.

Old method

The extraction method now in use, which involves "scrubbing" the tar sand with hot water and steam, has a serious disadvantage not shared by spherical agglomeration. This is in the need for huge "tailing" ponds to contain the effluent produced by the process. The waters of these man-made lakes (one of them measures nine square miles in area and reaches a depth of 300 feet) are murky with suspended clay and other fine mineral matter that do not readily settle out. As such, they cannot be discharged into the rivers of the area, and the volume of tailing water continues to increase. (These same contaminants are locked in the hard spheres of the spherical agglomeration process.)

It has been suggested that the two processes may in fact serve as valuable complements of one another. The



The spheres that Dr. Ira Puddington observes leaving the rotating drum contain sand and other hydrophilic substances from a sample of Alberta tar sand. The valuable bitumen is left behind in a light hydrocarbon solvent within the drum.

tailing water may be too dirty for recycling in the hot water process, but its clay content makes it ideal for use as the bonding agent in spherical agglomeration. Thus, the NRC process would help eliminate, at least in part, the most serious drawback to hot water extraction. In turn, the large amounts of kerosene or other light hydrocarbon required by spherical agglomeration could be provided by the hot water process during the initial production stage.

At present, Terra Energy of Calgary Limited holds a licence from NRC's

Canadian Patents and Development Limited (CPDL) to exploit the agglomeration process as it applies to tar-sand extraction. In the development research required to scale the laboratory process up to the much larger dimensions of a pilot plant, the Council has also provided financial assistance under its new Pilot Industry/Laboratory Program.

Should this novel process live up to its initial promise in tar-sand extraction, as many scientists believe it will, then NRC will have contributed significantly to one of the most important developments in energy-resource extraction of the century. (From Science Dimension, 1976/1, a publication of the National Research Council of Canada.)

CN Railway team in East Africa

A team of eight employees of Canadian National is in Nairobi, Kenya, to study and recommend plans for the decentralization of the 3,680-mile East African railway system.

The team will spend eight months in the East African community, which is made up of Kenya, Tanzania and Uganda.

The East African Railway Corporation's (EARC) railway serves the three independent nations and links inland areas with the Indian Ocean ports of Mombasa, Dar-es-Salaam and Tanga. In addition, the corporation operates road, marine and hotel services.

The CN has had previous experience in Africa through work with the railways in Zambia, Guinea, Nigeria and in East Africa.

W.R. Corner, CN's vice-president of accounting, heads the team of Canadian officials. The aim of the in-depth study is to increase the efficiency of the East African railway system so that it can meet effectively the economic needs of the three partner states of the community. All aspects of the administrative and operating elements of the EARC will be reviewed and recommendations made to assure its sound financial administration within the three sovereign states of East Africa.

A tripartite agreement was signed recently. The project is funded by a World Bank loan.

Improved assistance for new housing

Jean-Robert Gauthier, Parliamentary Secretary to Urban Affairs Minister Barney Danson, has announced that Order-in-Council approval has been given for changes in the rules that govern the amount of assistance available under several federal housing programs, including the Assisted Home-Ownership Program, the Residential Rehabilitation Assistance Program and the Assisted Rental Program.

The new regulations complement amendments made to the National Housing Act in December, when Parliament approved the new Federal Housing Action Program.

Details of the changes are as follows:

Assisted Home-Ownership Program – Assistance under this program is now available to any household of two or more persons buying a new house priced within AHOP limits. Previously, AHOP was limited to families with one or more dependent children whose family incomes did not exceed a maximum set by Central Mortgage and Housing Corporation (CMHC).

Financial support

Two types of financial support are available under the revised program. All purchasers, regardless of income, are eligible for a loan advanced over a five-year period. Its amount in the first year is sufficient to bridge the gap between an interest-rate of 8 per cent and the rate of interest charged to the borrower on the first mortgage. The advances diminish gradually during the five-year period. This loan replaces the interest-reducing grant available under the old AHOP regulations, and is secured by a second mortgage. It is interest-free for the first five years and repayable with interest after that time or when the house is sold or refinanced.

Persons with children who need additional help to keep their monthly payments under 25 per cent of their income may be eligible as well for a subsidy of up to \$750 annually in the form of a non-repayable grant.

