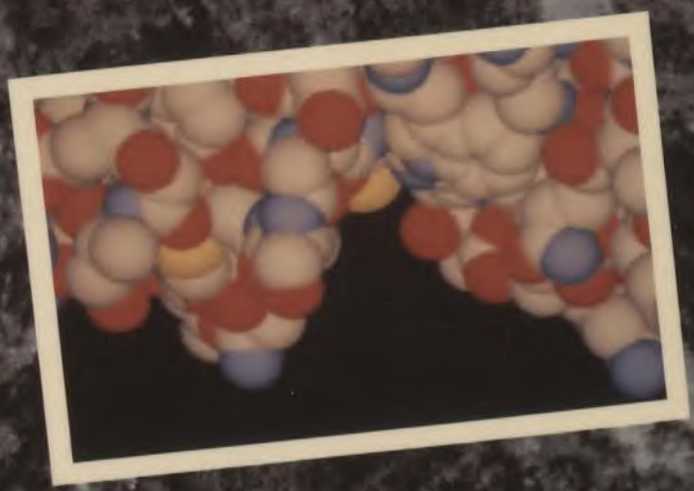
If your business involves Biotechnology development...



Canadian opportunities can make the difference

Biotechnology

Canadian partners for global markets

Canada

Canadian firms make excellent partners

A partnership with Canadian firms offers...

Excellent opportunities for co-operating with Canadian companies

- Canada's more than 400 firms in biotechnology have over 10,000 products at various stages of production.
- 87% of Canadian biotechnology firms have alliances with at least one other organization.
- Projections indicate that $1 billion will be invested in new Canadian manufacturing facilities in the period 1988 to 1992.

Unrestricted access to a very rich North American market

- The Canada-U.S. Free Trade Agreement (FTA) will increase the availability of duty-free biotechnology goods and customer support services.
- FTA will make most goods traded between the U.S. and Canada duty-free by 1998; presently most goods related to industrial biotechnology are free of tariffs.
- FTA prohibits non-tariff barriers between Canada and the U.S.
- As of January 1, 1991 the Goods and Services Tax will make Canadian manufactured exports tax-free, increasing our competitiveness on the world market.

Rapid growth in the Canadian biotechnology industry

- Total sales reached $600 million in 1989.
- A strong annual growth in revenues of nearly 30% is observed in Canada's biotechnology industry.
- 42% of sales revenue was spent on R&D in 1989; this high level of research is continuing.
- R&D accounted for aggregate spending of $275 million in 1988.

Source: Canadian Biotech '89: On the Threshold

This document was created to help expand business co-operation between Canadian and foreign firms and institutes in the biotechnology industry. The document consists of two sections. The first outlines reasons why Canadian firms and institutes make good partners in rapidly expanding global markets. The second section provides a selection of profiles of Canadian firms and research institutes seeking co-operative business arrangements with their foreign counterparts.

Canada is committed to building on its substantial base of intellectual capital, expertise and accomplishments in technology-intensive fields such as biotechnology. Our competitive business environment, technological know how, financial support, and well-established R&D infrastructure are highlighted in this document.

Le présent document a été produit dans le but de favoriser l'accroissement de la collaboration entre les entreprises canadiennes et étrangères œuvrant au sein de l'industrie de biotechnologie. Il comprend deux parties. La première brosse un tableau des raisons pour lesquelles les entreprises canadiennes et les instituts de recherche sont des partenaires de choix au sein des marchés internationaux en pleine croissance. Quant à la seconde partie, elle présente une sélection des profils d'entreprises et d'instituts de recherche canadiens désireux de conclure des accords de coopération avec des sociétés ou organismes étrangers.

Le Canada s'est engagé à accroître ses fort nombreuses compétences et connaissances dans les domaines à forte concentration technologique tels que celui de la biotechnologie. Cet ouvrage met en lumière notre climat commercial concurrentiel, notre abondant savoir-faire sur le plan de la technologie, nos sources de financement ainsi que notre excellente infrastructure en matière de R-D (recherche et développement).

Diese Broschüre wurde geschaffen, um wirtschaftliche Kooperationen zwischen kanadischen und ausländischen Firmen auf dem Gebiet der Biotechnologie zu fördern. Sie ist in zwei Teile gegliedert. Der erste Teil erläutert, warum kanadische Firmen in weltweit schnell wachsenden Märkten interessante Partner darstellen. Der zweite Teil umfasst eine Auswahl von Leistungsprofilen kanadischer Firmen und Forschungseinrichtungen, die geschäftliche Kooperationen mit ausländischen Partnern suchen.

Kanada hat sich zum Ziel gesetzt, auf seinen bedeutenden geistigen Errungenschaften, seinem Sachverstand und seinen Leistungen in technologieintensiven Gebieten, wie der Biotechnologie, aufzubauen. Unser am Wettbewerb orientiertes wirtschaftliches Umfeld, unser technologisches Know-how, die Möglichkeiten finanzieller Unterstützung, und die gutausgebaute Infrastruktur auf dem Gebiet von Forschung und Entwicklung werden in dieser Broschüre hervorgehoben.

Industry, Science and Technology Canada - Industrie, Sciences et Technologie Canada

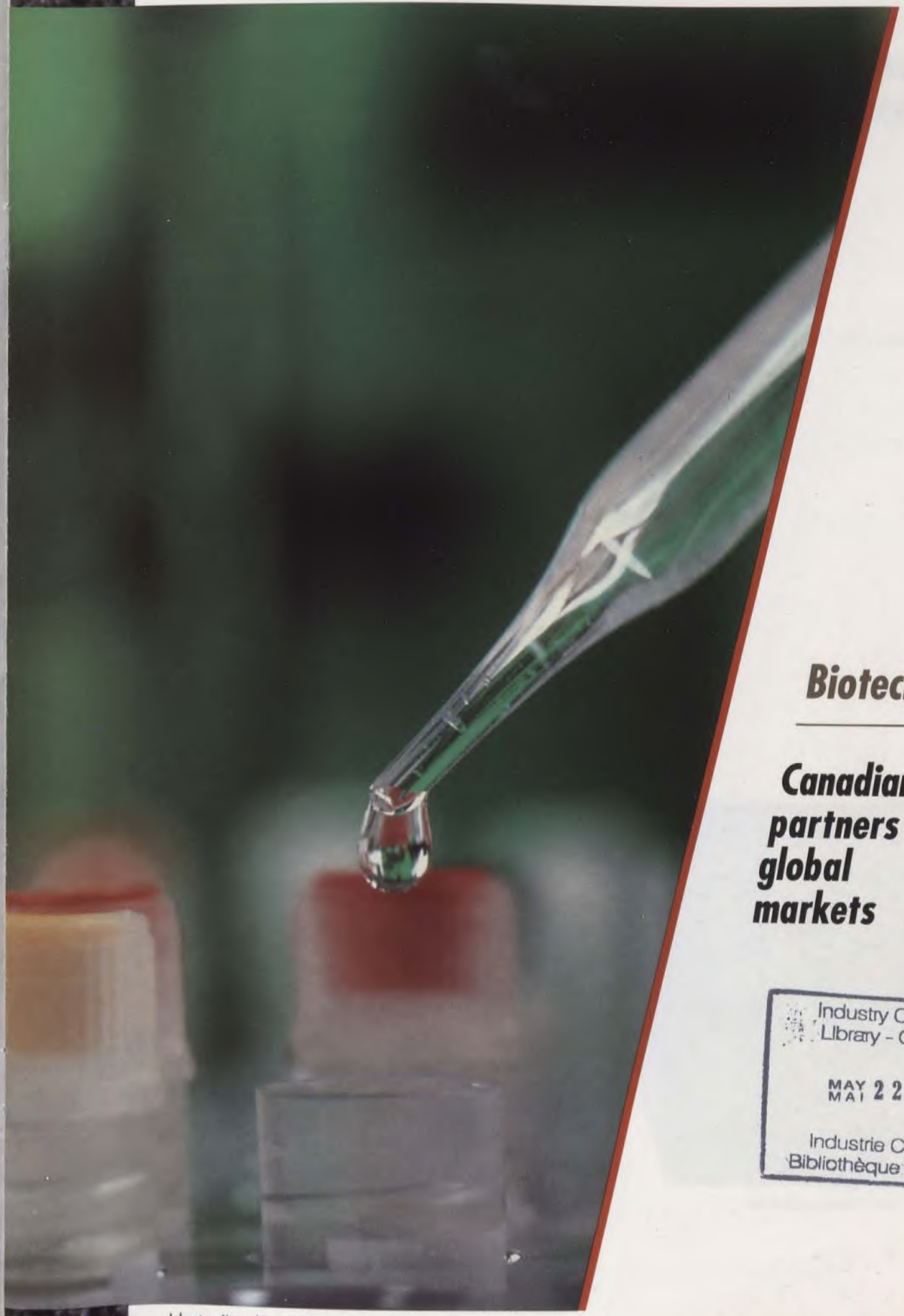
External Affairs and International Trade Canada - Affaires extérieures et Commerce extérieur Canada

Investment Canada - Investissement Canada

National Research Council of Canada - Conseil National de Recherche Canada

Biotechnology

Canadian partners for global markets



Laboratory, National Research Council Canada

Biotechnology

Canadian partners for global markets

Biotechnology in Canada

"In a world of imperfect options strategic alliances are the fastest, least risky and potentially most profitable way to go global and to deal with the hyper competitive international marketplace driven by technology."

