INNOVATION

Supplement to Canada Commerce — Spring 1987

INNOVATION

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Innovation Supplement
This is a reader's magazine, open to ideas and information from its readers. Offers and requests of technology transfers must come from our readers in Canada to match those supplied from abroad.

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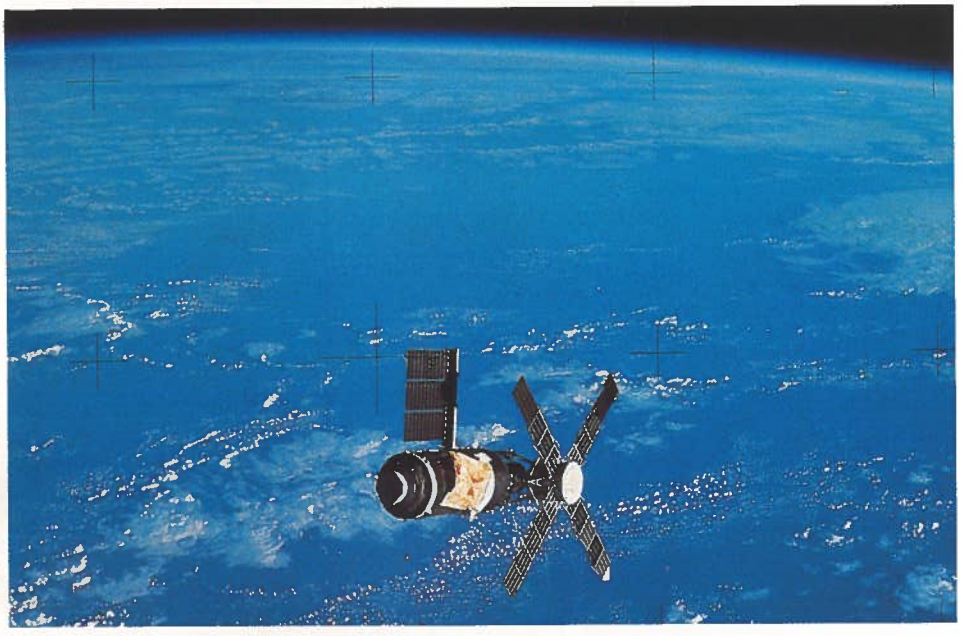
Editorial



IN spite of dire predictions that Canada is becoming a technological backwater, the fact remains that, as a nation, we support a wide range of world-class research facilities – at the National Research Council and the various provincial research councils, at our universities and in the private sector.

Canada's concern for adequate research support is shared by others. Every country in the world faces the same dilemma – how to allocate scarce funds among the hundreds of competing priorities?

And these priorities include not only the various fields of research, but the equally pressing business, social and infrastructure requirements for capital and operating funds.

Part of the answer lies in making more effective use of both personnel and finances. More and more, research organizations are reaching out to help the community at large, making available both their staff and facilities to solve technological problems. No longer can researchers look upon their labs, workshops and equipment as their own private fief, in particular if these facilities have been provided out of the public purse.

While the Structures and Materials Laboratory at the National Research Council, featured in this issue of *Innovation*, is primarily engaged in the testing and development of new materials for the aeronautical industry, its staff and facilities are offered to a much wider clientele – firms that require sophisticated new materials like those developed for use in aircraft and space vehicles to remain at the leading edge of their own industries.

Centres such as the University of New Brunswick are also applying high tech developed for one segment of the economy to an entirely unrelated field of activity. Thus the military uses of the NAVSTAR Global Positioning System have been adapted to the fields of civilian surveying and navigation, as outlined in our coverage.

In the private sector, Lallemand has taken the world's oldest biotechnology product – yeast – and built a worldwide business supplying bakers, brewers and even France's most prestigious wineries with new and stable forms of this basic ingredient.

This issue of *Innovation* also takes a look at a new Canadian concept designed to develop entrepreneurs – TIEM. Backed by a large multinational company, one of Canada's largest investment dealers, and supported by the Canadian government, TIEM has developed a method of bringing the potential entrepreneur through six stages of development in an effort to reverse the current high failure rate experienced by new businesses.

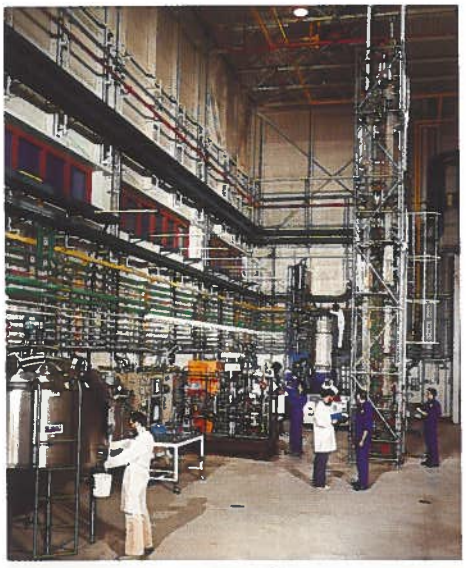
R&D Notes

Although in operation less than a year, Canada's largest provincially operated laboratory and research complex in Edmonton is proving to be a valuable asset for the Alberta Research Council.

The biotechnology pilot plant provides industry with research capabilities up to and including commercial application of biotechnological processes. It is a key element in Alberta's effort to diversify its economy by attracting new industries.

Other facilities include the Electronics Test Centre and Gasoline and Oil, Geological Survey, Soils, Industrial Services, Analytical Chemistry and Forest Products laboratories.

These resources augment the Research Council facilities in Calgary, Devon, Nisku, Red Deer and Lethbridge.



The Alberta Research Council's biotechnology pilot plant.

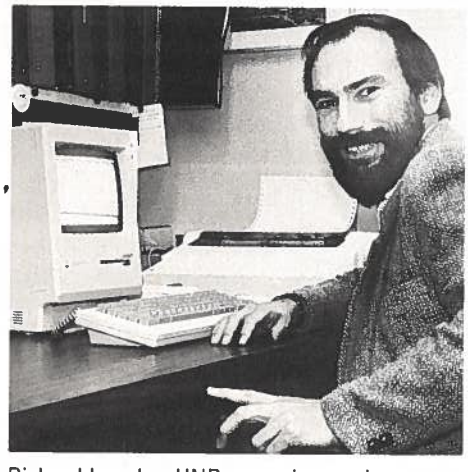
University of New Brunswick

Satellites revolutionize surveying and navigation

BY JEANNE INCH
University of New Brunswick

SATELLITES are to the 1980s what railroads were to the mid-1800s. They are roads to a new frontier – to new ways of working, of collecting and disseminating information, of navigating and of manufacturing. Already communication and weather satellites are taken for granted. And all across Canada, there are Canadians hard at work developing satellite technology.

At the University of New Brunswick (UNB), engineers and scientists have been working on a variety of space-related research projects for several years. This story takes a look at the contributions surveying and electrical engineers are making in developing the uses of the Global Positioning System (GPS) for surveying and navigating.



Richard Langley, UNB surveying engineer.

In the 1600s, when navigators were steering their course to the New World by the stars and crude instruments, no one imagined that the generations of the late 20th century would wear wrist watches measuring time down to the millisecond.

In 1987, no one can predict how future generations will be affected by current space exploration and satellite development.

That's how Richard Langley, a geodesist in surveying engineering, views space-related research – an open door to endless possibilities.

For several years, he and his University of New Brunswick colleagues in engineering have been working with data from a particular group of satellites, those of the NAVSTAR Global Positioning System (GPS). When these seven satellites were designed in the early 1970s by the United States Department of Defense, few people foresaw their usefulness to civilians.

These satellites, which orbit the earth every 12 hours at a height of 20 000 km, are now being used by non-military personnel for surveying and navigating.

Geophysicists and engineers use them to monitor such phenomena as movements of the earth's crust associated with earthquake activity, volcanic action and continental drift.

The receivers, which pick up signals broadcast by the GPS satellites, have become commercially available. But the price tag of $100 000 to $200 000 for a receiver prohibits wide-scale purchase.

Dr. Langley predicts the price will drop and the size of these bulky receivers will shrink, possibly to wrist-watch dimensions.

That's far in the future. Not so far removed is the installation of GPS receivers as the ultimate navigational device in the automobile. Even now, Japanese and American car manufacturers are considering GPS receivers as top-of-the-line options for the cars of the 1990s at a cost of $1000, not out of line with the high-quality tape deck of today.

The GPS system in space will be complete when 18 satellites are in orbit and three spares have been launched. That date has been postponed to the early 1990s because of the U.S. space shuttle disaster, Dr. Langley explains.

"When the system is fully operational, and the prices are down, surveying engineers will be able to move right in and start using it in a big way."

The UNB surveying engineering team, with the help of graduate students and research assistants, has been preparing for that time for several years. It has developed computer programs for planning surveys using the GPS system and for

processing data collected by GPS receivers. It has been working on programs for navigating – on land and sea and in the air – via GPS satellites. And it has examined potential uses of this new technology and shared those ideas with colleagues in Canada and beyond.

Most of the team's work has been done at computer terminals using data collected by others.

But this summer, the team moved out of the lab and into the field to conduct a survey of southern New Brunswick. With financial assistance from the Natural Sciences and Engineering Research Council (NSERC) and the Canadian International Development Agency (CIDA), the team rented four GPS receivers from an Edmonton company, Canadian Engineering Surveys.

And with the aid of the Land Registration and Information Service (LRIS) (a joint service of the Maritime provinces) and a team of students, the researchers completed their survey in two short weeks. Using traditional methods of surveying, the job would have taken months, including time to cut down trees or build towers to ensure clear lines of sight for the measuring instruments.

Surveying via Satellite

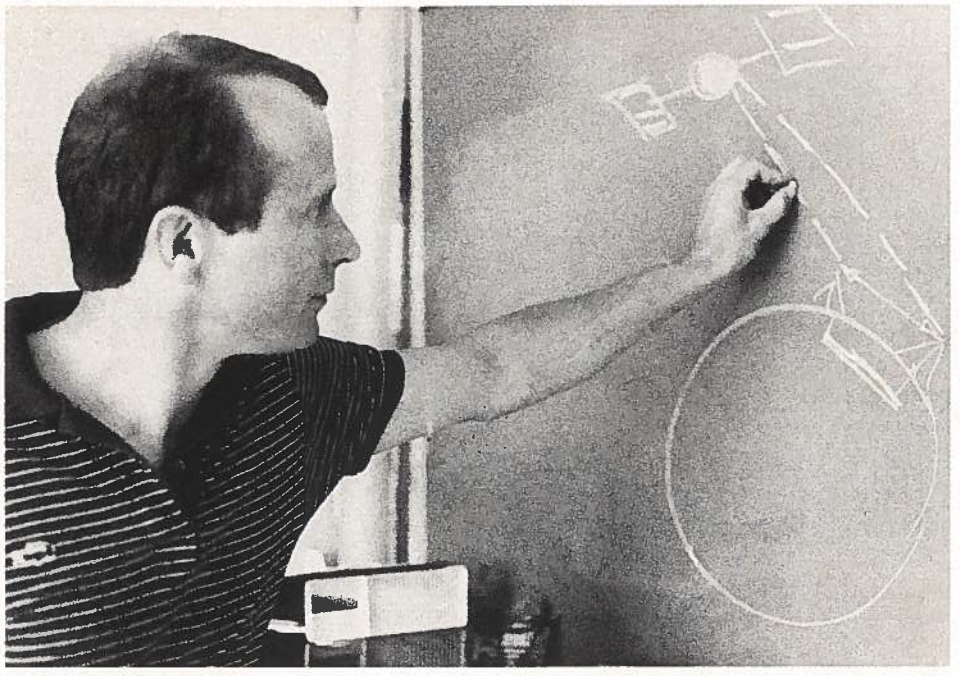
"The one big advantage of GPS is that it is an all-weather system which operates day and night," says Dr. Langley, who helped organize the survey. "GPS doesn't have to be able to 'see' another point in order to measure it. The receivers only have to sense the satellite electronically."