Assisted Rental Program – Changes in the rules governing this program will permit CMHC to make loans to the builders of modest rental accommoda-

tion to bridge the gap between market rents and the annual costs of operating new rental projects financed at current mortgage-interest rates.

Under the old regulations, CMHC could make an outright grant of up to \$900 a unit to builders in return for an agreement to control rental-rates.

Unit assistance up

The new rules increase the maximum unit assistance to \$1,200 in the first year of a period of ten years during which successive annual loans are made in regularly diminishing amounts. The loans are interest-free during this period, but are subject to interest at the end of the disbursement period. Repayment by instalments begins one year after the end of the disbursement period.

Residential Rehabilitation Assistance Program – The maximum amount of money a home-owner may borrow from CMHC to rehabilitate a house is increased from \$5,000 to \$10,000 under the new RRAP regulations. The maximum amount of a grant in the form of loan-forgiveness is increased from \$2,500 to \$3,750. This grant portion of an RRAP loan is determined by various factors, including the size of the loan and the borrower's income.

The maximum amount that may be borrowed to rehabilitate hostel- or dormitory-type accommodations remains the same at \$1,000 for each bed in the building.

RRAP funds are intended primarily for persons of moderate income who want to extend the useful lives of their houses. The program is not universal but is closely associated with the Neighbourhood Improvement Program, which is helping many municipalities preserve and improve older urban neighbourhoods that are in danger of decay or destruction. RRAP is available also in other specially-designated areas and for housing operated by non-profit companies.

For the first time, CMHC will be able to make moderate-priced housing developments more attractive to municipalities by providing a \$1,000-a-unit grant to cities and towns that approve medium-density housing within AHOP and Assisted Rental Program price-limits. The regulations define medium-density housing as not more than 45 units an acre and not fewer than ten.

Canada/Finland nuclear pact

On March 5, Canada and Finland signed in Helsinki an agreement concerning safeguards on nuclear material, equipment, facilities and information transferred between the two countries. At present nuclear trade between Canada and Finland consists largely of the sale of Canadian uranium to Finland, which is developing an important nuclear-power-generating program.

Both Canada and Finland are parties to the nuclear non-proliferation treaty and have placed their entire nuclear power programs under the safeguards regime of the International Atomic Energy Agency.

The present agreement is intended to satisfy the national safeguards policies of both countries on a bilateral basis, in support of their commitments under the non-proliferation treaty.

Both governments see the pact as a positive step in the promotion and expansion of nuclear co-operation for peaceful purposes between the two countries, and as a useful example of international understanding in this field.

Main items of agreement

The salient elements of the agreement are:

Transferred items shall be retransferred to third states only with the consent of the supplying party.

Nuclear materials covered by the agreement shall be enriched or reprocessed only with the consent of both parties.

Materials covered by the agreement shall not be used for any nuclear-explosive device.

If international safeguards under the non-proliferation treaty should for any reason cease to be applied in either country, standby safeguards mechanisms shall be implemented.

Both parties shall take such measures as are necessary, and satisfy the recommendations and requirements of the International Atomic Energy Agency, to ensure the physical protection of nuclear material covered by the agreement.

Both parties shall consult annually, or at any time at the request of either party, with the possible participation of the International Atomic Energy

Agency and shall institute the necessary administrative arrangements to ensure effective implementation of the agreement.

The agreement shall remain in force for 30 years but the provisions relating to safeguards shall remain in force while any material or equipment subject to the agreement remains in existence and until these are no longer useable for the manufacture or acquisition of a nuclear weapon or other nuclear-explosive device.

Never too late to learn

Cora Seidler was a university dropout — 60 years ago.

The 81-year-old great-grandmother hoped to rectify that as she started her Sociology 100 class offered through the University of Regina's extension department in Moose Jaw, Saskatchewan.

Her reason for returning to university is simple: "I haven't had a chance to continue since I dropped out in 1915. Now I hope to finish off my degree," she says.

Mrs. Seidler finished her second year of arts at the University of Toronto. She attended school in Regina in 1916.

Asked if she had ever pursued a career, Mrs. Seidler replied laughingly, "I've been married four times. That's quite a career." Mrs. Seidler has never been divorced.



Cora Seidler

Queen's to do research on security

A grant of \$250,000, payable over five years, has been received by the Centre for International Relations of Queen's University, Kingston, from the Department of National Defence.