Source: James Miller, President & CEO, Quadra Logic Technologies Inc., (Vancouver, B.C.), 1990.

Canada is committed to developing and supporting a strong biotechnology industry. Canada has excellent infrastructures to support ventures in biotechnology, having over 50 universities with research and training programs, several major government facilities, and federal and provincial assistance programs. The banking community, investment firms, and Canadian companies in many sectors are eager to establish international linkages to build and maintain strategic partnerships which are competitive on a global basis. Biotechnology is a key enabling technology for a growing range of industries, including:

- agriculture
- environment
- aquaculture
- food & beverage
- forestry
- mining
- chemical
- health
- energy

Calycomonas, National Research Council Canada

Canada's offer to biotechnology firms

The Canadian embassy and consular staff will provide information and contacts enabling your company to assess:

- Prospective Canadian joint venture partners and investment situations
- Market potential for your products
- Distribution channels
- Financing mechanisms
- Supporting infrastructure
- External research support
- R&D incentives
- Government financial support for capital investment and product development export
- Consultants who specialize in biotechnology

Examination of callous cultures, National Research Council Canada

Canadian firms make excellent partners

Canada offers...

1. World-recognized Canadian technological know how in biotechnology;
2. A sound base for penetrating the North American market;
3. A pool of highly-skilled scientists, engineers, and medical and health professionals;
4. Solid network structure among companies, universities and government institutes;
5. Strong Canadian collaboration in world-class research projects through National Centres of Excellence;
6. Extremely efficient and cost effective transportation and communications with international markets;
7. Patent protection in line with that of other countries;
8. A favourable regulatory climate with a relatively streamlined approval process for clinical and field trials, and straightforward product approval processes, particularly for medical devices;
9. An extremely generous tax support mechanism for R&D;
10. Competitive tax structures;
11. A wide range of research support programs;
12. Financing for all stages of business growth from R&D to production.

Peptide Analogues of human parathyroid hormones,
National Research Council Canada

1 Worldwide recognition in biotechnology

Canadian biotechnology firms, associated research and development centres and universities have played a large role in developing Canadian expertise, know how and technical solutions to complex biotechnological requirements.

Examples include:

- Bioleaching ..... Mineral and ore recovery
- Bioelectronics ..... Organic semiconductor substances, biosensors
- Biomaterials ..... Bioconversions, production of new materials
- Bioprocess Engineering ..... Fermentation and separation process engineering, control systems
- Cellular Genetics ..... Somatic & monoclonal cells
- Computer Modelling ..... Rational design of proteins and drugs
- Developmental Genetics ..... Gene transfer, cell culture, somatic embryogenesis
- Industrial Micro-Organisms ..... Chemical, food industries, environmental remediation
- Microbial Ecology ..... Environmental & agricultural behaviour prediction, fermentation
- Protein Engineering ..... Modification of bioactive substances
- Regeneration Methods ..... Agriculture and forestry applications

Source: National Biotechnology Advisory Committee Annual Report 1987-1988

2 A sound base for penetrating the North American market

Recognized strengths include a wide range of activities. The following list offers some examples:

- Animal Science ..... Ag-West Biotech Inc., McGill University, University of Guelph
- Biomaterials ..... Centre for Biomaterials
- Biomedical Engineering ..... University of Alberta, National Research Council (NRC)
- Diagnostic Products ..... Cangene, Precision Biologicals Inc., ADI Diagnostics Inc.
- Environmental Diagnostics ..... CBR Int'l. Biotechnologies Corp.
- Genetic Engineering ..... McMaster University, University of British Columbia, Centre for Protein Structure and Design (NRC)
- Pharmaceutical ..... Laval University, Bio-Méga, Quadra Logic Technologies, SynPhar Labs Inc.
- Plant Production ..... Plant Biotechnology Institute (NRC), University of Guelph
- Synthetic Polymers ..... Polydex Biologicals
- Human, Animal Vaccines ..... Connaught, Vetrepharm, University of Toronto
- Water Monitoring ..... Integrated Exploration
- Wastewater Treatment ..... ADI Limited, Paques Lavalin

Sources: Canadian Biotech '89: On the Threshold, Québec Biotechnology: On the Leading Edge

3a Human Resources

Highly-qualified workforce in biotechnology-related fields: university degrees awarded in Canada in 1988

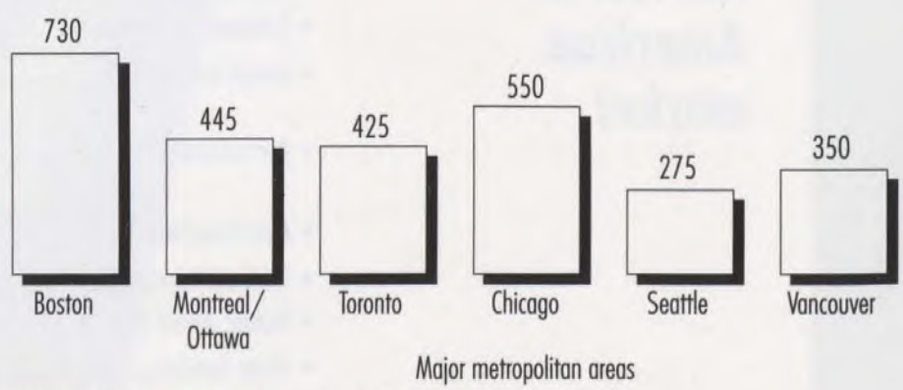
	Bachelor's Degree	Master's and Doctoral Degree
Agricultural/ Biological Sciences	7,210	1,114
Engineering/ Applied Sciences	7,992	1,919
Health Professions	7,423	1,137
Mathematics/ Physical Sciences	7,229	1,625

Source: Statistics Canada, Universities: Enrolment and Degrees (81-204) 1989 & 1990 Versions

3b Research capabilities

The availability of talented research professionals is critical to the creation, development and utilization of new technologies. Canada's major metropolitan areas are highly competitive with similar U.S. centres in this respect.

Relative intensity of research capabilities of selected Canadian and U.S. metropolitan areas, 1989*



* Does not include government research establishments

Source: Science, Technology and Economic Analysis Division (ISTC)/OECD

4a National Networks

National networks have been formed to foster collaboration among researchers from industry, universities and government. They provide an easy access to people and biotechnology activities in Canada. The networks are:

AQUATECH: Fisheries/marine aquaculture
For more information contact: Ms. I. Price, Fisheries and Oceans, Tel: (613) 990-0275, Fax: (613) 996-9055

BIOCROP: Plant strain development
For more information contact: Dr. J. Singh, Agriculture Canada, Tel: (613) 995-3700, Fax: (613) 992-7909

BIOFOR: Forestry and forest products
For more information contact: Dr. W.M. Cheliak, Forestry Canada, Tel: (819) 997-1107, Fax: (613) 990-3437

BIOMINET: Mineral leaching and metal recovery
For more information contact: Dr. R.G.L. McCready, Energy, Mines and Resources, Tel: (613) 992-1596, Fax: (613) 996-9673

BIONET: Human and animal health care
For more information contact: Ms. S. Hasnain, Drugs Directorate, HWC, Tel: (613) 957-0298, Fax: (613) 952-7422 or Ms. A. Fraser, Animal Diseases Research Institute, Tel: (613) 998-9320, Fax: (613) 952-2285

BIOQUAL: Waste treatment
For more information contact: Mr. C. Barraud, Technology Development Branch, Environment Canada, Tel: (613) 991-1577, Fax: (613) 991-1634

BIOREM: Nitrogen fixation
For more information contact: Dr. L.R. Barran, Plant Research Centre, Agriculture Canada, Tel: (613) 995-3700, Fax: (613) 992-7909

4b Industry Oriented Associations

IBAC: The Industrial Biotechnology Association of Canada supports Canadian industrial biotechnology and promotes its development and evolution.
For more information contact: Mr. R. Quinn, IBAC, Tel: (613) 233-4559, Fax: (613) 233-3882

CIB: The goals of the Canadian Institute of Biotechnology are to promote technology transfer in a wide range of industrial sectors and to provide networking opportunities.
For more information contact: Mr. R. Quinn, IBAC, Tel: (613) 233-4559, Fax: (613) 233-3882

APRO: The Association of Provincial Research Organizations is a national network of regional organizations dedicated to using science and technology for the economic and social development of Canada and the provinces.
For more information contact: Mr. J. Hutch, Saskatchewan Research Council, Tel: (306) 933-5402, Fax: (306) 933-7896 or Dr. K. Pulfer, APRO National Office, Tel: (613) 567-2993, Fax: (613) 236-3754

5 National Centres of Excellence

National Centres of Excellence are examples of strong Canadian collaboration in world-class research projects. Following a review of many highly competitive proposals, the federal government is supporting 14 centres. Each centre combines the talents of researchers working out of a number of institutes across the country, leading Canada into the 21st century. They include 35 universities, 500 researchers, and over 40 companies in the field. Biotechnology is a major component in 7 out of 14 National Centres of Excellence.

