canada 1977 commerce

Summer edition

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Canada Commerce

Vol. 141 No. 3 Summer Edition 1977

Published by the Department of Industry, Trade and Commerce

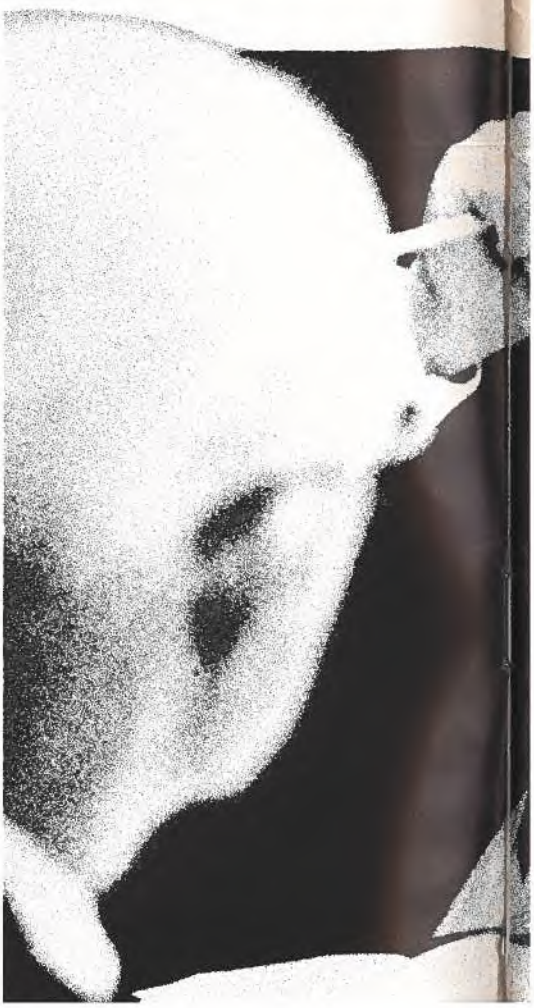
Established 1904

Address correspondence to:
Editor, Canada Commerce, Department of Industry, Trade and Commerce, 240 Sparks Street, Ottawa, Ontario K1A 0H5
Telephone: (613) 996-9001

Contents

Library Research
J. Flynn
B. Fraser
Typography by
Nancy Poirier Typesetting Limited
Printed by
Richardson, Bond & Wright Limited
Paper stock
Abitibi Caslon Gloss 120M

aussi en français



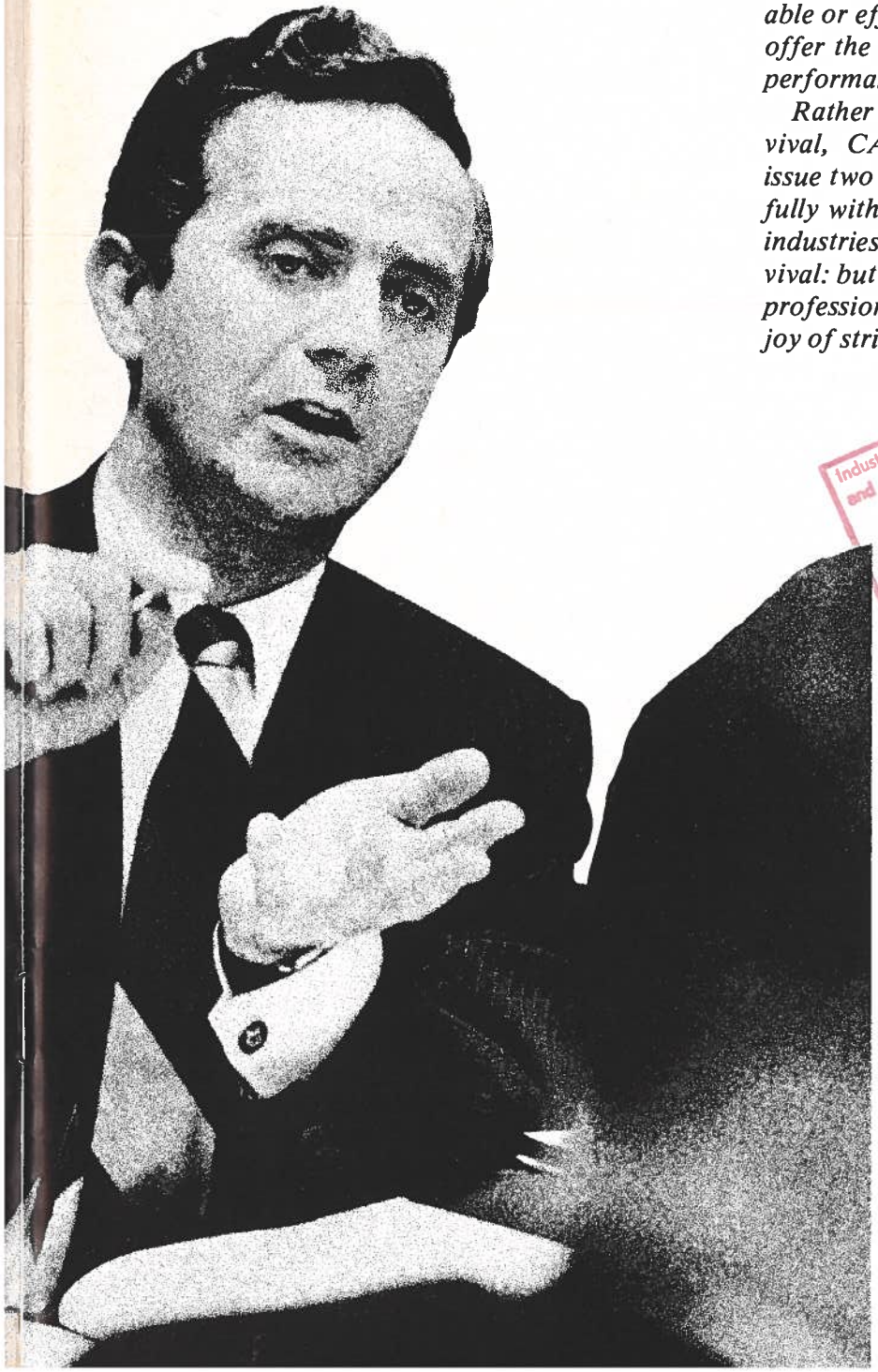
Some Preach, Others Practice

Moses descended Mount Sinai in triumph. He had been told by the Supreme Authority that his people would be led out of the desert to a land flowing with milk and honey. Better still, Moses held in his hands two stone tablets. On them were inscribed The Commandments, ten simply phrased rules, the observance of which guaranteed a place in Heaven.

If Moses could not shepherd his flock along the straight and narrow path to Paradise, what hope of success awaits those lesser mortals who preach that Canada's economic survival depends upon exporting at least as much in dollar value as we purchase in foreign markets?

None would deny the logic of earning enough to cover personal expenditures. Less easily understood is the seemingly remote link between what we produce and the increasing volume of commodities from other countries. Some goods of foreign manufacture are welcomed because nothing similar is obtainable from domestic sources. More often purchases are dictated by the combination of quality and price. But if Canadians, among the world's most affluent citizens, love a bargain, it follows that potential buyers of Canadian goods and services abroad are just as cost conscious. During the Depressed Thirties, prices were made more attractive by the simple expedient of lowering wages. Such policies are no longer acceptable or effective. The viable alternative solution is to offer the world products that are superior in design, performance and longevity.

Rather than preach the gospel of economic survival, CANADA COMMERCE highlights in this issue two Canadian companies that compete successfully with giants in their respective fields. Both serve industries in which high technology is vital for survival: but equally important are the human factors — professional pride, a competitive spirit, and the sheer joy of striving to be the best in the business.



International lenders spur expansion programs

C.W. ROSS, Commercial Counsellor, Brasilia

Brazil's phenomenal 8.6% real growth in GNP last year, spurred by a 10.5% increase in industrial production, recently prompted the Minister of Finance, tongue firmly placed in cheek, to describe the country's 1976 economic performance as a "recession: Brazilian style."

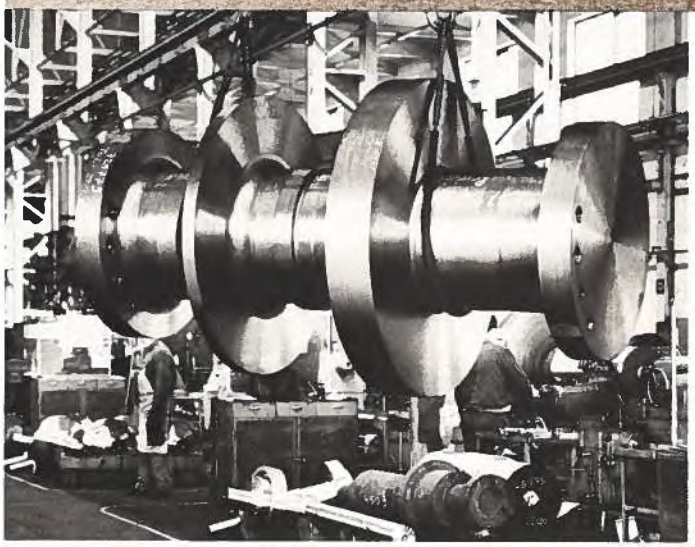
Despite continuing balance of payments problems, Brazil also managed to reduce its balance of trade deficit to $2.2 billion from $2.5 billion in 1975, and to increase official reserves to $6.4 billion, the highest level since 1973. The increase in reserves is due largely to Brazil's ability to attract massive international loans, a reflection of its excellent international credit rating. The performance has, however, exacted a price — domestic inflation exceeded 46% for the year.

Current policies are aimed at reducing the balance of trade deficit, rate of inflation, and government spending — measures which are expected to cause real economic growth to drop to the 4% - 5% range over the next year. But Brazil's programs for major import substitution and industrialization are expected to proceed with little hindrance, and massive expenditures will be made in the steel, non-ferrous metals, agricultural chemicals, fertilizer, petrochemicals and forestry sectors. Most infrastructure expansion programs are likely to go ahead, most probably in the telecommunications, transportation and power generation and distribution areas.

All these sectors, despite Brazil's increasing industrial capabilities, require imports and will offer sales opportunities for Canadian firms that subscribe to aggressive, innovative marketing efforts.

The Economic Development Council's "Priorities and Guidelines for 1977" identifies other areas of export opportunities for Canadian companies. The Council calls for:

- *Expansion of exports of manufactured and semi-manufactured goods, minerals and non-traditional agricultural products and agro-industrial products.*
- *Stepped-up production of agricultural products, particularly wheat, barley, malt and rye, both for export and import substitution.*
- *Expansion in production of petroleum and its derivatives.*
- *Continuation of a program for self-sufficiency in raw materials for the steel, petro-chemical, fertilizer, non-ferrous metals, pulp and paper and agricultural chemicals industries.*
- *Development of the capital goods industry.*
- *Development of production of alcohol as additive or substitute for gasoline and diesel fuels.*
- *Development of mass public transportation facilities.*

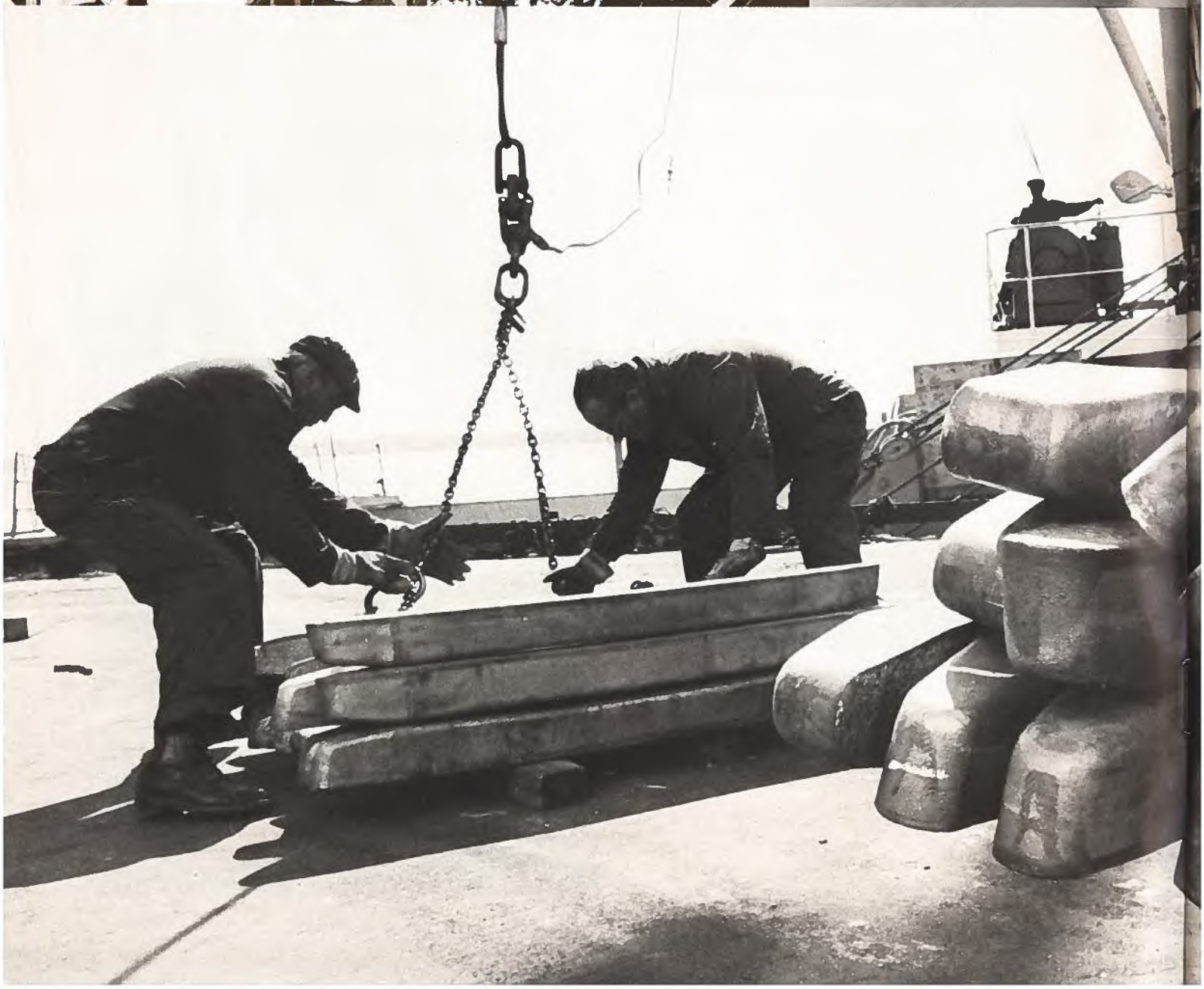


As plentiful as grains of sand on the shore, but coffee beans by the billion, even at inflated prices, are not enough to close Brazil's import-export gap. Nor is economic equilibrium achieved by exporting raw materials, or in manufacturing consumer products — e.g. Volkswagen sedans — for sale in foreign markets.

Balancing the national budget has become an art which few countries have mastered.

The Massey-Harris tractor spraying a coffee plantation in the State of São Paulo is not a product of Canada. Made in Brazil, it provided employment for the labour force of that country.

Brazil does rely upon foreign technologists and consultants. For the design of Brasilia Cathedral, Brazil relied upon architect Oscar Niemeyer. The sculptures are the work of A. Ceshiati.



Resource-rich Brazil smiles in an economic straitjacket

JOHN P. BELL,
Consul and Senior Trade Commissioner, São Paulo

Much of the South American country's vast natural wealth is not quickly or easily redeemable. Impatience to join the big league of industrial powers is tempered by a cautious approach to international transactions which might threaten Brazil's desire to control its economic destiny. Canadian businessmen who can sympathize with Brazilian nationalism will be welcomed in an exciting marketplace with tremendous potential.

The seemingly obvious source of statistics for our picture captions was a 210-page, full-colour Brazilian magazine, one issue of which would cover CANADA COMMERCE production costs over a 3-year period. But having recovered from the visual impact of superb colour photography, we resorted to a sobering encyclopedia list of facts and figures. In terms of easily accessible mineral wealth, Canadians have little cause to be envious of Brazil's treasures.

On these pages the Art Editor gives pride of place to Brazilian copper ingots. The 1975 production amounted to 2,000 metric tons: Canadian smelters produced 500,000 metric tons.

Faced with a staggering $4 billion bill for petroleum imports in 1976, Brazil has 12 offshore drilling rigs and two survey ships searching for new fields which might push the domestic output above 63 million barrels per year (Canada produced 521 million barrels in 1975). With a total oil carrying capacity of 2,071,000 tons, Brazil's fleet of 40 ocean tankers is one of the world's largest.

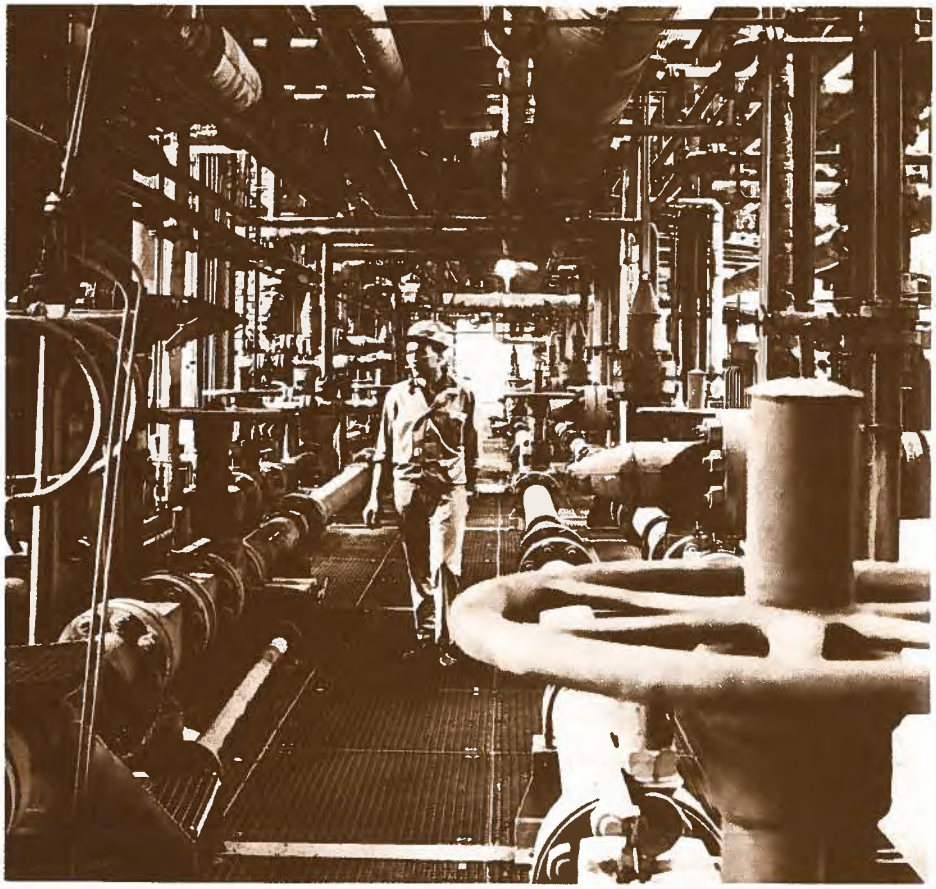
Brazil, the world's fifth largest country, with a population of 110 million, and a GNP of over $110 billion, contains vast agricultural, mineral and forestry wealth which in many cases is only beginning to be tapped. These factors, together with its burgeoning and broadening industrial base, have led most experts to agree to Brazil's "manifold destiny" as an emerging world power. While Brazil, like most countries, faces considerable and immediate economic problems (which it is working hard to contain), it offers innumerable opportunities for Canadian businessmen.

Canadian executives should take firm note, however, that the road to riches in Brazil is rather like a game of snakes and ladders, except that the rules are not always simple and have been known to change in mid-game. Hence the need to learn the rules of the game before getting into the action. Good sources of advice are the Canadian Embassy in Brasilia and the Consulates in São Paulo and Rio.

After almost a decade of growth averaging 10% a year, the Brazilian miracle has been plagued by balance of payments problems, inflation and a rapidly increasing foreign debt. A basic cause of these troubles has been the international oil crisis.

Brazilian oil imports (covering 80% of the country's needs) cost $3.8 billion in 1976 ($850 million in 1973). To redirect the economy under the changed international realities, the government has moved to lower the level of imports through a variety of measures, develop import substitution industries, and vigorously push exports. To reduce dependency on oil imports, Brazil has sought the participation of foreign petroleum companies in exploration under "risk contracts", and has undertaken a National Alcohol Plan for the production of sugar cane and manioc alcohol to be used as an additive in gasoline. It has also signed a major agreement with Germany for the development of nuclear energy. For all its difficulties, however, Brazil registered an 8.6% increase in Gross Domestic Product in 1976.

Of most concern to Canadian exporters are the various measures the Brazilians have taken to limit imports.



In the first place, tariffs are high, in some cases up to 205%, basically on consumer goods. The most serious obstacle is considered to be the prior deposit scheme requiring Brazilian importers to deposit 100% of the FOB value of imports for 360 days with the Bank of Brazil, without interest or monetary correction, this over and above the amount actually paid for the imported goods.

Items considered essential, such as oil, coal, fertilizers, wheat and certain forms of steel are exempt from this measure, as are capital goods and equipment with no national similar which are financed from abroad for more than five years. As well, imports of aircraft components, non-ferrous metals and data processing equipment must be approved by the respective development agencies.

A recently introduced export incentive scheme provides for a 90% reduction in duties, exemption from the import deposit requirement, and a reduction on the industrialized products tax on imported capital equipment to enterprises undertaking to increase exports by 10% a year. The program does not apply, however, to equipment for which there is a national similar.

A major preoccupation is the maximization of Brazilian content of capital equipment. Another factor of interest to Canadian exporters is the recent major cut back in Brazilian government spending. Although foreign debt has increased considerably over the past few years (to $28 billion), it is considered to be at a manageable level, and foreign lenders and the World Bank, as well as the Inter-American Development Bank continue to make major commitments to Brazil.

Looking at this background information, it would appear that prospects for export to Brazil are not overly encouraging. For many products, this is true.

For instance, it makes no sense for manufacturers of consumer products to accord high priority to Brazil, at least not for straight export marketing. On the other hand, the various priority projects planned or underway in Brazil, especially for import substitution, coincide with just those areas in which Canadians have developed strengths.

Except for the obvious difference in climate, the Brazilian development of manufacturing, railway and air transport, forestry and agriculture, closely mirrors Canada's recent progress. As Brazil moves to substitute imports, which in some cases are traditionally sourced in Canada, it is crying out for specialized equipment and technology. For example, the Brazilian National Pulp and Paper Plan aims to move the country to self-sufficiency in paper, and to a net export position in pulp. Here, many Canadian firms have actively pursued opportunities for equipment and technology sales, and in some cases are seeking direct investment in pulp and/or paper manufacture.