The grant, made on the recommendation of the Association of Universities and Colleges of Canada (AUCC), is part of a new program of the Department of National Defence to encourage research into national and international security. Five such grants have been distributed by region to universities across Canada.

"The grant to Queen's will support research into problems related to the North, the North Atlantic and Western Europe in so far as they concern Canadian security," said Dr. Nils Ørvik, director of the Centre for International Relations. "It will also go towards a study of the role of the military in today's society, dealing broadly with certain civilian aspects of national defence and the military establishment. "Our research will undoubtedly be of interest to the three military educational institutions in Kingston, the Royal Military College, the Canadian National Defence College, and the Canadian Land Forces Command and Staff College," he continued.

More compensation for Pacific veterans

Veterans' Affairs Minister Daniel J. MacDonald announced recently that the Government would introduce a bill to provide special compensation for former prisoners of war. This legislation is expected to provide additional benefits for former prisoners of war of Japan, most of whom were captured at the fall of Hong Kong on Christmas Day 1941 and were kept in captivity until the end of the war. There are today some 1,140 former prisoners of war of the Japanese.

The proposed bill will provide similar compensation, but to a lesser degree and on a sliding scale related to the time spent as a prisoner of war, to those who were captured during or after the Second World War. There are from 6,000 to 7,000 former prisoners of war of Germany, Italy and North Korea who would be affected. Those who

were captured at the time of the Dieppe raid and who were shackled and suffered other maltreatment and personal indignity and who had been prisoners of war for over years will receive a greater benefit than those whose incarceration was for lesser periods.

The decision to provide special compensation follows consideration by the House of Commons Standing Committee on Veterans' Affairs of a study by Dr. J.D. Hermann on the effects of imprisonment during the Second World War. The compensation payable, which will benefit former prisoners of war and their families, will be indexed to keep pace with changes in the consumer price index.

Spending estimates tabled

Government spending estimates totaling \$39.55 billion for the financial year starting April 1 were tabled in the House of Commons on February 18 by Jean Chrétien, president of the Treasury Board.

Spending in 1976-77 will total \$42.2 billion after all supplementary estimates are in, 16 percent more than for the current fiscal year.

Seventy percent of all federal spending is attributed to redistribution programs affecting individuals, industry and provincial and other governments.

The proposed increase in public servants is 1.3 percent, to about 320,000 employees, excluding the armed forces.

Health and welfare, transport and payment of interest charges account for the greatest increases.

Cuts in aid spending

Because of federal spending restraints, the increase in the forthcoming budget of the Canadian International Development Agency will be held to 10 percent instead of the 20 percent annual increases of recent years.

The figure of \$1 billion in government estimates compares with \$903 million last year.

The percentage of the gross national product devoted to foreign aid is expected to drop to .569 compared to .587 for this fiscal year.

The projected budget for external affairs is \$241.4 million, compared with \$204.9 million for the present fiscal year.



Canadians celebrate coming of spring

Canadians salute the arrival of spring with festivals celebrating the reawakening of nature and a resurgence of its vitality.

Four of the most popular are the Blossom Festival at Niagara Falls, Ontario (May 7-18); the Ottawa Spring Festival (May 16-24); the Guelph, Ontario, Spring Festival (April 23-May 9); and the Creston Blossom Festival in British Columbia (May 21-24).

Niagara Falls

The Niagara Blossom Festival takes place in the fruit-belt of southern Ontario. Surrounded by orchards in bloom, it features a parade, folk dancing, sports competitions, handicraft exhibitions and sailing. Multicultural dancing and singing groups will, this year, present an opening show on May 7 entitled "Ethnic Heritage". During the parade held the next day, Miss Niagara Hospitality, Miss Canada, Miss U.S.A. and Miss Universe will salute the crowd from a special float. Parliamentarians, mayors of neighbouring communities and other eminent citizens will be on hand.

Ottawa

Ottawa's Festival of Spring (formerly the Canadian Tulip Festival) dates from September 1946, when Queen Juliana of the Netherlands sent a gift of 20,000 tulip bulbs to Canada as a token of the gratitude of the Dutch people for the role played by Canadian troops in the liberation of Holland dur-

ing the Second World War. The following year, another gift of tulips came, and year after year they have continued to arrive — until today over two million tulips of Dutch origin emblazon the Ottawa spring.