The survey via satellite worked this way: one receiver was stationed on the roof of Head Hall on the UNB campus; the other three were rotated among 11 observation stations in an area bounded by Saint John, Nackawic, Windsor, Chipman and Moncton.

The seven GPS satellites in orbit continuously broadcast coded signals of their positions to the ground receivers. By measuring the difference between the time these coded signals were sent and the time they were received, the relative positions of the receivers were calculated within an accuracy of a few centimetres.

The data were recorded on computer tape and are now being processed using software developed at UNB. The completed survey, in cassette form, will be passed on to LRIS for use as a control network for mapping purposes.

A measure of the success these survey scientists and engineers are having in the high-tech world of space research is their work on a computer program for planning surveys like the one carried out in New Brunswick last summer. David Wells, who has been working on navigation applications with Alfred Kleusberg, NSREC research fellow in surveying engineering at UNB, spent a year in West Germany working on the geometry required for positioning using GPS. Edmonton's Canadian Engineering Surveys picked up these ideas and developed a unique software package for practical survey design.



Alfred Kleusberg, Natural Sciences and Engineering Research Council research fellow in surveying engineering, is working on navigating via satellite.

Another UNB success is a differential positioning program (DIPOP) for processing GPS observations. This program has been distributed in Canada and overseas and is used by organizations such as the Defense Mapping Agency in the United States.

And there is MacSat, a Macintosh computer program for tracking satellites, in real time or simulation. "Initially, we developed MacSat as a teaching tool for our students. But it is a general purpose program which any interested amateur or professional can use," Dr. Langley says.

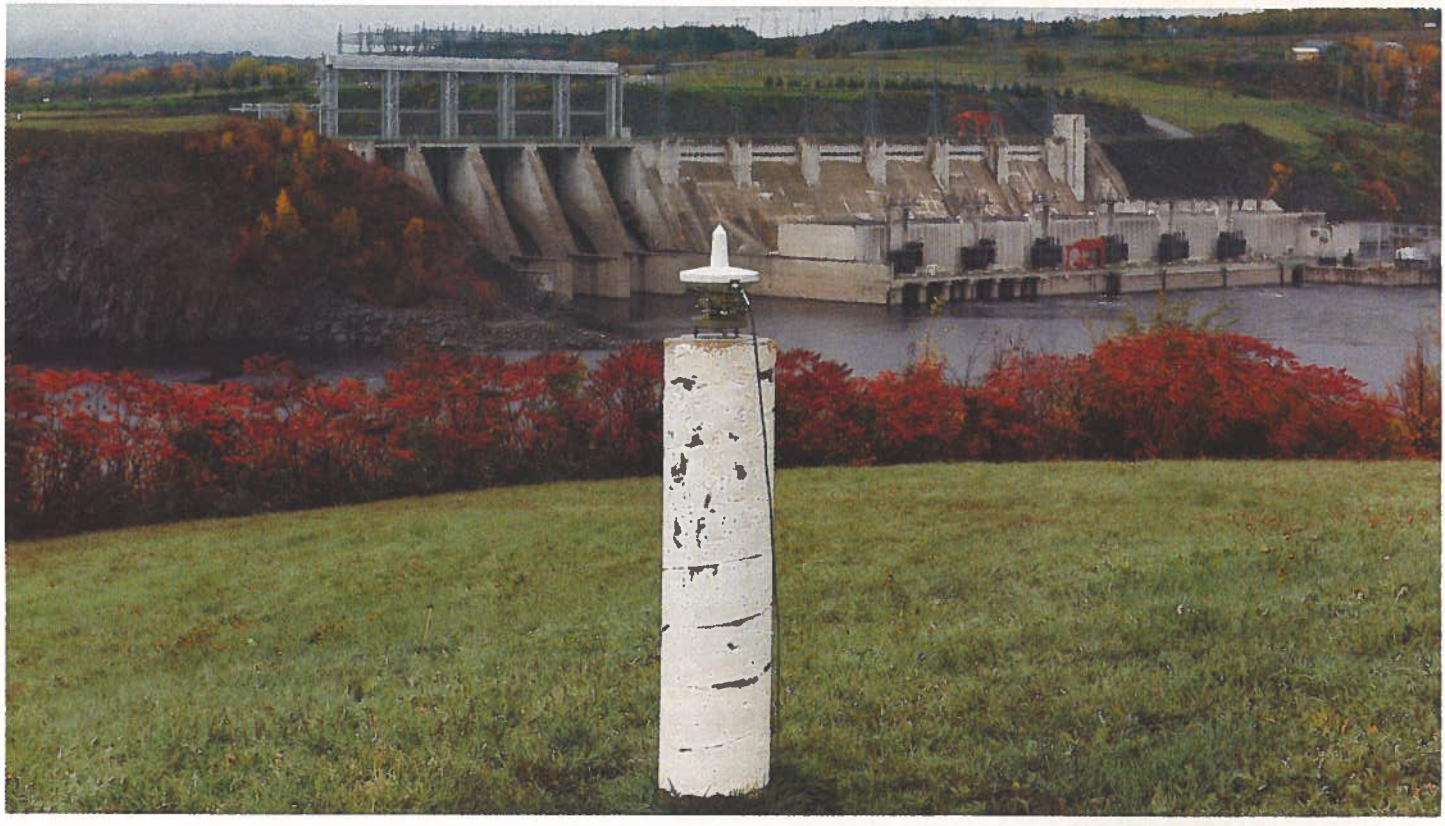
International Co-operation

Adam Chrzanowski, a professor of surveying engineering at UNB, also made use of the rented receivers. For several years he has been surveying the Mactaquac Dam in an attempt to determine if changes in the dam's superstructure were caused by shifts in the dam itself or in the area surrounding it. Because the traditional tools of surveying must be in full view of each other, the surveyed area until now has been restricted to a 2.5-km radius.

To get a complete picture of activity in the area, a diameter of 50 km must be surveyed, Dr. Chrzanowski points out. Satellite technology makes this possible.

"After repeating the survey in the next year or two and comparing the results, we shall be able to detect what types of movements are taking place in the whole area. We will be able to distinguish between separate local movements of the dam itself and possible geological movements in the region."

Dr. Chrzanowski had another reason for surveying the Mactaquac Dam. Together with Dr. Langley, he is testing a number of different



The second Global Positioning Satellite (GPS) survey of the Mactaquac Dam on the Saint John River.

GPS receivers for use in a much bigger project in Venezuela — the monitoring of ground settling in oil fields and its effect on a 40-km dyke that protects people living below the water level of a large lake. They must choose the most accurate and most economical receiver to be integrated into a local monitoring system next year.

Mapping the Oceans

Satellite technology promises great things for surveying and monitoring the movement of land masses. But its applications on the seas may be even more beneficial. Mapping the oceans is extremely difficult for a very obvious reason – there are no landmarks to indicate, for example, international boundaries or the location of mineral deposits on the ocean floor.

GPS technology has joined two fields that once were quite separate: surveying and navigation.

"You are surveying with GPS unless you need to know where you are and where you are going in real time. Then you are navigating," explained Dr. Kleusberg.

"In navigating there is no extended period of time to collect the information because the vehicle (with the receiver on board) is moving from second to second."

Dr. Kleusberg is designing a computer program which will eliminate errors in data obtained from satellites for navigational purposes.

The "fun" part of his research is determining how the movement of the vehicle affects the data collected by the receiver: an airplane is faster than a car, a ship pitches and rolls. This difference in movement affects the way the data are processed.

Dr. Kleusberg has been working with land data collected in tests using a truck on a pre-surveyed highway in Alberta. "The advantage of this test is the presence of an external control which is necessary in order to test our technique and our methods of computing."

In November, Dr. Kleusberg tested his technique on board a ship in sea trials sponsored by the Canadian Hydrographic Service.

Sharing the Results

These satellite surveyors do not keep all this knowledge to themselves. In 1985, Dr. Langley, Dr. Wells and Dr. Kleusberg formed Canadian GPS Associates with their colleagues, Petr Vanicek (who calls himself the dreamer of the group) and James Tranquilla, of UNB's electrical engineering department, plus six other scientists and engineers.

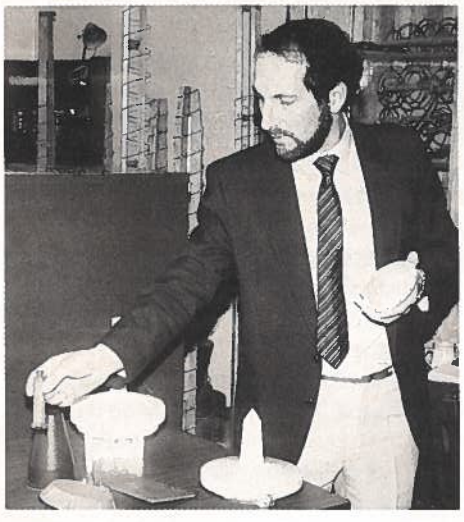
Since then, this group has been travelling the country explaining GPS technology and its applications to engineers and other potential users. With Dr. Wells as editor, they are now putting together a 500-page manual on GPS positioning.

The wide appeal of GPS technology is illustrated by the variety of professionals to whom this guide is directed: hydrographers, geophysicists, geologists, geographers, oceanographers, space scientists, and professionals in management, transportation, forestry and agriculture.

As manufacturers are working on a hand-held GPS receiver with a pop-up antenna and miniature computer screen, these scientists and engineers are developing practical uses of this exciting new technology.

PROFILE

Antenna Specialist Wins International Renown



James Tranquilla has become an expert in how antennas on satellite receivers work.

JAMES Tranquilla, Electrical Engineering professor at the University of New Brunswick, is one of the few people in the world who understands how antennae on satellite receivers really work.

The fact is that antenna manufacturers from as far away as California are asking Dr. Tranquilla to test the accuracy of their antennae. In some cases, Dr. Tranquilla gets first crack at testing a prototype antenna.

Dr. Tranquilla's expertise in satellite receiver antennae has been acquired over the past six years. Until recently, he has concentrated on analysing antennae on communication and weather satellite receivers.

But when surveyors began to use the satellites in the NAVSTAR Global Positioning System (GPS), his focus changed.

It became obvious to antenna manufacturers and users that the GPS antennae were not accurate enough for some surveying and navigation applications.

"Surveyors need to know exactly where they are within a few centimetres," Dr. Tranquilla says. The antennae which work just fine for weather satellites cause errors in data collected from GPS satellites.

"These antennae alter the phase – the property of the electromagnetic wave that's related to how far it has travelled from the satellite to the receiver. The farther the wave travels, the larger the phase number," Dr. Tranquilla explains.

"The antenna adds to the phase, not a lot, but enough to be significant when an accuracy of a few centimetres is required. We have to know how many centimetres or millimetres to subtract in order to know the true phase."

The manufacturers are now aware of this problem, but lack the expertise to do anything about it. As an individual researcher and as a consultant with Canadian GPS Associates, he is sharing his particular expertise not only with manufacturers, but also with government agencies in Canada and the United States and with potential users of GPS satellites, through testing and development stages.