Given the propensity for maximizing Brazilian content in equipment and the problems involved in direct export, some Canadian firms, since they cannot afford to ignore Brazilian developments are seeking to transfer and capitalize on their technology and expertise through joint-venture with Brazilian firms. The experience of 41 companies working through the São Paulo Consulate on this approach to the market indicate that this technique although far more difficult than exporting, can often be rewarding.

The following example illustrates the need to tailor the marketing approach to meet changing conditions. A Canadian exporter of specialty albums developed a sizeable market in Brazil in the early 60s. With the imposition of import restrictions, his market appeared lost, but imaginative thinking, and several visits to São Paulo led to the sale of the machinery used to make his product, which was not available in Brazil, and to a royalty arrangement that produces higher net remuneration than the earlier direct export sales.

Here are some guidelines to keep in mind: Canadian firms can set up a wholly-owned or majority-owned subsidiary in Brazil, but they would not be eligible for concessional financing which Brazilian-controlled enterprises receive from various Brazilian Government Development Banks and other agencies. Because of this, many foreign firms find it prudent to restrict their participation to a minority interest. On the other hand, some foreign firms, anxious to quickly introduce a saleable product, have not bothered to apply for concessions from the Brazilian National Development Bank and the Council for Industrial Development because approvals may take up to two years.

Repatriation of profits is effectively limited to 12% of the net registered capital invested initially and added to, as allowed, over a period of time by the foreign investor; remittances above 12% of capital are subject to a heavy withholding tax. Under certain conditions, imported equipment and technology may be capitalized as part of the equity base used to calculate remittances.

Associating with Brazilian interests facilitates the co-ordinating of Canadian and Brazilian objectives and, of course, eases some problems related to Brazilian regulations. Where sale of technology is concerned, compliance with the Brazilian National Property Institute (INPI) Normative Act 15 is required. All technology and royalty contracts must be approved by this agency and come under its guidelines, one of which stipulates that royalty payments may not exceed 5% of net sales, and normally may be paid for only five years, although in certain cases this may be extended to ten. Royalties derived from patents, however, may be paid over the life of the patent.

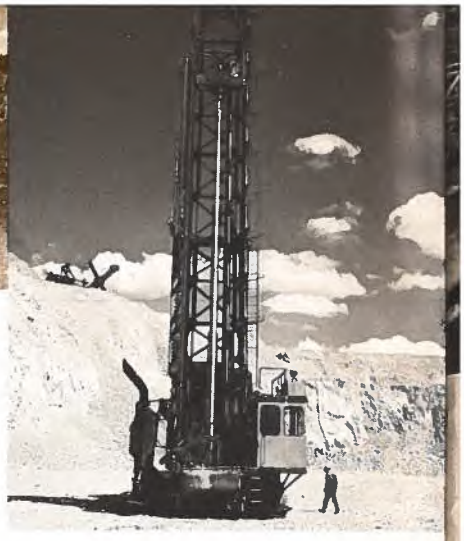
Canadian consultants should be aware that while there is no law requiring them to associate with Brazilian consultants, this is the only way they can realistically hope to obtain business. Some consultants have opened offices or entered into association with Brazilian firms, but since actual registered investment is low they have not developed a large capital base registered with the Central Bank on which to remit profits. Many Canadian consultants have obtained work on internationally financed projects where the remittance problem does not arise, and some with expertise that is clearly not available locally have been able to register their contracts with the Brazilian Central Bank for dollar repayment.

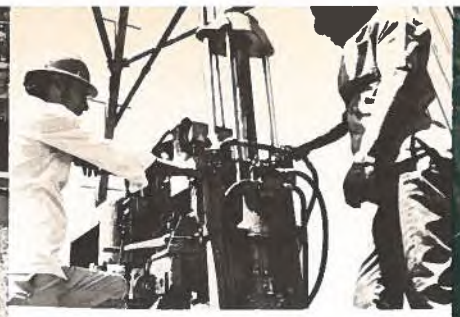
The above indicates that firms interested in exploring joint ventures, investment, and technology transfer should make early contact with a Brazilian lawyer and accountant.

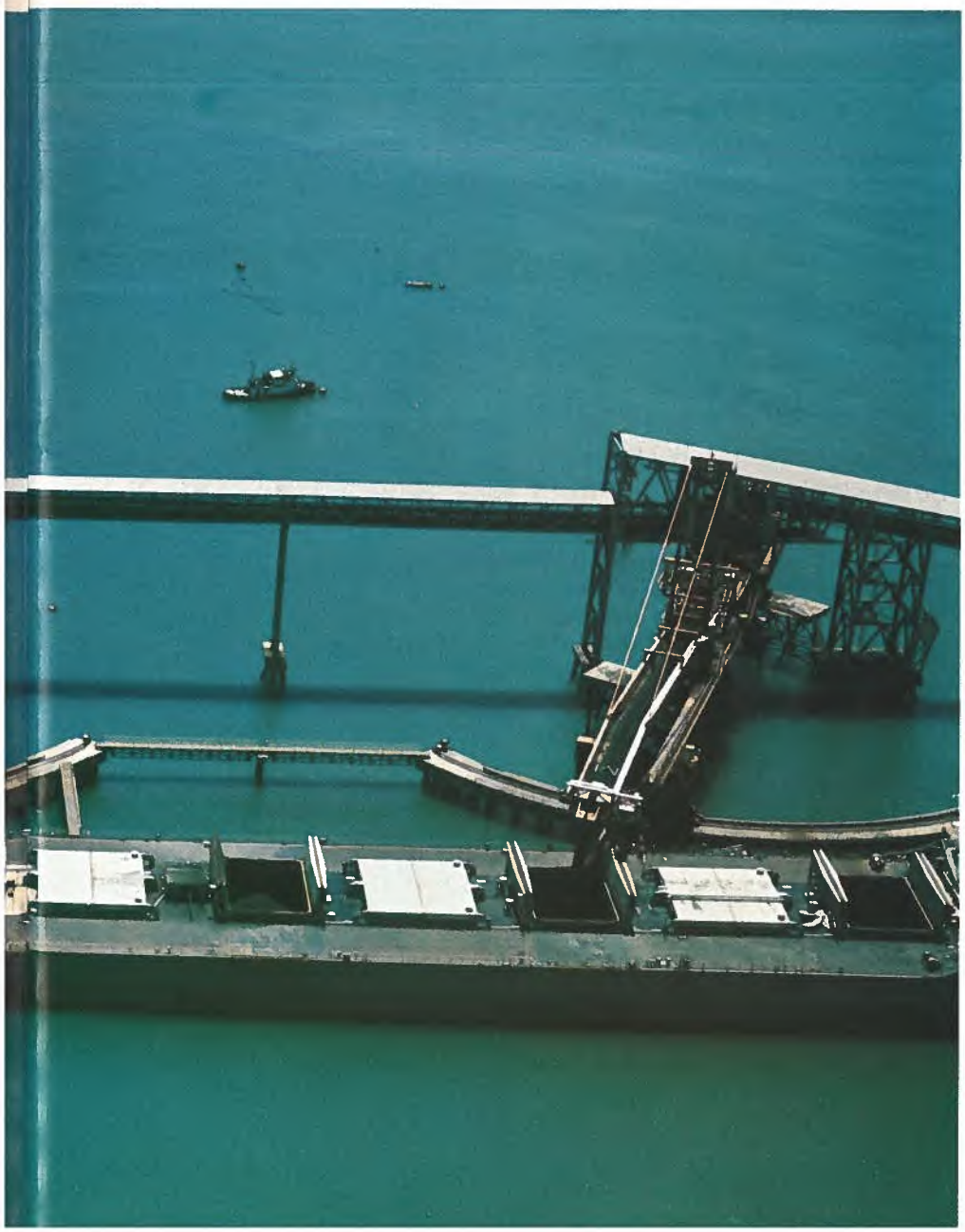
While serious types of joint ventures are logical in many cases, considerable opportunities for continued and new direct export from Canada remain, especially for high technology products. Potential is strong for hydroelectric power and transmission projects, airports, railway equipment and consulting, urban transport expertise, steel and mini-steel mills, cement plants, alcohol plants, mineral processing equipment, pulp and paper projects, sewage equipment, purebred dairy and beef cattle and semen, and breeding swine, to mention only the more important sectors. These sales will be executed most easily when Brazilian projects have obtained priority status exempting the purchaser from various import restrictions, when EDC and/or Canadian bank financing for more than five years is obtained, for equipment or services for which there is no national similar, or when purchases are made under a project financed by the IBRD or IADB.

It should be noted that Brazil is the largest recipient of both IADB and IBRD loans when soft window financing is excluded. The IBRD loans alone are between $500 million and $600 million annually, and will most likely continue at that level. At the same time, Brazilian importers do continue high import levels through paying deposits. One large importer recently confided to the Consulate that his firm had $30 million of compulsory import deposits lodged with the Bank of Brazil.

Most businessmen know that to develop new markets there is no effective substitute for personal visits. Personal contact is more essential in Brazil than elsewhere; business results depend on it.







The Amazon yields its iron treasures

G.M. DARYCHUK,
Vice-Consul and Assistant Trade Commissioner,
Rio de Janeiro

Deep in the Serra dos Carajas, a mountain range towering above the Amazon, are an estimated 18 billion tons of iron ore. One of the world's largest single deposits. Remote from road and rail, the harvesting may cost as much as $3.5 billion.

Canada and Brazil share the problem of having vast resources locked in inaccessible mountain ranges. Mineral reserves in the northeast Rockies include coal, iron, chrome and tungsten. The Serra dos Carajas has an estimated 18 billion tons of iron ore. Canada in 1975 mined nearly 55 million metric tons of iron ore, Brazil nearly 72 million metric tons. The South American country is also a larger producer of tin, phosphate rock and manganese, but their total market value is more than offset by Canadian yields of silver, lead, mercury, nickel, pyrite, sulphur, zinc and titanium.

In a remote area of Para state, in north central Brazil, Amazonia Mineraçao S/A (AMZA), is developing an iron ore resource expected to produce 50 million MT a year by 1986.

The price tag for this immense project is stiff; $3.5 billion without taking inflationary factors into account. But in Carajas, Brazil may well have the ultimate iron ore deposits. Reserves of enriched ore are measured at 15.7 billion MT of 66.7% iron, and 2.1 billion MT of 60.9% iron, all near the surface with little, if any, overburden. But if reaching the deposits will be a relatively simple procedure, moving them for processing and into world markets will demand a massive effort, far exceeding that required for Labrador projects.

Carajas is located in the Serra dos Carajas, a pair of low mountain ranges rising from the floor of the Amazon Basin roughly 550 km southwest of Belem. The nearest centre, Maraba, — 150 km — is a poor community of 9,000. There is no skilled or semi-skilled labour in the area and a continuing training program will have to be undertaken to meet Carajas' operational needs.

The project will also require construction of a super port on the Atlantic coast, a 900-km railroad traversing difficult terrain in three different climatic zones between the mine site and the coast, a townsite at the mine with supporting infrastructure for at least 5,800 people, a new town at Maraba and a second railroad fuelling and servicing station between the mine site and the coast, communication facilities and power supply. Auxiliary facilities at the mine will include maintenance shops, small railroad repair shops, warehouses, quality control laboratories, a power station, water treatment plant, storage for explosives and an administrative building.

The marine terminal will be sited near the existing commercial port of Itaqui, about 10 km southwest of São Luis, the Maranhão state capital, where the dock area can accommodate the largest ore ships without dredging, and meteorological conditions are favourable in all seasons.

The port has an access channel 1.8 km wide, the minimum necessary for navigation without tugboats. The natural dimensions of the vessel turning basin exceed the established standard of 1.4 km minimum diameter. High tides (6.5m in spring) create high velocity currents of up to 7 knots which will probably limit docking and departure operations to slack water periods. Two docks are planned, one to handle ships of up to 300,000 dwt., and the other, for ships up to 120,000 dwt.

The rail gauge for the mine-to-port line will be 1.6m, and it is anticipated that 15,000-MT unit trains will be used. They will travel on welded rail laid down in 400-meter lengths. The average train will consist of 160 cars of 110-MT capacity, loaded to only 92 MT. The prime mover will be two 6,000-h.p. locomotives.

The ore will be crushed at the mine to minus 150 mm. (6") in the primary crusher and then conveyed downhill to a stockpile at the railhead. A reclaim and loading rate of 12,000 MT per hour is planned at the mine's rail loop.

AMZA, owned approximately 51% by Companhia do Vale do Rio Doce (CVRD) and 49% by Companhia Meridional de Mineraçao, a U.S. Steel subsidiary, plan production to begin in 1981 with 12 million MT. So far, although more than 1,000 employees are working on the project, serviced entirely by airlift, almost no physical work has been done. More than $80 million has been spent, mostly on engineering, surveying and prospecting. It is estimated that construction will take up to five years to complete, and the mine another five to seven years to reach capacity.

Railroad construction, due to start last May, was delayed because of substantial cumulative errors in the surveying of the railroad itself. Engineering on the port and railway lines, however, is well advanced. Both these projects are now handled by Canadian engineering companies. There will be further opportunities for Canadian participation, since it is expected that approximately $300 million will be spent on imported capital goods for the project.

Following is a breakdown of the type of equipment required for the Carajas complex.

Railway

Total equipment needs for the line are forecast at $310 million: $50 million for construction equipment; $150 million for rolling stock, locomotives and maintenance-of-way-equipment; $80 million for rails and $30 million for support equipment.

The costliest job, clearance of the right-of-way for the railway line, will involve up to 75 crawler tractors plus a fleet of compactors, scrapers, rollers, etc. Some equipment will be available locally, but to speed up work Amazonia may decide to buy imported units for use by the various contractors on the job.

About 4,000 railway wagons (110 MT) and 50 electric locomotives will be required. Brazil can produce railway cars and perhaps some of the locomotives itself, but a recently announced railway expansion program will certainly strain the domestic manufacturer's capacity and, in all probability, will necessitate imports of a substantial amount of rolling stock. The line will be a single track, 1.60 meter gauge, 136 lb/yd rail with a possibility of double tracking in the future. Industry sources estimate that the output of the project will require ten 100-unit trains each way per day. A sophisticated signalling and scheduling system is necessary, but traffic congestion is inevitable with single tracking.

Although the system is planned for speeds of 75 km/hr, designers are making provisions for speeds of 120 km/hr. Initially, the railroad will be electrified from the Paulo Alfonso Dam in Bahia, from which AMZA will purchase power. The maintenance-of-way-equipment amounting to $15 million will be almost entirely produced abroad and includes tie-tamping, tie-setting and ballast laying equipment.

The top, right photo has the closest link with Canada. Alcan imports bauxite from Brazil, although the company's main sources are in the Caribbean — for the Quebec smelters — and Australia, which supplies Kitimat in British Columbia.

Bauxite is found in 44 countries, but is mined in only 24. Brazil's production was approximately one million tons in 1975, whereas Canada produced a slightly greater tonnage of aluminum metal.

Port Terminal

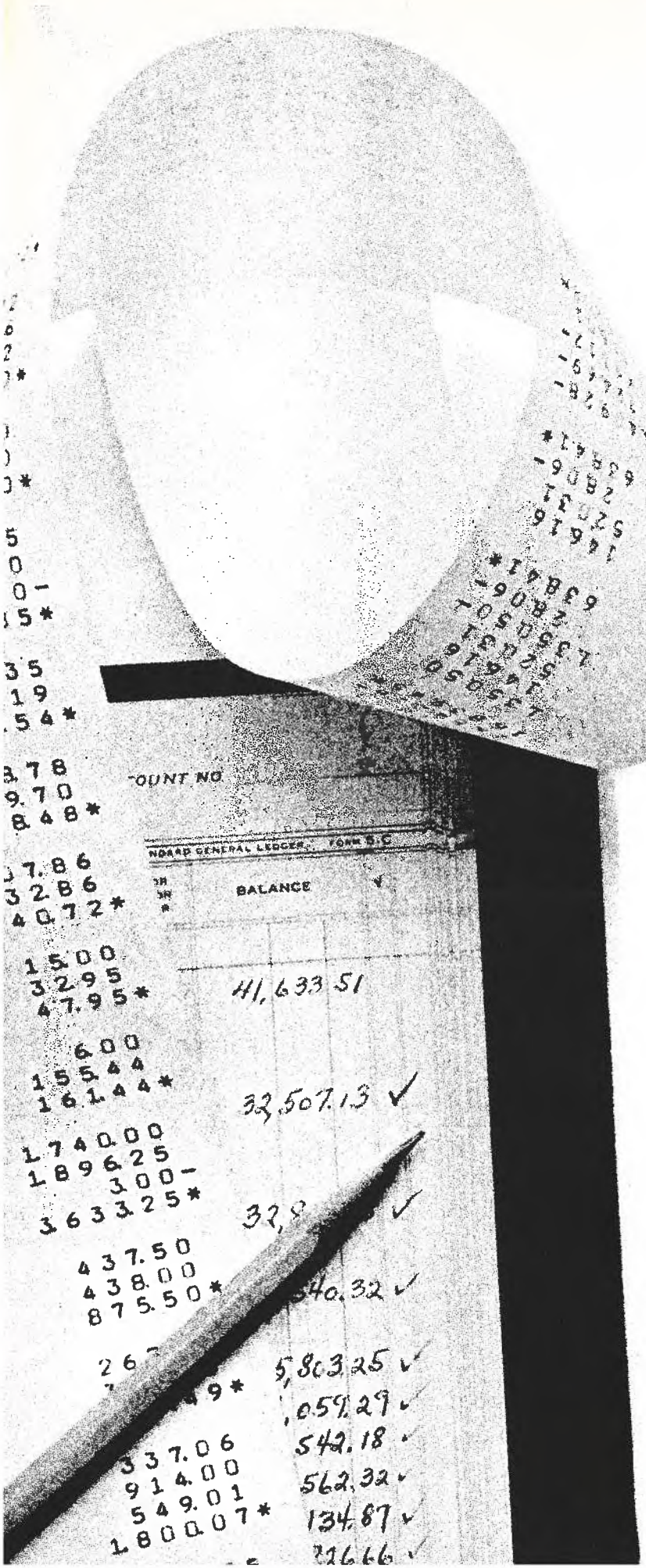
The Itaqui port is expected to cost approximately $165 million. Sheet piling for the dock area and most of the materials handling equipment will be imported. Projected costs are $7 million for four stackers and two reclaimers and $6 million for two 14,000 MT per hour shiploaders. More than 60,000 feet of conveyors and feeding equipment will be needed, the bulk of which domestic manufacturers will supply. Tugs, launches, crewboats and marine equipment will probably have to be imported and are expected to cost approximately $5 million. Crushing and screening installations costing $2 million will be located at the port site. Since the ore is high grade, the main task will be sizing ore to customer specifications. The bulk of the product will probably be a minus 10 mm (3.8"), sinter feed dried to a 4% moisture content. The $3 million secondary and tertiary crushing equipment will probably be purchased from local manufacturers, although some of the large screens and dryers, estimated at $5 million, will have to be imported.

The Mine

Imported equipment worth $25 million needed at the mine site includes eight 12 to 14 yd. power shovels, twenty-eight 150-ton electric wheel trucks, seven large graders, seven large crawler tractors, four large rubber tire tractors, primary crushers for 6" crushing and possibly 7,000 ft. of conveyors and feeding equipment.

In addition, Carajas will require about $2 million of imported laboratory equipment and $6 million of imported communications equipment including antennas, transmitting and receiving equipment, towers and telex hardware.

* Values are estimated in 1975 U.S. dollars.



Points of Contact

The following companies and agencies exert a major influence on key projects which now are underway or planned for Brazil. Canadian exporters interested in participating in the projects may write directly to the companies for which addresses are provided, and obtain information on others from the Post at Rio de Janeiro. The Post should receive copies of all correspondence.

Centrais Elétricas Brasileiros S.A. (Eletrobrás)

Part of the Ministry of Mines and Energy. Undertakes planning, technical co-ordination, financing and administration for Brazil's electric power supply, and prepares five-year investment programs for the sector.

Power generation and high voltage transmission are entrusted to four subsidiary companies, which also undertake design, financing, purchasing and project implementation.

Eletrobrás and ANDES of Paraguay have also formed Itaipú Binacional to implement the Itaipú hydroelectric project, currently the largest in the world, which is scheduled to begin operation in 1983. Responsible for liaising with industry is Dr. Alberto Cotrim, Eletrobrás, Avenida Nilo Peçanha, 50/Grupo 2617, Rio de Janeiro.

Canadian companies may obtain information on marketing opportunities from the following offices in Rio de Janeiro:

Furnas — Alvaro Guimarães,
Departamento de Contratos e Suprimentos,
Furnas,
Rua Real Grandeza, 219

CEPEL — Jerzy Z.L. Lepecki,
Executive Director,
CEPEL,
Cidade Universitária,
Ilho do Fundão,
Caixa Postal 2754
(CEPEL is Eletrobrás' research and development arm).

CAEEB — Paul M. de A. Magalhães,
Chefe, Departamento de Compras e Coordenaçao de Financiamento,
CAEEB,
Avenida Rio Branco, 135/11º andar.
(CAEEB, basically a consulting company, assists hydroelectric utility companies to undertake international bids and in the purchasing process).

Itaipú Binacional — Dr. Gelãzio da Rocha,
Assistant Technical Director,
Itaipú Binacional,
Avenida Rio Banca, 151/9º andar
or
João Messa Neto,
Assistant Financial Director,
Itaipú Binacional,
Rua São José, 90/2º andar.

Companhia Vale do Rio Doce (CVRD)
Founded in 1942 to exploit, transport and market iron ore resources. Expects to produce, process, market and ship 120 million tons a year of iron ore, concentrates and pellets by 1990. Its basic determination to explore and exploit Brazil's mineral deposits has led CVRD to form 29 companies in widely divergent areas such as forestry, shipping, metallurgy and engineering consulting; it holds minority interest in another 48 Brazilian companies, and investments in steel mills and coal, fertilizer and wood pulp production in Brazil and abroad.

Rede Ferroviaria Federal S.A. (RFF)
Brazil's seventh largest corporation was established in 1957 as a holding company for 14 railway companies which previously operated their own purchasing, planning and engineering departments. It is responsible for carrying out the government's Railway Development Plan.

Canadian exporters should use a selective rather than a blanket approach, offering only those products which are highly competitive internationally, or perform a unique function or service. Enquiries should be sent to Dr. Napoleão Goretti, Operations Directory, Rede Ferroviaria Federal S.A., Praça Duque de Caxias 86, Rio de Janeiro.

Conselho de Desenvolvimento Industrial (CDI)
Part of the Ministry of Industry and Commerce, but jointly controlled by a number of other ministries, the military, the Central banking establishment, and manufacturing and commercial associations.