1. Bacterial diseases: molecular strategies for the study & control of bacterial pathogens of humans, animals, fish & plants
2. Biotechnology for insect pest management
3. Genetic basis of human disease: innovations for health care
4. Neural regeneration functional recovery
5. Protein engineering: 3D structure, function and design
6. Respiratory health network of centres of excellence
7. Ocean production enhancement network

For more information contact: Mr. D. Hull, Research Grants and Scholarships Policy, Industry, Science and Technology Canada, Tel: (613) 993-6857, Fax: (613) 990-2007; Ms. C. Armour, Strategic Grants and Networks, Natural Sciences and Engineering Research Council, Tel: (613) 995-6295, Fax: (613) 992-5337

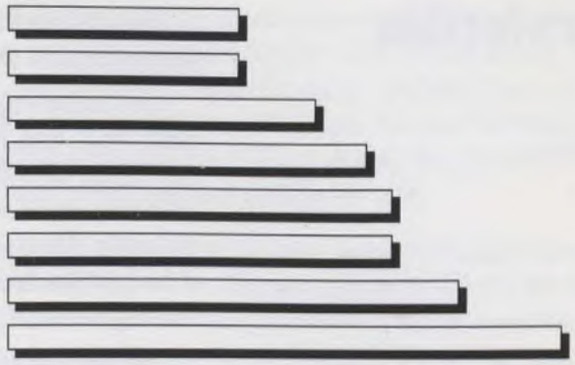
Source: NCE Program Backgrounder, 1989

Institute of Marine Biosciences, National Research Council Canada

6a Integrated communication and transportation systems allow efficient and rapid servicing of markets

- **Most reliable telephone system in the world with direct-dial global access.**

Cost of a direct-dial 5-minute telephone call:



6b Transportation

- **Air links between Canadian cities and other parts of the world.**

	Vancouver	Calgary	Winnipeg	Toronto	Montreal
			(Flight Hours)		
New York	6.5 (*)	5.0	4.5 (*)	1.5	1.0
San Francisco	2.0	1.5	3.0	5.5	7.5 (*)
Amsterdam	9.5	8.5	11.5 (*)	7.0	6.5
Paris	13.5 (*)	12.5 (*)	12.0	7.5	7.0
London	9.0	9.5	10.0 (*)	7.0	6.5
Frankfurt	9.5	9.0	11.5 (*)	7.5	7.0
Prague	12.0 (*)	14.0 (*)	14.0 (*)	11.0 (*)	9.0 (*)
Moscow	14.0 (*)	17.0 (*)	16.0 (*)	12.0 (*)	9.0
Tokyo	9.5	11.5 (*)	14.5 (*)	13.0	15.0 (*)
Hong Kong	13.0	16.0 (*)	17.0 (*)	18.5	20.0 (*)
Taipei	15.0 (*)	17.5 (*)	21.5 (*)	20.0 (*)	21.5 (*)
Singapore	18.5 (*)	22.0 (*)	23.0 (*)	23.5	24.0 (*)

(*) Shortest time with a stopover.

7 Patent protection

Under the new Patent Act, the life of a patent is 20 years from the date of filing. The new Act applies to patents filed after October 1, 1989. It takes up to three years to process a patent after the filing date.

Under the Patent Co-operation Treaty, an applicant can file one application in Canada and ask for patent protection in any of the 43 signatory countries.

The Canadian Patent Law states that inventions for new microbial life forms such as bacteria, yeasts, molds, fungi, actinomycetes, algae, cell lines, viruses, protozoa and processes for preparing them may be patentable. To be patentable, such inventions must relate to new man-made life forms which previously did not exist in nature; they must be reproduceable by others by the method used by the inventor or from publicly available culture collections; and they must satisfy the other requirements of the Patent Act. Processes which utilize microbial life forms may also be patentable if they meet the usual requirements of a patentable process.

For more information contact: Patent Office, Consumer & Corporate Affairs Canada, Tel: (819) 997-1936, Fax: (819) 997-2721

Source: Consumer & Corporate Affairs Patent Info The Canadian Patent Office Newsletter, Vol 2, No 2, December 1989.

8 Regulatory agencies

The Canadian biotechnology industry is regulated mainly by three federal departments: Health and Welfare Canada, Agriculture Canada, and Environment Canada.

Health and Welfare Canada regulates drugs (for both human and animal use), cosmetics, medical devices, radiation-emitting devices, foods and food additives, chemicals and other products that may affect human health.

For more information contact: Health Protection Branch, Health and Welfare Canada, Tel: (613) 957-1059, Fax: (613) 952-7422

Agricultural products of biotechnology, including human and animal foods, fertilizers, pesticides, seeds, products that could potentially be plant pests, and veterinary biologics are regulated by Agriculture Canada.

For more information contact: Food Production and Inspection Branch, Agriculture Canada, Tel: (613) 993-4544, Fax: (613) 998-1312

The protection of wildlife, water, and the environment falls under the mandate of Environment Canada.

For more information contact: Biotechnology Centre, Environment Canada, Tel: (613) 953-1652, Fax (613) 953-3173

The time required for regulatory approval varies greatly from product to product, and ranges between 90 days and 22 months. Canadian regulations are comparatively streamlined both for R&D and product approval. For example medical devices approval can be obtained within days; pharmaceutical approval is more complex and depends on the compounds themselves and their claims.

Sources: Biotech: A User's Guide; National Biotechnology Advisory Committee Annual Report 1987-1988; Financial Post, 83 No 24.

9 An internationally competitive tax structure

Canada's tax treatment of R&D is among the most attractive of industrialized nations

- The Canadian corporate income tax system provides a number of significant R&D tax incentives for firms. It allows for a 100% deduction for current (1990) R&D expenditures, as well as for capital expenditures made on R&D machinery and equipment. In addition, there is an investment tax credit on qualifying R&D expenses incurred in Canada. The rate of the federal credit is 20% of R&D expenditures for large companies and 35% for small ones. Both current (1990) expenditures and expenses on machinery and equipment qualify for the credit.
- A 1990 study by the Conference Board of Canada reveals that the Canadian corporate tax system provides greater overall incentive for companies to engage in R&D than does the tax system of nine other leading industrial countries. The study shows that Canadian tax incentives for R&D reduce before tax income required to cover the costs of doing $1.00 worth of research to $0.65, whereas U.S. incentives reduce the cost to only $0.97. The U.S. tax credit is based on a less generous assumption of an increase in R&D expenditure over a specified expenditure base than is provided in Canada.

Before tax income required to do $1.00 worth of research: *
A ten-country comparison, 1989

Country	Cost ($)	Rank
Canada	0.657	1
Australia	0.703	2
Korea	0.805	3
France	0.813	4
United States	0.972	5
United Kingdom	1.000	6
Japan	1.003	7
West Germany	1.027	8
Italy	1.033	9
Sweden	1.040	10

* Present values

Source: The Conference Board of Canada, May 1990, Jacek Warda, International Competitiveness of Canadian R&D Tax Incentives: An Update

10 Comparison of Canadian and U.S. Corporate Income Tax

	Canada	United States
Federal tax rates*		
- for general business	28%	34%
- for manufacturing	24%	34%
Provincial and state tax rates	5.5% to 17%	0% to 12%

*The Canadian federal tax rates are effective July 1, 1989. At present there is also a 3% federal surtax on corporate income tax.

Depreciation

Canadian depreciation rates are somewhat lower than U.S. rates, but are still higher than those based on the economic life of the asset.

	Canada	United States
Per cent of capital gains included as income (as of January 1, 1990)	75%	100%
Treatment of operating losses by carry-over years	Back 3 years Forward 7 years	Back 3 years Forward 15 years
Consolidation of companies	Not permitted	Permitted for subsidiary at least 80% owned
Minimum tax	no minimum corporate tax	alternative minimum tax of 20% of defined alternative minimum taxable income
Intercorporate dividends	100% deductible	80% deductible

Source: Investment Canada, 1990

11 Financing biotechnology operations

Federal tax credits for R&D

The Government of Canada provides tax credits to companies carrying out research in Canada. The amount of the credit varies from 20% to 35% depending on the size of the company.

Grants and contribution programs

A) Industry, Science and Technology Canada - Incentives for R&D:

The **Strategic Technologies Program** (STP) provides financial assistance for the development and application of biotechnology, advanced industrial materials and information technologies. In the area of biotechnology, it supports projects which are of strategic importance to the development of industrial biotechnology in Canada and which enhance the international competitiveness of Canadian industry.

Thirty-three per cent of the $120 million set aside for this five-year program is devoted to biotechnology-related projects. These include feasibility studies, R&D alliances and technology application alliances. Projects which qualify for assistance under STP can receive up to 50% of eligible costs. Such costs include salaries, reasonable operating costs and special purpose equipment. There is no maximum per project.

For more information contact: Ms. C. Cheffins, Biotechnology Division, Tel: (613) 954-3042, Fax: (613) 952-4209

B) The National Research Council of Canada (NRC):

NRC's **Industrial Research Assistance Program** (IRAP) is an excellent starting point for companies interested in collaborating with Canadian companies in R&D activities. A national network of technology advisers is in regular contact with companies involved in innovation. Some 5,000 firms were helped last year through IRAP.

The network strives to help the companies find and use the expertise and resources they need to be competitive. To do this, IRAP has established ties to federal and provincial laboratories, technical institutes, universities and other professional bodies. IRAP also offers financial support (up to 50% to a maximum of $500,000) for promising research projects where the substantial risk to the company would make it difficult to undertake alone. These research projects could include a collaborative effort between a Canadian and a foreign company.