Dr. Tranquilla is working on a design of an antenna, one that will meet that first vital requirement for accuracy. Once he builds a prototype, it will be up to an interested manufacturer to take it further.

Until this past summer, Dr. Tranquilla did all of his tests in the anechoic chamber in UNB's Electrical Engineering Department. This chamber, like a television studio, is a quiet room where no reflections or interference can affect the performance of the antennae.

The obvious next step was to test the same antennae in the real world, surrounded by trees, on top of buildings, near railway tracks and under power lines.

So, he tested the antennae used by the surveying engineers in their survey via satellite to compare the results obtained in the field with those in the ideal world of the anechoic chamber.

Last fall, he joined the surveying engineers again in sea trials of different GPS satellite receivers. While Alfred Kleusberg was testing his computer program for navigating by GPS satellite, Dr. Tranquilla was observing how the antenna is affected when it is on the mast of a ship, surrounded by cables and wires.

Dr. Tranquilla expects the new generation of antennae to be available for testing in the next few months. Chances are he will get first chance at determining whether or not many of them make the grade.

NRC's Structures and Materials Laboratory

Solving Canada's Materials Problems

WITHOUT a doubt, the aeronautic and space industries are at the leading edge of materials development. It is only natural, therefore, that the Structures and Materials Laboratory be part of the National Research Council's (NRC) National Aeronautical Establishment (NAE).

"In particular, research activities centre on the design, strength and structural integrity of aerospace structures..."

According to Dr. W. Wallace, head of the Structures and Materials Laboratory, an increasing number of other industries are making use of these facilities to answer technical problems. In particular, research activities centre on the design, strength and structural integrity of aerospace structures and, therefore, the properties of structural materials are of prime importance.

Although much of the work is done in collaboration with other research institutes, universities, large industries and government agencies, Dr. Wallace and his staff also respond to technical enquiries from small companies and the general public. The staff consists of about 50 employees and a number of students and guests work along side them, making use of the lab's unique equipment.

Inviting guest researchers is an activity that Dr. Wallace encourages, since it makes more efficient use of millions of dollars worth of advanced test analytical and process equipment, much of it unique in Canada and possibly the world. As an example of this, Dr. Wallace has personally supervised more than a dozen student projects, many at the graduate level.

Research activities are divided into several areas: Metallic Materials, Composite Materials and Structures, Non-destructive Evaluation, Fatigue and Damage Tolerance of Structures, Aeroacoustics and Engineering Physics.

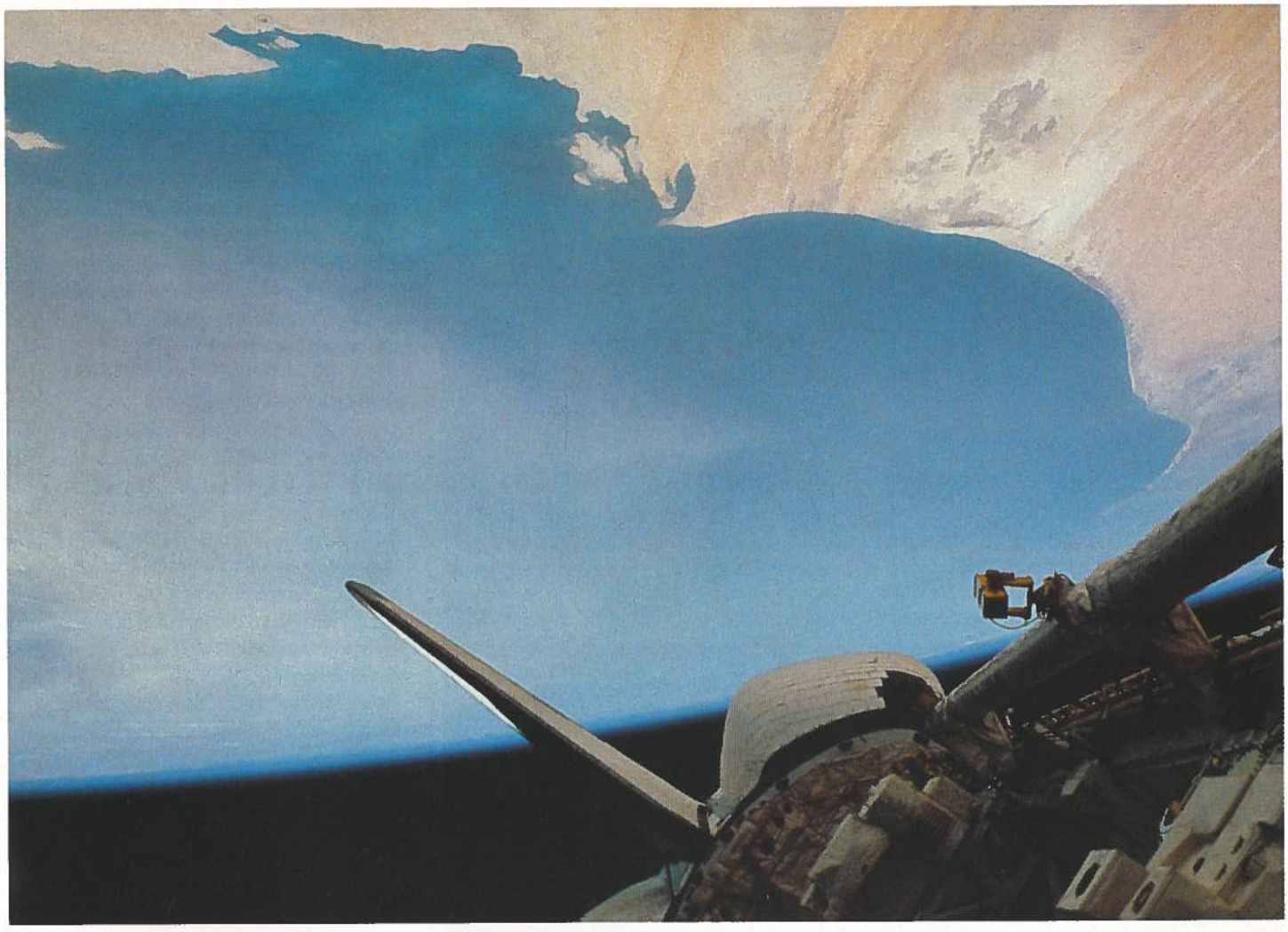
Metallic Materials

Many of the alloys used in the aerospace industry and, to a growing degree, in other sectors have several alloying ingredients which contribute to strength, workability, corrosion resistance and a host of other attributes. Their microstructures are complex due to the large number of phases and precipitates which can form under various conditions of heat treatment or thermomechanical processing.

Typically, in the lab, researchers can determine changes in grain size and shape, grain boundary structure and precipitate distribution as a function of temperature, time and cooling rate during heat treatment or thermomechanical working or welding. Researchers also study the fracture surfaces of failed components to determine the crack initiation sites and the mechanisms of crack propagation. By correlating this information with such other factors as fabrication history or conditions of service, it is often possible to establish the exact cause of the failure.

Since each component of an aircraft must meet stringent design specifications for the expected service conditions, the choice of material will be based on appropriate tests to determine such properties as strength, ductility, creep and fatigue resistance, fracture toughness, corrosion resistance, density and stiffness. Cost is also a factor in the final selection of materials. The lab contains equipment to perform the sophisticated mechanical tests which are becoming increasingly important due to tougher performance requirements.

Several universal testing systems can be computer controlled to perform tests under a variety of loading and environmental conditions. For example, one of the lab's machines has been set up to measure the effect of combined creep and fatigue loading in corrosive environments and at temperatures up to 800°C. These tests, designed to investigate the growth of cracks in turbine engines under simulated service conditions, allow turbine engine users to determine the life span of components and engine overhaul inspection intervals.



A thermal vacuum testing facility was developed to test the joint brakes on the Canadarm, shown here in action on NASA's space shuttle.

Powder Metallurgy Processing

Since powder metallurgy offers several advantages over the conventional processing of ingot materials, the laboratory has been investigating this area for several years. Among the advantages of these materials are:

- Powders tend to be of uniform composition and, after consolidation, produce a non-segregated structure.
- Grain sizes are small which improves strength at ambient temperature and formability at high temperature.
- Powders can be compacted to a near-net shape, thereby lowering machining costs.

As a result of these investigations, staff members are experienced in handling and encapsulating nickel-base superalloy powders to avoid contamination, in consolidating powders by hot isostatic pressing or extrusion, and in further processing the consolidated material by forging and heat treatment. Recently, this work has been expanded to include powder processing of aluminum and titanium alloys.

To aid in this work, the laboratory has a hot isostatic press (HIP) capable of applying high pressure and temperature simultaneously. This pilot-plant scale HIP system is the only facility in Canada capable of applying pressures up to 210 MPa and temperatures up to 2000°C. In addition, the system can be programmed to impose specific heating and cooling rates during processing.

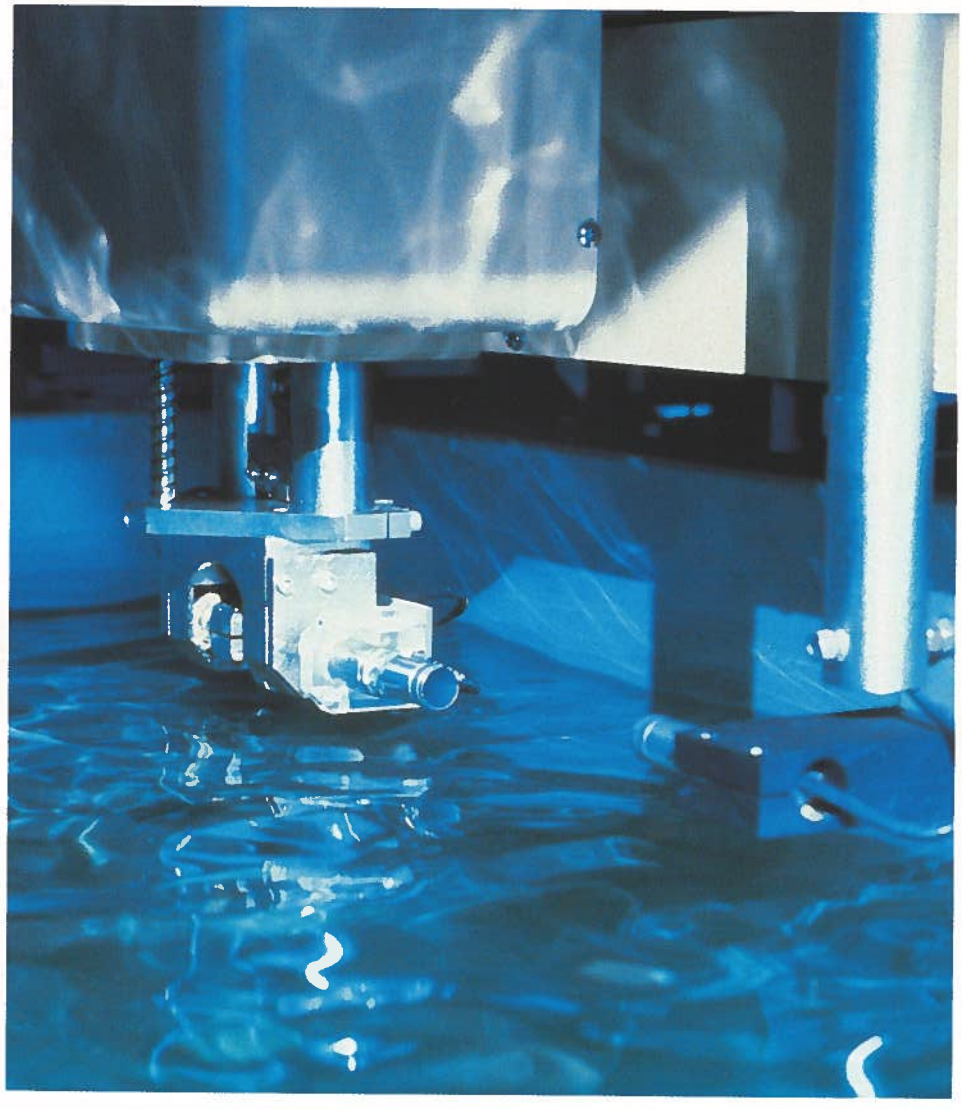
The three main areas of application of HIP are:

- consolidating metallic or ceramic powders or metal-matrix composites to 100 percent theoretical density;
- closing subsurface cavities, microporosity or other defects in castings or service exposed turbine components; and
- joining metals by pressure diffusion bonding.