The industrial development agency assesses and assigns priority to industrial projects. To assist the most highly rated, it recommends incentives, including rebate of indirect taxes, state and municipal tax holidays, accelerated depreciation, income tax exemptions and credits and, of significant value to importers of machinery and equipment, 50% to 80% waivers of custom duties. The CDI does not, however, have the authority to grant tax exemptions and reductions. That belongs to the Ministry of Industry and Commerce.

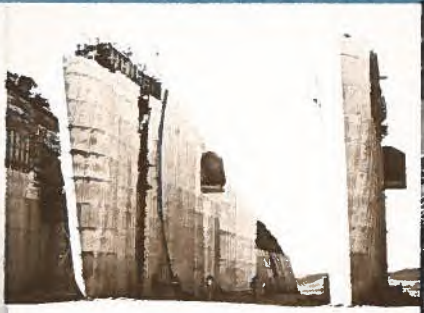
The CDI's ultimate responsibility is the rapid upgrading of Brazil's industrial base, promoted strongly through import substitution. Subsequently, demand for foreign sourcing will diminish significantly, but in the short term foreign manufacturers can still capitalize on Brazil's requirements.

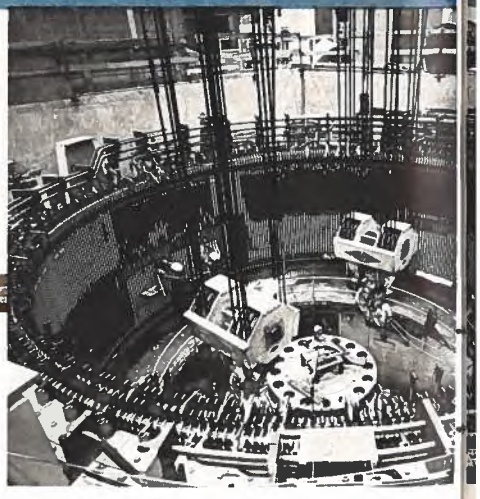
Sectors most favourably considered by CDI are industrial and capital goods, basic metal producing industries, chemicals and petrochemicals, metallic and non-metallic products, the automotive industry, and consumer goods. While CDI's applicants are mainly Brazilian, submissions for projects from foreign companies are considered.

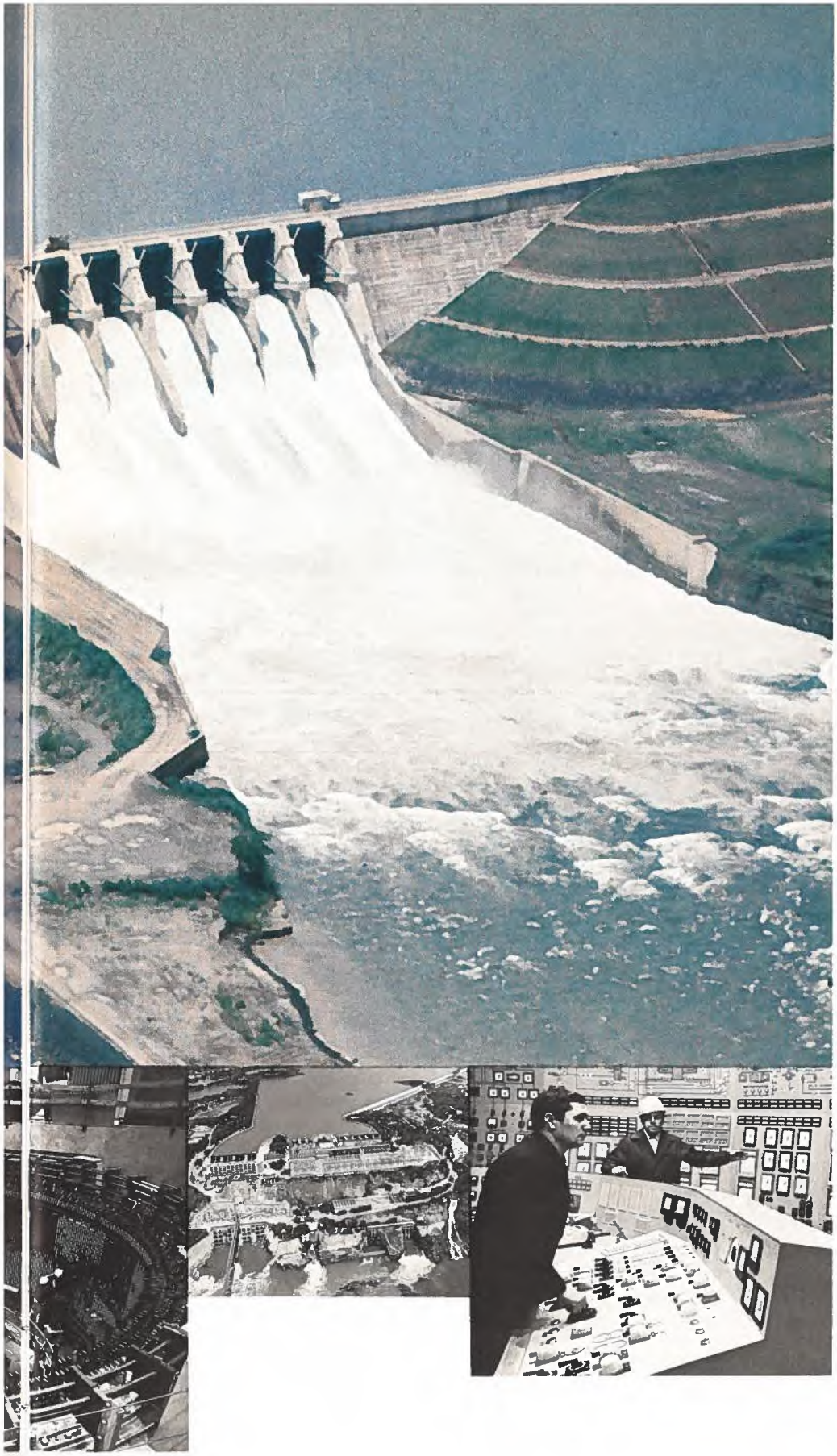
Companhia Siderurgia Nacional (CSN)
Brazil's second largest steel mill is currently implementing large expansion programs at its Volta Redonda plant and is considering construction of another plant at Sepitiba Bay, near Rio de Janeiro, where a special port is under construction. The company plans to export at least 10% of its production.

Technical expertise is being provided by U.S. Steel, and Armco Steel will extend operational assistance. Planning, engineering, specifying and purchasing is carried out by CSN's engineering subsidiary, Companhia Brasileira de Projetos Industrias, Praça Brazil 128, Volta Redonda, R.J.

Occupying almost half of South America, Brazil is the fifth largest country in the world. One state — Minas Gerais — has one tenth of the world's known iron reserves, and the Amazon — 4,000 miles — accounts for one seventh of the fresh water discharged by rivers into the ocean. Less than 2% of the country is cultivated, yet it accounts for more than one third of the world's coffee.







Hydro plans dwarf the Aswan and James Bay projects

ERWIN HROMADA,
Commercial Officer, São Paulo

Brazil has one of the highest hydroelectric potentials in the world, estimated to be between 100,000 and 150,000 MW. Only 17,199 MW has been utilized, and hydroelectricity generates less than one-fifth of the country's energy consumption.

Faced with a balance of payments problem and the need to reduce dependency on imports, Brazil embarked on an industrialization program. But the program received a setback when oil jumped in price and began accounting for nearly 30% of Brazil's import bill. Development of hydroelectric resources assumed a new urgency.

In recent years, demands for energy (more than 50% consumed by industry) has increased by 12% annually, and is expected to reach 273 billion kwh by 1990. To meet those requirements and reduce reliance on petroleum, Brazil must double its generating capacity every six or seven years. It is currently spending up to $2 billion a year, or a total of $32 billion between 1969 and 1985, on hydroelectric developments, expanding its thermoelectric capacity and building nuclear stations.

The plane smartly dips its wings and swoops out of a turquoise sky into the sparkling pink of the setting sun. Nightfall in southern Brazil is a flamboyantly colourful but short spectacle. Because we are flying over hilly country and seemingly endless green forests, I begin to wonder about a night approach to the landing strip.

The bearded pilot grins at me as he drops to tree-height. When I can almost count the needles on a soaring Paraná pine, we cross a ridge and, suddenly below us all is frenzied activity; black waters swirling angrily as they converge on a narrow between nearly perpendicular walls, river banks churned up into a crisscross of fresh dirt roads, and heavy earthmoving tractors, their headlights coming on one by one, scaling up steep slopes. The giant structure of a concrete plant rushes by, and I can just make out what looks like a workers' camp; hundreds of prefab housing units lined up against the reddish brown Paraná soil.

We have arrived at Foz do Areia, one of the largest hydroelectric plants under construction in Brazil. When completed, it will be the sixth largest in the world. Canadians have been involved with the project from the beginning.

Foz do Areia is located on the Iguaçú River downstream from its junction with the Areia River, in the western part of Paraná State, southern Brazil. Already Brazil's largest producer of soya and coffee beans, Paraná in recent years has diversified its agricultural base and pursued an aggressive industrialization campaign. Quick to recognize the opportunities offered by a young, wealthy land beginning to flex its muscles, Brazilians and foreigners alike have pushed Paraná's population up from 6 million to 14 million in the last 10 years. But realization of the opportunities depends on hydroelectric development, and the federal government has cooperated closely with COPEL, the Paraná state utility company, to implement an ambitious electricification program. Foz do Areia will add 2,250 MW to the state's power supply. Initial generation is expected in January, 1980.

The Iguaçú is the main river in Paraná. From its source near Curitiba, the state capital, it runs a course of about 1,000 km, and has a difference in elevation of more than 800m. Its drainage basin, approximately 66,000 sq. km, occupies almost one quarter of the state territory. The basin's power potential was evaluated in 1969 as part of the Power Study of South Brazil (ENERSUL), carried out under the supervision of Canambra Engineering Consultants Ltd., a Canadian consortium. Southern Brazil's development program for the generation and transmission of electric power is based on this study.

The magnitude of the Foz do Areia, which will eventually outrank Egypt's Aswan Dam, is relatively unknown outside Brazil. Its reservoir will be 130 km long, with a storage capacity of 7,300 million cubic meters and an area of 197 sq. km.

A rock fillway on the left abutment will be controlled by four tainter gates, each 13.5m wide and 18m high. The spillway chute will terminate in a flip-bucket and is designed to pass 11,000 cubic meters per second.

The intake channel will be about 450m long with a bottom width of 95m, and the intake structure will be 70m high with six 7.4m inside diameter power tunnels, each 225m in length. These tunnels will have plain concrete lining except at the reinforced concrete transitions and the steel-lined lower horizontal portion.

A semi-outdoor powerhouse is planned to accommodate six 375-MW generating units, three of which are to be installed by the time the plant begins to operate, and for which Canadian firms have entered bids.

The Foz do Areia project typifies Brazil's drive toward rapid increase of its electrical power supply. It is expected that 20% of the financing required for the national program will be obtained from foreign sources, and that 80% will be provided in equal parts by ELETROBRÁS, the federal government's electric power agency, and the state utility companies involved.

ELETROBRÁS, which comes under the Ministry of Mines and Energy, is co-ordinator of Brazil's power industry, but the big spenders in the country's complex power system are the agency's subsidiaries and affiliates. One of the most important subsidiaries is ELETROSUL, located in São Paulo Post territory in southern Brazil, which in turn has its affiliates, CESP (Centrais Elétricas de São Paulo) and COPEL.

ELETROSUL, headquartered in Florianopolis, capital of Santa Catarina, is responsible for co-ordinating electric power in the southern states of Parana, Santa Catarina and Rio Grande do Sul. It was founded just a few years ago and farmed out projects like the 1,200 MW Salto Osorio plant, built by COPEL in Paraná state, until it acquired its own expertise. Now, ELETROSUL itself is building the 2,000 MW Salto Santiago project, for which a Canadian company has successfully bid on the turbine requirements. Opportunities for Canadian input for transmission of this power, for which $82 million will be supplied by the Inter-American Development Bank, should also be forthcoming.

CESP supplies the heavily populated and industrialized state of São Paulo. It has designed and built the huge Urubupungá complex on the Rio Paranà, where São Paulo meets Mato Grosso. The 1,300 MW Jupiá station of

Sao Paulo, the largest city, has a population of 7,693,000. Most Brazilians live within 300 miles of the coast. Under Portuguese rule from the early 16th century until 1882, the national language is Portuguese.

Three hundred years ago Brazil was the world's biggest supplier of sugar. In the 18th and 19th centuries, gold and diamond sales brought the most revenue, but coffee is now the best known export, although soy is No. 1 earner of foreign currency.

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that complex has been operating for five years. The Ilha Solteira plant, first phase of which is operative, will add another 3,200 MW of output, raising the Urubupungá complex to a grand total of 4,500 MW. CESP has other projects coming up, most likely in 1978.

Foz do Areia (COPEL), Salto Santiago (ELETROSUL), and Urubupungá (CESP) will create 8,750 MW of new power for more than 45 million southern Brazilians who, although they comprise less than half the country's 110 million population, produce three-fifths of the gross national product, three-quarters of the industrial output and four-fifths of Brazil's present total electrical energy demand. But the three projects combined pale when compared to mighty Itaipú. The Itaipú hydroelectric plant is being developed by Brazil in co-operation with Paraguay on the Rio Paraná, the border river. Itaipú will have an installed capacity of 12,600 megawatts, larger than the biggest plant now in existence (the 10,000 megawatt Grand Coulee in the United States), and larger than James Bay. The initial stage of construction got underway October 1, 1975. The signing of the first big civil engineering contract, with a consortium of Brazilian companies, provided for 1976-78 expenditures of $300 million to cover the temporary diversion of the Rio Paraná.

Total cost of the Itaipú is currently estimated at more than $5.8 billion, some $650 million of which should be spent on imported equipment. The first of the tenders for imported generating equipment was called earlier this year.

Another international joint-venture in progress, between ELETROBRÁS and Argentina's state company, Agua y Energia Electrica, is the Garabi hydroelectric complex on the River Uruguay, which marks the frontier between the countries. Garabi is to have an installed capacity of 2,000 megawatts, to be shared equally by Brazil and Argentina.

All this potential has not escaped the notice of manufacturers from West Germany, Japan, the U.S., Switzerland, and Italy. Over the past few years, they have set up factories in Brazil to contribute to and prosper from the country's electrical power developments. Canadians are also taking advantage of this huge internal market for power generation and distribution equipment, but there is greater opportunity for companies prepared to consider some Brazilianization of their product. To find out practical ways and means to "get into the act" and secure sizeable orders, it will be necessary to take a brief look at the structure of the Brazilian power production and distribution industry.

The industry is structured to place control of power production and high voltage transmission into federal hands while allowing the states to control power distribution. To all appearances, the federal government will, sometime in the future, exercise a monopoly on power production. For the present, however, the state-controlled companies still exercise a considerable degree of autonomy.

Although ELETROBRÁS and its four subsidiaries (ELETROSUL/FURNAS/CHESF/ELETRONORTE), dominate the industry, their influence is mitigated by history and by the solid technical capability of some of the state-controlled companies. Some of them continue to expand their own power production facilities while simultaneously buying power from the ELETROBRÁS subsidiaries.

ELETROBRÁS does not enforce standardization policies for equipment and operating practices. The industry's efforts to achieve standardization pre-date the creation of ELETROBRÁS and are carried out through an industry committee, the Associação Brasileira de Normas Técnicas. ELETROBRÁS, its subsidiaries, the state-controlled companies, and LIGHT, a Canadian-controlled power company, are all members of the committee, whose chairmanship rotates among the different power companies. Brazil's manufacturers of equipment for the power industry are also represented on this committee.

We would advise Canadian companies interested in participating in the Brazilian expansion program to first contact one of our Consulates in Brazil. Our Trade Commissioners know their territory and are in a position to render effective assistance. Canadian firms like Dominion Engineering, General Electric, Westinghouse, Trench Electric and others have done just that, and a solid working relationship has developed that could very well result in contracts worth many millions of dollars each. Needless to say, the principle of commercial confidentiality applies to dealings of our Consulates with Canadian businessmen.

Canadian capabilities in the electrical area are already widely known and recognized in Brazil. By working with the Trade Commissioner, you obtain active assistance and guidance through the seemingly intricate maze of Brazil's electric power structure, an important first step in getting your piece of the action.

En passant we should mention that few Canadians in our experience have found business trips to Brazil a dreary chore. Most enjoy the country's incredibly blue sky, its green forests where orchids and pine trees grow side by side, and its golden beaches most pleasantly decorated. The cities offer entertainment to please all tastes, and you will find first-rate cooking representative of all countries of the world. The climate is mild, and the people extraordinarily friendly, eager to please and to be helpful.

A preliminary trip to Brazil would certainly be an experience to be treasured, especially if it marked the beginning of a profitable business relationship with an electric power company or two.

Telecommunications in Brazil

ROBERT VANDERLOO,
Vice-Consul and Assistant Trade Commissioner, Rio de Janeiro

Brazil has only recently entered the modern telecommunications era.

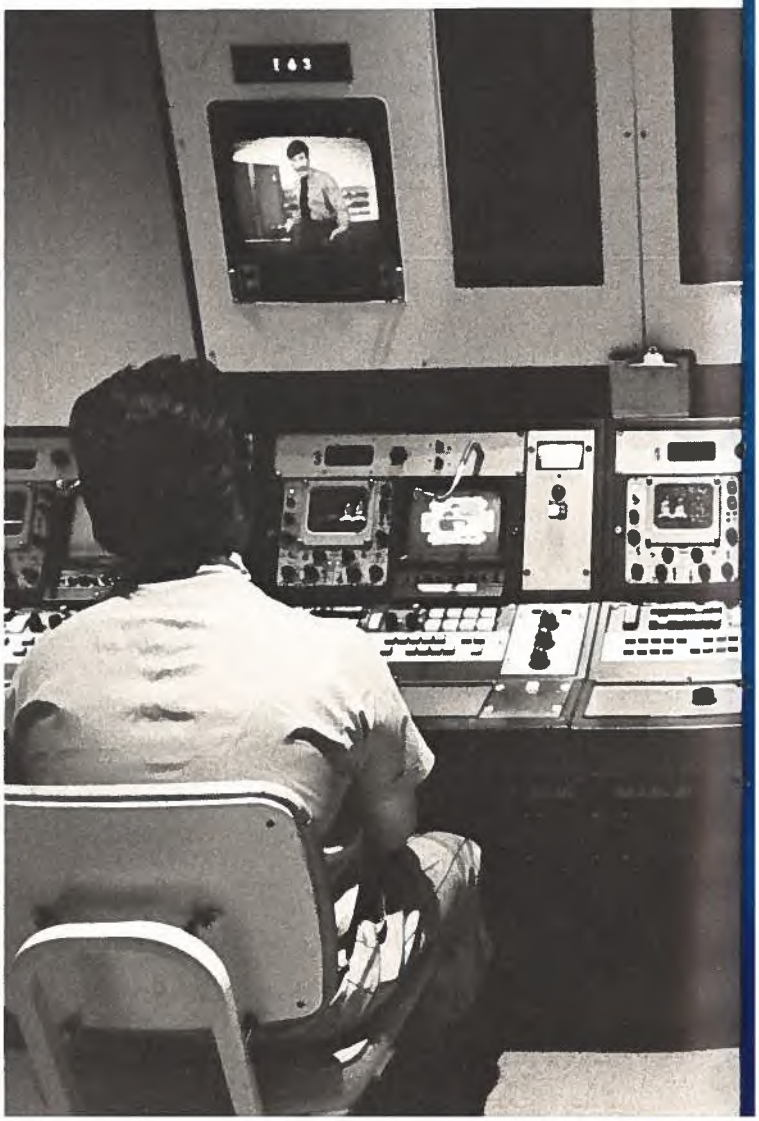
In 1965, the government formed Empresa Brasileira de Telecomunicações (EMBRATEL) to serve as an all-purpose telecommunications company. It now is responsible for satellite and submarine cable activities, as well as for the expansion and operation of interstate and international telephone, telex, television and data transmission.

In 1967, the Ministry of Communications was established to formulate policy and oversee operations. In 1972, TELEBRÁS was formed directly under the Ministry as the national telecommunications holding company, which now includes EMBRATEL and the various state telephone companies.

Brazil joined the International Telecommunications Satellite Organization (Intelsat) in 1967 and built its first satellite receiving station and antenna at Tanguá, near Niterói, in the state of Rio de Janeiro. A second satellite antenna,built at Tanguá in 1975, doubled Brazil's capacity for communications with the outside world. Whereas Brazil started with only a 1.9% interest in Intelsat in 1967, today the country has a 4.9% share and is the fourth largest user and shareholder among Intelsat's 92 members.

Intelsat brought some isolated communities into the national communications system, but large parts of the Amazon and Central-Western Regions must still be integrated. Accordingly, Brazil is undertaking a domestic satellite system which initially will link 95 cities through 44 earth stations. The ground system can be expanded as demand develops. The first phase of the national system is expected to cost approximately $240 million — $80 million for the satellite and $160 million for the earth stations. The system will have a 3,756 circuit capacity to be used for telephone, telex and data transmission, as well as for simultaneous transmission of four television channels. Six hundred circuits will be available for a national security network.

The satellite will be 100% foreign design and manufacture. Although the specifications ask for a transfer of technology, EMBRATEL sources have indicated that it is not essential. With the construction of the satellite stations at Tanguá, Brazil has gained some technological experience and it is expected that national content for the domestic program will start at 20% and eventually reach 80%. One Brazilian company, AVIBRAS is already producing satellite antennas and is currently working on a 10-meter prototype antenna for this program.



canada 1977
commerce

De Havilland

Canada Commerce

Summer 1977 Edition
Published by the Department of Industry, Trade and Commerce

Established 1904

Minister
Jean Chrétien
Minister of State for Small Business
Leonard S. Marchand
Deputy Minister
G.F. Osbaldeston
Editor
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Design and layout by
Stephen Shewchuk.

Contents

Photos reproduced by courtesy of:
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Richardson, Bond & Wright Limited
Paper stock
Abitibi Caslon Gloss 120M

For centuries before Orville Wright coaxed his heavier-than-air machine off the ground, men had been obsessed with the idea of emulating the birds.

Thanks to the then marvel of wireless telegraphy, the first aeroplane flight enjoyed immediate world acclaim, and until the outbreak of war in 1939 each new aviation triumph earned international accolades for the flyers concerned.

British aeronautical engineers designed aircraft that could refuel in widely scattered colonial possessions and earn prestige for the Empire en route to the ends of the earth.

American individualists — Lindbergh the most famous — squeezed into one-off "specials" in the quest for immortality; but the bourgeoning U.S. aircraft industry put profit before glory and fashioned planes to telescope travel times between Eastern cities and all populous points west to the Pacific coast.

Few Canadian flyers aspired to world fame. In Canada, the aircraft has always been regarded as an essentially utilitarian machine, a workhorse rather than a thoroughbred race winner, a vehicle capable of blazing trails to parts of the country beyond reach of earthbound transportation.