For more information contact: Dr. J. Jaworski, Tel: (613) 993-5466, Fax: (613) 952-1079

NRC's **Biotechnology Contribution Program** assists firms to undertake collaborative R&D projects with the NRC biotechnology institutes. These include the Biotechnology Research Institute in Montreal, the Plant Biotechnology Institute in Saskatoon, the Institute for Marine Biosciences in Halifax and the Institute for Biological Sciences in Ottawa.

The objectives of this contribution program include stimulating technological innovation in the private sector, increasing the commercial applications of NRC supported research, and improving the return on investment from federally funded research for its economic and social benefits to Canada.

Program eligibility is restricted to companies incorporated either provincially or federally in Canada, provincial research organizations, and institutional laboratories and other research organizations, excluding universities. Recipients must demonstrate that they will engage in cost-shared collaborative research which will complement NRC's activities in biotechnology research.

For more information, contact: Biotechnology Program Office,
Tel: (514) 496-6233, Fax: (514) 496-5324

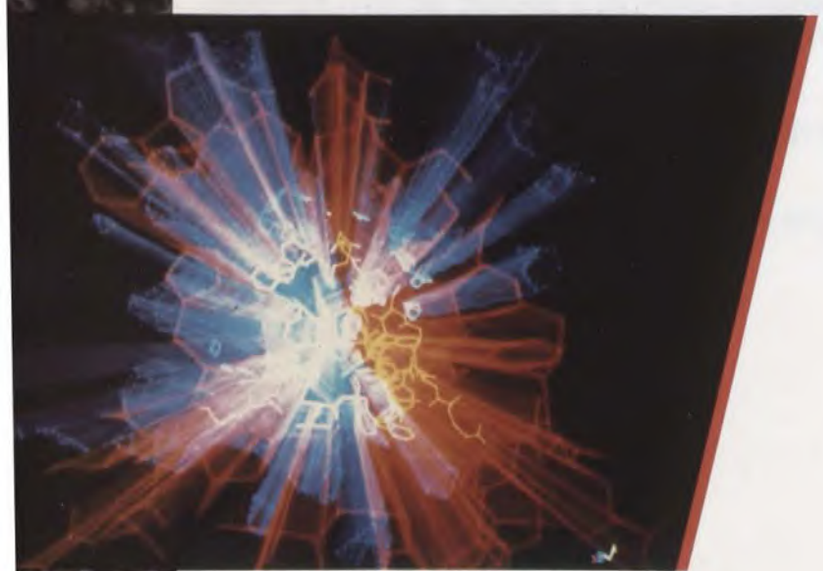
C) Medical Research Council of Canada (MRC) - Research Support:

At least 20% of MRC's $215 million annual budget is spent on research projects which are built on the techniques of biotechnology. These research projects cover the range of biomedical research, from the most basic of molecular biology to techniques of gene mapping and molecular diagnosis directly applied to patients.

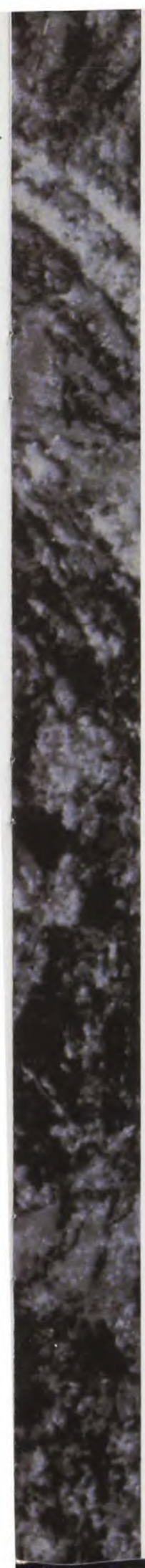
MRC promotes, assists and undertakes basic applied and clinical research in Canada in the health sciences. Scientists in universities and their affiliated teaching hospitals and research institutes with research related to human health are eligible to apply.

MRC offers programs for support of research and research training. Operating grants to meet the direct costs of research account for 67% of MRC's budget, and a further 14% is spent on multidisciplinary research grants. Approximately 12% is used for research training to the PhD level, and for post-doctoral research training fellowships for both basic scientists and for health professionals. A further 6% is used for salary support awards designed to allow recipients to spend the majority of their time on research. The rest is for minor programs such as symposia and workshops.

For more information contact: Dr. F.S. Rolleston, Scientific Evaluation,
Tel: (613) 954-1801, Fax: (613) 954-1800



Computer image of enzyme, National Research Council Canada



D) The Natural Sciences and Engineering Research Council (NSERC):

The Council's mandate focuses on the funding of university-based research and offers a diverse range of programs including the following university-industry collaborative programs and training activities:

- Co-operative R&D Activities (research grants, shared equipment);
- Industry Research Chairs;
- Industrial Research Fellowships;
- Research Personnel Exchanges;
- University-Industry Affiliations (helping you to establish liaison offices on campus, circulate R&D bulletins, offer consulting services, etc.);
- Networks of Centres of Excellence (NCE) Program; and
- Strategic Grants Program.

There is an emphasis on flexibility and shared responsibility in these programs. Non-Canadian firms can be considered as collaborators if significant benefits to Canada are foreseen.

Over the last six years, NSERC's funding of biotechnology research has grown from $11 million in 1983-84 to almost $20 million in 1989-90 (excluding the NCE scholarships and fellowships programs). This real growth in funding demonstrates the Council's continuing commitment to the support of this rapidly developing and strategically important research area.

For more information contact: NSERC at Tel: (613) 995-6295, Fax: (613) 992-5337.

E) Investment Canada

Investment Canada has a service which provides professional and timely responses to a diverse cross-section of inquiries raised by potential investors.

Investment Canada can answer questions on: the availability of federal, provincial and municipal incentive programs or policies; biotechnology firms or institutes in Canada; and, information on the biotechnology industry.

For more information contact Investment Canada, Investor Services Group, Tel: (613) 995-9998, Fax: (613) 996-2515.

12 Financing options

There are various mechanisms available to finance each stage of business development. The following are detailed examples of Canadian companies which have progressed financially. These companies (unnamed) have obtained financing from both the private and public sectors based on their merit.

A) The first company we are profiling is an excellent example of the type of funding available provincially.

Products: Bio-Process Control

$40,000 – Initial investment from partners

$15,000 – 80% from the "Centre Québécois de Valorisation de la Biomasse" (CQVB) and 20% from the company, to conduct a validation study. The CQVB is a provincial funding agency in Québec.

$265,000 – 80% from CQVB and 20% from the company. Funds were used to develop a prototype.

$160,000 – Capital inflow from shareholders.

$565,000 – 52% from the "Agence Québécoise de Valorisation Industrielle de la Recherche" (AQVIR), which is a provincial funding agency for R&D, 15% from the CQVB, and 33% from the company. Funds were used to produce five bio-process control systems to be tested in Canada by two universities, two federal research institutes and a multinational.

B) The second company we are profiling illustrates the wide array of funding which is available from the federal government.

Products: Medical Devices

$200,000 – Seed financing from the National Research Council's Industrial Research Assistance Program to develop a new product. This federal program provides technical assistance to companies.

$2,500 – From the Technology Inflow Program to seek out foreign partnerships. This program provides assistance to Canadian companies to access technologies not available in Canada.

$100,000 – From the Industrial Research Assistance Program to develop new products.

$50,000 – For an Industrial Post-Doctoral Fellowship from the National Sciences and Engineering Research Council.

C) The third company we are profiling is a spin-off of a pharmaceutical company. They have been very successful in obtaining seed capital from the private sector.

Products: Pharmaceuticals

$18 million – Seed financing has been obtained from the following groups:

- Four Canadian pharmaceutical companies
- A venture capital company
- A life insurance company
- A chartered bank
- The Ontario Development Corporation

Testimonial

Allelix Biopharmaceuticals Inc. is in the business of developing biopharmaceutical products in collaborative arrangements with pharmaceutical companies. In our experience, the ethical pharmaceutical companies are enthusiastic about investing in R&D in this country. This reflects the quality of our scientific research in the life sciences and the possibilities of securing adequate patent protection for product discoveries.

In 1988, our company entered into a joint venture with Glaxo Canada Limited, the country's second largest pharmaceutical company, to develop new drugs to treat bone disorders such as osteoporosis, bone cancer and bone fractures.

The collaborative research program involves a minimum investment of $10 million over five years from Glaxo. The project is a significant milestone for Glaxo because it is their first venture into discovery research in Canada. Prior to this, Glaxo's focus was on manufacturing, marketing and clinical testing.

Glaxo's President and CEO, Jacques Lapointe notes, "We chose Allelix as a research partner because it is one of Canada's major players in the field of biotechnology. In addition, we were impressed by the expertise and commitment Allelix has made to medical research, as well as their imposing network of scientists in universities and other institutions."

Source: Graham Strachan, President & CEO, Allelix Biopharmaceuticals, Mississauga, Ontario, 1990.

Canada

Strategic partnerships

Prairie Plant Systems Inc.

108-106 Research Drive
Saskatoon, Saskatchewan
S7N 3R3

Perry W. Aulie
Business Manager

Telephone: (306) 975-1207
Fax: (306) 975-0440

Company history

PPS was established in 1988 to develop biotechnology products for agriculture and forestry. The company initially specialized in the micropropagation of horticultural crops, however forestry research is increasing in importance. The laboratory is located at the site of the Transgenic Plant Centre operated by Dr. Wilf Keller of the National Research Council. Collaboration with the National Research Council and the University of Saskatchewan facilitates low cost development of new products.