Isothermal Forging

The laboratory has modified a 450-tonne hydraulic press for use as an isothermal forging press. Isothermal forging is a process which allows high performance metallic materials to be deformed under closely controlled temperatures and strain rates.

Metallic pancakes up to 85 mm in diameter can be forged at temperatures up to 1100°C. These are large enough to be heat treated and cut for mechanical testing.



Ultrasonic C-scan facility.

Composite Materials

Since the 1950s, aircraft manufacturers have been using composites in non-critical aircraft components. Recently, however, they have started to use stronger composites such as plastics reinforced with high-strength fibres, for example, graphite, kevlar or glass, for primary flight-critical components.

These composites, because they are very strong, stiff and light, enable structures to be built with considerable savings in weight. The composite section of the laboratory works on the development, evaluation and application of composite materials, especially fibre-reinforced polymers, and has made several important contributions in the field of epoxy matrices.

The composites facility consists of a chemical lab, a lay-up shop and equipment required for the preparation, curing and testing of composites. The equipment includes conditioning cabinets, a hot press, various ovens, an Instron, pendulum impact and constant amplitude fatigue testing machines, and an autoclave jointly operated with NRC's Division of Mechanical Engineering.

The autoclave is a cylindrical chamber (12 m in diameter and 1.8 m long) which can be pressurized up to 1.4 MPa (200 psi) and is used for curing composites. The gas medium can be electrically heated up to 370°C and the entire system is computer controlled.

The laboratory conducts numerous mechanical tests according to such standards as those defined by the ASTM and NASA, to characterize the material and evaluate its performance. The data obtained can be used in the design, analysis, manufacture and testing of structural components made of these materials.

Non-destructive Evaluation

The demand for higher levels of reliability in manufactured products has increased to the extent that quality assurance is now an important part of the manufacturing process.

This is especially relevant in the aircraft industry where aspects of safety are so critical. Therefore, great efforts have been devoted to the development of methods for assessing initial quality and monitoring deterioration that may occur in service.

In addition to standard chemical and physical tests, non-destructive evaluation (NDE) techniques have proved useful in detecting such flaws as cracks, voids and inclusions in metallic materials. Over the years, the Structures and Materials Laboratory has developed expertise in the application of NDE techniques to conventional aircraft materials. The inventory of equipment includes dye penetrant and magnetic particle kits as well as portable ultrasonic, X-ray and impedance instruments.

With the increased use of fibre-reinforced composite materials, it has been necessary for the laboratory to acquire and develop instrumentation capable of detecting flaws such as delaminations and porosity which can affect the structural performance of these materials. Ultrasonic techniques are sensitive to transverse delamination and, using scanning techniques, they can provide a means of examining large panels. The lab's ultrasonic C-scan machine combines an ultrasonic unit with a computer-controlled scanning system. The output is an image of internal defects displayed in a line-scan format similar to that used in a television receiver.

The scanner is based on an immersion tank 183 cm long, 122 cm wide and 122 cm deep which can be partially drained to permit through-transmission testing with water jets mounted on a manipulator yoke. The system is capable of scanning at rates of up to 15.2 cm/sec. on any of the three linear axes and any combination of scan and index axes is allowed. To facilitate inspection of parts with cylindrical symmetry, the system is equipped with a digital turntable. Proposed enhancements to the system include a computer control system interfaced to an existing 32-bit minicomputer so that image enhancement techniques can be used to improve the probability of flaw detection in C-scan imagery.

Plans are now in progress to investigate other NDE techniques which may be applicable to composite materials, in particular those used in aerospace applications. These techniques include:

- acoustic emission testing where stress waves are produced by local damage growth caused by the application of load to the part; and

- acousto-ultrasonic testing where stress waves are induced by the injection of ultrasonic waves and detected by means of emission sensors.

Fatigue and Damage Tolerance

While fatigue, in the traditional sense of load cycles to failure, is still an important design criterion, current emphasis is placed on improving the ability of a structure to tolerate flaws that may have been induced during manufacture or appear during service.

A new emphasis is now placed on the length of time that a flawed component can be used safely. The combination of residual static strength, crack initiation and crack growth studies known as damage tolerance assessment can provide insight on the question.

While these studies have been part of the testing for most modern materials and results are known, data are seldom available for older materials and forgings. The laboratory, therefore, maintains computer-controlled servo-hydraulic test machines ranging in size from 20 to 200 kN that are used extensively to determine crack growth characteristics. The machines can provide crack growth data under specific geometrical conditions where there are reservations concerning the applicability of linear elastic fracture mechanics (e.g., for very short cracks) and for determining crack growth under spectrum loading.

The group involved in this activity has dealt with a broad range of components over the years, and has considerable expertise in fixturing as well as extensive knowledge of non-destructive evaluation (NDE) techniques.

Before assessing the fatigue life or damage tolerance of a structure, it is necessary to determine the loading that the structure experiences in service. So the laboratory has developed an extensive loads data acquisition and analysis facility using transducers to measure and record stresses. By using such analyses, fleet managers can assess the impact of the aircraft's operational role.

Full-scale Tests

The ultimate validation of fatigue and damage tolerance analysis is the full-scale fatigue test. This brings together the expertise of the various groups. While not in continuous use because of the large investment in time and money required, the necessary equipment is maintained by the lab since such tests serve as a focus for much of the work that is done. They also help to ensure that the test work is of a practical and useful nature.

Flight Impact

Since 1969, the laboratory has maintained and operated facilities for the study of bird impacts under laboratory conditions. The threat of serious damage to aircraft during take-off and landing has multiplied as aircraft speeds have increased and therefore design of windshields and other vulnerble parts must take this into consideration.

Facilities at the lab include two pneumatic cannons which can accurately propel bird carcasses against stationary targets at speeds up to 427 m/s (955 mph). These "bird guns" are located at NRC's Uplands, Ottawa, site and are supported by instrumentation which includes several high-speed cameras capable of recording impact speeds

Aircraft windshield damaged by a bird impact.

up to 9000 frames per second. Heaters and liquid nitrogen-based cooling systems are available for conditioning test articles to high and low temperatures in the range of –40°C to 54°C.

Aeroacoustics

The Aeroacoustics Group performs research on the mechanisms, the effects and the processing of acoustic noise and signals involved in the operation of aerospace vehicles and other high-level noise sources. These areas include:

- studies on the generation of high-intensity noise by aerodynamic flows;
- the excitation and fatigue of structures due to noise;
- the advanced processing of speech signals for machine interaction.

Typical examples of high-level aeroacoustic noise sources include high-speed jets, rocket exhausts, high-speed fans and propellors, turbulent and unsteady airflows and shock waves.

These high-level noise sources can produce adverse effects such as vibration and fatigue on aircraft and space vehicles as well as on people and buildings in the vicinity. The research and development required to solve aeroacoustic problems involves the complementary disciplines of structures aerodynamics, flight testing and digital signal processing.

A major effort of some of the Aeroacoustics Group over the past few years has been research into future speech technology applications in cockpit automation.

Engineering Physics

Machine vision research at the laboratory has focused on the application of photogrammetry to real-time position sensing and guidance control. Photogrammetric techniques enable an operator to derive the position and orientation of an object from a two-dimensional camera image of it.

Technology developed since the early 1970s has advanced to the use of closed-circuit television cameras, patented image-processing hardware and proprietary photogrammetry algorithms which provide on-line, real-time operation. Packaged together, this technology is referred to as a Real-time Photogrammetry System (RPS).

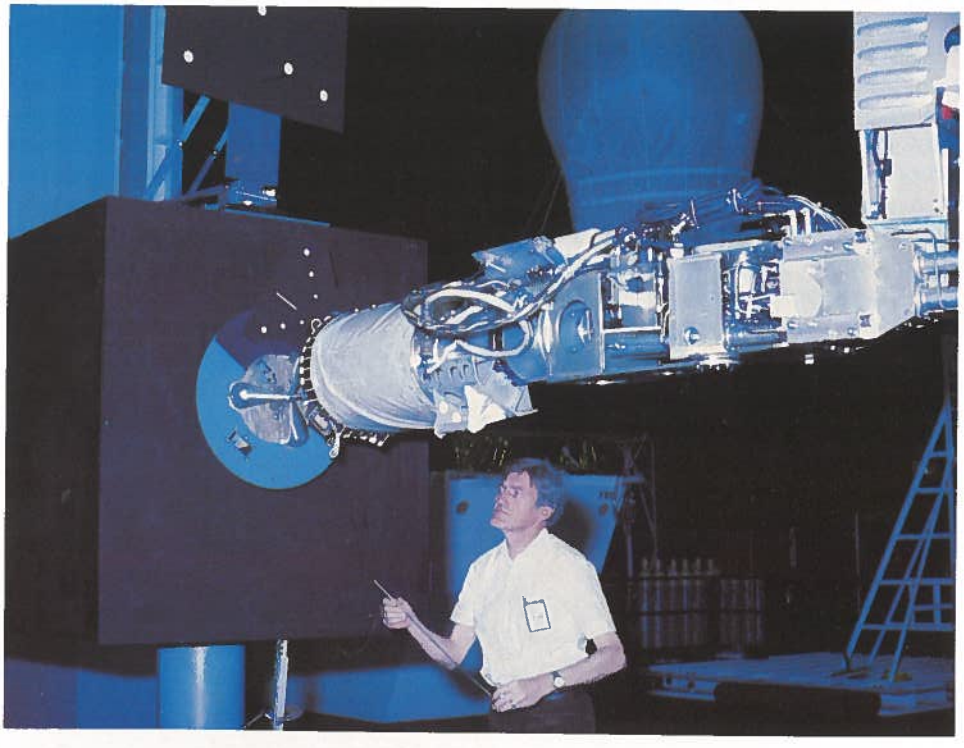
The RPS is being further developed as the heart of a Space Vision System (SVS) experiment which is part of NRC's Canadian Astronaut Program. The object of SVS is to assist astronauts in tasks such as the grappling and docking of space payloads and satellites, or even the assembly of the space stations. The system was slated to be in use last year but was postponed until the rescheduling of the space shuttles.

On a more mundane level, RPS technology has been transferred to the private sector for the development of industrial robots for welding and for unloading conveyors. Research into improved systems for both space and industry is continuing.

For the small and medium-sized business with structural materials problems, the NRC facilities and expertise are available within the constraints of time and staff.