The romantic mystique of flying was actually strengthened during World War II, and with the peace came a new breed of aircraft: the jet presented man with a fresh challenge, the Sound Barrier, and beyond that a new threshold — to speeds faster than sound. Many aircraft enthusiasts are still mourning aborted plans for Canadian Mach II fighters and super jetliners, but the cost of developing such aircraft has now escalated beyond the financial resources of all but the most prosperous industrial nations with major domestic customers.

What hasn't changed is the earth's terrain. High mountain ranges, steep-sided valleys, remote rivers, inaccessible lakes and vast forests still impede the takeoff and landing of mammoth jetliners. And ever-mushrooming suburbs keep stretching inter-city air times.

Canadian aviation pioneers modified their planes to contend with geographical and weather hazards. That hard-earned experience spawned a range of commercial aircraft which, if short on glamour, lacks none of the sophistication necessary for safe, low cost air travel.

From "seeking the bubble reputation even in the cannon's mouth", De Havilland Canada, offspring of one of the most famous companies in the history of aeronautics, has developed planes that have enhanced Canadian prestige abroad, have boosted export sales and show promise of earning a place in the annals of the world's great utilitarian aircraft.

Pedigree Planes

So many facts and figures have been churned out about aircraft that the layman is no longer impressed except by new absolutes — biggest, fastest, highest flying, largest payload. But among the names that claim most space in the history of aviation is De Havilland.

Geoffrey de Havilland designed his first aeroplane without having actually seen one, and in it he learned to fly. His personal score of "pedigree planes" is unmatched by any other manufacturer. That great name survives in Canada, and De Havilland of Toronto continues to introduce classic aircraft.

Get talking to race horse owners and they will tell you that thoroughbreds with the longest pedigrees are the most prolific winners of turf classics. Lineage is also a preoccupation with cattle breeders, which is hardly surprising in the light of the price tag on supreme show champions.

Pedigrees are not confined to livestock. Consider the astonishing range of instant cameras invented and developed by Dr. Land. The first Polaroid had seemingly miraculous qualities, yet the Polaroid breed was to become more refined when Land genius was mated with the brilliance of film dye experts.

Greater sophistication would come from the Polaroid association with electronic engineers. Each succeeding generation of cameras has been sired by the same innovator, whose latest brainchildren, the instant ciné camera and film and projector, must rank as his greatest achievements.

If pedigree is dependent upon a common blood line, none of the big three automobile manufacturers can rightly claim to have a thoroughbred in the current range. Ford's new Fiesta, which may prove to be the most significant model introduced in the period 1975-80, is a European mongrel with British, German, Spanish and Belgian strains.

It has been adopted by Detroit and within two years it will be accepted as a full-blooded American (with a near-identical Canadian twin).

There are pedigree automobiles. Each Ferrari built in Modena, Italy, owes its existence to the design genius of Enzo Ferrari, and his only consistent rival on Grand Prix circuits is Colin Chapman, creator of the Lotus.

Every car in the world that comes under starter's orders in a road race owes something to Ferrari or Lotus ancestry.

And the next time you watch a television advertisement which sets out to prove that Detroit computers are devising formulae for better automobiles, don't be too skeptical, because some of the "advanced" engineering features in tomorrow's showroom models are the very things that earned Ferrari and Lotus their pedigrees.

In spite of takeovers, amalgamations and contractions in the aviation industry, there are also pedigree aircraft, some of them Canadian.

De Havilland Canada was not formed until 1928, but a DH6 prototype was assembled and flown in this country as early as July 1917 — by which time a De Havilland fighter had proved superior to the German Fokker.

Every third Allied plane was a D.H. and 95% of the U.S. World War 1 aircraft production was based upon De Havilland design.

Two war surplus D.H. bombers made Canadian aviation history with a trans-Canada flight in October 1920. Capt. Thompson flew the Calgary-Vancouver stage over the Rockies.

The De Havilland 50-passenger DASH 7 can trace its ancestry back to December 1909, when Geoffrey de Havilland (descended from a de Havylland who landed in England with William the Conqueror in 1066), a self-taught pilot, aero engine designer and aircraft manufacturer, made his first flight in a De Havilland biplane powered by his own four-cylinder 50 hp engine.

Sir Geoffrey de Havilland lived to see the Canadian company, staffed by men who had helped him develop legendary aircraft like the De Havilland Tiger Moth, Mosquito, Vampire and Comet (the world's first commercial jetliner), introduce the highly successful Beaver and Buffalo. Both machines were evolved from the makeshift aircraft that first conquered Canada's vast expanses of inhospitable terrain and treacherous flying weather. Just as rail links joined Eastern Canada with the Prairies and the Pacific Coast, so did aircraft establish sky routes to remote northern areas which otherwise would have been inaccessible to business entrepreneurs.

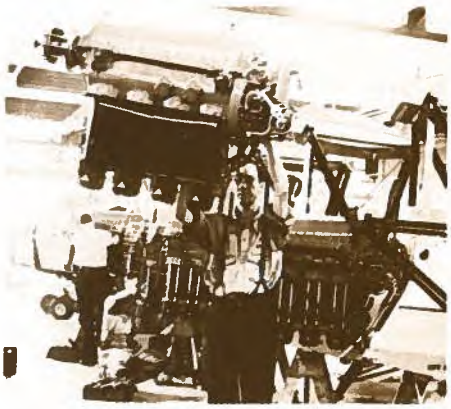
Whereas the gestation period for humans is nine months, several years are necessary to transform the blueprint of a commercial aircraft into a machine which is certified as being safe to carry fare-paying passengers. When the DASH 7 was first announced in 1969, Canadian newspapers worked up tremendous enthusiasm about its ability to take-off and land on short runways. But short take-off and landing (STOL) characteristics are precisely the opposite of those which claim world headlines and capture public imagination. Most of us are immune to everything but absolute figures — highest speed, fastest rate of climb, heaviest load, longest flight without refuelling — that it's become almost impossible to get excited about a flying machine that carries only 50 passengers as compared to the Jumbo Jet's 345-payload, travels at one fourth of the Concorde's speed and costs a mere $3.8 million as against $102 million for the American B-1 bomber.

But just as the sub-compact Ford Fiesta is a superbly engineered vehicle which will become increasingly popular as world oil supplies sink to levels which push the fuel towards $2.00 per gallon, so will the new De Havilland DASH 7 gain international recognition as an economical and time-saving means of inter-city travel. Heading the list of buyers will be developing countries which have little need for jumbo jet runways, the expense of which is crippling and cannot be recovered from passenger revenue.

The wheel is turning full circle: until the outbreak of World War II, aviation experts argued that runway costs ruled out the development of large landplanes. So the United States, Britain and Germany went in for big flying boats, which was logical when one remembers that water occupies 70% of the earth's surface. And, of course, Britain is an island and her Empire was then spread across the five great oceans. America saw in the flying boat a means of wresting the lucrative North Atlantic passenger market from British and European shipping lines. Thus it was that in 1937 British Imperial Airways and Pan Am inaugurated flying boat services between Foynes, in the west of Ireland, and the New World. Imperial Airways established a base at Botwood, Newfoundland. Not many miles away, at Gander, the trees on a high plateau (rare in that part of the world) were being cleared to accommodate an airfield that would change aviation history, help to turn the tide of World War II and establish Canada as the hub of trans-world air communications.

An airport was being built at Gander, not because the war clouds were gathering over Europe but to accommodate a De Havilland airliner capable of flying nonstop across the Atlantic. Hitler's invasion of Poland would put an end to that pipe dream, but another De Havilland project was destined to create havoc in German cities and write a glorious chapter in the history of De Havilland Canada.

Those readers who would question the link between a 40-year old aircraft blueprint and the 1977 De Havilland DASH 7 might give thought to the impact which the Thirties had upon their own families. The decade preceding World War II may seem an eternity away, but all our yesterdays helped to determine what and where we are today.



H.R.H. the Duke of Kent is greeted by Phil Garratt, for 22 years De Havilland Canada chairman, at the Toronto plant. The main production in 1941 was the D.H. Tiger Moth, the trainer in which most Canadian and British wartime pilots learned to fly.

The Duke (brother of King George V1) secretly flew across the Atlantic sitting on a mattress in the bomb bay of an unheated 4-engined Liberator. Above 15,000 feet, crew and passengers sucked oxygen through a rubber tube. A few weeks later the Duke was killed in an RAF Sunderland flying boat off the West Coast of Scotland.

De Havilland's golden era really started in 1934. It was the year of the England-Australia Air Race, and all the experts were predicting that American aircraft would dominate the event. Working night and day for months, De Havilland designed, produced and tested a challenger, the Comet 1. It was an all-wood cantilever monoplane with two De Havilland Gypsy Six engines.

Three Comets were built and sold to competitors at $20,000 each. The De Havillands were placed first and third — the winner (piloted by Charles Scott and Tom Campbell-Black) covering the 11,300 mile route in the then incredible time of 70 hrs. 59 min.

The Comet's all-wood construction ran counter to the increasing popularity of metal fuselages and wings. But Geoffrey de Havilland had in Toronto a subsidiary company with easy access to Canadian yellow birch, Sitka spruce and Douglas fir. Wood laminations, he argued, would give strength and lightness, and minimum weight meant maximum speed. He decided to develop his London-Australia air race aircraft. With two Rolls Royce engines, no guns and minus protective armament, he would have a light bomber which could deliver its load and evade enemy fighters.

He presented his concept to the Air Ministry in 1937, a year when only the voice of Winston Churchill publicly thundered against the growing menace of the German Luftwaffe. Air Force chiefs ridiculed the idea that De Havilland's bomber would be capable of outsmarting the world's swiftest fighters. And when he revealed that the new brainchild would be made of wood, one Air Marshal scornfully referred to an "updated relic of a bygone era" and voted against granting a research and development contract. That same august body of experts had earlier rejected a bomber of revolutionary geodetic construction (the Vickers Wellington, an outstanding aircraft designed by Barnes Wallis) and an eight-gun fighter (the incomparable Spitfire).

Thanks to the phenomenal success of his Tiger Moth, the single-engine trainer produced in England and Canada, Geoffrey de Havilland could afford to invest in one, but only one prototype "Wooden Wonder". He pushed ahead, not through obstinacy but because he passionately believed that his aircraft would be more than a match for any enemy pursuit plane.

By 1938 government orders (for Tiger Moths and twin-engined Oxfords) were crowding every inch of floor space at the Hatfield plant, so rather than incur the wrath of Air Ministry moguls, De Havilland bought a 17th century manor to accommodate the team assigned to his pet project.

English manors have vast kitchen areas. It was here in the early months of the war that the first Mosquito took shape while the engineers made their calculations and came up with an astonishing set of figures. Powered by two Rolls Royce Merlin engines, the Mosquito would beat 409 mph, or it could carry a 1,000 lb. bomb load and cruise for 1,500 miles at 325 mph. Ridiculous! The Spitfire could not better 370 mph.

The prototype plane took to the air on November 25, 1940, with young Geoffrey de Havilland, the chairman's son, in the pilot's seat. Cruising at 220 mph, it responded smoothly to the controls.

Five weeks later, C.D. Howe, Canada's Minister of Munitions and Supply, watched the younger de Havilland demonstrate the aircraft's speed and manoeuvrability. A second Canadian was present — Lord Beaverbrook, Churchill's Minister of Aircraft Production.

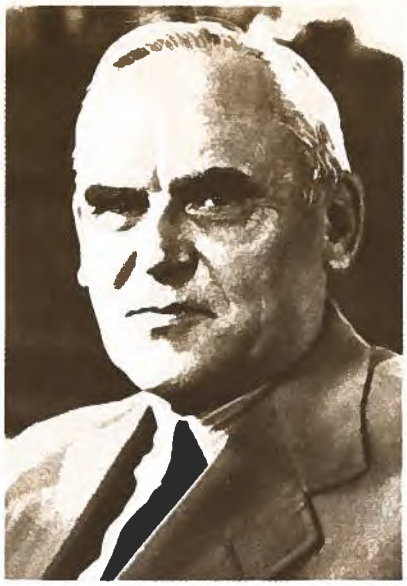
The Mosquito took off, climbed, disappeared into the clouds and minutes later reappeared, diving steeply towards the aerodrome. Leveling out at 200 feet, it swooped over the heads of the two Canadians at 408 mph.

Not many miles away, Frank Whittle had his experimental jet engine running on a test bench, its potential as yet unrecognized by the powers-that-be.

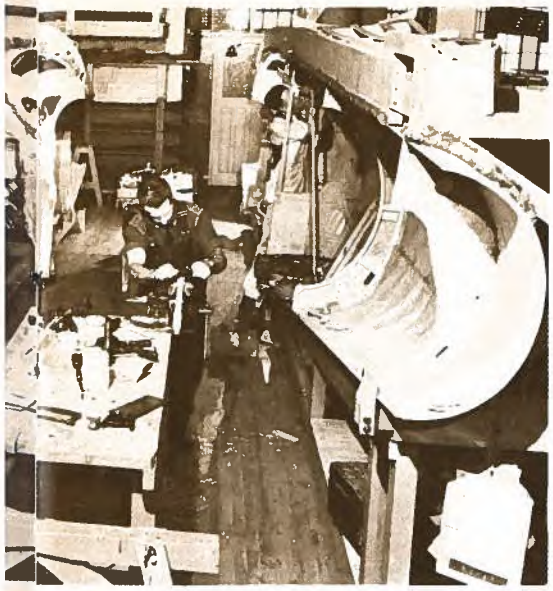
C.D. Howe had just seen the fastest machine in the world. While others doubted, the Canadian accepted as gospel the designer's claims that the Mosquito would prove to be an outstanding fighter-bomber, bomber, night fighter, photo-reconnaissance aircraft.

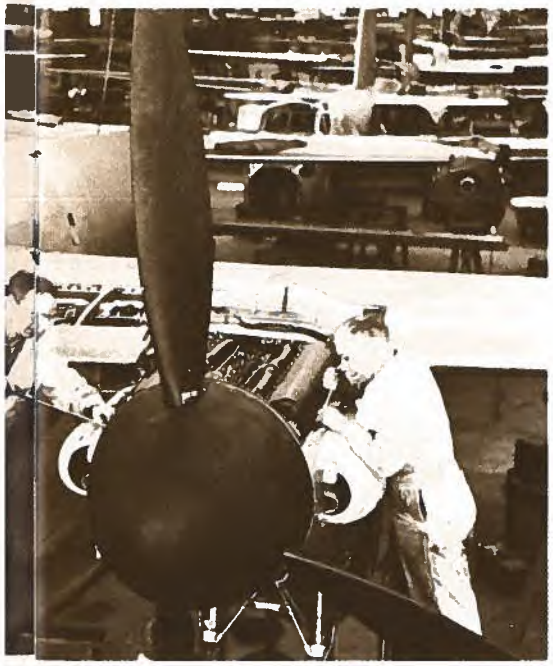
Howe lost no time in approaching Beaverbrook and de Havilland: the Mosquito must be built in Canada.

C.D. Howe (top left), his ship torpedoed en route to Britain, had a second hair-raising experience when young Geoffrey de Havilland flew the "Wooden Wonder" at 408 mph, 200 feet above the Canadian Cabinet Minister's head. That night, December 29, 1940, C.D. Howe was caught in the middle of London's worst incendiary bomb raid. It was Howe who insisted upon manufacturing in Canada the D.H. Mosquito, fastest fighter-bomber of World War 11.



Into that narrow fuselage, on hush-hush wartime Stockholm-Scotland flights, the British packed two VIP passengers — strapped securely on stretchers for minimum bulk. Every other inch of space was crammed with ball bearings — for Canadian Mosquitos.





When the Canadian Armed Forces ordered British De Havilland Vampire jet fighters (second only to the Gloster in Allied air forces), no financial provision was made for servicing jet engines in Canada. So De Havilland Canada footed the bill for building overhaul facilities. After some thin early months, the enterprise showed a handsome profit.

His suggestion won their immediate approval, one reason being the nightly procession of German bombers to the London area. During the first two weeks of September 1940, air raid alerts at the De Havilland Hatfield factory had cost 84,309 man-hours.

From nose to tailplane, the Mosquito was British-made. Obviously the Canadian company would have to find in North America the suppliers of parts and components to produce replicas of the brilliant original. There was a ready-made solution to the engine problem — the 1,000 hp Merlin, which also powered the Hurricane, the Spitfire and the still-to-come Lancaster bomber, was being manufactured under license by Packard of the U.S.A. (after Henry Ford had refused to assist the British war effort).

It took seven months — an eternity in wartime — for the British and Canadian Governments to formally approve C.D. Howe's Mosquito project, but in August 1941 Lee Murray, the Hatfield general manager, arrived in Toronto to work out production schedules with Phil Garratt, managing director of the Canadian subsidiary. Some of the Canadian engineers and aero specialists who attended those initial planning meetings are still at Downsview, Toronto.

No peacetime endeavor matches the phrenetic pace set by industry in wartime. British Commonwealth forces were the only bulwark against Nazism in that summer of 1941. America had yet to enter the fray and the production machinery of "the great arsenal of democracy" was still far short of the momentum that would eventually see a single assembly line turn out 4-engined bombers at the rate of one per working hour.

The De Havilland Canada target of two aircraft by September 1942 was dependent upon ships with vital jigs and components eluding German U-boats which prowled the North Atlantic. In fact, some supplies did not get through; but an even greater threat to production schedules was air force vacillation. The bomber chiefs had laid first claims to the Mosquito, but its success as a night fighter in European skies excited the interest of the fighter boys in Ottawa and they wanted the blueprints modified to satisfy their requirements.

Eventually and inevitably a compromise was reached — the RCAF would be equipped with fighter-bombers. Now a fighter and a bomber are two very different animals, and if you want an aircraft with enough fire power to destroy enemy fighters and at the same time have the capacity to deliver an effective bomb load, the aero technologists must be masters of their craft. Yet all design, structure and performance problems become almost academic if suppliers fail to come up with parts identical to those specified by the original designers. De Havilland scoured Canada and the United States for component manufacturers. The tailplane unit had to come from Vancouver, 2,628 rail miles west of the main assembly plant.

There were items which neither America nor Britain could supply in sufficient quantities. Sweden was a prime source of ball bearings. But that country was neutral and ringed by enemy forces. In the early months of the war, Britain maintained a hush-hush air service with Scandinavia, flying a Lockheed Lodestar between Stockholm and Scone in Perthshire, Scotland (where the writer learned to fly at the controls of an RAF De Havilland Tiger Moth).

Although a fine plane for leisurely commercial operations, the Lockheed could not hope to survive in skies dominated by Heinkels and Messerschmitts. Only one Allied aircraft could maintain the Sweden-Scotland air link: the De Havilland Mosquito. Since they could fly higher and faster than the enemy, unarmed "Mossies" would take off from Stockholm laden with ball bearings and in full view of German secret agents. Field Marshal Hermann Goering ordered the Luftwaffe to modify a Focke-Wulf Fw190 to operate at 40,000 feet, but Mosquitos had been converted to reach 45,000 feet, and only two were lost on "the milk run" across enemy-held Europe. From Scotland, the precious ball bearings were flown to Toronto by 4-engined Liberators, sometimes by way of West Africa, the South Atlantic and Brazil.

Frustrating as it is, that kind of experience grooms men to produce pedigree aircraft.

Canadian in concept and character

World War II brought to Canada the world's most experienced pilots, some of them household names as a result of their global records in the face of impossible odds.

In that pre-jet era, there was no climbing clear of the worst Canadian weather; and when the elements and mechanical troubles conspired against them, master aviators from more temperate climates suffered trials and tribulations all too familiar to Canadian bush pilots.

Thus it was that De Havilland of England gave free rein to Toronto confreres when they sketched the first outline of a plane designed expressly for Canadian conditions.

On May 7, 1945 the factories producing weapons of war for the Allied forces were going full blast. Twenty-four hours later the guns in Europe were silenced for the first time in almost six years. Conflict raged still in the Pacific arena, but with mountains of military hardware now available for shipment from European and Middle East battlefronts, most North American factories throttled back from round-the-clock operations to normal day shifts. For those temporary plants which had been created solely to produce armaments, the shutdown came almost immediately.

All De Havillands, and each one assured a place in the annals of Canadian aviation history. The Vampires, above, the first jets to fly in RCAF colours, were shipped from England in crates and assembled by De Havilland at Downsview. A prototype Vampire flew in 1943, but did not enter service until 1946. The Goblin jet engines were designed by De Havilland, the company responsible for the development of the first British jet.

The top right photo shows the Mosquito, of which 1,034 were built in Toronto. A Canadian "Mossie" covered the 377 miles from Malton to La Guardia, New York, at an average speed of 411 mph.

Historians concentrate upon broad issues of war and peace, and records of World War II offer a plethora of statistics on army strengths and casualties, the might of opposing naval armadas and the relative destructive power of rival air forces. Very little, or so it would seem, has been written about the sudden impact of peace upon millions of factory workers who for years had been geared to an all out war effort.

Their bread and butter had come from forging weapons of destruction, and when the Japanese surrender followed within three months of VE-Day, the instruments of victory suddenly became expensive junk which served no useful purpose in peacetime.

The transition from war to peace is not easy for manufacturers of military aircraft. De Havilland Canada suffered the additional handicap of being the subsidiary of an English company which, if not in exactly the same predicament, could not afford to spread its activities between plants on opposite sides of the Atlantic.

One of the few warplanes which wasn't axed in 1945 was the De Havilland Vampire. Production of this, the second Allied jet aircraft, was maintained because it so obviously spearheaded a new force in world aviation, military and civil. Geoffrey de Havilland had a second jet project on the drawing board. This was a jetliner which would be powered by four Ghost jet engines developed from the De Havilland Goblin unit employed in the Vampire fighter.

Canadians may wonder why the English company did not subcontract sections of the jetliner to the Toronto plant. This wasn't feasible, for the simple reason that time and financial considerations precluded the building of prototype planes.

The world's first jetliner, the 4-engined De Havilland Comet, was built "straight off the drawing board". Even as it took shape, Geoffrey's eldest son was killed at the controls of an experimental tailless jet "flying at a speed greater than had previously been attained by man".

As aircraft approached the Sound Barrier, a host of new aerodynamic problems presented themselves and the solutions depended upon the combined efforts of small, closely-knit teams of airframe and wing technologists, jet engine specialists and test pilots.

The death of young Geoffrey de Havilland — his brother had been killed in a Mosquito crash — in pursuit of the speed of sound would be followed by other jet disasters. John Derry died when his experimental De Havilland 110 crashed at the Farnborough Air Show. Two Comet jetliners disintegrated on commercial flights because of metal fatigue, an entirely new factor which would prove to be critical in designing high speed aircraft.

Whilst it is true that war surplus fighters and bombers could not earn their keep in civil aviation, there were other species of warplanes which could be modified for commercial use. One of the finest examples — and it's still flying — is the twin-engined Catalina flying boat. Although the top speed in mint condition was less than 180 mph, it could span 3,000 miles without refuelling and proved ideal (but so noisy!) for antisubmarine patrols.