Queen Juliana, who had spent the war years in Canada during the occupation of her country, also arranged for a personal annual presentation of bulbs to celebrate the birth there in 1943 of her daughter Princess Margriet.

This year, as always, the tulips will be the main attraction at the Festival of Spring. More than 150,000 occupy a single bed at Dow's Lake at the southern end of the city. They also bedeck Parliament Hill, miles of scenic driveways, city cycle-paths, the Rideau Canal, parks and squares and major public buildings.

Festival events include a procession of decorated boats on the Rideau Canal, a bathtub race on Dow's Lake, a giant craft-market and beer-garden in Major's Hill Park, and fireworks displays.

Guelph

The Guelph Spring Festival is chiefly a musical event. This year its organ-

izers are concentrating on Canadian artistic talent, supported by a few outstanding international contributions. The Canadian talent will be represented by the Hamilton Philharmonic Orchestra, the Cantata Singers of Ottawa and the Canadian Mime Theatre from Niagara-on-the-Lake, Ontario.

For children, there will be Magic Tom and, for the swing and jazz set, Moe Koffman and his quintet. The Orford String Quartet will appear both in concert and in a special ensemble.

The attractions from outside Canada will include the Italian string orchestra I Musici di Roma, the Polish composer and conductor Krzysztof Penderecki and the Greek pianist Gina Bachauer.

Creston

The Creston Blossom Festival, like the one at Niagara Falls, features orchards in full bloom. The town's population doubles each year as visitors join the residents of this community in southeastern British Columbia for a round of festivities that includes a parade, a beauty queen contest, folk dancing, a Bavarian beer-garden and a midway with rides and sideshows.



Every year, millions of tulips herald the coming of spring in the capital. They are seen in profusion on Parliament Hill (top left), along Dows Lake (above), on scenic driveways and on

paths and parks all over the city. The tulips originated from a gift of bulbs from Queen Juliana of the Netherlands after the Second World War. She spent the war years in Ottawa,

Computers and communications

An article in the Department of Communications quarterly, *In Search*, states that "the awesome power of the computer has been extended through communications" and that "within a decade, the use of the computer and computer communications will multiply by ten".

A United States company, Data Transmission, has estimated that the annual volume of computer communication calls in the U.S. will increase from 3.7 billion in 1970 to 32 billion in 1980, while the number of terminals in use will leap from 84,000 to one million. Canadian requirements will probably be one-tenth of these figures.

Canada is already constructing networks to satisfy its needs in the area of computer communications. Two systems, Infodat and Dataroute, are making it possible to transmit vast quantities of information. These systems use private lines. Public switched data services such as Datapac and Info-switch are now being planned for this year and beyond.

Commercial uses

Applications of computer communications are countless. Banks and trust companies are already using computer communications to centralize their accounting operations. Airlines and hotel chains use them to assure quick reservation service to clients. And companies with branches scattered across the country rely on computer communications to manage their inventories more efficiently. At any given time, these companies can determine the location, condition and quantity of the thousands of parts used in their equipment, how many of these parts need to be replaced and when.

Architects, city planners, and engineers are now able to simulate the conditions that will affect their projects before constructing them. They can observe on a cathode ray tube (CRT) screen the schematic flow of traffic on a planned highway or traffic exchange, or watch a jumbo jet landing on airport runways still on the drawing boards.

Doctors can be kept up-to-date on the condition of patients in intensive care units. They can transmit data

from cardiograms, encephalograms, tissue samples, and biochemical or bacteriological specimens to be analysed by a remote computer.

Students can receive individual instruction by a computer that adapts itself to their learning speed.

Police organizations can fight crime more effectively by searching data banks. For several years, the police have been able to identify fingerprints by computerized comparison. Even tax inspectors can now discover forms showing income which taxpayers may wittingly or unwittingly have omitted in their annual tax returns.

Computers and human rights

These are only some of the areas in which computer communications have begun to be used. While accepting the benefits of this technology, there are however, inherent dangers.

Governments and large companies have extensive files on many aspects of the individual's life: school records, income, debts, credit ratings, medical associates, group memberships, and past offences, whether serious or not.

Vast data banks containing this type of private information have the potential to threaten individual rights. Safeguards are essential to prevent the abuse of computer power.