In the words of Dr. Wallace: "Our labs are not for the privileged use of our few NRC employees, but rather they are a national resource that must be made available to as many users as possible from industry, universities and government."

Further information regarding the use of these facilities or the initiation of co-operative research studies can be obtained by writing to: Dr. W. Wallace, Head, Structures and Materials Laboratory, National Aeronautical Establishment, National Research Council Canada, Ottawa, Ontario K1A 0R6.



A space vision system, developed by the NRC Space Technology Program, assists a Canadarm simulator in a grappling task during a demonstration at the Johnson Space Center, Houston, Texas.

Through Modern Biotechnology

Lallemand Transforms Ancient Art

Lallemand's 150 000 litre commercial fermentator.

OVER the past seven years the Montréal firm of Lallemand Inc. has spent over $10 million modernizing its equipment for the production of the world's oldest biotechnology product – yeast.

In its latest expansion, completed in mid-1986, Lallemand opened new pilot plant facilities which allow it to marry existing fermentation expertise with computerized control – a process which will allow Lallemand to increase its share of world yeast markets.

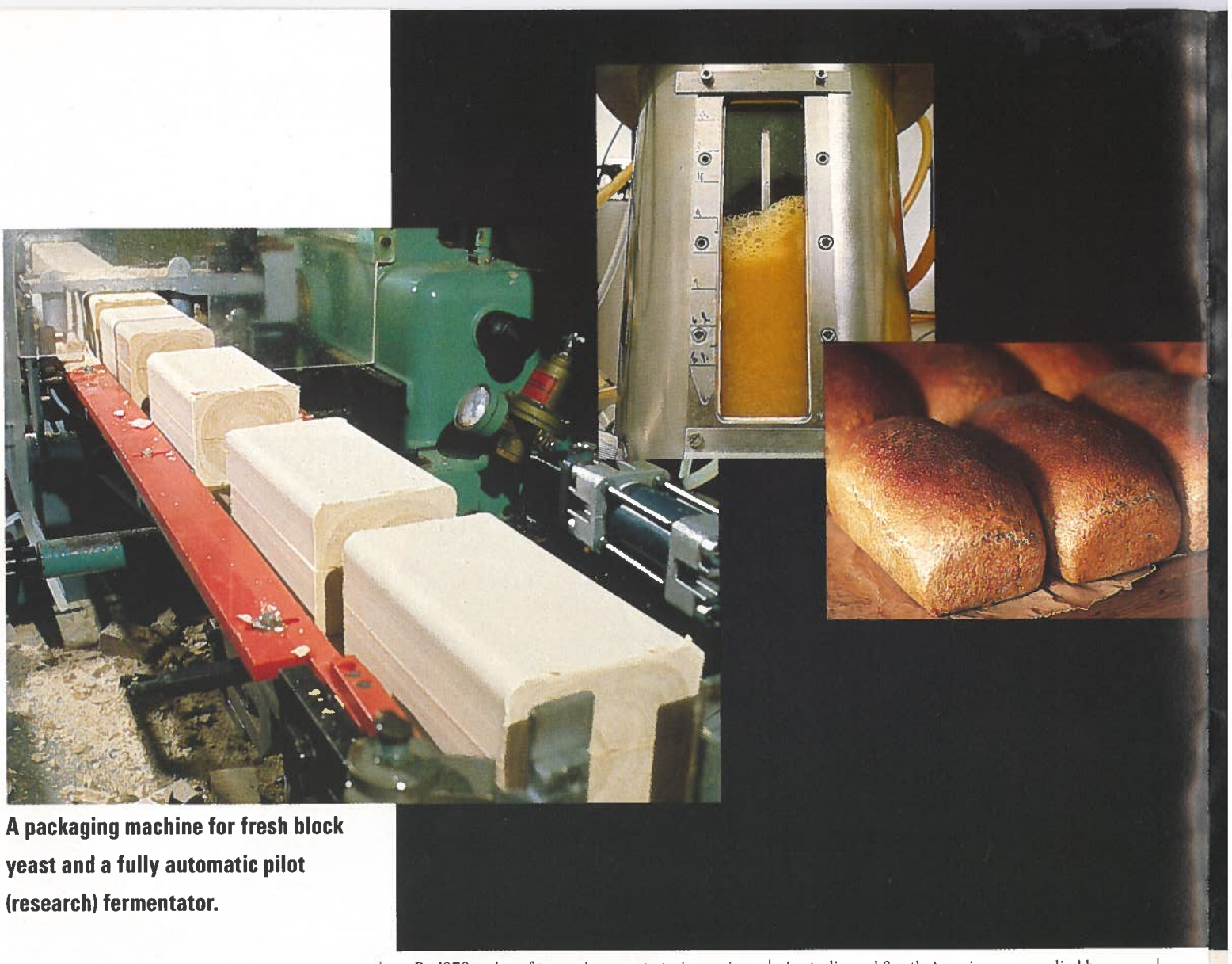
The completion of the pilot plant facilities enables Lallemand to research and develop improved fermentation techniques and to evaluate new yeast strains in commercial applications.

Since it started production in 1923, Lallemand has always made improvement in strain selection and process control a priority. And for the past 15 years, the emphasis has been on more active strains with improved storage stability. Other innovations have been aimed at better packaging – granular yeast in bags, compressed block yeast in plastic film and, most recently, bulk liquid yeast.

During the past three years, Lallemand has developed a bulk handling system to deliver liquid yeast to commercial bakeries. Two large bakeries in Montréal now receive and use liquid yeast for all of their production – the first in North America to use this system.

The concentrated yeast liquid is shipped to the bakery in tanker trucks like those used to transport milk. At the bakery, it is stored in refrigerated tanks. From here the yeast liquid is fed to the bakery's mixers through a magnetic flow meter controlled by a microprocessor batching system. This computerized control reduces product handling and improves scaling precision to the mixers. Yeast performance and stability are also improved and the system brings the bakery one step closer to full automation.

With the baking industry in a static situation during the early 1970s, Lallemand started to explore new markets for commercial yeast. The two areas showing the most promise were distilling and commercial wine production. The company successfully introduced specialized strains to both of these markets.



A packaging machine for fresh block yeast and a fully automatic pilot (research) fermentator.

By 1978, sales of two wine yeast strains, primarily in California, proved that wine yeast had a developing market. Sensing that Europe would provide the largest demand, Lallemand undertook market research and development in the major European wine regions and was rewarded with increased sales. It also uncovered an interest in new wine yeast strains. With a commitment to these new developments, the company initiated contacts with wine institutes and as a result increased the number of yeast strains offered.

With the development and commercialization of specialized yeast strains, export sales to Europe grew rapidly. This past year, Lallemand produced and exported some 15 strains of wine yeast to European wine regions, becoming one of the largest and fastest growing wine yeast producers in the world. Lallemand now holds a major share of the market, improving its position by responding to industry needs.

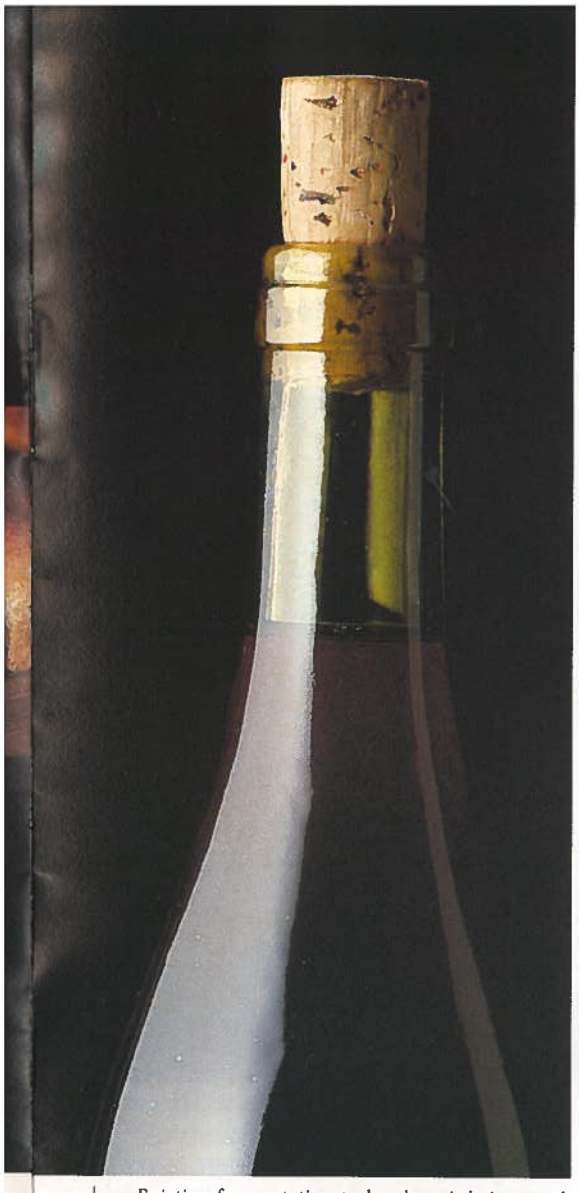
Apart from the dried wine yeast, Lallemand also markets malo-lactic bacteria, used for the de-acidification of wine. More recently, the firm has become partners with a major supplier in Champagne to produce and market immobilized yeast cells for the region's famous products. In addition to Europe, markets in New Zealand, Australia and South America are supplied by Lallemand. Last year's production consisted of enough wine yeast to produce a billion and a half bottles of wine.

This latest expansion includes two new pilot fermentators as well as a commercial one. All three fermentators are totally automated and allow fermentation research in the pilots to be scaled up to commercial size.

The pilot fermentators both have a capacity of 2000 L and are equipped with a variety of sensors and controls to measure pH, dissolved oxygen, NADH and alcohol. The analysis of exhaust gas is also possible. To permit complete plant development of new strains, downstream harvesting equipment allows separation, dewatering and drying of the test yeast strains.

In the meantime, the new commercial fermentator has a capacity of 150 000 L and is connected to the same control system as the two pilot fermentators. This allows scale-up trials to be conducted, using the same fermentation parameters with the same on-line software. The ultimate goal is complete automation of the fermentation process with feedback control.

One of the goals in developing this new project was to enable the system and equipment to work with biotechnology products other than yeast.



Existing fermentation technology is being used to develop applications for new micro-organisms and to evaluate their use in commercial fermentation processes. Another future area of research is the evaluation of all available substrates and their potential for yeast production with improved yields and reduced production costs.

In a joint venture with Laval University, research is being aimed at developing a yeast strain with greater resistance to freezing and to higher alcohol levels. The use of modified whet as a supplement to molasses in the commercial production of yeast is also being evaluated.

Lallemand's commitment, both technologically and financially, is to improve existing yeast technology and to enlarge the range of micro-organisms and potential products required to remain competitive in the 21st century.

"...it was mostly by chance that bakers and brewers developed their products."