- Annual Sales: $200,000
- R&D Expenditures: $150,000
- Number of Employees: 4

Major Products and Markets

The sale of tissue cultured horticultural crops provide the majority of revenue for PPS. These sales consist primarily of hardy fruit trees native to the prairie region of Canada.In addition, contractual services are provided to the National Research Council as well as to other private agricultural firms. These services have ranged from tissue culture research, to plant growth studies.

Technology of the Company

- micropropagation of horticultural crops
- elaborate growth facilities including isolated environmental growth units for transgenic plants, insect challenging and pollution studies.
- extensive land base for product testing

Products in Development

A treatment to enhance growth and increase survival of transplanted forest seedlings. Laboratory and field tests have been completed.Exchange of plant material with Asia. A joint venture micropropagation facilitate is currently under evaluation.

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Prairie Plant Systems Inc.

(continued)

Desired alliance with other biotechnology firms

We are looking for:

- strategic production and marketing agreements to link our company to a wider range of micropropagated crops
- joint venture development of agriculture or forestry products. This agreement may exploit our strategic relationship with the National Research Council Plant Biotechnology Institute.

Canada

Strategic partnerships

The University of British Columbia, Department of Botany

#3529 – 6270 University Boulevard
Vancouver, B.C.
V6T 2B1

Dr. A.D.M. Glass

Telephone: (604) 228-4847
(office) (604) 228-3342 (lab.)
Fax: (604) 228-6089

Nature of Research

The goal of the research is to characterize the transport protein(s) involved in the absorption of potassium by barley roots. This involves:

(a) Isolation and purification of plasma membrane and tonoplast polypeptides which are over-expressed under conditions of potassium limitation, conditions which lead to enhanced absorption of potassium.
(b) Generation of antibodies to these polypeptides and their use to probe transport in vesicles isolated from plasma membrane and tonoplast enriched fractions.
(c) Isolation of cDNA clones containing sequences coding for these polypeptides.
(d) Reconstitution of transport activity in liposomes.
(e) Use of molecular probes to localize (in situ) activity of these transport systems in the root (epidermal/cortical cells/stelar cells) as well as to quantify their expression under conditions of potassium limitation.

Major achievements

1. Physiological responses to potassium limitation have been characterized.
2. Three major membrane polypeptides have been identified in tonoplast enriched fractions. These peptides are over-expressed under conditions of potassium limitation.

Current industrial involvement

The research is supported by a 3 year grant from the Potash Phosphate Institute of Canada and an NSERC University Industry Liaison Grant.

Research group profile

Principle Researchers:
Dr. A.D.M. Glass (physiologist/biochemist 60 publications)
Dr. M.Y. Siddiqi (physiologist 40 publications)
Mr. J. Mehroke (biochemist)
Mr. R. Tyers (biochemist)

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Canada

Strategic partnerships

University of Toronto, Centre for Plant Biotechnology

University of Toronto (all three campuses)
P.A. Horgen, Director
University of Toronto
Erindale Campus
Mississauga, Ontario
L5L 1C6

Telephone: (416) 828-5424
Fax: (416) 828-5328

Nature of research

25 scientists, highly varied programs

- Cell culture and secretion of pharmaceuticals
- Mushroom breeding and biotechnology
- Microbial production of hydrocarbons
- Stress physiology and forest renewal
- Use of recombinant DNA markers to identify plant pathogens
- Molecular basis of pathogenicity in plants

Major achievements

- Use of biotechnology to break down natural barriers in breeding of cultivated mushroom.
- Development of polymers for adhesion of plant cell cultures.
- Identification of stress resistant proteins in forest tree seedlings.
- RFLPs and Allozymes to identify plant pathogens.
- Development of transformation as a tool for mutagenesis in forest pathogens.
- Basic studies in ribozymes.
- Organelle molecular genetics.

Description of research

For specifics, contact the Director.

Current industrial involvement

Considerable international involvement.

Industrial involvement sought

Yes

Research group profile

- Principal researchers are: 25 scientists and 200 other research personnel.
- Universities/Institutes involvement: Centre of Canada's largest university.

Other comments

For more information, contact the Director.

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Canada

Strategic partnerships

Westech Agriculture Ltd.

R.R. #1
Alberton, P.E.I.
C0B 2B0

Nora Gaudette

Telephone: (902) 853-3636
Fax: (902) 853-3298

Company history

R & D of new barley varieties. Produce these new varieties through anther culture and *Hordeum bulbosum* crosses. Micropropagation of disease-free strawberry varieties.Number of Employees: R & D 2; Manufacturing 2; Marketing 2.

Major products and markets

The tissue culture strawberry plants are passed on to nursery operations where plants are field-grown for summer production. Product is sold in the Maritimes, USA and overseas.

Customers comment on uniformity, vigour and healthiness of our plants.

Technology of the company

Westech has the biotechnology of tissue culturing strawberries, blueberries, raspberries, and some ornamentals. It also has expertise in variety development of barley.

Products in development

Continual work in developing new varieties of barley.

Desired alliance with other biotechnology firms

Developing new products for micropropagation that have a niche in the marketplace.

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Canada

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Chemical

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Canada

Strategic partnerships

B.V. Sorbex, Inc

c/o McGill University
Department of Chemical Engineering
3480 University St.
Montreal, QC
H3A 2A7

Dr. B. Volesky, President

Telephone: (514) 398-4276
Fax: (514) 398-6678

Company history

B.V. SORBEX, Inc. was established in 1988, based on the unusual promise of a recent discovery. It acquired the rights to the results of more than a decade of innovative research that established extraordinary potential of certain types of natural and industrial microbial materials to concentrate heavy metals. The founder of B.V. SORBEX, Inc., Dr. B. Volesky has pioneered the research on new biosorbents, metal-sorbing materials, at McGill University in Montreal and brings with him into the Company not only an extensive know-how in the new field but also several key patents issued and more pending, staking thus firmly the basis for the new technological venture.

While there has been no sales activity so far, the Company, positioned at the leading edge of the new technology, is developing and preparing to market the family of new biosorbent materials and also integrated environmental engineering services based on the application of new biosorbents in the metal removal and recovery from industrial solutions and effluents.

Major products and markets

The Products: Goods and Services

A) The SORBEX® family of new biosorbents is based on a rigid and chemically robust formulation of highly metal-sorbing microbial biomass raw materials. The biosorbent granules have a suitable size of 0.5 to 3 mm allowing their convenient use in the sorption process contact equipment. *New biosorbents* can be either specific for a targeted recovery of valuable metals from dilute industrial processing or waste solutions or broad-range for detoxification of wastewater or effluent solutions by removing heavy metals. Biosorbents can be regenerated for multiple reuse just like ion exchange resins which they outperform in many applications and also outprice by a good margin. Cheap biosorbent materials can concentrate and recover gold, or remove toxic metals such as lead or chromium from the environment. The application potential of new biosorbents is enormous: from *detoxification* of waste waters to recovery and resale of precious metals.

B) SORBEX Equipment: A unique sorption pilot plant facility is a partially automated, self-standing pilot-scale hardware module with two different designs of the contractor element. Apart from packed-bed down-flow sorption units, the system can have a proprietary mixed-bed contactor which eliminates clarification pretreatment of the feed stream and allows the possibility of a long-term continuous-flow operation without fouling using non-granulated and thus much cheaper biosorbents. It offers faster kinetics of the sorption process using much smaller and more efficient active biosorbent particles.

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B.V. Sorbex, Inc

(continued)

C) SORBEX Services: A range of environmental engineering services and analytical capabilities necessary for the review of the customer's wastewater problem, leading to and including the treatability study aimed at assessment of the new biosorbent technology potential for the particular customer. A complete contract operation package for full-scale sorption plant installations can be negotiated performing with or without metal recovery benefits.The markets increasing environmental pressures are strengthening the environmentally based markets and the highly competitively priced biosorbents for heavy metals are opening new applications and opportunities. Metal finishing and plating operations, mining and ore processing industries, chemical and power generating plants are all target areas representing a more than $1 billion/year estimated existing market niche for the new biosorbent technology.

Technology of the company

B.V. SORBEX technology is based on extensive and innovative research work which resulted in the discovery of potent metal-binding biomass types. This technology is capable of effectively and very economically removing heavy metals from industrial solutions and effluents which are this way detoxified and rendered harmless to the environment. Some metals of sufficiently high values can be recovered and resold. Several US and Canadian patents have been issued to protect the technology relevant to some metals, more patents are currently pending.

The core of this technology is a family af new biosorbent products (SORBEX)® which retain metals either selectively or as a broad spectrum of heavy metallic species. The unique biosorbent materials are derived from specific types of microbial biomass by a simple process which makes them applicable in large-scale metal sorption and water-purification processes. The granulated biosorbents can be regenerated and reused in a multiple adsorption/regeneration cycles. Their application eliminates often practiced chemical precipitation processes resulting in hazardous sludges difficult to dispose of. The biosorbent technology provides a low-cost and a highly competitive alternative to the expensive ion exchange applications.

The Company is basing a range of process equipment and environmental engineering services on the new biosorbent technology.

Products in development

While some of the newly discovered highly metal-sorbent materials of microbial origin have been identified and their function studied and examined with different types of heavy metals, their formulation for the scaled-up industrial applications is being currently developed and optimized. R&D activity in progress follows ongoing research of the metal biosorption phenomenon. New biosorbents are being continuously screened for and investigated while the established ones are being improved and process-formulated. As a result, new biosorbents both highly metal-selective and broad-range are being developed. This continuous R&D activity is essential in order to maintain the Company at the forefront of the new technology.