Engineers, data processing experts, lawyers, sociologists, and politicians will have to work together in search of the delicate balance between legitimate needs for protecting public safety, and preservation of the fundamental freedoms of citizens in a liberal and democratic society.

Machine analyses air we breathe

Viking, the unmanned space laboratory now hurtling through space on its way to a rendezvous with Mars next July – in time for the U.S. Bicentennial celebrations –, is carrying a highly-sophisticated trace gas analyser developed at the University of Toronto's Institute for Aerospace Studies, in collaboration with the University of Minnesota. The analyser is designed to measure the Martian upper atmosphere.

Meanwhile, here on earth, U of T aerospace scientists have modified the Mars-bound instrument for use on

earth, and called it TAGA – Trace Atmosphere Gas Analyser. It will be used for environmental studies, geochemistry, medical research and paramilitary purposes.

TAGA, for which the University of Toronto holds the patents, can detect carcinogens (cancer-producing substances), mutagens, which can cause changes in human genes, and other matter in the atmosphere at concentration of one part in one billion.

Professor Barry French, aerospace engineer and physicist at the Institute of Aerospace Studies, collaborated in the design with Dr. Neil Reid, a chemist who has worked with the National Aeronautical and Space Administration, and U of T's Dr. Adele Buckley, the first woman to complete a doctorate of philosophy at the Institute. "We have demonstrated that we should soon be able to incorporate changes that will make TAGA sensitive to one part in a trillion," says Professor French.

Variety of applications

Professor French hopes that TAGA will be used to assess potential hazards before new industrial processes are installed and that it will also be used for detecting disease in its early stages, determining what drug has been taken in an over-dose, monitoring medical conditions in infants, assessing conditions in premature infants (who cannot afford to part with blood for testing) and detecting caches of drugs and explosives.

He says TAGA could facilitate the screening of a large number of people in a short time without specialists in attendance. "Its services should also be low in costs," he says. "Since readings are instant, neither doctor nor patient will have to wait long for results. It's 'non-invasive' – that is, no needles or tubes are required."

TAGA, its inventors believe, could be useful to the police, who have expressed interest in it as a device for detecting hidden caches of drugs. It might one day be possible for TAGA to "smell print" around furniture or objects and detect similar traces that will relate to those discernible on a person or clothing.

A model of TAGA that can be mounted on a survey aircraft may one day make possible the detection of ore or oil deposits in the earth or even under water.

Arts and culture at the Olympic Games

The broad outlines of a festival of Canadian culture, to take place during the Olympic Games, was announced recently in Montreal. This will be the first time in the history of the Olympic Games, since the 1969 amendment to the Olympic regulations, that the Games have been accompanied by a national arts program. Canadian art will be presented in all its forms, from opera to weaving, from July 1 to 31. Many events will be free.

Federal/provincial sponsorship

Yvon DesRochers, director general of the Arts and Culture Program, stated that the program had been made possible through the co-operation of all provincial and territorial governments. He thanked the Federal Government for its participation and singled out the Quebec Department of Cultural Affairs for special praise.

Quebec opera

The Opéra du Québec will be reborn in time for the festival. In fact, as the lighting of the Olympic flame signals the start of the Games, a performance of Rossini's *The Barber of Seville* by

the Opéra du Québec at Salle Wilfrid-Pelletier, Place des Arts, on July 1, will signal the start of the cultural festival.

Free events

Free events will take place regularly throughout July in Place Jacques-Cartier, Lafontaine Park, the Municipal Golf Course and along Sherbrooke Street. Many of the free shows are being produced specially for children.

Mosaicart

The ten provinces and two territories of Canada will sponsor a "mosaic of art", called *Mosaicart*, which will take place from July 15 to 31. Indian and Eskimo arts will be included.

Handicrafts

Eighty artisans from all parts of Canada will demonstrate techniques of various handicrafts: ceramics, weaving, batik, jewelry, etc. This display will be seen at the Municipal Golf Course, opposite the Olympic Stadium, from July 1 to 31, 1976.

During the month of July, on Sherbrooke Street, from Atwater to the Stadium, there will be an exhibition consisting of projects chosen by a special

jury from among hundreds of projects submitted to the contest *Corridart/Art in the Street*.