From Happenstance to Science

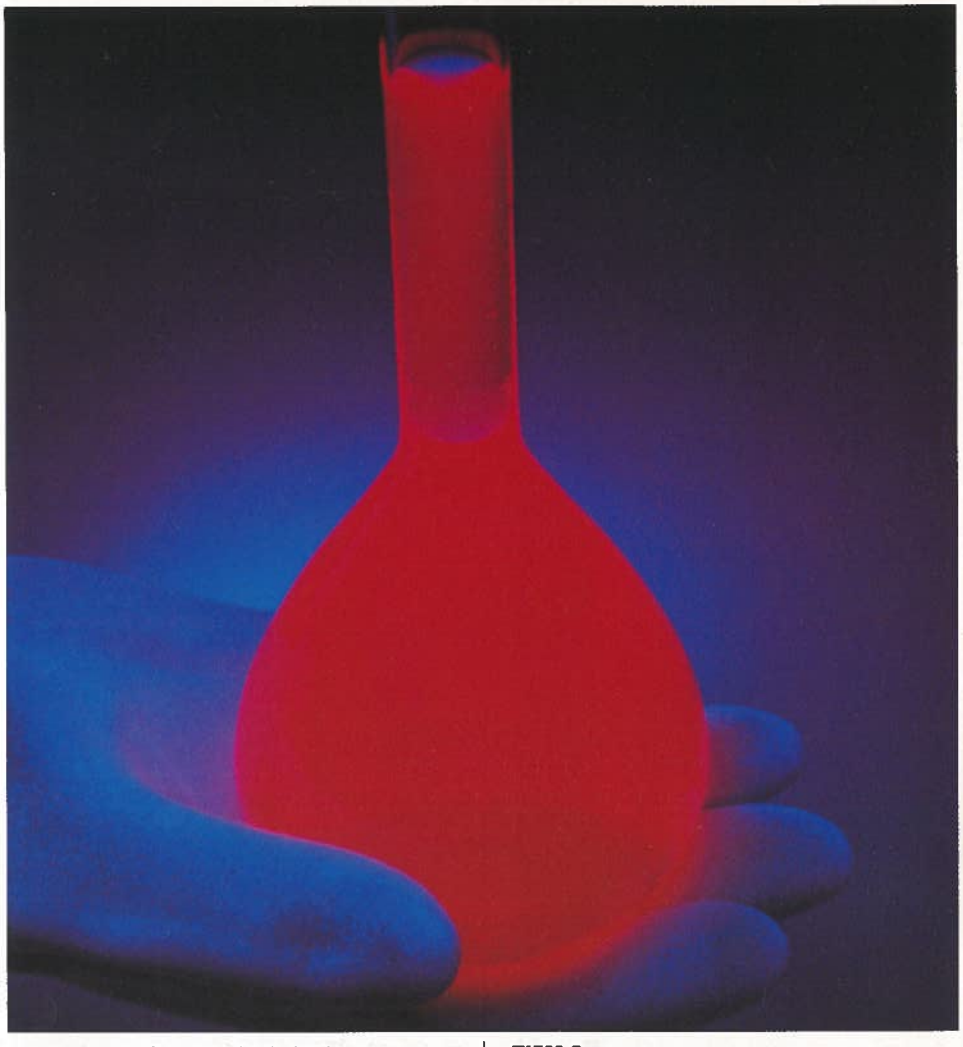
YEAST and fermentation have been part of daily life since at least 4000 B.C. when Egyptians enjoyed leavened bread washed down with beer and wine. And the Romans spread these customs throughout the then-known world. To assure an adequate supply of wine, the Romans even planted grape vines wherever they went.

But yeast fermentations were not understood and it was mostly by chance that bakers and brewers developed their products. To assure some consistency, until quite recently bread was made from "sourdough", a method whereby the baker would keep a small amount of the yeast-infected dough to innoculate the next day's production. And alcoholic fermentations continued to be left to chance and spontaneous development.

During the early 19th century, by-products of the distilleries and bakeries were used to ferment bread dough. As the bakeries became larger, the distilleries found an increased market for their residues. And, towards the end of the century, it was the researchers, Pasteur and Hansen, who discovered the role of yeast in fermentation and the importance of pure culture formations. This, in turn, led to the establishment of several firms, each of which produced modest amounts of yeast from aerated grain mashes.

As the availability and cost of grain in Europe became a deterrent factor, researchers in Berlin developed a method for producing yeast from molasses fortified with ammonium salts. Subsequent research improved the yeast yield without alcohol production. Today the industry still employs this modified Deloffre process, tailored to exploit the new strains being used. Research over the last 30 years has centered on yeast strain improvement and automation of the fermentation process.

TIEM–work to solve small business problems



"The substantial support for TIEM among government, business leaders and local communities reflects the recognition of small business as a major force in the Canadian economy."

IF, as some futurists think, big businesses in Canada and other industrialized nations are dying or already as dead as dinosaurs, then TIEM Canada Inc. of Mississauga may well have solutions for some of Canada's emerging economic and social problems.

And those solutions are based on providing support to latent entrepreneurs – the backbone of small businesses. It is a program that is receiving federal government backing and financial support on a results-oriented basis.

TIEM is a Canadian company that has, under licence from Control Data Canada (CDC), adapted CDC's Small Business and Job Creation Network Technology to Canadian conditions by adding a pre-incubator stage to the formula. Since first being applied in the U.S. and Europe in 1979, this Control Data technique has led to the establishment of some 200 new businesses a year of which close to 90 percent are still in business five years later. This compares with the generally accepted failure rate for new small businesses of some 80 percent – in other words, a complete reversal of results.

The TIEM concept incorporates six key elements:

- **Business Opportunity Program**
  Involves conducting a detailed analysis of the targeted community to identify viable business opportunities for local entrepreneurs.
- **TIEM Centres**
  Provide each approved entrepreneur with targeted training and on-site guidance, prior to starting operations. Over 90 percent of business failures are attributed to poor management practices.
- **Business Technology Centres**
  Provide start-up enterprises with affordable office space and shared office services.
- **Seed Capital Funds**
  Address the problem of start-up capital for small businesses by establishing a community-funded and -managed seed capital fund in each targeted centre.
- **Employee Training**
  Provides for the timely training of skilled employees to meet current and projected labour requirements.
- **Community Co-operation Boards**
  Composed of locally based business, financial and public sector representatives, the boards co-ordinate community resources and assume responsibility for the establishment and administration of the seed capital funds and the Business Technology Centres.

The project was begun early in 1986 in five designated cities – St. John's, Newfoundland; Sydney, Nova Scotia; Québec, Quebec; Winnipeg, Manitoba; and Vancouver, British Columbia. To get it under way, particularly the Business Opportunity Program, the TIEM Centres and the Employee Training sectors, the federal government agreed to provide some $40 million in repayable loans and results-oriented training allowances.

Under the federal funding scheme the Department of Regional Industrial Expansion is providing a repayable contribution of $11.8 million for TIEM's start-up and operating expenses during the first three years of operation. TIEM will repay the amount in years four and five.

Federally funded studies and analyses have been completed and TIEM Centres established in the five designated cities.

In parallel funding, the Canadian Employment and Immigration Commission (CEIC) may contribute as much as $28.2 million under the Canadian Jobs Strategy Innovations program, designed to provide financial assistance for pilot and demonstration projects that test new solutions to labour market problems.

The agreement between CEIC and TIEM provides for the payment of $14 000 or more for each permanent job which lasts for two years. Half of the amount is payable when the job is created, with the balance payable in two equal installments at the end of the first and second years. Any jobs which do not last the two years are subject to a repayment clause. Approximately 3300 new permanent jobs are expected to be created over the five years of the agreement.

In addition to the CEIC grants, TIEM will receive a small royalty on sales made by the firms established under the program. In return, the firms will be provided with ongoing advice and assistance.

As a private enterprise, TIEM has brought together a team of experienced private sector business developers, and two of Canada's most experienced firms in entrepreneurship – Control Data Canada and McLeod Young Weir – who, along with the Federal Business Development Bank, are shareholders in TIEM.

Although TIEM has been in operation for less than a year, it reached most first-year goals in its first six months.

The five targeted TIEM Centres were established, managers selected, some 560 of the 1950 entrepreneurs who applied were interviewed and, of the 150 who qualified, 60 were enrolled at the centres and six were setting up business. By the end of November 1986, the five Community Co-operation Boards and local seed capital funds had been established.

At the same time, TIEM management had convinced large financial groups, such as insurance companies and pension funds, to invest in local seed capital funds under the federal government's provisions for such funds as outlined in its last budget. Under these provisions, such institutions would be able to match every locally raised dollar with three. The management also reached tentative agreement with most provincial governments to provide a further four dollars to match the one dollar funded locally.

Thus, for every million dollars raised locally for the seed capital fund, the financial institutions may invest $3 million, which, if matched by the province, provides $8 million dollars for investment in the locality's new businesses.

Another accomplishment has been the sign-up of local accounting and law firms willing to provide accounting and legal advice to new businesses at no or low cost to the client.

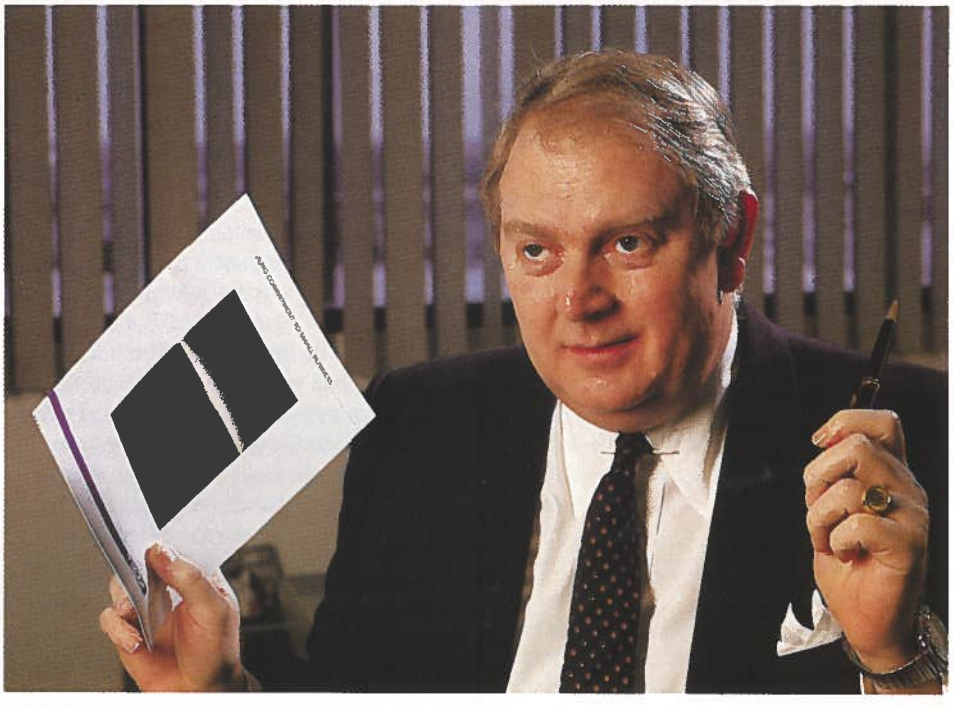
While it is too early to assess the success of this experiment in entrepreneurship, it is an interesting development that follows recent government initiatives to work with the private sector in all facets of the economy.

Although most of the concepts and ideas put forward by TIEM's business program have been tested and tried under a variety of conditions, it is thought to be the first time that all the ingredients have been brought together in a comprehensive package, particularly one of this size and scope.

Chris Scott, chairman of the board of TIEM, is confident. "The TIEM concept is not only a formula for entrepreneurial success," he says. "It's also a framework for community-based economic renewal.

"The substantial support for TIEM among government, business leaders and local communities," Scott adds, "reflects the recognition of small business as a major force in the Canadian economy."