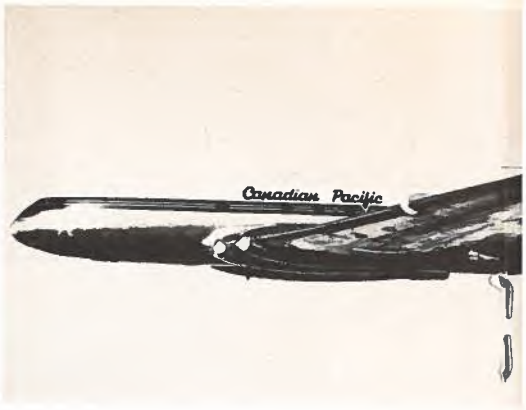
During the war, amphibious versions of the American flying boat were built by Canadian Vickers and Boeing (Canada). When peace came there were literally hundreds of Catalinas dotted around the world and most of them (except those supplied to the U.S.S.R. under Roosevelt's Lease-Lend Program) found ready purchasers.

We are talking about an aircraft that had been designed in the early Thirties and made its maiden flight in 1935. Later models benefited from wartime advances in avionics, but these improvements were neutralized through years of hard use and abuse on active service. Over 200 war-weary "Cats" made their way to the De Havilland plant at Downsview, Toronto. Conversion for commercial operations entailed a complete strip-down of the hull, engines, controls and wiring.

It was a mammoth operation and in some ways reminiscent of animal dissection in a hospital laboratory. Just as medical researchers can trace the cause of disease from studying sections of the human anatomy, so do aviation technologists profit by dismembering planes with thousands of flying hours to their credit. Comparisons could also be made between the design techniques which had made the clumsy Catalina so successful on slow marathon flights and the unique laminated wood structure of the highly manoeuvrable Mosquito, for years the swiftest fighter-bomber in the sky.

Whilst the Catalina conversions were undertaken to meet the weekly payroll — which had contracted to 350 from a wartime peak of 7,169 — the creative juices of the Toronto design team showed no sign of drying up. In 1946 came the single-engine Chipmunk trainer — a worthy successor to the English-designed Tiger Moth, of which 1,747 had been built in Canada, some for sale to the U.S.A. For the first time a wholly Canadian product was adopted by the parent company. De Havilland England mass produced the Chipmunk for the RAF and also did excellent business with air training establishments throughout the world. Downsview built 217 Chipmunks, closing down the assembly line in 1951 to concentrate upon bigger and more sophisticated aircraft types.

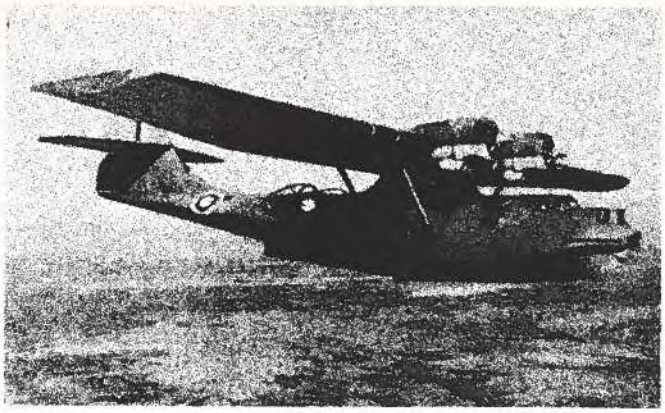
Toronto veterans who learned their crafts under the aegis of Sir Geoffrey de Havilland recall with warm affection the British creators of a whole string of outstanding aircraft. Yet none of them was specifically designed to cope with the combination of terrain and weather which makes Canada one of the world's toughest proving grounds for aircraft, especially those which must operate on short runways or waterways hemmed in by hills. Necessity being the mother of invention, the British, because of their pre-war interests in the Middle East, India and South East Asia, had applied themselves to the problem of building planes for areas plagued by desert sandstorms, monsoons and perennial high humidity. De Havilland England was supplying to the world and allocated its research and development budget to reap harvests in the most lucrative markets. The Canadian subsidiary, on the other hand, did not have enough voting strength in the main boardroom to grab the cash necessary to compete successfully against American manufacturers of small aircraft.



The all-Canadian Chipmunk trainer (above) loops the loop, a manoeuvre that's an essential ritual for the advanced novice.

Top left, the D.H. Comet, the world's first jetliner. At the cost of two Comets, world aviation came to grips with metal fatigue, a vital factor in designing for flying high and fast in safety.

Right, yet another De Havilland first, this the Beaver light transport, which made its maiden flight in August 1947. The men deserve to be better known because of their individual contributions to Canadian aviation, industry, prestige and export earnings.



The breakthrough came with the Canadian-designed Chipmunk trainer. Sales and royalties produced a healthy balance in the Toronto bank. There was enough money to gamble on a small communications aircraft, the answer to the prayers of Canadian bush pilots, men who are acknowledged to be the best all-rounders in the business.

These pages have contained so many references to *British* aircraft designers, the *English* De Havilland company and its *Canadian* subsidiary, that the reader might get the idea that the De Havilland saga was a form of U.K.-versus-Canada rivalry, with the London-based team always trying to score points in needle matches with their "Colonial" cousins. Nothing could be farther from the truth. Professional rivalry there was: it exists in every large manufacturing organization which is blessed with creative designers and engineers. But the key figures at boardroom policy meetings are the financial wizards, whose first loyalty is to the shareholders, regardless of nationality.

(left) Phil Garratt

During the period 1936-65, the dominant personality at De Havilland Canada was Phil Garratt. Toronto-born, he began his aviation career with the Royal Flying Corps in 1916, served as a fighter pilot on the Western Front, did stunt flying in the early Twenties, was an RCAF flying instructor and joined De Havilland in 1928 as general manager of the Canadian subsidiary.

Company chairman for 22 years, he deserves much of the credit for weaning the Canadian offspring from its English parent and mentor. From being an assembly plant working to British aircraft blueprints, Phil restructured the Downsview company, making it responsible for all stages from concept to construction.

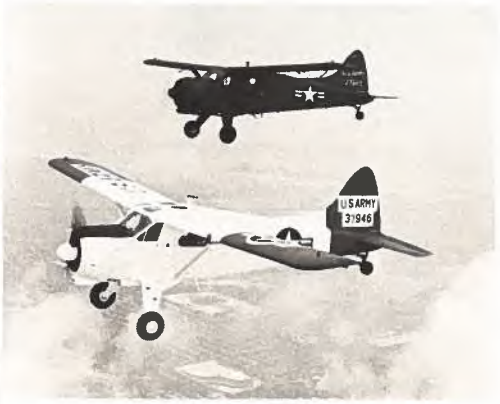
The first major essay in original Canadian design was the Beaver, a single-engine STOL aircraft capable of soaring above 50-foot obstacles within 1,000 feet of its starting point. Bush pilots have to contend with these statistics all over Canada, whereas fliers on the tiny mainland of Britain have only one mountain higher than 4,000 feet, almost never use inland lakes or waterways and have access to excellent runways close to their centres of operation.

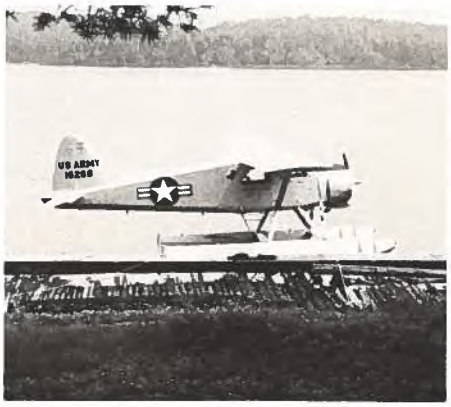
Since it would earn its living remote from major servicing facilities, the Beaver had to be rugged and reliable, its engine and controls impervious to extremes of climate, its "constitution" strong enough to survive for long periods without the care and cossetting lavished upon aircraft in the United Kingdom.

For 55 million years beavers have inhabited only northern regions of the globe, but maps of Antarctica show a Beaver Lake, Beaver Glacier and Beaver Island. They were so named by members of an Australian Antarctic Expedition. Their research, mobility and survival depended upon the De Havilland Beaver's ability to keep healthy regardless of weather and terrain.

A prototype Beaver was test flown in 1947 by Russ Bannock, now President of the all-Canadian company. Production continued until 1968, with 1,692 satisfied customers owning planes which, even when 20 years old, can fetch $25,000, the original price tag.

Fully loaded to 5,100 lbs., a Beaver landplane can takeoff in 560 feet.





The Beaver made its début in 1947, but not to the thunderous applause of a large audience of prospective buyers. The staggered dates on the first pages of the Beaver order book sent cold chills along the spines of company accountants. That same frightening sensation would be repeated at the introduction of the Otter, the Caribou and the Buffalo. Those fears proved groundless: the aircraft named showed a profit. And now there's the brand new DASH 7. Remembering the futility of all that earlier anxiety, the reader might be lured into the false assumption that chairborne, self-appointed aviation experts are not the least bit concerned about the economic future of the DASH 7. Alas, the media is worried. Some Canadian journalists work up a great lather of excitement when first told about a new Canadian enterprise, are too busy to research the subject, yet at the dictate of a publishing deadline type reams of tutti-frutti copy. Months later, with the daily routine even more hectic, they do an update on the original story and struggle to hold reader interest by pouring cold water over a Canadian project which, unlike Jack's magic beanstalk, didn't soar to the heavens overnight.

The proof of any Canadian pudding is when the Americans find it to their liking — and ask for more. U.S. enthusiasm over the Beaver waxed slowly. Although a prototype took to the air in 1947, Washington did not sit up and take notice of the Canadian aircraft until it won a design contest in 1951. Naturally, the Americans insisted upon an exhaustive test-and-try-before-we-buy program. Sound business practice. The Beaver emerged from the trials with honour, but still the Pentagon hesitated: again perfectly understandable, because Washington air chiefs now had the urge to sign eight-figure contracts. To make assurance doubly sure, they drew up a new schedule of tests. Not that Americans lack courage in the marketplace; but after all they are masters of the science of aeronautics. Talk to any silver-haired international airline captain whose occupancy of the left-hand pilot's seat dates back to the Nineteen Forties and he will admit that he probably owes his professional longevity to American aero design excellence. So why did the U.S.A.F. want the Beaver? Simply because it was the world's most versatile single-engined light transport. For that reason the Buy America Act was bypassed, allowing the U.S.A.F. to make its first peacetime purchase of foreign planes.

Deliveries commenced in 1954, and by 1967 no fewer than 1,600 had been sold — all but 244 of them to export customers in 23 countries (the U.S. Armed Forces taking 968 and the British Army 36).

De Havilland Canada didn't bang the publicity drums very hard when the first production aircraft rolled off the assembly line in 1954. Until March 23 of that year world attention was focused on the impressive performance of the British De Havilland Comet, the first jet in airline service.

Conceived during World War 11, the Comet had everything going for it. The designer was Ronald Bishop, the man responsible for the remarkable Mosquito fighter-bomber. A war hero piloted the jetliner through all its tests. John Cunningham, a graduate of the De Havilland Technical School, had served with the Royal Air Force and was dubbed "Cat's-Eyes Cunningham" because of his astonishing success in shooting down enemy bombers at night (flying Bristol Beaufighters and D.H. Mosquitos).

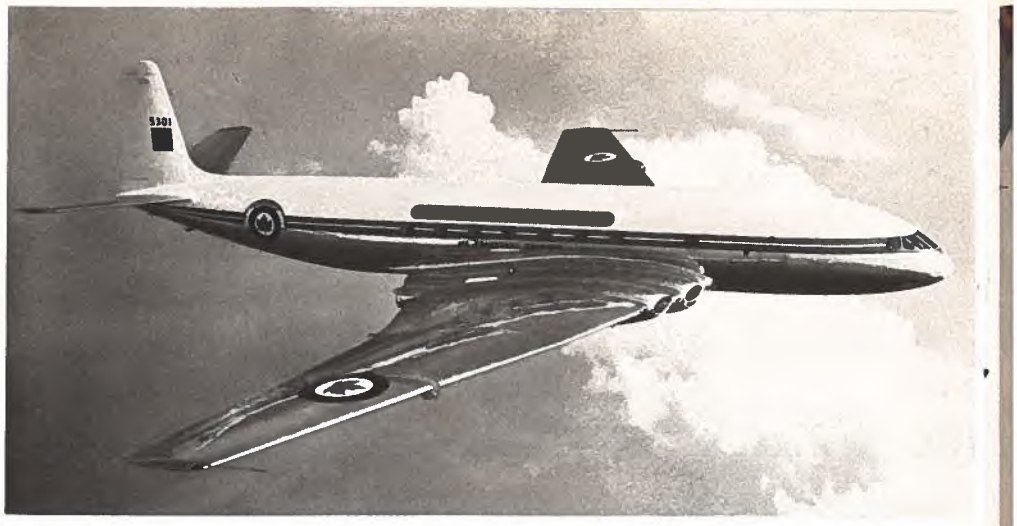
Having been the first manufacturer to design a landplane specifically for transatlantic service (that ambition thwarted by Hitler), Sir Geoffrey de Havilland wanted to build a long-range, passenger jetliner. The British Air Ministry attached great importance to airmail (the Empire still straddled the globe in 1946), while BOAC, the most obvious customer, preferred a cargo-passenger load mix which would better guarantee break-even flight revenues. When BOAC hinted at an initial order for 24 Comets, Sir Geoffrey compromised, and in doing so paved the way for America's eventual supremacy in long haul air travel.

The 4-engined Comet made its first flight in July 1949, started airline service in May 1952, and was an immediate success on South Africa, India, and Far East routes.

Disaster struck in January 1954. A BOAC Comet took off from Rome airport and disappeared near the island of Elba. Three months later a second Comet went missing, again off the Italian coast.

The mystery surrounding these jetliners tragedies had to be solved. The Comet had introduced a new, faster mode of air travel, and at least a dozen famous companies in different parts of the world were working on jet-engined passenger planes.

The Royal Navy located sections of the first Comet at the bottom of the Mediterranean. Special equipment was designed to explore the sea floor and divers spent months salvaging hundreds of pieces of shattered metal.



Although the Comet jetliner, top left, was manufactured in England, De Havilland Canada had expert overhaul facilities, thanks to self-funded enterprise dating back to D.H. Vampire jet fighter.

If there's a secret to Downsview design success, it's in leaving other manufacturers to produce the biggest, fastest, highest-flying planes. Versatile, rugged and reliable are De Havilland Canada hallmarks — exemplified in the Caribou and Buffalo. The latter was designed to satisfy requirements of the U.S. Army, which has access to domestic manufacturers who virtually dominate the transport sector of world aviation.

Back at the Royal Aircraft Establishment in Farnborough, fragments of the Comet were painstakingly fitted together like a jigsaw puzzle. In a nearby hangar a huge water tank was constructed, and into it, for pressure testing, went a complete Comet fuselage.

Simulated flight conditions provided data which was communicated to aeronautical engineers all over the world. When the tests reached the equivalent of 9,000 hours of flying, a rivet in a window frame sprang loose, and almost immediately a rent appeared in the side of the cabin.

At the Court of Inquiry on the Comet disasters it was established that De Havilland designers had made provision for working pressures greater than those required by the Air Registration Board.

In the words of Geoffrey de Havilland: "although we suffered disaster, it caused attention to be focused, not only on pressure cabin design, but on the whole subject of metal fatigue. It accelerated research . . . . throughout the world and thus brought about greater knowledge of the problem".

Four years and eight months after the first Comet crash a Comet 4 inaugurated the first jetliner service across the Atlantic. In recognition, America presented De Havilland with the Elmer A. Sperry Award "for the vision, courage and skills displayed in conceiving, developing and producing the world's first jet powered passenger transport aircraft, the De Havilland Comet, powered by De Havilland, Ghost, jet engines. This accomplishment is especially noteworthy as providing the example and inspiration which has brought into being the succession of efficient, high-performance, subsonic jet transports that have followed under various leaderships throughout the world."

The elaborate equipment which tested Comet fuselages to destruction at Farnborough is now used, in modified form, by every major plane maker. The De Havilland Canada test equipment occupies an entire hangar and its complexity gives a clue to the vast sums expended to ensure that aircraft designed in Canada will meet the stringent air safety standards imposed by world regulatory bodies.

The twin-engined Caribou military transport took shape during the Comet crises. In the quest for the ideal tailplane configuration, Toronto designers tried different shapes. One experimental elevator section caused excessive flutter — so much, in fact, that the tail broke away as the prototype Caribou pulled out of a V-dive.

The crew bailed out, but with memories of the British disasters all too vivid, Toronto technologists formed a special team to redesign the fuselage and evolve a new tail unit. This delayed the production program and escalated research and development costs to the point where the company's financial controller could see the bottom of the money barrel.

Strong nerves were needed in the boardroom because the Caribou was De Havilland Canada's first "heavy" aircraft. Fully laden, it would top 28,500 lbs., and with maximum overload the weight would go to 31,300 lbs. It's at the 12,500 lb. (empty) mark that American air safety rules tighten so much that foreign aircraft manufacturers rarely meet the standards. To be an economically viable proposition the Caribou had to attract customers outside the small Canadian market. It simply had to earn Washington certification.

Bob McIntyre

The man assigned to the job of getting the Caribou airworthy was Bob McIntyre, a 1936 Honours graduate in Mechanical Engineering, Toronto University. With a Massey Fellowship grant, he had studied aeronautics at Cambridge University, England, and worked at the Royal Aircraft Establishment in Farnborough before joining De Havilland Canada in 1943 as project engineer on the Mosquito.

For almost a year McIntyre made twice monthly trips to Washington with blueprints of the Caribou. Some meetings didn't get under way at the appointed hour because F.A.A. officials had to deal with a series of sheared wing crashes involving a particular type of American aircraft. In that atmosphere, the Americans weren't always sympathetic to a Canadian with tailplane design problems.

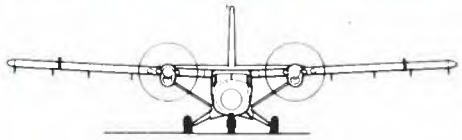
On July 30, 1958 the Caribou soared above the Downsview airfield, answered to the controls like a docile house pet and made a perfect landing. For De Havilland Canada it meant the vital transition from creator of small transports to big league manufacturer of go-anywhere medium heavies.

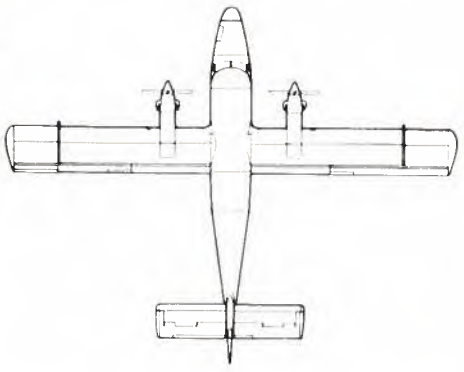
The first Caribou delivery was made in 1959, with the United States the largest single customer.

After the Caribou came the Buffalo, a twin-engined military and utility transport designed primarily to meet U.S. Army requirements. A total of 86 have been sold in Canada, the U.S.A., Brazil, Peru, Ecuador, Kenya, Zambia and Zaire. A recent contract worth $77 million was for the latest DHC-5D version. The new customers were the Democratic Republic of the Sudan and the Government of the United Arab Emirates.

The twin-engine Otter first flew on May 20, 1965, and is now operating in over 60 countries.

The paucity of performance and other technical data in these pages will disappoint aviation enthusiasts. For them De Havilland produces an endless stream of leaflets and bulletins — most of them virtually unintelligible to the layman.

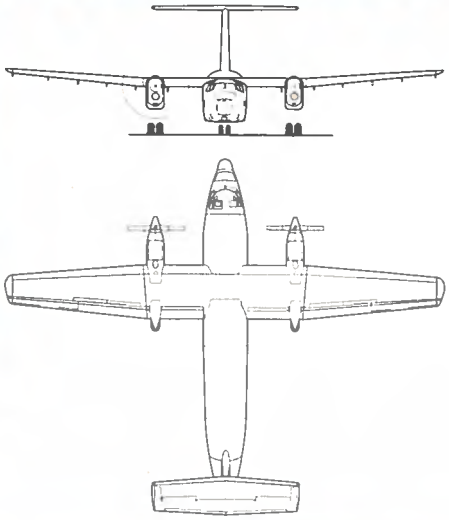




For the average air traveller, the supreme test comes when he finds himself at a small, short-runway airport in a remote corner of the world hemmed in by cloud-capped mountains. On the apron is a miscellany of passenger planes, some long past their prime. In that company, in that terrain, it's a wonderful moment when the airline representative leads the way to a De Havilland Twin-Otter.

Powered by United Aircraft of Canada PT6A-27 turbo-propeller engines, the Twin-Otter will takeoff in 700 feet fully laden. Sudden loss of one engine produces little swing and it will continue to climb at 79 knots.

More than 550 Twin-Otters are in service throughout the world. Bon voyage and happy landings.



Production of this supplement was inspired by a Toronto taxi-driver. When asked to drive the writer from Malton airport to De Havilland on Garratt Boulevard, Downsview, he closed his eyes and with a wry expression enquiried: "De-who at where?" True, the passenger's accent was Scottish, but at the end of a circuitous (and unnecessarily expensive) journey to Downsview, the taxi-driver — locally born and boasting a university degree — found himself confronted by a huge building with letters 24 inches high and stretching across 40 feet. After reading aloud, "THE DE HAVILLAND AIRCRAFT OF CANADA LIMITED", the driver shamefacedly refused a tip and said: "I reckon I should know something about that outfit". He should: he is one of the part owners of a company with a proud record in aviation. De Havilland does much for Canadian prestige abroad, and it's a dollar earner in export markets dominated by American aircraft manufacturers. When you compete successfully against masters of a craft, there's cause for Canadian pride.

Keen-eyed observers in the Toronto area have a chance to see a constant procession of "flying test beds". On the left an Augmentor Wing jet STOL version of the Buffalo jointly developed by De Havilland and Boeing (with Spey 801 SF turbofan jets supplied by Rolls Royce of Canada). By vectoring air between the upper and lower segments of the trailing edge of the flap, the wing lifting capability is doubled and the total thrust increased.

The world's first and best-selling turboprop airliner, the Vickers Viscount, (above), has a new lease of life. Modified by United Aircraft of Canada, it provided a wealth of information on the PT6A-50 engines and Hamilton 24PF propellors used on the DASH 7.

The Dash 7

International experts who are in the aviation industry and can hear cash registers tinkle above the roar of aero engines forecast that between fifty and sixty-five billion dollars will be invested in new planes before 1987.

The DASH 7 — maximum payload 11,640 lbs. — is designed to airlift some of that cash to Canada.