Film festival

The film festival has two themes: "Cinema and Sport" and "A Retrospective of Canadian Film". In addition, there will be a festival of animated film and a special program of 12 video-tape productions. Some 120 films will be shown in all.

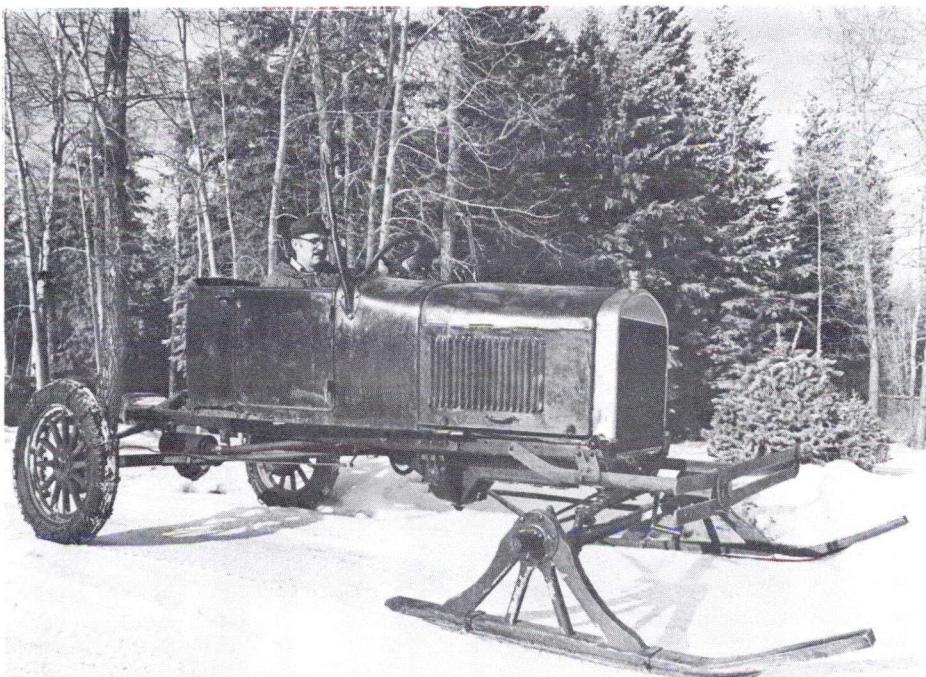
Other exhibitions will be presented covering all forms of the arts, including literature, engraving and "environmental arts".

GNP annual review 1975

The gross national product in 1975 was \$154.8 billion, an increase of 9.9 per cent from 1974. However, this growth includes an increase in prices of over 9.5 per cent. The recession that began in 1974 "bottomed out" early in 1975 but, because the subsequent recovery proved to be relatively weak, the total level of real output in the economy increased by a mere 0.2 per cent. The performances of individual expenditure aggregates reflected the basic recessionary character of the year; investment in residential construction and exports of goods and services both declined in real terms in 1975, there was a dramatic swing in inventories of more than \$2.8 billion, and personal expenditure on consumer goods and services recorded its smallest real growth since 1970.

There was a modest increase in the current dollar value of exports, but this was outweighed by a substantial increase in imports and the balance of trade in goods and services worsened by \$3.3 billion. The slight increase in real gross national expenditure was accompanied by a significant deceleration in prices but the GNE implicit price index nevertheless increased by 9.7 per cent.

Current dollar expenditure on consumer goods and services grew 14.8 per cent in 1975, but this represents an increase of only 3.7 per cent in real terms. For the year, the largest real increase in both absolute and percentage terms was in expenditure on semi-durable goods, which grew 7.3 per cent. This increase was accompanied



Emile Hermary of Red Deer, Alberta, takes an outing in the unique snow

machine he built from parts of a Model T Ford.

by a relatively modest price increase of 5.9 per cent. Expenditure on durables was also fairly strong, growing 14.8 per cent in current dollars and 5.7 per cent in real terms, as spending on new and used automobiles rose 20.6 per cent. Spending on services and non-durable goods increased 14.7 per cent and 15.6 per cent, respectively, in current dollars, but by only 2.2 per cent and 2.8 per cent in real terms. There were large price increases during the year in both of these categories.