Chris Scott, TIEM Chairman



Technology Transfers

Offered

Offered

Canada
- High-resolution Quadrupole Mass Spectrometer
- Large-diameter Instrumented Sheave Block
- Variable Volume Sampler for Aerosols and Gases
- Forced-draft Fire Drainage System
- Camera Lens Masks to Determine Co-ordinates
- Frequency Offset Diversity Receiver System
- Particle Injection Device for Thermal Spraying
- Safety Helmet
- Wood Furnace

Federal Republic of Germany
- Waste Conversion Device
- Insulation Material
- Lead Recycling Process
- Granulation Technology
- Long-life Engine

France
- Micrography
- Abattoir Waste Converter
- Bandage Cutting Devices
- Pipe Supports
- Robot Cleaner
- Filtration Systems
- Optical Lamp
- Mini Drink Dispenser

German Democratic Republic
- Buffing Process
- Electrocardiograph

Japan
- Ceramic Tiles

Switzerland
- Self-service Car Wash

Requested

Britain
- Health Care Products and Services

Offered

Canada

High-resolution Quadrupole Mass Spectrometer 8228
By applying a very small DC voltage, modulated at a few hundred hertz, to the quadrupole rods of an RF quadrupole mass spectrometer, it is possible to obtain a much improved signal-to-noise ratio and significantly higher resolution.

Large-diameter Instrumented Sheave Block 8270
This large sheave block was designed to handle the electromechanical cable attached to underwater towed vehicles where bending radius and armour abrasion are critical. Encapsulated sensors provide data on cable speed, cable length and cable tension. Companies requesting to see the complete set of design drawings will be asked to sign a confidential disclosure agreement.

Variable Volume Sampler for Aerosols and Gases 8431
A method and apparatus to collect, for analysis, the solid or liquid particles in suspension in an aerosol. The technique is more efficient and simpler than the conventional "bubbler" or "impinger" techniques and it is suitable for a wider range of particle size and composition.

Forced-draft Fire Drainage System 6256
This forced-draft ventilation system will effectively isolate and ventilate a fire in any part of a structure, e.g., a ship or a building. A system of ducts, fans and thermally actuated gates drains smoke and hot gases from the area of the fire and ensures fast-burning and highly localized fires which extinguish themselves after all the combustibles in the area have been consumed.

Camera Lens Masks to Determine Co-ordinates 7992
A simple, compact and robust 3-D vision camera, with built-in multi-stripe projection device, provides real-time operation on objects moving at random undetermined speeds. The camera's dimensions are 10 x 5 x 5 cm. Its resolution range is one percent of the depth of view and, unlike existing systems, it can be used under ordinary background illumination conditions which makes it suitable for a wide range of industrial robotics applications.

Frequency Offset Diversity Receiver System 8024
This diversity receiver for digital minimum shift keyed (MSK) modulated mobile radio signals does not require many of the expensive subsystems commonly found in such receivers. It offers high quality, low error rate performance in circumstances where shadowing is a significant problem and channel bandwidth and power are constrained such as in UHF and VHF satellite communications systems.

Particle Injection Device for Thermal Spraying 8116
This device controls the volume and speed of particles being injected into the plasma flame of a flame spray coating torch. Improved injection results in complete melting of the particles and produces a coating of more uniform thickness and better quality.

For any of the offers listed above, write to:
Canadian Patents and Development Limited,
275 Slater Street, Ottawa, Ontario K1A 0R3;
Tel: (613) 990-6100.
Please quote the appropriate case number.

Safety Helmet
A Canadian inventor wishes to sell outright the manufacturing and marketing rights to his invention, a blinking safety hat. It consists of a helmet with five lights operated by batteries inserted in the helmet. It is claimed that the lights can operate continuously for at least eight hours when conventional dry-cell batteries are used, and that an adapter may be used to connect to a power source, i.e., motorcycle or automobile or the dynamo of a bicycle.
Write to: R. Lahaie, 37 Hotel-de-Ville Street, Hull, Quebec J8X 2E1.

Wood Furnace

A group of university inventors is offering, through a licensing agreement, their invention, a new process of wood combustion which can obtain a high efficiency at high and low temperatures. The feeding chimney can hold enough wood to provide heat for up to 20 hours. The process is mainly based on controlling the circulation of gas using air entries that have particular shapes and locations.
Write to: Sylvain Desjardins, Co-ordinator, University-Industry Liaison Office, University of Sherbrooke, Sherbrooke, Quebec J1K 2R1; Tel: (819) 821-7840.

Federal Republic of Germany

Waste Conversion Device

A joint venture, licensing or sale of patent agreement is offered for a multi-material, hydraulic briquetter for waste material. The compression system is not affected by foreign material and allows for two-way compression at the same time.
Write to: Ingenieurbüro H. Reuss, Rütenbrocker Strasse 1, Postfach 3509, 4500 Osnabruck, Federal Republic of Germany.

Insulation Material

A licensing arrangement is offered for the manufacture of a new insulated building material which is permeable, waterproof and frostproof. Low priced, it is suitable for basements, flat roofs, cold storage and rubbish pits.
Write to: Canadian Embassy, Commercial Division, Friedrich-Wilhelm Str. 18, D-5300 Bonn 1, Federal Republic of Germany.

Lead Recycling Process

Partners are sought for a joint venture, lead recycling pilot plant for recycling lead storage scrap and acids by wet electrochemical refining. The new process is said to eliminate emissions of poisonous materials.
Write to: Th Darmstadt, Institute for Chemical Technology, z.Hd. Herrn Prof. Dr. H. Wendt, Petersenstr. 20, D-6100 Darmstadt, Federal Republic of Germany.

Granulation Technology

A licensing arrangement is offered for a cost-effective direct granulation process for liquid blast furnace slag. No further granulation is required to produce ready-to-use construction materials.
Write to: Herrn E. Kerber, Marbachweg 332, D-6000 Frankfurt/Main, Federal Republic of Germany.

Long-life Engine

A company in the Federal Republic of Germany wishes to enter into a licensing agreement with a Canadian firm. The technology offered consists of a long-life combustion engine M-11, four-stroke, one piston, 250 cm^3. The engine can be applied to power generators, pumps, conveyor belts, air compressors, small airplanes and boats and other uses.
Write to: Dr. Hans Juergen Schultz, Manager, Canadian-German Chamber of Industry and Commerce Inc., 2015 Peel Street, Suite 1110, Montréal, Quebec H3A 1T8; Tel: (514) 844-3051.

France

Micrography

A French company wishes to enter into a licensing agreement with a Canadian company for its semi-automatic apparatus which duplicates films, called "DZ1 Diazo Duplicator". The company claims that it can recopy masters directly using a mercury lamp instead of a quartz cylinder, thus eliminating the risk of reproducing dust and other defects on the duplicated film. The apparatus is claimed to have adjustable speed of between 200 and 2000 m/h.
Write to: M. Hannacart, C.M.M., 7, boulevard de Créteil, 94100 Saint-Maur, France; Tel: (33) 1.42.83.52.14.

Abattoir Waste Converter

A French company wishes to enter into a licensing agreement with a Canadian firm for the manufacture of its compost station which can convert in three days every kind of waste material produced by an abattoir into stable, homogeneous, odour-free fertilizer. This process treats directly all forms of waste, including offal, viscera, animal droppings, fluids, fats, blood and any other waste material, according to the needs of the abattoir.
Write to: COGEBIO, 74, rue du Rey, F-8 1100 Castres, France; Tel: (33) 63.59.33.96.

Bandage Cutting Devices

A French company is offering, through a licensing agreement, its devices for cutting bandages. The first is a new type of scissors for cutting gauze and other bandage material neatly. The second is a dispenser which dispenses and cuts bandages to the size required.
Write to: M J-P De Ruyter, Sogueplast, 4, route d'Issenheim, 68500 Guebwiller, France; Tel: (33) 89.74.12.77.

Pipe Supports

A French company is offering to Canadian firms, through a licensing agreement, the manufacturing rights for its wide range of pipe supports and miscellaneous accessories. The firm claims these supports are resistant to climatic and environmental changes.

Write to: Claude Bernard, Gérant, Societé Nicalex S.T., Champenoux, B.P. 53, 542 80 Seichamps, France; Tel: (33) 83.21.82.00.

Robot Cleaner

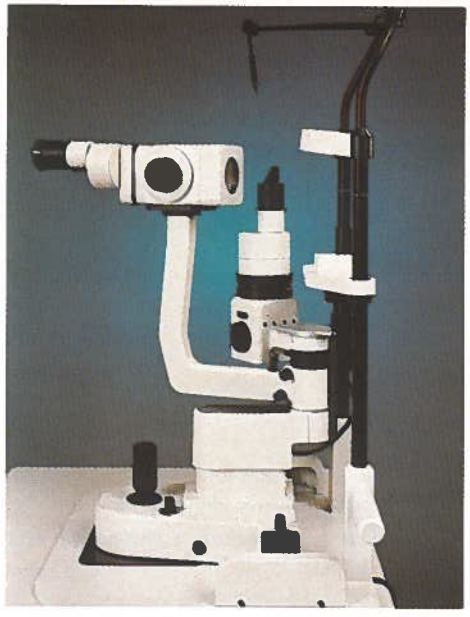
A French company wishes to enter into a licensing agreement for the manufacture of its robot which is used in cleaning ship's hulls and which can work above and below water. The firm claims the robot weighs 98 kg, is compact and can be used easily by untrained personnel. It can move forward or in a rotating movement and goes forward in steps of 1 cm to 40 cm at a speed of 150 m/hr. An articulate arm directs a rotating brush, which moves at an angle between -90° and +90°. The robot can perform a wide variety of tasks from removing algae from hulls to carrying out inspections by video.

Write to: Chantiers du Nord et de la Méditerranée, Établissement de Dunkerque, Service CTE, B.P. 1503, 59381 Dunkerque Cedex 1, France; Tel: (33) 28.65.97.00.

Filtration Systems

A French company is offering to Canadian manufacturers, through a licensing agreement, its technology for filtration systems. The systems consist of a silicon carbide base and patented ceramic membrane filters which can be applied to many areas, including: *agriculture*, in dairy ultrafiltration, protein extraction from lactoserum, and filtration of wine, fruit juice, beer and vinegar; *pharmaceuticals*, water purification, separation and sterilization; *electronics*, in separation of impurities to produce extremely pure solvents; and in *water treatment*. It is claimed that these filters can stand temperatures up to 300°C as well as various chemicals.

Write to: M Poidevin, R.P.S., 16, rue Demarquay, 75010 Paris, France; Tel: (33) 1.42.01.20.16.



Optical Lamp

A French company wishes to enter into a licensing agreement with a Canadian firm for its product, a modular optical lamp specially adapted for lasers used in eye examinations. The firm claims that this multifunctional lamp can be an important tool during surgery. An electric command system can be added, if needed, as well as a dual-observation tube for an assistant or a photo/video camera. It also comes with a complete line of accessories.

Write to: Frank Morand, Laboratoires DOCI S.A., Z.A. Les Pradeaux, 13850 Greasque, France; Tel: (33) 42.58.85.68.

Mini Drink Dispenser

A French firm wishes to enter into a licensing agreement with a Canadian company to manufacture its "Minimate", a hot and cold drink dispenser which can be operated manually or by coin.

Write to: F. E. Galopin, S. A. Polymat, 4, rue de l'Industrie, Monaco MC 98000, Monaco; Tel: (33) 93.50.89.53.

German Democratic Republic

Buffing Process

A firm in the German Democratic Republic is offering to Canadian companies, through a licensing agreement, its technology for a thermal/chemical buffing (capping) process which increases the longevity of the buffer in buffing chambers used to polish semiconductors to extremely precise tolerances. The process operates in a reduced nitrogen atmosphere in the temperature range of 280°C to 670°C and in a pressure range of 0.1 to 3.0 Ncm^{-2}.