If a neighbour has recently invested in a new automobile, it's safe to predict that he will replace it within five years. Should he fall on hard times, his 1977 model may be retained for 6-8 years, by which time breakdowns, repairs and replacement parts will make it a doubtful asset and he will be forced back to a local showroom, even if it means taking on hefty monthly re-payments. A fastidious owner can grow old with the same car, and because he is careful the machine will rarely be pushed to the point where vital parts fracture through metal fatigue.

Whereas $24 million covered the research and development necessary to put the first four Buffalos in the air, the initial quartet of DASH 7s represents a total investment of approximately $120 million (four prototype B-1 bombers will cost U.S. taxpayers $4 billion).

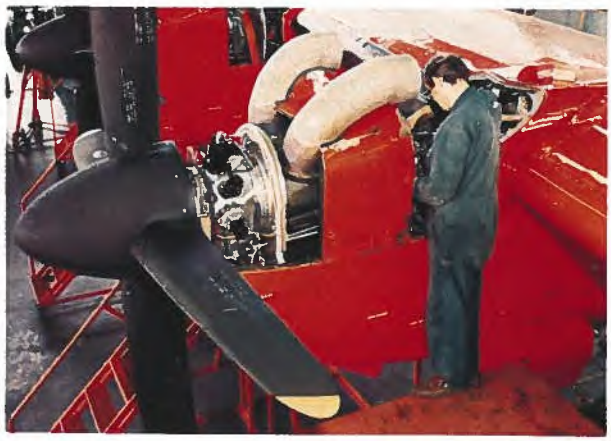
Costing $3.75 million each, the DASH 7 production line will break-even when the 125th plane is sold. The total research and development investment is recoverd at the 250 mark, beyond which the profit margin is comforting.

The existing Downsview production team can turn out DASH 7s at the rate of one per month. Output would have to be increased if, as some experts suggest, world demand goes beyond 300 — to as high as 500 planes.

Metal fatigue was only hinted at in aviation circles until a Comet jetliner desintegrated in midair over the Mediterranean in January 1954, almost exactly half a century after Orville Wright's first flight at Kitty Hawk, North Carolina. Years before the Comet disaster alerted designers to the critical stresses imposed upon high flying jetliners, author Nevil Shute based the plot of "No Highway" on metal fatigue. Shute, by the way, was really Nevil Shute Norway, a brilliant aeronautical engineer before he made his fortune as a novelist. Nevil's first job was with De Havilland, but he later joined Barnes Wallis and helped design the airship R100 — the one that flew across the Atlantic to Montreal and sister ship of the R101.

Thanks to electronic and laser devices, aircraft manufacturers are now able to detect early warning signals that presage metal fatigue. Even so, the normal healthy life span of a passenger jet is judged to be 30,000 flying hours. Many first generation jets are past middle age, and experts forecast that aircraft operators will spend somewhere between fifty and sixty-five billion dollars on new equipment before 1987.

How much of that market can De Havilland Canada hope to capture with the DASH 7? Well, the prospects are brighter than they might have been for the Canadian subsidiary of a British enterprise.

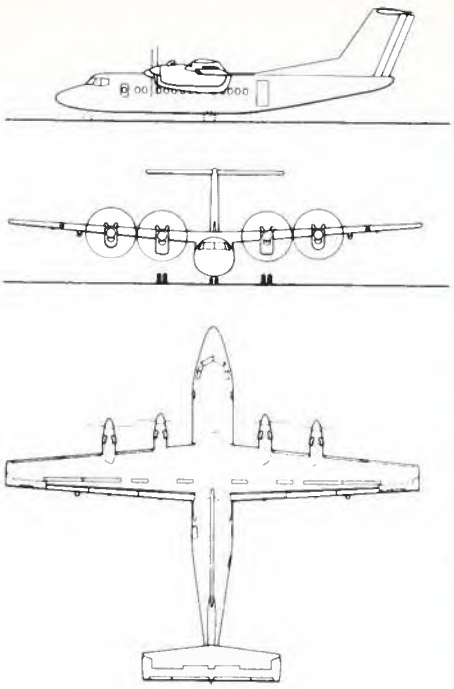


Because it incorporates the latest advances in the science of aeronautics, the DASH 7 production line should still be turning out competitive planes in 1987.

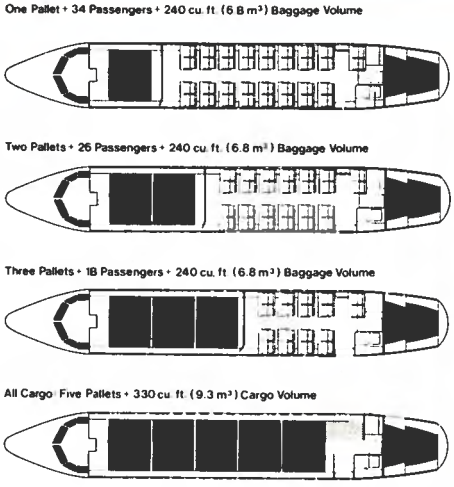
Airlines are haunted by the spectre of in-the-red balance sheets, so they give Operating Costs a far higher priority than the most miserly automobile owner. It's in this area that the DASH 7 scores top marks. Designed for comfort as an all-passenger carrier, it can be converted quickly for passenger-freight operations, or as a quick-load, easy-access freighter. And it can operate from any airfield with a 2,600 ft. runway.

Geoffrey de Havilland's organization was absorbed by Hawker Siddeley in the early Sixties. Sir Geoffrey was not appointed to the new board, nor was any attempt made to perpetuate the De Havilland name in England.

De Havilland Canada survived, but when Phil Garratt stepped down as Chairman, his successor was a Hawker Siddeley man and the long-established team of Downsview executives did not have a voice when policies were formulated in London. Which brings us to 1968, when Bob McIntyre — who nursed the Mosquito and the Caribou through their teething troubles — headed a small group of men with their eyes on the distant horizon. What would be a natural successor to the 20-passenger Twin-Otter? The answer to that question took them around a world generously dotted with De Havilland agents who are constantly in touch with airline operators and rival manufacturers.



So the weather is bad, you're holed up in Singapore, and there in the hotel across the street are three representatives of a Swedish aircraft company. In Melbourne there's an airport strike, so you knock back a few beers with Dutch aviation specialists. The talks in Tokyo are friendly but formal. Unlike the Swedes and the Dutch, the Japanese aircraft executives aren't globe-trotting, but the same topic surfaces at every De Havilland stop-over: tomorrow's short haul, medium sized passenger plane. In London there's no need for guarded statements or discreet probing: the Canadians are sitting alongside representatives of Hawker Siddeley, the parent company. The verbal exchanges are fast and free, and from them emerges one undeniable fact: both companies are interested in the same sector of the airline market.



The Honourable Jean Chrétien, Minister of Industry, Trade and Commerce, with Russ Bannock, President of De Havilland, at the Paris Air Show in June.

Although potential buyers of the DASH 7 had been kept informed of the aircraft's progress from blueprint stage to Certification by Canadian and U.S. federal aviation authorities, it was in Paris that critical eyes first focused on performance, passenger accommodation and cargo facilities.

Like many senior personnel at Downsview, Russ Bannock is a De Havilland Canada veteran who has helped build the company's enviable reputation as a manufacturer of versatile and reliable aircraft. The future of the DASH 7 is now dependent upon marketing skills in the international market — where the competition is fierce.

Suppose we forget professional rivalries and concentrate instead upon some sobering financial statistics. Geoffrey de Havilland started up as an aircraft manufacturer with one thousand pounds sterling, a loan from his grandfather. The engine he designed was built for 250 pounds. Another 150 pounds went on two sheds which served as workshop and hangar. With his wife ready to sew the fabric covering for the fuselage and wings, Geoffrey was able to keep the tool bill down to twenty pounds, which bought the necessary planes, saws, chisels, files, gluepot, vice and drill. When the first plane collapsed, he built a stronger one. It flew successfully and he sold it for four hundred pounds on the very day he spent the last penny of the original thousand pound investment.

A Whitehall memorandum of April 1909 announced that the War Office "has decided to cease making experiments with aeroplanes as the cost has proved to be too great, namely 2,500 pounds".

De Havilland Canada designed the Buffalo and built four pre-production models for $24 million. In 1969, when the DASH 7 was a mere figment of the designer's imagination, the Toronto executives realized that the process of turning fancy into fact would require somewhere in the region of $80 million, and four planes would put the figure above $100 million.

That kind of money isn't easily prised away from the mammoth General Motors Corporation by an overseas subsidiary, and Hawker Siddeley did not have the resources of G.M. Nor did the English holding company share Toronto's enthusiasm for a Canadian-designed STOL airliner. Pure coincidence, but British designers were toying with the idea of a medium-sized passenger aircraft. So, too, were SAAB of Sweden and Fokker in the Netherlands. The Japanese had interesting blueprints, as did half a dozen other manufacturers.

In its role as 50-passenger plane, the DASH 7 has a full load range of 800 miles and can takeoff in 2,600 ft. (790 m.). The cargo version carries six tons (5,440 kg.). Pratt and Whitney PT6A-50 turbine engines make the De Havilland one of the quietest commecial aircraft in use.

A new aircraft design has to be backed up with superb engineering (in retrospect, it might be said that the engineering of the original Comet jetliner did not match its brilliant design). Manufacturing techniques must also be the latest and best — and here the DASH 7 scores: De Havilland went shopping for high precision machinery — some items costing as much as $8 million each.

Some Canadian journalists have suggested in recent months that the world market for STOL airliners is an insubstantial dream, that De Havilland have pressed on with the DASH 7 simply because the men at Downsview enjoy building aircraft. The skeptical scribes should take a trip down to Washington and analyze the statistics prepared by the sharpest minds in the business of marketing aircraft. The scale of future requirements are calculable, if only because of the legions of skybirds that will come to the end of their safe operational lives by 1982. The big problem will be to finance new types. In Europe, manufacturers have accepted the inevitable fact that airlines, banks and financial institutions are finding it increasingly difficult to put up vast sums for aviation research and development. Because of the jobs involved, governments are the only viable alternative, although the American aircraft industry has yet to work up an enthusiasm for sharing the boardroom table with bureaucrats.

De Havilland Canada ceased to be a subsidiary of Hawker Siddeley in 1972. The Toronto company is now wholly Canadian, with two representatives of the Department of Industry, Trade and Commerce serving on the De Havilland Board. That being so, the reader could be excused for thinking that this CANADA COMMERCE supplement has been produced in response to a nod from the top echelons of government. In fact, the initiative was that of the writer, as are the opinions expressed and conclusions drawn.

In 1978, De Havilland Canada will celebrate its fiftieth anniversary. It is hoped that the brief historical references in these pages will encourage Downsview to prepare for posterity, not a dull, dry recital of significant dates and technical facts and figures, but a full-blooded account of the characters who made and manned those wonderful De Havilland flying machines that have contributed so much to the history of Canadian aviation, and indeed of Canada.

Industry, Trade and Commerce

Industrie et Commerce

No companies from Canada, the first country in the world to have a domestic satellite system, bid on Brazil's program. Canadian companies have, in fact, missed out on many telecommunications opportunities in Brazil, which five years ago was literally begging for a local industry.

Many far-sighted firms from the U.S. and Europe established manufacturing facilities here to produce basic equipment and relied on their parent companies for sophisticated products. Brazil now has a growing telecommunications industry that is expanding as a result of stringent import restrictions, and many of the foreign-based firms are now also manufacturing the sophisticated product lines. The upshot is that opportunities to sell directly to Brazil or even to locate a manufacturing facility are becoming difficult.

Opportunities still exist in stored program control, data transmission equipment, time division multiplex, subscriber carriers, and components in general — which offers most potential for Canadian firms — but indications are that in most cases local manufacture will be the only way to enter the market. Canadians interested in locating in Brazil should approach TELEBRÁS in Brasilia.

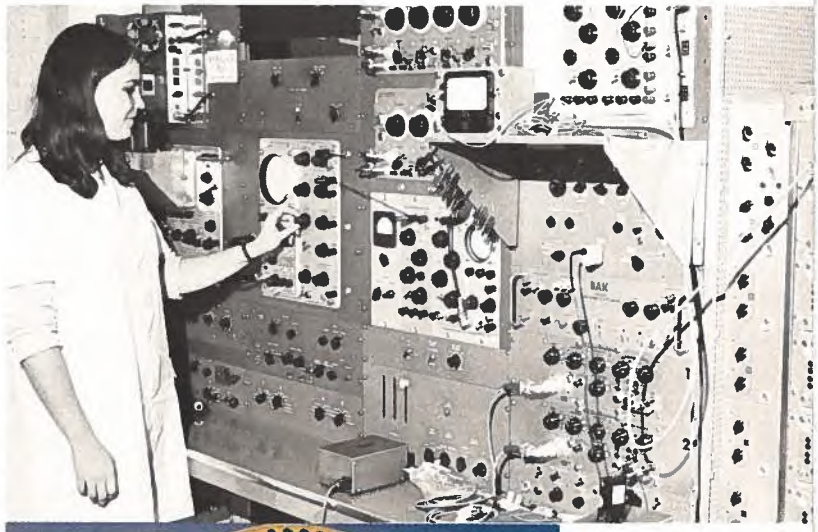
In July and August each year, all telecommunication companies send five-year work plans to TELEBRÁS outlining all equipment requirements for this period. TELEBRÁS, in turn, has just created a new directorate to centralize this information and undertake product research and development. It is, therefore, in a position to determine which products are available in the country, which must be imported and also which Brazilian companies are interested in pursuing joint venture arrangements with foreign firms.

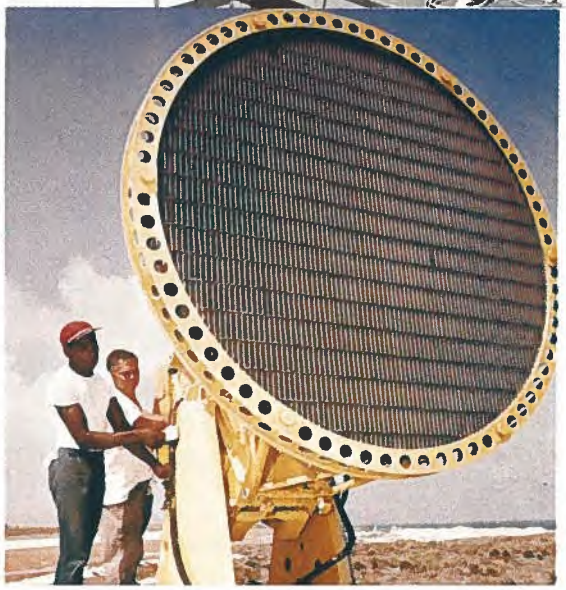
The local industry is less advanced in railway telecommunications, although many foreign firms are beginning to explore local manufacturing opportunities. There is a market here for Canadian-made centralized traffic control systems, since less than 20% of demand can be supplied in Brazil, and the quality is poor.

Equipment is also required for the Amazonia Mineraçao (AMZA) railway, which will link the Carajas iron ore project to the sea. International bids for the equipment should open by July, 1977, but AMZA has not yet decided which requirements will be open to international bidding and which will be supplied locally.

Requirements:

1. Primary transmission system (microwave radio), with approximately 20 radio stations, configuration (1 + 1) and multiplex (120 channels).
2. Secondary transmission system (UHF radio, symmetrical or coaxial), with 57 repeating stations with shunt, capacity for 48 channels, multiplex (24-60 channels).
3. Tele-supervision system for rail traffic control, with dispatch centre in São Luis and 57 remote units.
4. Portable radio-telephone system with controls in VHF stations, installed in the radio microwave stations (see 1 above) — 20 units and dispatch centre in São Luis, plus coding and decoding equipment for the portable VHF units.
5. Select-call telephone system for the railway — 57 pieces of equipment plus one for São Luis.
6. Test and measurement equipment for telephone exchanges, multiplex, VHF, UHF and microwave radios, cables, carrier equipment, rectifiers, etc.
7. Interphase equipment for the microwave system and the various sub-systems.

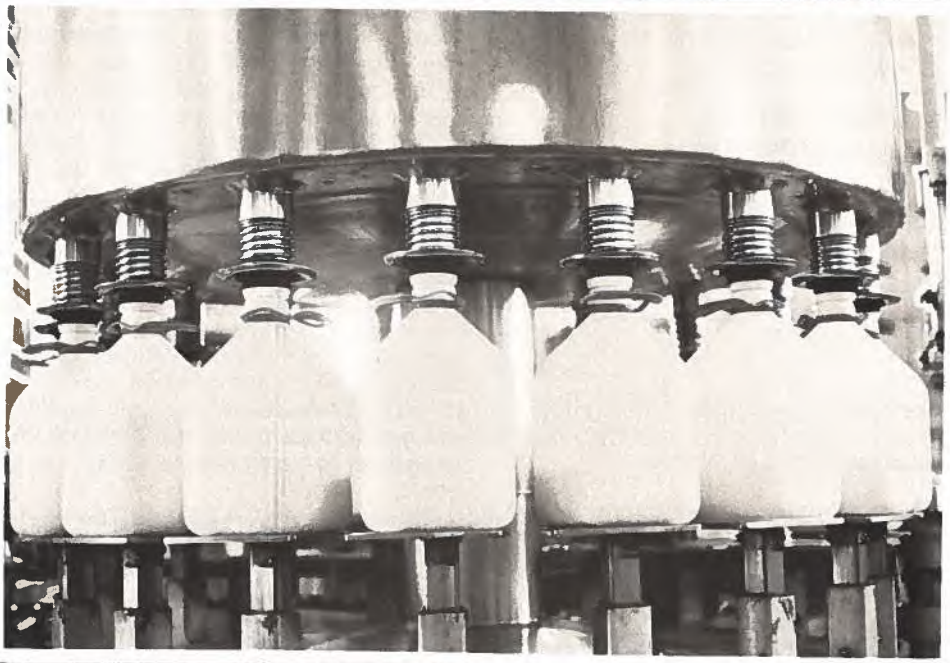




Brazilians like Canadian cream (and powdered milk) in their coffee

Canada took some of her best Holstein-Friesian cattle to the 10th Annual World Dairy Expo in Wisconsin last October and dazzled all comers by taking top honours across the board. Although we didn't take any animals to Latin America's most important cattle event, Brazil's Livestock Show at Porto Alegre in Rio Grande do Sul, much the same thing was accomplished: all winning champion bulls were descended from stock originally exported from Canada.

L.R. KOHLER, Consul and Trade Commissioner, São Paulo



Brazil's population of 110 million people is matched by an equal number of cattle: however, only 30% are dairy cattle. Brazil annually imports thousands of tons of skim milk powder from Canada and other countries to meet chronic milk shortages. Clearly, the need to upgrade the quality and quantity of its milk production is a high priority.

Modern farming methods were developed by German, Italian and Japanese immigrants, but cattle breeders and dairy farmers have relied upon pedigree stock of British descent, much of it imported from Canada.

Beef cattle grow fat on the vast grasslands of the Brazilian Highlands, but the best grazing areas are the grasslands of Rio Grande do Sul.

Brazil started importing Holstein-Friesians from Holland in 1894 and continued sourcing there until 1960, when the evolved breeds in Canada attracted their attention. Since then, import patterns have altered significantly. While statistics are unavailable, the Brazilian Association of Holstein-Friesian Breeders says that during the period 1972 to 1975 about 40% of their "quality" animal requirements were sourced in Canada, and the rest in the U.S., the U.K., Denmark and West Germany. "Quantity" requirements are, understandably, imported from LAFTA members, principally Argentina.

While Brazil does not rank as one of Canada's top five customers for purebred dairy cattle, the Brazilian market merits increasing attention, as the following table shows.

Brazilian Imports of Canadian Dairy Cattle

Year	$Value
1971	427,000
1972	128,000
1973	71,000
1974	283,000
1975	404,000
1976 (first 10 months)	1,153,984

Source: Stats Can / Cacex

The Ministry of Agriculture is taking steps to control the quality of Brazil's dairy cattle herd by encouraging state governments to establish breeding centres to better distribute the impact of quality imports. Accordingly, the above statistics do not include the recent $2 million sale by a Canadian exporter of 2,000 purebred Holstein-Friesian cows to the state of Paraná. The state of Goiás is also considering a similar transaction with Canada.

Another indication of Brazil's links with Canada is its purchase of Romandale Royal Red, the only living son of ABC Reflection Sovereign, considered by some to be the world's greatest Holstein-Friesian bull. Acquired for $110,000 in 1975, Romandale Royal Red is already startling the Brazilian cattle community. From May to November 1976, he produced 4,500 ampoules of semen at $25 each, making an important contribution to Brazil's artificial insemination program. The buyer is also happy; his total initial investment was amortized within one year and now he can look forward to nothing but profits.

One of Romandale Royal Red's daughters, Espiga Royal Red de Santa Ines, is already waving the Canadian flag with gusto. Apart from being the 1975 Brazil National Grand Champion, this animal was best udder winner at three major shows in Brazil, and is reported to be averaging better than 20 litres daily in her first lactation.

Canadian dairy semen has also made good progress in this territory despite legislation that discourages imports of cattle semen from many countries. The Association of Brazilian Breeders of Holstein-Friesian cattle has opposed the importation of semen for any prolonged periods, but accepts the fact that purebred semen must be imported to upgrade existing dairy herds.

The Association's lobbying was sufficiently strong in 1969 to persuade the Brazilian Central Bank to issue, through CONCEX (Conselho de Comércio Exterior), Resolution 72, which more or less called for planned phase-out by 1975 of semen imports. The breeders admitted, however, that by 1975 Brazil didn't have enough qualified bulls to carry on the work, and recommended to the Central Bank that leniency for semen imports should be exercised at least until 1978.

The following table compares domestic semen production to imports in number of doses for the period 1970-1974.

A striking fact is that Canadian dairy semen exports to Brazil climbed in inverse proportion to the imports' downward trend. The following has been Canada's export pattern since 1971.

Brazilian Imports of Canadian Dairy Semen

Year	U.S. $ Value
1971	4,000
1972	1,000
1973	6,000
1974	107,000
1975	129,000
1976 (first 10 months)	740,000

Source: Stats Can / Otimista (Brazilian semen importer)

There is nothing new in the knowledge that Canadian Holstein-Friesian rank among the best in the world, but it's nice to know that in addition to assisting in the upgrading and increase of milk production in a lesser developed country, we are also earning valuable export income dollars for Canada.

Discrimination	1970	%	1971	%	1972	%	1973	%	1974	%
National Production	61,916	40.9	119,924	52.0	251,495	52.4	460,271	68.9	1,043,814	81.7
Importation	89,467	59.1	110,667	48.0	228,347	47.6	207,869	31.1	233,723	18.3
Total	151,383	100	230,591	100	479,842	100	668,140	100	1,277,537	100

Source: Gado Holandes, September 1976.