Capital formation

Total gross fixed-capital formation grew to \$37.3 billion, an increase of 13.5 per cent. This is a considerable slowdown from the increases of the previous two years. In real terms, capital formation grew only 1.6 per cent. The weakness was concentrated in residential construction, which declined by 10.7 per cent in real terms as a result of a precipitous drop in housing starts in late 1974 and early 1975. There was a significant shift in the composition of residential construction during the year, as starts on duplexes and row housing increased 40 per cent, while single detached housing starts rose only 1.5 per cent and apartment starts declined 4.9 per cent. Business investment in plant and equipment grew 4.7 per cent and investment in machinery and equipment 2.5 per cent. Within non-residential construction, the increase was stronger in engineering (construction of highways, pipelines, utilities, etc.) than in building construction.

Investment in inventories swung from an accumulation of \$2.7 billion in 1974 to a decline of \$0.8 billion in 1975, all of which took place in business non-farm inventories. There was strong liquidation in both manufacturing and

wholesale trade after accumulations in 1974, and in both sectors the run-down was largely in durable goods. Retail trade was virtually flat for the year (close to zero value of physical change) after an accumulation of approximately \$0.2 billion in 1974.

External sector

The external sector was one of the major sources of weakness in 1975. Exports rose 3.0 per cent, while imports were up 11.0 per cent, resulting in a \$3.3-billion deterioration in the trade balance to a record deficit of \$5.5 billion. The customary deficit on service transactions worsened by \$1.0 billion, but the change in merchandise trade from a surplus of \$1.5 billion in 1974 to a deficit of \$0.8 billion accounted for about 70 per cent of the swing in the trade balance. The increase in exports was due to a very large increase in natural-gas exports, plus substantial increases in iron ore, coal, agricultural and industrial machinery, and motor vehicles and parts, while the rise in imports was accounted for by increases in energy goods, notably petroleum, and by strong increases in machinery and equipment and motor vehicles and parts. On the service account, the deterioration resulted from a larger travel deficit and higher interest and dividend payments abroad.

Total revenue of all levels of government (excluding intergovernment transfers) rose 7.7 per cent in 1975, the lowest rate of increase in several years. All major tax categories showed considerably lower rates of growth than in 1974, reflecting both lower tax-rates and the slowdown in business activity. On the other hand, total government expenditures continued the strong growth of the previous year, although at a slightly lower rate, and increased 20.0 per cent. Outlays on goods and services rose about 16 per cent, as wage and salary payments, which account for over 50 per cent of total government expenditure on goods and services, increased about 18 per cent. Transfer payments to persons grew 23 per cent, with higher unemployment benefits an important factor in the increase. Thus, with expenditure rising more rapidly than revenues, the government sector as a whole registered a deficit, on a national accounts

basis, or \$4.6 billion in 1975 – the first large deficit since the early 1960s.

Labour income

Labour income rose 14.0 per cent in 1975 compared to an increase of 16.9 per cent in 1974. A major factor in the lower rate of growth was the effect of larger lay-offs and more man-days lost in industrial disputes. There were only marginal increases in employment during 1975, and most of the increase in labour income reflected higher average earnings. Wages and salaries in the goods-producing industries increased 10.0 per cent compared to 14.0 per cent in 1975, as the industries in this group were particularly affected by strikes and layoffs. Wages and salaries in the service-producing industries rose 16.3 per cent after a 17.7 per cent increase the year before, with a slower rate of employment growth the major reason for the deceleration.

Corporation profits before taxes fell 2.9 per cent in 1975, the first decline since 1970, and the second in 15 years. It followed four years of substantial increases. Profits in both mining and manufacturing decreased, while profits in trade were virtually unchanged and finance profits increased substantially.

Accrued net income of farm operators was unchanged over the year, with an 8 per cent increase in gross income being offset by higher operating costs. The value of grain production was up about 10 per cent, owing mainly to larger crop-production, but the value of livestock production declined marginally. Net income of non-farm unincorporated business was up 9 per cent, the largest increases occurring in retail trade and community and personal services.

The shares of the GNP held by labour income and profits followed their normal cyclical patterns and reflected the marginal increase in real output in 1975, as labour's share rose to 56.0 per cent from 53.9 per cent the year before and profits' share fell to 11.5 per cent from 13.0 per cent. Farm income's share of the GNP fell slightly, while that of non-farm unincorporated business was unchanged.

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