Simultaneously with the continued new product R&D, the Company focuses on the selection of suitable representative client industries and studies their specific problems in collabarative efforts based on specifically designed individual effluent treatability study programs. The experimental test pilot plant operations are to follow those programs leading to the optimized client-specific design of the biosorption effluent treatment and eventually metal recovery schemes.

Desired alliance with other biotechnology firms

The start-up Company is looking for:

- equity based partnership(s) and/or financing for developing the new technological venture;
- strategic alliance with pharmaceutical (biomass source) or chemical campanies interested in diversification into environmental (bio)technology and markets;
- strategic alliance with engineering consulting firm(s) interested in new process technology;
- marketing and representation in different areas of the world.

Canada

Strategic partnerships

Diagnostic Chemicals Limited

West Royalty Industrial Park
Charlottetown, PEI
C1E 1B0

J. Regis Duffy, President

Telephone: (902) 566-1396
Fax: (902) 566-2498

Company history

Diagnostic Chemicals Limited was founded in 1970. It employs 55 people, most of whom are scientists. The company has 3 divisions – Diagnostic, Biotech and Fine Chemicals – Manufacturing.

Major products and markets

The company exports 60% of all products mostly, to the United States. We manufacture diagnostic kits for the determination of various components in blood, such as glucose and cholesterol.We also manufacture about 75 fine chemicals, many of which are used on ELISA procedures in the biotechnology field. A number of enzymes we isolated from animal and plant sources, that is, urease, cholesterol esterase and glutamate dehydrogenase.

Technology of the company

Fine Chemicals – manufacturing
Enzyme isolation and purification
The development of analytical procedures used in human and animal clinical chemistry.

Products in development

Serum controls, new diagnostic procedures.

Desired alliance with other biotechnology firms

Needed, companies to expand marketing of these products.

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Canada

Strategic partnerships

ICI Biological Products North American Technical Centre (NATC)

2101 Hadwen Road
Mississauga, Ontario
L5K 2L3

Dr. David Gannon, Manager

Telephone: (416) 823-7160
Fax: (416) 823-0044

Company history

Imperial Chemical Industries PLC is a major international chemical company. ICI Biological Properties was formed in 1984 to focus the company's efforts in production and marketing of biological products. Since 1984 the business has expanded by both organic growth and acquisition. The 1989 formation of the North American Technical Centre in Mississauga signifies an increased commitment to develop the North American business of ICI Biological Products.

Major products and markets

ICI Biological Product's products include inoculants, specialty enzymes, the biodegradable fermentation-produced polymer 'PHBV', the microbially produced human food QuomR, peptides and other research biochemicals (Cambridge Research Biochemicals), DNA fingerprinting (Cellmark Diagnostics), and environmental initiatives (e.g. the Deep Shaft biological wastewater treatment system).In addition ICI Biological Products works with clients from a wide range of industries to develop biological products,in collaborations varying from research contracts to full joint ventures. The North American Technical Centre is focusing on collaborations with U.S. and Canadian companies.

Technology of the company

ICI Biological Products offers the complete range of fermentation and related technologies necessary for the production of biologicals, from laboratory R & D, through scale-up, economic evaluations, product licensing and registration and full-scale production. Our business has unique skills in many areas and a proven track record in successful development of biological products.

Products in development

New developments in inoculants, enzymes, biodegradable polymers and biochemicals are in progress.

Desired alliance with other biotechnology firms

We are looking for collaborations with other companies in the U.S. and Canada to develop biological products. These companies would ideally have strengths which complement ICI Biological Products, e.g. strong market-oriented companies who see the potential of biotechnology but have limited in-house expertise or experience in the production of biologicals.

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Canada

Strategic partnerships

Monsanto Canada Inc.

2330 Argentia Road
P.O. Box 787, Streetsville Post Office
Mississauga, Ontario
L5M 2G4

Dr. J.R. (Jack) Wearing
Director, Research & Business Development

Telephone: (416) 826-9222
Fax: (416) 826-3119/6416

Company history

All Monsanto operations in Canada employ 1400 people with manufacturing facilities, research, distribution and sales offices across the country. Sales of Monsanto Canada Inc. and the affiliated companies, Searle Canada Inc., The NutraSweet Company, and Fisher Controls Company of Canada Ltd., approached $500M for 1989. They are wholly owned subsidiaries of Monsanto Company of St. Louis, Missouri, a world leader in high quality specialty chemicals, plastics, and man-made fibers; agricultural chemicals and feed ingredients; pharmaceuticals; low calorie sweeteners; and industrial process controls. The Monsanto Company employs 42,000 employees worldwide in 100 countries and has annual sales approaching $9 billion.

Major products and markets

Marketing and manufacturing of agricultural and industrial chemicals and plastic resins. Biotech products being commercialized for plant and animal agriculture. The chemical business is the largest of the Monsanto units. It is a leader in performance materials, with a diverse portfolio including detergents and phosphates, man-made fibers, plastics and elastomers, process chemicals, resin products, rubber chemicals and instruments, specialty chemicals and other products. Manufacturing occurs at LaSalle Quebec, Monsanto's first facility in Canada acquired in 1944. The facility now employs 300 people and is being upgraded toward becoming a plant of the 90's. The agricultural business markets a range of crop-protection products and animal feed supplements to grain, poultry, and livestock producers. Primary markets include Western Canadian cereal grains, Eastern Canadian row crops, and coast-to-coast forestry management and industrial and residential turf control. Most of these products are manufactured at LaSalle and in Winnipeg and Calgary. Monsanto's technology enables Canadian producers to improve crop and animal yields and efficiently compete in world markets.

Technology of the company

- Fermentation (organic and amino acids), enzymes (genetic engineering)
- Plant cell tissue culture
- Recombinant DNA (microbial, fungal/yeasts, plants, animals)

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Monsanto Canada Inc.

(continued)

Products in development

Diverse research projects with canadian universities and government laboratories in the fields of:

- plant science
- animal science

Desired alliance with other biotechnology firms

Complementary expertise to assist with Canadian and worldwide product development.

Other comments

Affiliations with other Monsanto companies in Canada:

- Searle Canada (Oakville)
- Fisher Controls Company of Canada Limited (Woodstock)
- The Nutrasweet Company (Mississauga)

Canada

Strategic partnerships

SCIEX, A Division of MDS Health Care Ltd.

55 Glen Cameron Road
Thornhill, Ontario
L3T 1P8

Dr. William R. Davidson
Director, Research and Development

Telephone: (416) 881-4646
Fax: (416) 881-9832

Company history

SCIEX was incorporated in 1974 by a group headed by Professor J.B. French from the University of Toronto Institute for Aerospace Studies. Following a series of exploratory contracts in the environmental and explosive detection market areas, the company's first commercial product, the TAGA 3000, was introduced in 1978. A tandem mass spectrometer (MS/MS), the TAGA 6000, was subsequently introduced in early 1981.

In 1981, SCIEX was acquired by MDS Health Group Limited. The ELAN ICP/MS system was introduced in 1983 to supplement the product line and open new markets in the area of elemental analysis.

Realizing that a small Canadian company cannot meet the needs of the global marketplace, SCIEX sought Joint Venture relationships in the mid 1980's. In 1984, SCIEX and British Aerospace (BAe) formed a Joint Venture in contraband detection equipment. SCIEX was responsible for R&D and manufacturing of the AROMIC Contraband Detection System, and BAe handled world-wide marketing, sales and service. The first systems were installed in the Middle East in 1986.

In 1986, Perkin Elmer (PE), the largest analytical equipment manufacturer in the world, and SCIEX formed a Joint Venture in the area of analytical mass spectrometry. Again, SCIEX was responsible for the R&D and manufacturing of the products offered to the joint venture, and Perkin Elmer handled world-wide marketing, sales and service.

Major products and markets

SCIEX develops and manufactures several products, all with the common theme of trace chemical analysis. The TAGA 6000 Mobile Environmental Laboratory is a tandem mass spectrometer system which is oriented to the monitoring of the environment for trace chemical pollutants. The system, which is also available in a non-mobile form, is marketed and sold by SCIEX directly.

Through its joint ventures with British Aerospace, SCIEX manufactures the AROMIC Contraband Detection System. The unit, available in either a stationary or mobile configuration, is used throughout the world for the detection of illicit drugs and for airport security.

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SCIEX, A Division of MDS Health Care Ltd.

(continued)

The three products which are manufactured by SCIEX for the analytical instrumentation joint venture with Perkin Elmer include: the ELAN 5000 Elemental Analysis System, a second generation ICP/MS which has a wide variety of markets in areas which require the trace level analysis of materials for elements; the Laser System 320, oriented towards the direct elemental analysis of solids in conjunction with ELAN 5000; and the (API) III, an LC/MS/MS system, with major markets in the quality control and research areas of the Biotechnology and Pharmaceutical industries.

Technology of the company

The SCIEX technology is based on the analysis of complex matrices for the presence of trace compounds or elements. The major emphasis of the technology relates to mass spectrometry as a method of analysis.The unique Atmospheric Pressure Ionization (API) source for the organic mass spectrometers has opened up new markets in the life sciences area. This has been achieved by offering instrumental capabilities which are solving several significant analytical problems.