Canada Exports to Brazil — January-October/ 1976

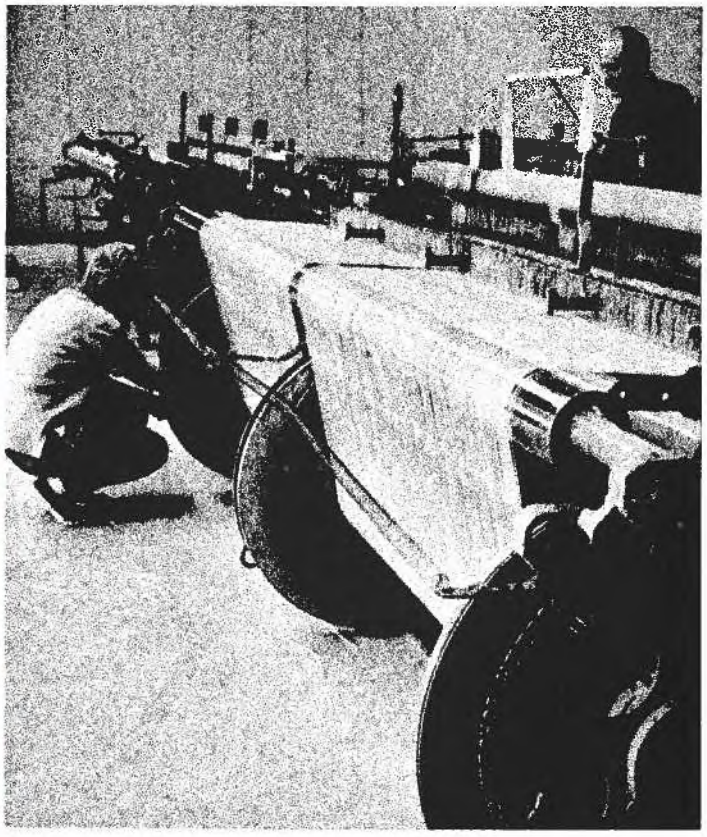
	($ million)
Wheat	149.8
Newsprint	19.0
Potash	10.3
Aluminum	9.7
Steel	9.7
Aircraft engines and parts	9.0
Switch gears & protection equipment	8.3
Motor vehicles and parts	7.2
Sulphur	5.9
Asbestos	4.8
Copper	4.2
Crushing & milling machinery parts	3.9
Pulp	2.1
Machine tools	1.5
Parts & access. typewriters	1.5
Computer peripherals	1.4
	$248.9

219 statistical classifications top 16 of which accounted for $248.9 million or 88.95% of the total of $279.8 million.

Canada Imports from Brazil — January - October/ 1976

	($ million)
Motor vehicles and engines	31.1
Coffee, instant, green, ground	18.7
Footwear	8.7
Orange juice	8.2
Cocoa	7.7
Textile fabrics	4.0
Clothing	3.8
Canned corn beef	3.3
Yarn	3.3
Lumber	3.2
Leather	3.1
Baler and binder twine	1.9
Raw cotton	1.6
Ferro-alloys	1.4
Sewing machines	1.3
Women's handbags and purses	0.9
	$102.2

342 statistical classifications top 16 of which accounted for $102.2 million or 80.15% of the total of $127.5 million.



Green signals for Canadian railway suppliers

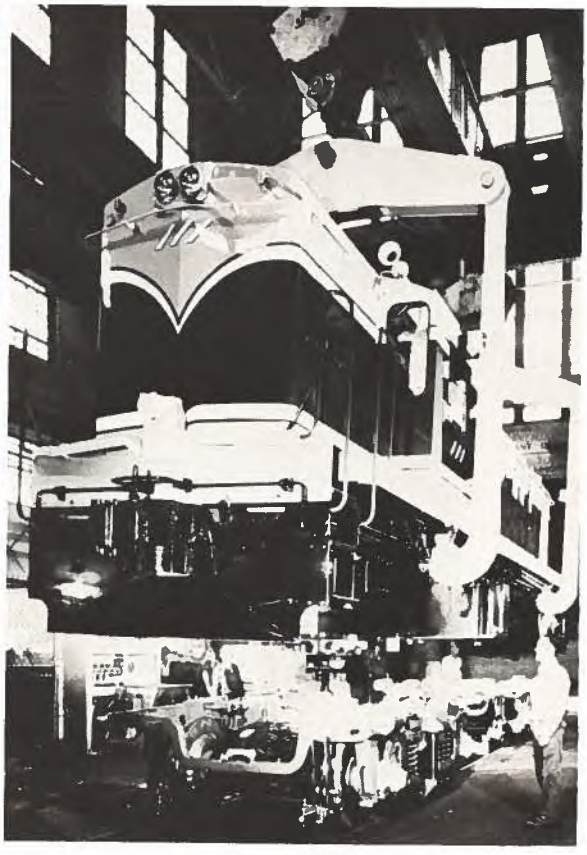
Soaring costs and government cut backs have put Brazil's ambitious plan for a modern railway system well behind schedule. The plan was implemented with great urgency in 1974 when it was realized that existing facilities could not cope with iron ore shipments to the Volta Redonda steel mill and improve also the movement of other resources and agricultural products to industrial centres and seaports. Altogether, the plan included 70 projects and called for an investment of $3.05 billion between 1975 and 1979.

Highest priority was accorded to the construction of an 834-km electrified "Railway of Steel" linking the iron region of Belo Horizonte with São Paulo and Volta Redonda. Completion was scheduled for 1979. Initial railway cost estimates of $1.1 billion have now swelled to $3 billion and could reach $4 billion. This exceeds the budget for the entire rail program, and the figure has been revised to $8.5 billion. Completion date for the line has also been postponed to 1984 at the earliest.

Originally, $550 million was to have been spent on the Railway of Steel in 1976 — $420 million in 1977 and considerably less in 1978 and 1979. In contrast, only $200 million was allocated to the project last year and $370 million for 1977. The cut backs have seriously affected more than 20 Brazilian companies constructing the line which invested heavily in imported earthmoving and tunnelling equipment. Involvement in other big projects, such as the Itaipú hydroelectric development and the Rio and São Paulo metros, has softened repercussions for the larger firms, but smaller ones, with 80% of their capital tied up in the project, are in jeopardy.

Some parts of the rail program have been shelved indefinitely and work on others, including upgrading of 10,800 km of track, conversion of 3,200 km to a 1.6 meter gauge and electrification of 1,450 km, will not start until 1979. In the meantime, existing railways, which are already overburdened, will have to cope with increased traffic. The Centro do Brasil railway, for instance, which currently carries most of the ore from Minas Gerais to Rio, Volta Redonda and São Paulo, may be required to carry up to 50 million tons a year, although it was designed to carry less than half that tonnage.

Despite increasing the production of equipment for the rail sector by Brazilian companies, and the slowdown in the railway modernization program, future demand is expected to be great, and many opportunities exist for Canadian manufacturers to sell direct or under license. The Brazilian Government has just recently agreed to the establishment of two more locomotive manufacturers, one of which, Engenharia de Maquinas S.A. (EMAQ), will manufacture diesel locomotives under license of Bombardier-MLW Ltd., Montreal. Prospects for other Canadian companies are promising.



Locomotives of Canadian design are well suited to rugged terrain. They will continue to perform, despite a subminimum amount of the care and attention normally lavished upon their European counterparts. It is the ability to survive long periods of hard work, difficult conditions and infrequent servicing that gives Montreal locomotives the edge over some more sophisticated power units.

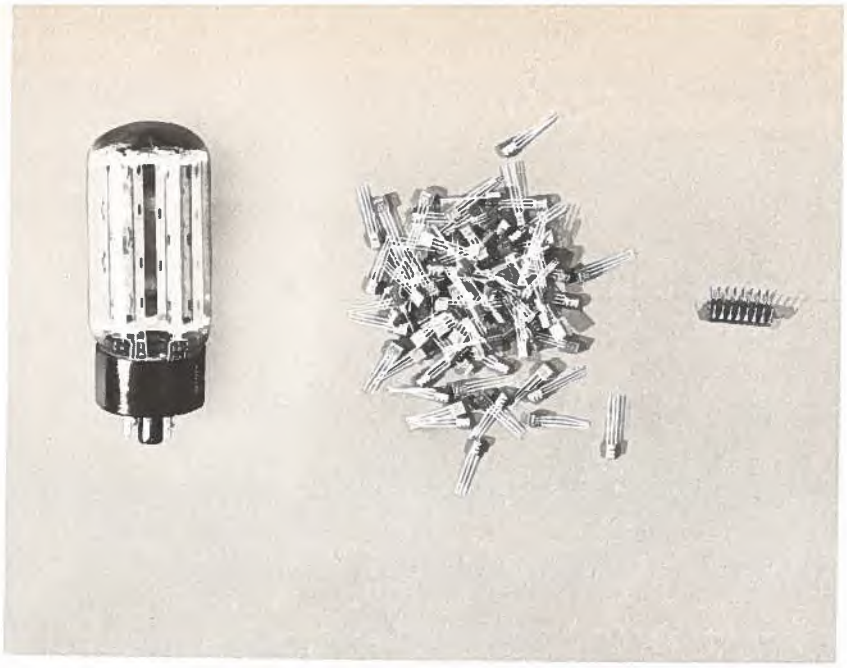
If You Can't Beat the Telecommunications Giants — Supply Them

HARRY TRAYNOR, Editor

Eulogies and epitaphs appear with depressing frequency in historical records of the electronics industry.

One reason is the frightening speed at which last year's technological triumph is being overtaken by products and systems that will claim tomorrow's headlines.

A small Ontario electronics laboratory is the newest challenger in a scientific field which has proved to be a graveyard for many Canadian companies.



Scriptwriters who churn out material for comedians have three inexhaustible sources of humour. Topping the list of mirth-provoking topics is mothers-in-law. Second place in the joke charts is occupied by governments: they inspire a wealth of stage humour, except in countries where the rulers insist upon having the last hollow laugh. In those parts of the world in which governments run the national telephone system, comedy writers run sleek limousines on the proceeds of jokes about wrong numbers. And a peculiar breed of British playwright has developed a string of stage farces in which irate mothers-in-law eavesdrop on the telephone revelations of naughty husbands and nutty daughters.

Although far from perfect, North American telephone networks have an efficiency record that spares them too much stage ridicule. The weakest link in the telephone system is, of course, the party line, that bane of rural life familiar to more than 600,000 Canadians subscribers.

Like flies to a honeypot, party lines attract gossipmongers who monopolize the communications channel and seem bent upon establishing new telephone endurance records.

Alas, marathon talkers are not easily suppressed, but something new in telecommunications circuitry does eliminate the other major frustrations of party lines. On trial now in Alberta is a little black box which will be readily available to all party line users.

Installed by the telephone company, it confines the ringing signal to one subscriber and guarantees complete privacy of conversation between the two parties concerned.

The new electronic wonder cannot handle two calls simultaneously, but should a garrulous neighbour hog the line too long, neighbours may signal their disapproval by jabbing the receiver cradle buttons. A feature which will delight the summer cottage fraternity is the instantaneous disconnection and reconnection of the telephone. Before locking the cottage door for the last time in the fall, the subscriber simply rings the exchange operator, who dials a coded message to the little black box.

Not so long ago, fireside entertainment depended upon the uncertain life span of the vacuum tube (top left picture). Beside it is a pile of transistors, which made possible the tiny pocket radio. The isolated item in the same photo is an integrated circuit. It can outperform thousands of transistors and is the core of Mitel's contribution to the science of telecommunications. The integrated circuit is, in fact, a miniaturized version of yesterday's spaghetti-like mass of wires and tubes and soldered joints, which consumed enormous quantities of energy and produced self-destroying heat.

Mitel Corporation

At that moment the line goes dead and is no longer a financial liability. When spring comes around, another call to the exchange, another coded signal to the little black box, and hey, presto, the cottage phone is operational again.

The old adage about familiarity breeding contempt is true of the average subscriber's attitude towards the telephone. It's such a familiar, commonplace piece of equipment that some users may be tempted to dismiss the latest party line development as an overdue refinement, something the electronic engineers should have perfected long ago. In fact, the technology which makes possible the separation of different number signals and ensures private conversation on party lines is less than two years old. Evolving the circuitry of the little black box was a 12-month, full-time assignment for two telecommunications technologists. Their experiments involved the design of special test equipment, the production of various prototypes and a succession of one-off printed circuit boards, integrated circuits and other components.

Twelve months of trial and error produced one working model devoid of "bugs". In that time, the company concerned — Mitel Corporation — had expended something like $150,000 in research, labour, parts and midnight oil. Mitel's little black box is now with the Alberta Government, which owns the province's telephone system. If laboratory and field trials in the West are successful, Canada alone could absorb over half a million units which, depending upon the size of individual production contracts, would cost $100-$150 each.

Banish the thought that the innovative Mitel Corporation is a subsidiary of one of those giant international conglomerates that buy time on television to sweep viewers through acres of research and development laboratories. Mitel is a 225-strong company with headquarters in Kanata, near Ottawa. It started operations in 1972 with cash resources of $4,000 — the joint savings of two 29-year old electronic engineers. Young, yes, but both had impressive qualifications.

Mike Cowpland

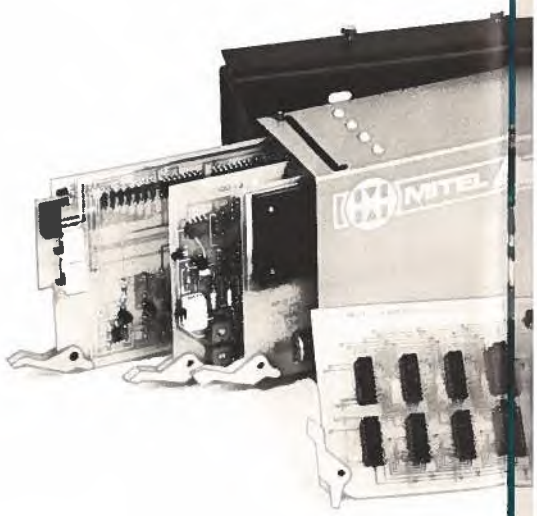
Mike Cowpland got his B.Eng. at the Imperial College, London, before emigrating to Canada in 1965. Four years with Bell Northern Research Ltd., paved the way for a job as manager of the microcircuit design group at Microsystems International Ltd.

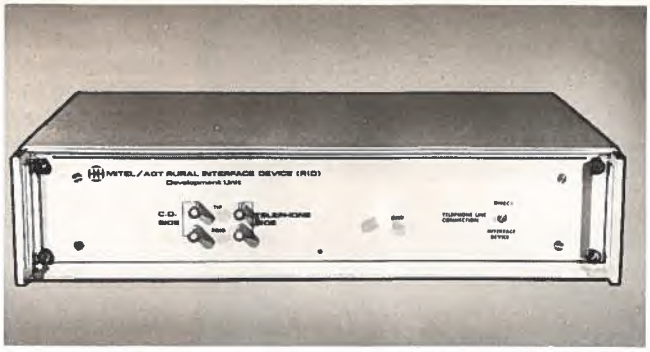
In 1971 it was back to university, this time to Carleton, in Ottawa. Cowpland emerged with a Ph.D. and rejoined Microsystems. There he found a kindred spirit in Terry Matthews, an Honours graduate of Swansea University, Wales.

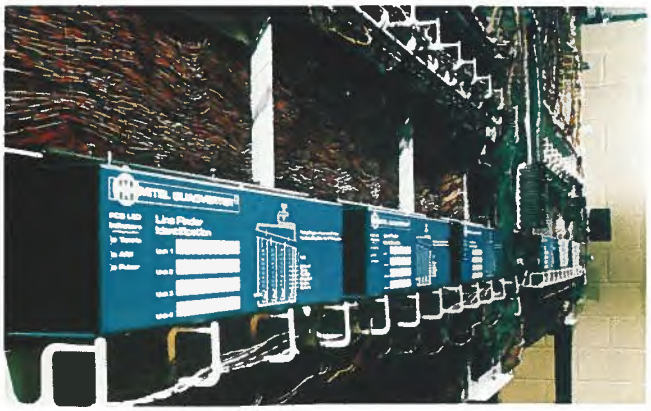
Terry Matthews

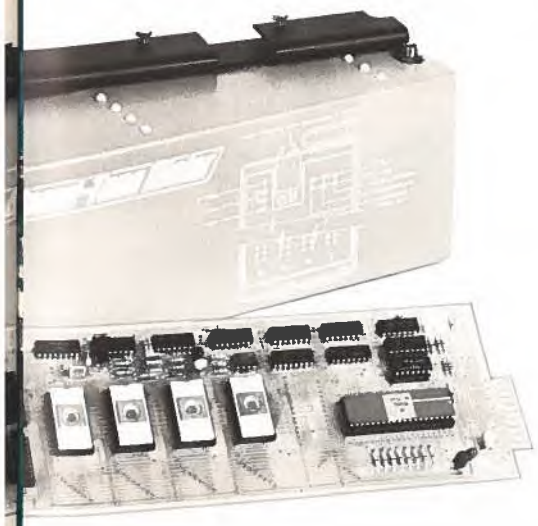
Terry Matthews is a short, slim, bearded Welshman who explains the function of a telecommunications circuit with the fervour of an evangelist. Armed with his Honours Engineering Degree, Terry started his professional career with the British Post Office, which runs the U.K. telephone network and pioneered trans-Atlantic communications by satellite. Young Matthews was in telecommunications research, working seven-day weeks and overtime until he had accumulated enough cash for long winter sojourns under the Mediterranean sun.

The Welshman arrived in Canada in 1969, but did not find an immediate market for his electronic wizardry.









For a company that seems to delight in recruiting young, attractive secretaries who are on first-name terms with the President and Vice President, it is somewhat surprising that Mitel should resort to a stuffy name for their party-line telephone equipment. The hand-held AGT Rural Interface Device, shown left above, was developed from the much larger prototype, top right.

Many major advances in electronics can be traced to aviation and space programs, where weight and volume are critical, and engineers must crowd into a minute package sophisticated equipment that will perform for years without the need for servicing or replacement.

Rather than fret and fume, Matthews worked off excess energy wielding a demolition contractor's sledge-hammer — for $2.00 per hour.

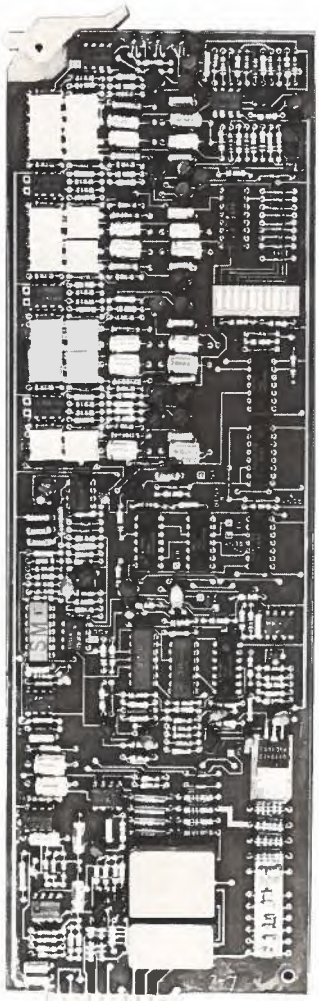
Much more frustrating for Matthews was his stint with Microsystems International Ltd., Ottawa. Convinced that the company (now no longer in business) was on the wrong track, he accumulated a file of recommendations that seldom got more than a cursory glance at director level. That sort of treatment is unacceptable to fiery Celts (Welsh, Scots and Irish) who have the strength of their convictions: if they believe that they're right, they'll fight rather than say Amen to a weak chorus of boardroom platitudes.

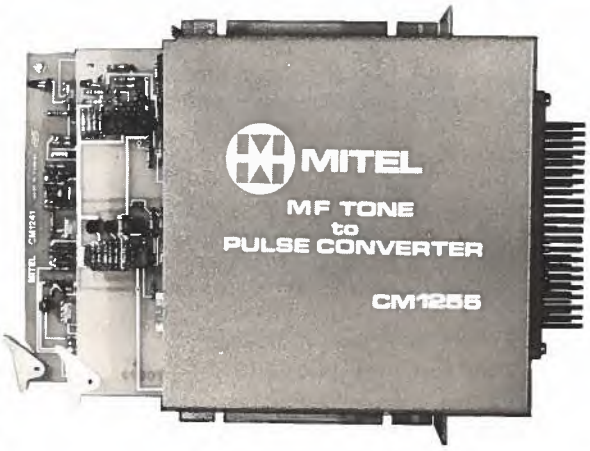
In resigning from Microsystems, Matthews and Cowpland turned their backs on what at that time appeared to be well-paid, lifetime security. Both men had wives, children, hefty house mortgages. To launch the Mitel Corporation, they could scramble together only $4,000, which soon disappeared in salaries for two electronic engineers, one assembly-line operator and a secretary. The single room that served as laboratory, workshop and office did not seriously drain the bank balance, but Welsh eloquence at daytime telephone rates is costly. Matthews contacted every telephone company in North America, made formal overtures to managements and encouraged their electronic engineers to air whatever technological problems were worrying them.

Realizing that Mitel could not hope to get contracts for bread-and-butter electronic projects, Matthews and Cowpland presented themselves as a team that could achieve the hitherto impossible in terms of telephone circuitry.

As the column of red entries in the company bank statement lengthened, the two partners mentally prepared their wives for a move to rented homes. A peach a day became the staple diet: it kept the doctors away, but not the creditors. At the end of nine months sales totalled $11,000, losses $40,000.

And then the tide turned: Plessey Canada Ltd., a subsidiary of the British electronics giant, wanted a very sophisticated version of the touch tone telephone system and sent a specification to specialists in the field. The Mitel Corporation was not at that time a Plessey supplier, yet the first working prototype miraculously appeared bearing the Mitel trademark.





It was a bold move by Cowpland and Matthews. And risky, because Plessey test laboratories are crammed with equipment that measures electronic performance to the equivalent of seven decimal places. The potential supplier must also impress corporation purchasing personnel; and heaven help the little man who cuts his price too close to the survival level.

Mitel won a Plessey contract for 100 touch tone systems. Great! Six months steady work; but now there was a requirement for assembly line operators, and there would be bills for component parts and other overheads requiring a constant flow of hard cash.

Rather than place themselves at the mercy of bank loan officers, the two partners decided to offer a 25% interest in the company to a small group of Ottawa lawyers who could afford to speculate $120,000.

Production of the 100 units for Plessey was farmed out in sections to some of the small electronic firms that abound in the Montreal-Ottawa-Toronto triangle. Mitel engineers designed special test apparatus to check the quality of components and the assemblies entrusted to sub-contractors. From the outset, Cowpland and Matthews delegated routine responsibilities so that they could exercise their creative talents and design products to meet the special needs of new clients.

Whereas the first nine months had brought in only $11,000, sales in 1974 bounded to $365,000, topped $1.6 million the following year and surged to $5.2 million in 1976. Certainly production volumes kept increasing, but more significant was the number of patents registered by Mike Cowpland during the period 1973-76.