Electrocardiograph

A company in the German Democratic Republic is offering to Canadian firms, through a licensing agreement, its technology for a six-channel electrocardiograph called "RFT Bioset BOS 6000". The firm claims the electrocadiograph is an advanced tool for use in intensive heart circulation and angiological evaluation. It features all standard leads – Frank, Cabrera and Nehb, heart curve and sphygmogram. The unit's computer runs an automatic systems check of its functions and those of the analogue channels. Patient and recording data are printed alphanumerically along the edge of the chart printout. An accessory, the MS 6000, a two-channel oscilloscope, is offered for use with the Bioset BOS 6000. The MS 6000's two analogue time functions give users the choice of a still or moving display, instead of a printout.

For the above two offers, write to: Ogilvie Taylor & Associates Inc., 355-25L South End Avenue, New York, NY 10280, U.S.A.; Tel: (212) 912-0986.

Japan

Ceramic Tiles

A Japanese company wishes to enter into a licensing or joint-venture arrangement with a Canadian manufacturer to fabricate ceramic tiles made of various waste materials through a moulding process followed by a "no-heat" treatment. The basic material is ceramics (30 percent by volume). This technique can also be used for the manufacture of roofing materials and the outer and inner walls of buildings. Mould patterns are available for various designs on the surface of the products. Any size and colour of these items are possible.

Write to: Hiroshi Kimura, Technology Information Section, Daiichi Enterprise Co., Ltd., Mitoko Building, 2-4, 6 Chome, Akaska, Minato-Ku, Tokyo 107, Japan; Tel: 03-582-0941.

Switzerland

Self-service Car Wash

A Swiss company wishes to enter into a licensing or joint-venture agreement with a Canadian firm to manufacture its new self-service car wash system. The system is entirely pre-manufactured and can be erected in a building within a week.

Write to: EWI Electrowatt Engineering Services Ltd., Division Data Processing and Communications, Bellerivestrasse 36, Ch-8008 Zurich, Switzerland; Tel: (1) 251.62.61.

Requested

Britain

Health Care Products and Services
A British manufacturer of products used in hospitals wishes to acquire new products, through licensing agreements, in the following areas: medical disposables, anaesthesia, intensive care, sterilization, orthopedic instruments, orthopedic implants, surgical instruments, blood analysis, medical electronics, stoma care and incontinence (ref. 191/N/86).
Write to: J. D. Emanuel, Managing Director, Pax Technology Transfer Limited., 6 Donovan Avenue, London N10 2JX, England.
Please quote the reference number.

Special Events

Summary

SWITZERLAND
- International Exhibition of Inventions and New Techniques
  Geneva – April 1987

U.S.A.
- Annual High Technology R&D Trade Fair
  Arlington, Virginia – May 1987

SINGAPORE
- AnaLabAsia '87
  Singapore – May 1987

FEDERAL REPUBLIC OF GERMANY
- International Trade Fair for Waste Disposal
  Munich – May 1987
- Ligna Hanover
  Hanover – May-June 1987

AUSTRALIA
- Interbuild
  Melbourne – May 1987
- Meditex
  Sydney – June 1987

CANADA
- 1987 International Mechanical Pulping Conference
  Vancouver – June 1987

U.S.A.
- International Restaurant Hotel Suppliers Exposition
  Miami – September 1987

HONG KONG
- International Food and Beverage Fair
  Hong Kong – September 1987

CANADA
- Expocam
  Montréal – September 1987
- Electronicom '87
  Toronto – September 1987

FEDERAL REPUBLIC OF GERMANY
- International Plastics Exhibition
  Friedrichshafen – October 1987

U.S.A.
- International Marine Trade Exhibition
  Atlanta – October 1987

SAUDI ARABIA
- Saudibuild '87
  Riyadh – October 1987

International Exhibition of Inventions and New Techniques
Palais des expositions
Geneva, Switzerland
April 3-12, 1987
Write to: Salon international des inventions, 8, rue du 31-Décembre, CH-1207 Geneva, Switzerland.
Tel: (022) 36.54.49.

Annual High Technology R&D Trade Fair
Hyatt Regency Crystal City
Arlington, Virginia
May 4-6, 1987
Write to: Technology Catalysts Inc., 6073 Arlington Boulevard, Falls Church, VA 22044, U.S.A.
Tel: (703) 237-9600.

AnaLabAsia '87
First Southeast Asian Laboratory and Analytical Technology and Equipment Show
World Trade Centre
Singapore, Singapore
May 13-16, 1987
Write to: UNILINK, 5 Donalda Crescent, Agincourt, Ontario M1S 1N5.
Tel: (416) 291-6359.

International Trade Fair for Waste Disposal
Trade Fair Grounds
Munich, Federal Republic of Germany
May 19-23, 1987
Write to: Münchener Messe- und Ausstellungsgesellschaft GmbH, Postfach 121009, 8000 München 12, Federal Republic of Germany.
Tel: (089) 51.07.0.

Interbuild
The International Materials and Equipment Exhibition
Royal Exhibition Building
Melbourne, Australia
May 26-29, 1987
Write to: UNILINK, 5 Donalda Crescent, Agincourt, Ontario M1S 1N5. Tel: (416) 291-6359.

Ligna Hanover
International Trade Fair for Machinery and Equipment for the Wood Industries
Fairgrounds
Hanover, Federal Republic of Germany
May 27 - June 2, 1987
Write to: UNILINK, 5 Donalda Crescent, Agincourt, Ontario M1S 1N5.
Tel: (416) 291-6359.

1987 International Mechanical Pulping Conference
Hotel Vancouver
Vancouver, British Columbia
June 2-5, 1987
Write to: W. Robert Wood, Deputy Manager, Technical Section, CPPA, Sun Life Building, 23rd Floor, 1155 Metcalfe Street, Montréal, Quebec H3B 2X9.
Tel: (514) 866-6621.

Meditex
Australian Exhibition of Clinical/Surgical/Diagnostic Technology
Sydney, Australia
June 15-18, 1987
Write to: Sue Baines, 162 Goulburn Street, BPI Exhibitions, Darlinghurst, Australia.

International Restaurant and Hotel Suppliers Exposition
Miami Convention Center
Miami, Florida
September 12-14, 1987
Write to: Saul Mandell, 14411 S. Dixie Highway, Suite 209, Miami, FL 33176, U.S.A.

International Food and Beverage Fair
Ocean Terminal
Hong Kong, Hong Kong
September 16-20, 1987
Write to: Karen Fifer, SHK International Services Ltd., 22/F 151 Gloucester Road, Wanchai, Hong Kong.

Expocam
Place Bonaventure
Montréal, Quebec
September 26-28, 1987
Write to: Jack McLean, Southex Exhibitions, 1450 Don Mills Road, Don Mills, Ontario M3B 2R2.
Tel: (416) 445-6641.

Electronicom '87
Metro Toronto Convention Centre
Toronto, Ontario
September 28-30, 1987
Write to: Scott Silcox, Southex Exhibitions, 1450 Don Mills Road, Don Mills, Ontario M3B 2X7.
Tel: (416) 445-6641.

International Plastics Exhibition
Friedrichshafen Fairgrounds
Friedrichshafen, Federal Republic of Germany
October 7-10, 1987
Write to: Hubertus Burgl, Intl. Bodensee-Messe GmbH, Messegelande 7990, Friedrichshafen, Federal Republic of Germany.

International Marine Trade Exhibition
World Congress Center
Atlanta, Georgia
October 16-18, 1987
Write to: Edward Conrad, Southern Exp. Management Co., 1150 Hightower Trail, Atlanta, GA 30338, U.S.A.

Saudibuild '87
4th Building and Construction, Operations and Maintenance Show
Riyadh Exhibition Centre
Riyadh, Saudi Arabia
October 18-22, 1987
Write to: UNILINK, 5 Donalda Crescent, Agincourt, Ontario M1S 1N5.
Tel: (416) 291-6359.

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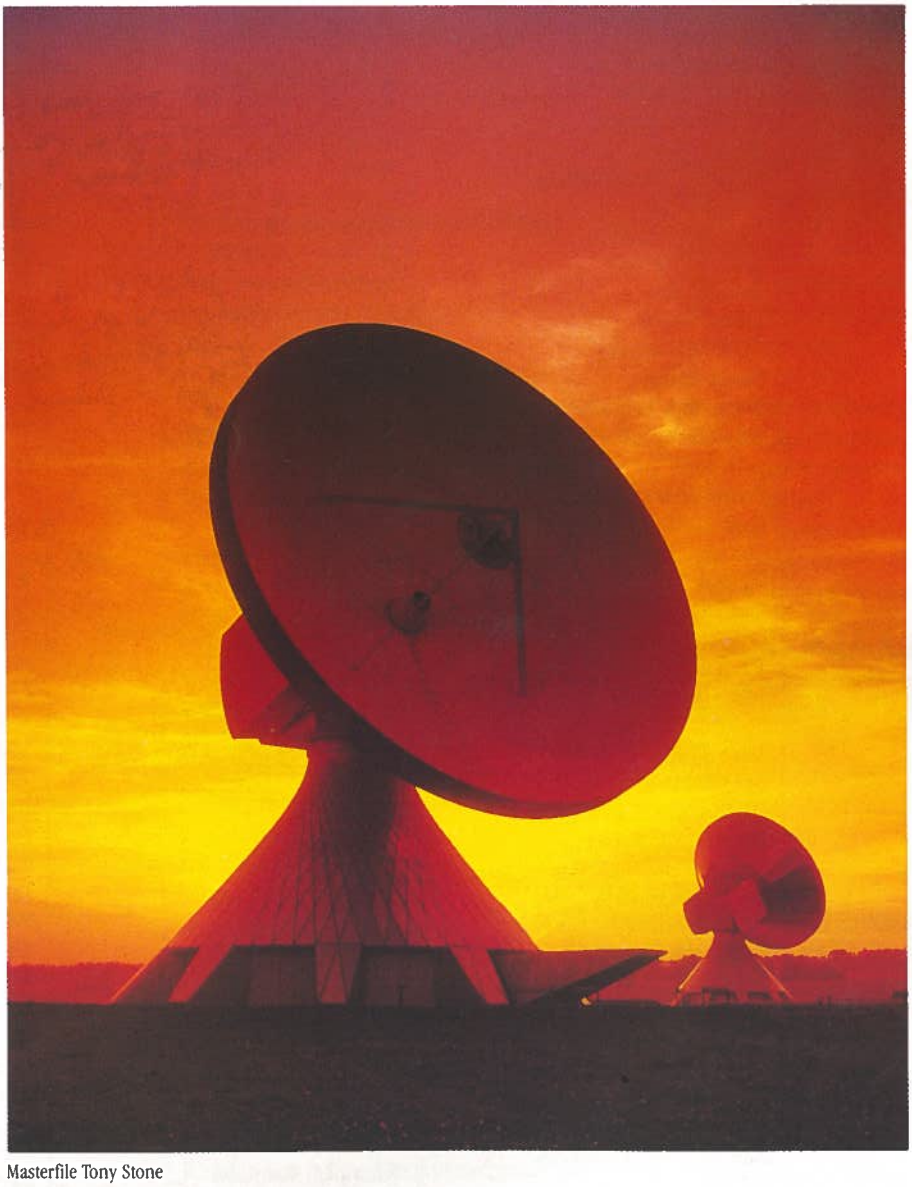

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