Products in development

SCIEX is continuing to develop innovative products in the area of trace chemical analysis. As the company matures, the product line is becoming less niche oriented, and is aimed towards a lower-cost, higher-volume platform.

Desired alliance with other biotechnology firms

Strategic R&D alliances to develop novel new applications, and perhaps new products based on our present technology, in emerging markets related to Biotechnology.

Canada

Strategic partnerships

University of Toronto Carbohydrate Research Centre Faculty of Medicine

8 Taddle Creek Road
Toronto, Ontario
M5S 1A8

Professor J.J. Krepinsky, Director
Telephone: (416) 978-4122
Fax: (416) 978-6885

Nature of research

CRC is an instrumental facility providing technical support for research in protein engineering and glycobiology, particularly in the area of three-dimensional studies of oligosaccharides, glycopeptides, and glycoproteins. It consists of the Analytical Biochemistry Laboratory (ABL), Mass Spectrometry Laboratory (MSL), and NMR Spectrometry Laboratory. These laboratories are equipped with the state-of-the-art instrumentation and manned by highly qualified and experienced personnel. Each laboratory is directed by a specialist who collaborates with researchers in other Departments and Organizations on design, execution, and interpretation of experiments required by the research programs of these researchers. CRC does not have a research program of its own.

The following are examples of research in which CRC participates:

- structural determination of oligosaccharides, oligopeptides, and glycopeptides of biological significance
- conformation determination of oligosaccharides, oligopeptides, and glycopeptides of biological significance
- determination of biosynthesis of oligosaccharide portions of glycoproteins, including cloning of glycosyltransferases
- structural determination of natural products and drug metabolites
- synthesis of oligosaccharides and glycopeptides of biological significance
- computer modelling of carbohydrate and glycopeptide molecules
- development of carbohydrate-based cancer therapy
- genetic control of oligosaccharide processing
- carbohydrate role in the immune response

Major achievements

Among collaborating investigators are Drs. Bennick, Carver, Deber, Dennis, Krepinsky, Sarkar, Schachter, Aspinall, Jeejeebhoy, Gariepy, Lingwood, Rauth, Strasberg, Uetrecht, Yates, and many others. As an example of an area of major achievements is cited the elucidation of many aspects of the structure and function of oligosaccharides of N-linked glycoproteins (Drs. J.P. Carver, H. Schachter).

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University of Toronto Carbohydrate Research Centre Faculty of Medicine

(continued)

Description of research

ABL provides specialized chromatographic separation, carbohydrate analysis, oligonucleotide synthesis. MSL provides high-resolution high-mass mass spectrometric analysis using also soft ionization techniques such as fast atom bombardment, GS-MS analysis, exact mass measurements. The usual mass range is up to 12,000 amu. NMR provides measurements and analysis of NMR spectra at 300MHz and 500MHz instruments, using all modern NMR experiments such as heteronuclear correlation spectroscopy.

Current industrial involvement

CRC is currently collaborating with a number of pharmaceutical, chemical, food, and bioengineering industries. These include Ortho Pharmaceuticals, Connaught Immunologicals, Glaxo Pharmaceuticals, Cangene, Genetics Institute, Allelix, CIL, and Diversified Research (Weston).

Industrial involvement sought

Collaborations in all aspects of glycobiology requiring expertise of CRC. It should be noted that CRC expertise will include X-ray analysis and chemical synthesis.

Research group profile

CRC Human Resources Profile

Principal Researchers are:

Laboratory Directors (PhD): A.B. Baptista (ABL)
A.A. Grey (NMR)
H.Y.S. Pang (MSL)
Visiting Scientist: Dr. L.R. Radics
Scientific Support Staff: 3

Faculty Supervisory Committee

- Dr. J.P. Carver (Oligosaccharide and Glycoprotein Conformation and Computer Modelling)
- Dr. A.G. Harrison (Mass Spectrometry)
- Dr. J.J. Krepinsky (Enzymology and Molecular Biology of Oligosaccharides of N-linked Glycoproteins).
- Drs. Carver, Krepinsky and Schachter are also members of the Protein Engineering Network of Centres of Excellence.

Universities/Institutes Involvement:

Major collaborations:University of Toronto:Departments of Biochemistry, Chemistry, Immunology, Medical Biophysics, Microbiology, Molecular and Medical Genetics, Pharmacology, Pharmacy;York University: Department of Biology, Chemistry;University of New Brunswick: Department of Chemistry;Research Institutes of the Hospital for Sick Children, Mount Sinai Hospital, St. Michael's Hospital, Toronto General Hospital, Wellesley Hospital.

Canada

Strategic partnerships

University of Waterloo Department of Biology

Microbial Biotechnology Laboratory

Department of Biology
University of Waterloo
Waterloo, Ontario
N2L 3G1

Phone: (519) 885-1211
Fax: (519) 746-0614

Dr. O.P. Ward, Research Professor

Nature of research

Research and development program on basic and applied aspects of microbial biotechnology related to fermentation and enzyme technology.

Major achievements

Fifty percent of the research projects have industrial sponsors.

- Successful development and commercialization of microbial based fermentation processes for production of enzymes;
- Technology related to the applications of enzymes in bioprocessing has been transferred and applied in industry.

Twenty years experience in the development and optimisation of fermentation and enzyme based industrial processes.

Description of research

Fermentation based projects currently under investigation include:

- Studies on production of hemicelluloses from mesophyllic and thermophilic microorganisms;
- Studies on factors affecting fungal morphology and the relationships between culture conditions and product formation in fermentations;
- Optimisation of production of pharmaceutical proteins and other biologically active compounds from wild-type and genetically engineered organisms.
- Production of eicosapentaenoic acid (EPA), docohexosaenoic acid (DHA) and arachidonic acid (ARA) by algae and fungi;
- Isolation and culture optimisation studies with microbial strains with potential applications in organic synthesis and biodegradation.

Projects involving studies on the applications of enzyme biotransformations in organic synthesis include:

- Stereospecific biotransformations involving condensation of aldehyde and carbonyl groups to produce carbonols mediated by TPP-linked decarboxylases;
- Use of oxidoreductases for stereospecific synthesis;
- Development of specific aldolase biotransformation processes for chiral synthesis of rare sugars and highly substituted amino acids;
- Applications of esterases and lipases in biocatalysis.

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University of Waterloo Department of Biology

(continued)

Projects related to microbial degradation recalcitrant compounds include:

- Isolation of microbial strains with specific biodegradative properties;
- Optimisation of fermentation processes for production of biodegradative strains;
- Optimisation of biodegradation processes.

Research expertise

- Microbiology, microbial physiology, fermentation development and scale-up
- Fermentation downstream processing, enzyme and biochemical purification
- Optimisation of enzyme applications and whole cell biotransformation processes;
- Strain isolation, selection, mutation, genetic transformation.

Previous and current industrial collaborations

- Allelix Biopharmaceuticals Inc.
- ABI Biotechnology Inc.
- Avondale Schering
- Biocon Group
- Canadian Venture Foundation
- Ceimici
- International Biochemicals
- Joseph Seagram & Sons Ltd.

Non-industrial research support:

- Natural Sciences and Engineering Research Council of Canada
- National Research Council – IRAP
- University Research Incentive Fund, Ontario
- Canadian International Development Agency

Industrial involvement sought

- Enzyme biotransformations; collaborations related to the further development or technology transfer of biotransformation processes based on existing projects. Collaborations on new enzyme biotransformation processes;
- Collaborations related to implementation of fermentation or enzyme based processes for production or modification of omega-3 fatty acids:
- Development of microbial fermentation based processes;
- Strategic alliances related to the development and application of microbial based processes for degradation of toxic organic chemicals.

Research group profile

Principal researchers	5 (Ph.D's)
Research fellows	4 (Ph.D's)
Postgraduate students	9 (M.Sc, Ph.D's)
Other research staff/students	3
Secretary	1

Canada

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Environment/Forestry

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Canada

Strategic partnerships

ADI Limited

P.O. Box 44, Station 'A'
Fredericton, New Brunswick
E3B 4Y2

John R. Dean, President
Andrew Steeves, Marketing Coordinator

Telephone: (506) 452-9000
Fax:(506) 459-3954

Company history

ADI Limited is one of the largest and oldest firms of consulting engineers, planners, technologists and technicians in Atlantic Canada. Founded in 1946, its 150 employees serve clients in industry, government, social services and commerce.

The Environmental Engineering Division of ADI Limited has been a leader in the development and application of biotechnical solutions to environmental problems. Industrial wastewater treatment and disposal has been a particular focus of the Division's twenty-six engineers and technical staff. Their objective has been to provide a robust, cost-effective treatment system which meets environmental regulations.

- Annual Sales: ADI: $5-10M;
  Environmental Engineering: $2-5M
- Number of Employees: ADI: 130-150
  Environmental Engineering: 25-30
  R&D: 3-6 (Environmental Engineering)
  Marketing: 13 total

Major products and markets

ADI is a provider of design and consulting services, research and development services and supplier of anaerobic wastewater treatment systems. These systems provide economic and effective solutions to environmental problems experienced by food processors, breweries, distilleries, pharmaceutical companies and other producers of warm, strong organic wastes.