On the far left is the best seller in the Mitel range of telecommunications marvels. Bought by telephone companies, it modifies normal switching equipment so that it can deal with domestic touch-tone telephones. One Mitel touch-tone-to-dial-pulse-converter can handle ten subscribers.

Although it emits musical notes, the customer's telephone is rather like a piano key which, when depressed, merely sets in motion a series of levers which eventually activate the hammer that strikes a wire and produces real music. But whereas the average piano has 88 keys and 230 steel-wire strings, the domestic telephone has only 12 buttons with which to select by touch-tone millions of different numbers. Hence the exact science of devising a small panel that will always compute, select and ring the required subscribers.

The figure is 20, and it brought the Cowpland total beyond 100. All the patents relate to the far-from-simple telephone invented by Alexander Graham Bell. The Scot (he was born in Musselburgh, near Edinburgh in 1847) was granted the patent for the "electric speaking telephone" on March 7, 1876, and almost immediately the stage was set for the first of 587 lawsuits successfully contested by the company bearing his name.

For most of us, the telephone is just a hand held instrument that permits conversation with people beyond audible speech range. If asked to name a recent telephone invention, North Americans would plump for the touch tone system. There again the layman thinks in terms of a receiver, this one with buttons that emit different sounds and is more convenient to use than the rotary-dial instrument. Some telephone subscribers dismiss the touch tone system as being a gimmick, a new toy for Joneses (who had earlier replaced their black receivers with coloured models to match the interior decor).

Earlier in this article reference was made to Mitel's involvement in touch-tone telephones, which may have encouraged the erroneous belief that Mitel's escalating sales figures can be attributed to the increasing popularity of the press-button models in homes and offices. In fact, the connection between telephone receivers and the Ontario company is remote. Mitel concerns itself with those parts of the telecommunications system which are activated by the caller's attempts to get through to another telephone number.

The "works" inside this 4" x 3" x .5" Mitel box transmits telephone numbers from exchange 'A' to distant exchange 'B'.

In the early days the telephone user depended upon the intelligence and manual dexterity of a switchboard operator who responded to the caller's signal, memorized the number required, plugged through to that number, activated a summoning bell and then mechanically connected the two lines. The first commercial switchboard went into operation in New Haven, Connecticut, in 1878, and it inspired engineer Charles Scribner to invent no fewer than 500 modifications.

Ninety-nine years and 13,113 technical improvements separate that first switchboard from the equipment designed by Mitel. But the same requirement motivated both the original telephone inventor and his modern counterpart: to be able to converse with someone at a different location.

The first switchboard in Philadelphia handled eight telephones. Today, there are over 240 million telephones in use throughout the world — 94.3% operated automatically. Switchboard operators are concerned mainly with international calls, although many subscribers on the other side of the Atlantic can dial direct to other European countries and parts of North America.

With 240 million telephone numbers in operation, the incidence of "wrong numbers" might well have become a public nuisance comparable to the irritation suffered by householders close to major airports. But the simple truth is that efficient dialling produces the correct number in most parts of the world. And much of the credit must go to innovative electronic engineers like Mike Cowpland and Terry Matthews.

The novel appeal of the subscriber's touch tone receiver is incidental to technological advances in the touch tone "switching system".

For one thing, the time lag between initiating a call and getting through to a distant subscriber is now reduced to very few seconds. And some domestic receivers can be programmed so that often-used numbers are obtained by depressing a single button. Electronic engineers have also devised touch tone circuits which would prevent an employee from using the office phone to ring his favourite aunt 500 miles away.

These and dozens more telephone "refinements" keep Mitel engineers on their toes. Vice President Terry Matthews gets very enthusiastic about this or that prototype, but his eloquence is wasted on the lay visitor, to whom the flow of technical terms is quite incomprehensible. It's rather like being in a foreign land where all the natives understand each other but cannot communicate with a stranger who doesn't speak the language.

Whilst the science of telecommunications may be beyond the comprehension of most ordinary mortals, signposts along the Mitel road to success are easy to decipher. The one-room laboratory of 1972 has blossomed into an international force with production plants in Kanata, Ontario; Bromont, Quebec; Shannon, Ireland and Ogdensburg, New York. The head office is served by company sales organizations in Edmonton, Washington, D.C., Denver and Slough, near London.

Mushroom growth has attendant dangers, but the impressive list of Mitel addresses must be weighed against the modest payroll: 225 employees don't bite deeply into a turnover which keeps exceeding the $5.2 million rate established in 1976. Another healthy sign is the spectacular increase in export business. In 1975, it amounted to $60,000, climbed to $475,000 in 1976, and shows promise of topping the $3 million mark this year. In fact, foreign sales are now running level with domestic business, and by 1979 the company hopes to achieve a 3:1 ratio in favour of exports.

The inventive genius of Mitel is matched by proven business acumen. For months Terry Matthews and Mike Cowpland watched a Quebec manufacturer of MOS integrated circuits slip closer and closer to the point of insolvency. The plant in Bromont produced semiconductors — components employed in considerable quantities by Mitel equipment. So Mitel made a successful bid for Siltek International shares, revitalized the Quebec company and within seven months pulled it out of the red.

The Bromont plant is one of the largest of its kind and is now a major source of integrated circuits for several foreign countries including the U.S.A. Trading as Mitel Semiconductor, the Quebec subsidiary supplies a quarter-inch chip, a veritable jumbo in the world of sub-miniatures, to Universal Research Labs for its sophisticated Indy 500 television receiver game. Mitel has world rights to the circuit used, which is marketed in America, Australia, Germany and the Far East. A Canadian version of the game will be produced by Electrohome Ltd., Kitchener.

In addition to 70 standard types of integrated circuits, the Bromont plant specializes in CMOS integrated circuits for the telecommunications industry, and one of the most demanding customers is the parent company in Kanata. Mitel directors expect all their suppliers to maintain the hectic pace they set for themselves. When Matthews and Cowpland bid for a contract, they quote delivery dates that could never be met by observance of a 40-hour work week. Using a company Cessna aircraft, Mitel engineers will divide their day between three widely separated locations.

After an evening meal they can be sure of a welcome at the Matthews garden pool, and there dive into masses of technical facts and figures. Wives who drop their husbands at the Matthews residence can expect to have their sleep disturbed when hubby is transported home in the solitary passenger seat of a 2½ litre Daimler SP250 driven by the Mitel vice president. Designed by the maverick engineer who made Triumph motorcycles a major force in international competition, the Daimler sports car is in tune with its proud owner, delivering with a raucous roar 140 bhp at 5,800 revs per minute. Terry Matthews works off surplus energy by putting his foot hard on the accelerator pedal; Mike Cowpland punishes a tennis ball, flitting across the court with noiseless, soft-sole shoes.

The element of luck figures somewhere in every success story. Cowpland and Matthews worked together at Microsystems International. When that company folded, the electronic engineers dispersed, some joining companies which were potential clients of Mitel. The Federal Government absorbed a few former Microsystems technologists, men who would eventually be asked to pass judgement on Mitel requests for research and development grants. The name Matthews on an application form must have evoked many memories of a voluble Welshman who had proliferated management offices with recommendations, diagrams and blueprints and had accurately predicted the fate of Microsystems. Such men may be disconcerting colleagues, but they are usually pretty safe bets if given their head.

Government investments have paid off handsomely. The genius of two men saved an ailing plant in Quebec and is now earning millions of dollars in export contracts. True, the total strength of Mitel is only 225, but more than a dozen subcontractors keep their plants busy with Mitel products, and the challenge presented by sophisticated telecommunication equipment raises overall standards on the assembly line.

Alexander Graham Bell, inventor of the telephone, turned his attention to aviation in 1895. He was responsible for the tetrahedral kite in 1903, founded the magazine "Science", served as president of the National Geographic Society, created the Aerial Experimental Association and headed a team which devised the aileron control principle, developed the hydroplane and gave birth to the first aeroplane flown in Canada.

Terry Matthews is another innovator who seems destined to outlive his dedication to telecommunications. His love affair with the 122 mph Daimler sports car will give way to an infatuation with another mechanical contraption, and from that association may spring a whole series of engineering marvels which most of us will rush out to buy, and while we struggle to repay the bank loan, Matthews will be gliding across the Caribbean in his push-button yacht, grumbling about the millions he has to pay the Department of National Revenue.

Readers who despair of finding a reaiiy efficient air-conditioning system shouid regard Mitei headquarters as a sort of monument. This buiiding deiivered 80°F, summer and winter, regardiess of control settings and in defiance of expert attention. The high temperatures eventuaiiy reached the fiash-point of Terry Matthews. Dismissing the arguments of speciaiists in the fieid, he grabbed some toois and spent a weekend in the buiiding. That this pieasant-iooking structure is now a comfortabie workpiace simpiy confirms that the credentiais of some experts are suspect.

Showcase

Leather/Canada, Mar. 15-17: Twenty-seven manufacturers of ladies' leather apparel recorded sales of $2 million during the third annual Leather/Canada showing in Montreal, jointly sponsored by the Leather Bureau of Canada and IT&C. The 225 U.S. buyers brought in for the event by the Department expressed enthusiasm for the quality of the merchandise, mainly suede and leather coats and jackets, and it is estimated that final sales will reach $6 million.

International Automotive Service Industries Show (IASI), Mar. 16-18: For the first time in its history, IASI opened participation to foreign exhibitors, and 15 Canadian companies moved into Chicago's McCormick Place with everything from booster cables featuring built-in emergency lights to automotive body and frame straighteners. On-site sales exceeded $1 million, and 260 serious enquiries and follow-up sales are expected to produce another $15 million during the next year. Canada's exhibitors also appointed, or are negotiating with, more than 70 representatives.

The IASI is one of three shows in the next 12 months in which IT&C is sponsoring auto parts manufacturers as part of an accelerated drive to increase their exposure to the U.S. market. The Automotive Parts Accessories Association show, in which Canada has exhibited previously, will be held in Chicago next November, and the Pacific Automotive Show, in which the Department will sponsor its first National Stand, is scheduled for San Francisco in January, 1978.

Missions and Symposia

Canadian businessmen and Federal Government officials participated in a petroleum symposium in Caracas, Venezuela, February 28-March 2, in Maracaibo, Venezuela, March 3-4, and in Quito, Ecuador, March 7-8.

The Canadian delegation presented papers describing Canada's capabilities in the petroleum industry, ranging from exploration through hydrocarbon processing to design and construction of petro-chemical complexes. Officials from Venezuela and Ecuador, OPEC members, explained the policy, structure, plans and priorities of the industry in their countries. Attendance at the symposia was excellent, ranging from 120 in Caracas to 45 in Maracaibo.

Besides officials from IT&C and the Department of Energy, Mines and Resources, the Canadian delegation included representatives of **Associated Engineering Services Limited,** Edmonton, Alta.; **Bow Valley Industries Ltd., Canadian Overseas Engineering and Development Ltd., The Lummas Co. of Canada Ltd.** and **Petro-Canada,** Calgary, Alta.; **The Consumers' Gas Company**, Toronto, Ont.; **Foster Wheeler Ltd.,** St. Catharines, Ont.; **SNC Group**, Montreal, Que.; **Westinghouse Canada Ltd.**, Hamilton, Ont. and the **Alberta Research Council**.

Two demonstrations of Canadian-manufactured mobile airport equipment — the first for 32 U.S. businessmen and the second for 34 visitors from Europe, the Middle East, Africa and Asia — were held at CFB Ottawa (South), March 3-4 and March 6-12. The missions were jointly sponsored by IT&C and eight Canadian companies in co-operation with the Department of National Defence and the Ministry of Transport.

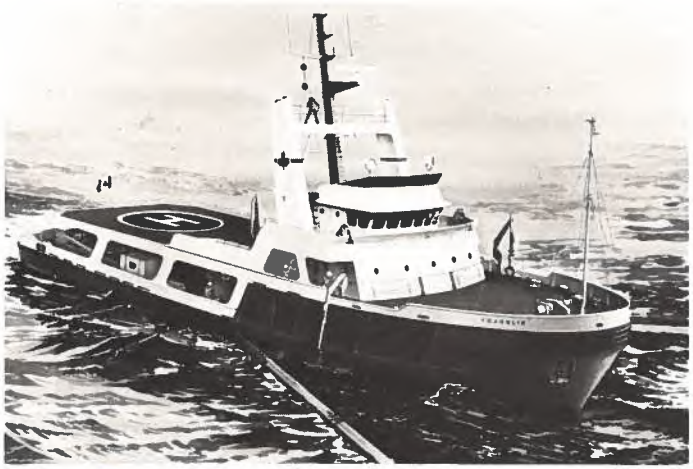
Equipment in the demonstrations included vehicles for crash, fire-fighting and rescue operations, high speed snowblowers, snowploughs, runway sweepers and refuellers.

Following the Ottawa demonstration, members of the second mission visited international airports and manufacturing plants in Montreal and Toronto. Participating manufacturers were **Canadian Foremost,** Calgary, Alta.; **CDN Research and Development Ltd./Nordic International**, Toronto, Ont.; **Danline Canada Ltd.**, Almonte, Ont.; **Frink of Canada**, Preston, Ont.; **King Seagrave Ltd.**, Woodstock, Ont.; **SMI Industries, EGW Limited** and **The Robert Mitchell Co. Ltd.**, Montreal, Que. and **Westank/Willock Industries of Regina,** Sask. and Vancouver, B.C.

During a non-ferrous metals mission to Europe, March 12-26, representatives of ten Canadian companies and the Canadian Association of Recycling Industries completed more than 210 visits to industry and related associations in Belgium, West Germany, The Netherlands, England and France. The representatives credited the mission with providing opportunities for developing valuable contacts that they would otherwise have missed. The IT&C Posts in Brussels, Dusseldorf, The Hague, Paris and London organized the itineraries for the mission members who represented, besides the Recycling association, **Alforge Metals Corporation Limited,** Orangeville, Ont.; **Anaconda Canada Limited** and **Union Carbide Canada Limited,** Toronto, Ont.; **Canadian Bronze Co. Limited,** Winnipeg, Man.; **Chromasco Limited, Noranda Metal Industries Limited** and **Niobec Inc.,** Montreal, Que.; **MSU Daymond Canada Limited,** Mississauga, Ont.; **Federated Genco Ltd.,** Scarborough, Ont.; **Special Metals Division of Noranda Metal Industries Limited,** Arnprior, Ont. and **Pole Lite Limited,** Laprairie, Que.

International Domestic Electrical Appliances Exhibition (IDEA), May 23-27: Ten manufacturers of Canadian domestic electrical appliances exhibited at the new National Exhibition Centre in Birmingham, England. On-site orders totalled $624,000, with sales over the next 12 months estimated at $5,904,000.

Offshore Technology Conference, May 2-5: The world's largest conference and exhibition related to offshore development attracted 60,000 delegates and trade visitors to Houston, Texas. Under the auspices of IT&C, 23 Canadian companies occupied 3,900 square feet of exhibit space in the Astrohall. On-site sales amounted to $181,000, with an optimistic 12-month forecast of $75,000,000 follow-up business.



Among the Canadian exhibits at Offshore Europe '77 (Aberdeen, September 13-16) will be the Bennett modular skimming system, which can be fitted to a wide variety of vessels engaged in oil clean-up.

14th Bologna Children's Book Fair, April 1-4: The world's largest fair devoted to children's books, held in Bologna, Italy, attracted 49 countries. Canada was represented by eight publishers (six English, two French) displaying 325 titles covering literature, history, geography, education, fiction, trade, etc. As a change from the collective stands at earlier government-sponsored book shows, Canadian publishers exhibited under their own trade names. Projected sales over the next 12 months are estimated at $536,000.

Novi Sad Agricultural Show, May 13-22: This year's agricultural fair in Novi Sad, Yugoslavia, attracted 1,600 exhibitors, including 547 from 52 countries. The attendance figure topped 600,000.

Nine Canadian companies occupied 400 square metres of space, exhibiting hay handling, tillage and tobacco harvesting equipment, feed mixers and skidders. Canada was represented also by artificial insemination and embryo transfer firms. On show were two bulls and 68 pregnant heifers, sold to Yugoslavia and shipped from Canada before the fair opened. The cattle collected a silver medal, and a gold award went to the Canadian exhibit.

This the second appearance of Canada at Novi Sad resulted in orders worth $282,000, with another $1,451,000 in follow-up business forecast for the next 12 months.

If you're a three year old and have travelled 40 miles from Belgrade to see a bewildering array of Canadian feed mixers, skidders and hay handling equipment at the Novi Sad Agricultural Show, there's some excuse for being vague about Yugoslav import regulations. And my name being Lelo Vladislav, you can guess at my imperfect English vocabulary. But I'm sure I heard some exhibitors discuss the probability of Canadian heifers giving birth in a nearby barn, so I grabbed this paper bag — just in case there's a calf that needs adoption by a Yugoslav animal lover.

Ligna Hannover '77, May 18-24: Occupying 10 halls and 35 outdoor spaces at the Hannover Fairgrounds, this exhibition of forest products equipment drew 773 companies from 25 countries. Eight Canadian exhibitors showed log debarkers, band saws, chippers, stair routers and V-grooving equipment. The initial on-site sales of $80,000 are expected to reach $55 million over the next 12 months.

DRUPA, June 3-16: Canada's first participation in DRUPA, the printing industry exhibition held at Duesseldorf, produced on-site sales in excess of $1 million. Nine companies from Ontario and Quebec drew 1,461 enquiries and appointed seven European agencies.

Follow-up business for the Canadian exhibitors is expected to bring in $7 million during the next 12 months.

Turkey's Vehicle Population

According to the latest statistics released in Turkey, that country's vehicle population in 1975 was composed of 400,093 automobiles, 142,029 trucks and 25,279 buses. Production figures for 1976 quoted 62,992 automobiles, 19,769 trucks, 18,915 pick-up trucks, 1,376 buses, 4,911 mini-buses and 31,455 tractors. Fourteen Turkish plants contributed towards the 1976 totals.

Whereas there was one automobile for every 100 citizens in 1975, the projection for 1982 is 10 cars per 100 citizens.

Production estimates for 1977-82 put automobiles at 694,500 with trucks numbering 159,502 and buses 22,825.

Canadian oilmen bound for Scotland

World experts in petroleum exploration, production and services will take part in Offshore Europe '77 in Aberdeen, Scotland, September 13 to 16.

Canadian exhibitors will demonstrate that they are innovative, competitive and meet schedules — well-established reasons for acceptance in international offshore operations.

Proven offshore capabilities are largely a result of Canada's geography, which includes not only onshore resources but also 152,000 miles (244,613 km) of coastline, both environments with problems demanding new equipment and techniques. The 1.5 million sq. miles (3.9 million km²) of continental shelf provide a natural but unforgiving laboratory for equipment and service trials. The fact that Canadian products more than meet these rugged conditions is another reason why they have found ready world markets.

At Aberdeen, the Department of Industry, Trade and Commerce is sponsoring a national exhibit demonstrating the versatility of Canadian industry. Participating companies offer a wide cross-section of the complexities that constitute a successful offshore operation.

Further information on Canada's offshore capabilities will be available at the adjacent booths of the provinces of Alberta and Newfoundland.

Participating companies in the Canadian exhibit are:

Barringer Research Limited, Rexdale, Ontario — designs and produces shallow and deep marine magnetometers as well as towed systems.

Canadian Marconi Company (Avionics Division), Montreal, Quebec — produces dual-channel satellite navigation and positioning equipment.

Fathom Oceanology Limited, Port Credit, Ontario — cable fairings for towed systems now augmented by PIPESTREAM fairings for drill risers and sub-sea piping.

John T. Hepburn, Limited, Toronto, Ontario — globally accepted deck machinery including oceanographic and anchor winches and drill platform thrusters.

Huntec ('70) Limited, Scarborough, Ontario — state-of-the-art seismic source/receiver packages designed for deep towing.

Lockheed Petroleum Services Ltd., New Westminster, British Columbia — innovative one-atmosphere sub-sea well completion and production systems.

MLW Industries, Division of Bombardier-MLW Ltd./Ltée, Montreal, Quebec — dependable diesel motive power applied to propulsion units, generating sets and prime mover power.

Sandisle Structurès Limited, Toronto, Ontario — utilizes fundamental geophysical principles to produce time and cost saving offshore structures.

Undersea Equipment Limited, Dartmouth, Nova Scotia — deep diving life support systems and associated equipment.

Willis Oil Tool Canada Ltd., Edmonton, Alberta — onshore, offshore and sub-sea production control valves.

Bennett Pollution Controls Ltd., North Vancouver, British Columbia — a consulting and engineering service that specializes in the prevention and control of oil pollution.

Canadian Experts Study Peruvian Airlink

A Canadian-Peruvian team led by **International Airport Consultants of Montreal Ltd. (CAIM)** will conduct a series of feasibility studies of six key airports in the Lima-Amazonas Corridor. This is CAIM's second Peruvian contract in recent months.

Efficient transport systems are considered vital to the improvement of Peru's economy, and these studies are designed to establish a coordinated link between Lima, the capital, and the country's north-eastern provinces. The CAIM team will examine sites at Cajamarca, Huanuco, Tingo Maria, Pucallpa, Tarapoto and Yurimaguas, in territory ranging from the rain forests of the Amazon Valley to the Andean mountains at altitudes from 130 to 2,600 metres.

Though landing strips exist at all sites, the demands of current aviation technology make up-grading or relocation essential if they are to function at their full potential. The study team's mandate is to determine the most feasible alternative for each, taking into account present and future traffic patterns and cost-benefit ratios.

The up-graded airports are needed for various reasons. Some sites, like Cajamarca, the Inca city where Atahualpa was captured by the conquistador Pizarro, are promising tourist centres. For some, like Huanuco, wedged in a narrow mountain valley between two high ridges, or Pucallpa, on the Amazon river system, transport by air is the most practical for regional development.

Participating in the project with CAIM are **Aviation Planning Services Ltd.** (**APS**) of Montreal, with **Laboratorio Geotécnico S.A.** (**LAGESA**) and **Lainez-Lozada, Navarro & Asociados SCRL** (**LLN**) of Peru. A field team has already started work on the assignment. The studies are sponsored by the World Bank.

CAIM is a consortium made up of the **SNC Group**; **Beauchemin, Beaton, Lapointe**; and **Bland, Lemoyne, Shine & Victor Prus**. The consortium was responsible for project management of Mirabel International Airport and is currently at work on airports in Barbados and the United Arab Emirates.

Spar big in satellite telecommunications

A newly formed and wholly-owned Spar subsidiary, Spar Technology Limited, will occupy a total of 158,000 square feet of space in RCA's Ste-Anne-de-Bellevue and Montreal facilities now employing some 500 people.

Spar's newly acquired capabilities qualify the company for the role of prime contractor in the development, design and fabrication of satellite communications systems in expanding world markets.

The new Division has solid Canadian roots. As the Berliner Gramophone Company — which Radio Corporation of America acquired and re-named RCA Limited in 1924 — it began operations in Montreal in 1901.

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