The ADI-BVF™ is one of the seven and most cost efficient anaerobic technologies offered by ADI. These seven anaerobic technologies range from low-rate to high-rate, including such technologies as sludge blanket, fixed film and hybrids. The ADI-BVF™ is a low-rate system that can be used to treat almost any warm waste stream of moderate to high waste strength, including high levels of organic suspended solids. The ADI-BVF™ membrane cover system is designed to complement the ADI-BVF™ system operation for the collection and removal of biogas, positive odour control, and rainwater collection.

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ADI Limited

(continued)

Other services provided by ADI include design consultancy of building design, environmental protection, power and process engineering, wood-fired heating, energy conservation and public works engineering. ADI has worked on projects in Australia, Barbados, Britain, France, India and the U.S.A. as well as throughout Canada. In addition to private clients, these projects have been financed by the Canadian Industrial Development Agency (CIDA) and the IADB. ADI is interested in foreign licensing arrangements and participating in joint ventures outside Canada. Subsidiaries are ADI International Ltd. and ADI Systems Inc.

Technology of the company

The thrust of research and development at ADI is the development of wastewater treatment systems appropriate to client needs. Key areas are the production of by-product biogas as fuel, the reduction of treatment sludges, improving wastes removal, using microprocessors for monitoring and control, and improving liquid and gas containment with membrane liners and floating gas covers. Several ADI developments have received patent and trademark recognition.

Products in development

Anaerobic wastewater treatment systems
Biogas handling systems
Sequencing batch reactors
Membrane liners
Membrane gas covers
Biogas odor control systems

Desired alliance with other biotechnology firms

ADI has technologies which it wishes to license to contractors and/or manufacturers outside of North America. ADI-designed wastewater treatment systems are suitable for industries with warm, strong, organic wastewaters. Often, these installations will have a net payback of under three years. Furthermore, these systems make maximum use of locally available materials and equipment.

Other comments

Licensees of ADI technologies will be entering a market of growing demand, high social acceptance and good profit potential.

Canada

Strategic partnerships

Aquaresearch Ltd.

P.O. Box 208
North Hatley, Qc
JOB 2CO

Karl F. Ehrlich, Ph.D./V.P., Sci. Dir.

Telephone: (819) 842-2890
Fax: (819) 842-2902

Company history

Aquaresearch Ltd. was founded in 1984, as an out growth of Le Centre de Recherche Environnementale. Aquaresearch Ltd. was founded as a water management company using knowledge of aquatic systems and microbial processes network for the marketing of its biotechnological systems. Aquaresearch Ltd. has its own R&D facilities in both biotechnology and environmental control for aquaculture.

Major products and markets

The Bacta-Pur System for water quality improvement is currently marketed by an expanding number of distributors in Europe, N. America and Australia. The fields of application of the Bacta-Pur System range from improvement of waste water treatment efficiency for municipal, industrial, agricultural, and aquacultural application, to biodegradation of hydrocarbons in soil, to lake restoration.

Technology of the company

The Bacta-Pur System includes:

- state-of-the-art biotechnologies for waste water purification,
- growth enhancers for water purifying bacteria,
- application and environmental control technologies,
- the technical expertise of how to optimize application of the biotechnologies under field conditions.

Products in development

Aquaresearch Ltd.'s ongoing R&D program is continuing development of new bacterial communities for specific waste water treatment applications. Research is also being conducted on biological filtration and filter development.

Desired alliance with other biotechnology firms

- R&D projects on preservation, particularly freeze drying of bacterial cultures
- marketing agreements for products distribution
- relationship with company producing bacteria cultures for composting.

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Canada

Strategic partnerships

Bercan Environmental Resources Inc.

6028 Mount View Road
P.O. Box 238
Lantzville, B.C.
V0R 2H0

Allan J. McInnes, President C.E.O.
Dr. John Chelsey Davies, Vice President

Telephone: (604) 390-3113
Fax: (604) 390-2312

Company history

Number of Employees: Manufacturing and Research 12; Sales 20

BERCAN ENVIRONMENTAL completed first and second stage research and development over a five year period, commencing in 1974 on to 1979 within the field of advanced formulas for fermentation/decomposition of organic matter using first generation microbial populations, encapsulation of both anaerobes and facultative anaerobes. This work provided compound formulations now manufactured in Canada with distribution through market representatives direct sales, to Bio-Augment and Bio-Remediate, natural fermentation by assisting natural (Nature's) organic decomposition. The manipulation of natural beneficial microbial populations allows for double the wastewater handling capacity in a conventional aerobic/anaerobic fermentation digester/reactor system commonly found world wide in every town/city village for sewage waste management, further guarantee is provided over BOD removals.

Major products and markets

Manufactured products for industrial, commercial, domestic, institutional and environmentally safe cleaners. These are products that completely replace chemical products used for the same purposes. For example:

- Removal of noxious odours (hydrogen sulphide gas from decomposition), the latter a major former of (sulphur dioxide) as in "Acid Rain" provides air pollution control, drain openers, the removal of heavy organic deposits from sewer lines, plumbing fixtures, etc.
- Grease trap bio-augmentation/remediation of grease/fast waste in restaurants, hospitals, institutions, with disease bacteria control, storm drain cleaners, garbage waste management with biological separation replacing incineration method.
- Hazardous chemical waste management, toxic chemical waste management with anaerobic/facultative bio-remediation formulas.
- Sewage, farm animal wastewater management with disease bacteria control, air pollution control, ground water pollution control, with recovery of micro nutrient fertilizers, natural gas (renewable energy).
- All bio-augmentation/bio-remediation completed without the addition of oxygen and the release of effluent waters free of biochemical oxygen demand is completed before effluent waters are discharged into pristine ecological reserves, ie. river, lake, ocean, ground water, stream, all preventing environmental pollution.

(continued)

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Bercan Environmental Resources Inc.

(continued)

Technology of the company

The discovery of beneficial anaerobic/facultative microbial populations of first generations along with the patent pending method of encapsulation of them in particular, the strains of genus methanobacteriaceae and others beneficial is a first time discovery of the types supporting anaerobic fermentation (beneficial) to man, with their first generation numbers available since the beginning of time. It has been proven by the assembly of these anaerobic/facultative types of microbes that not only organic matter in simple form can be decomposed and made safe, but that chemical and hazardous wastes in man's environment can be decomposed and made non toxic to the environment as well. Recent chemicals treated by anaerobic/facultative formulas are; ethylene glycol, methanol, xylene, toluene, patent armor-all (undiluted), phosphoric acid (26%), propylene glycol, addiment (concrete additive), cleaning compound (nos), insecticide (nos), compound resins (nos), water based resins, propionic acid, vehicle lubricants (hydrocarbons (nos), liquid synthetic plastics, tributyl phosphate, acetic anhydride, sonoco adhesives, linoil (linseed oil), sodium hydroxide, acetic acid (84%), resin plasticizer, neopentyl glycol, polyvinyl adhesives, etc.

Products in development

The anaerobic/facultative fermentation provides active super natant liquors that can be drawn off for inoculation purposes. By force feeding this super natant down into garbage landfill sites using gas well drilling equipment, the landfill can be inhibited to digest the biodegradable matter contained. This procedure can make by-products of high quality large volumes of natural gas free of hydrogen sulphide gas, for use as a renewable energy source. Further the porosity created in the landfill by digestion of matter, takes away the lateral pressures that are known to force leachate out and into arable lands, causing pollution. This same super natant pumping can be applied to bioaugmentation of bitumen locked into sand and bitumen unpumpable in drilled oil wells. The procedure employed is to apply super natant to increase fluidity, then directly ship the crude to refinery where heat temperature's applied will pasteurise in the process of refining by-products.

Desired alliance with other biotechnology firms

Due to the very broad range or use for these biochemical applications, as described very briefly in this questionnaire, time is limiting the introduction of these very innovative biochemical formulations. We are interested in expanding the introduction of these formulations into other countries and look to association with other bio-technical companies and those involved in the prevention of environmental pollution control and the recovery of usable by-products.

Other comments

By applying bio augmentation formulas of this type into existing sewage treatment plants for example, these systems be they aerobic or anaerobic design, the new fermentation method will increase their handling capacity. As aerobic systems at best take care of approximately 30% of the organic solids introduced, the introduction of this bio augmention method brings them up to 98% efficiency, the same applies to anaerobic systems. As microbial population can be made to work harder by our method, completing decomposition in less time, the need for expensive hardware installations and addition is not required. Documented in our files we are able to show that conventional digesters have been made to double their handling capacity, which means half the hardware costs are required to manage the average sewage wastewaters delivered into designed sewage treatment plants and removing the need to chlorination procedure as BOD and disease bacteria are biologically removed from the effluent discharge into the environment.

Canada

Strategic partnerships

Bioman Products Inc.

400 Matheson Blvd., Unit #4
Mississauga, Ontario
L4Z 1N8

Adele Sommerfield

Telephone: (416) 890-2555
Fax: (416) 890-0370

Company history

BIOMAN Products Inc. is just over 2 year's old with respect to complete operations. It originated as a spin-off daughter company of Mann Testing Labs, an analytical lab for the environmental, Human Drugs of Abuse and Equine Drugs of Abuse industries.

Bioman Products Inc. is primarily a distributor of E.L.I.S.A. diagnostic kits. B.P.I. supplies a variety of on-site immunoassay kits for environmental, agricultural, human drugs of abuse and equine drugs of abuse. B.P.I. also is involved in R&D and manufacturing of Elisa kits for Equine Drugs of Abuse. Major markets include analytical labs, food processing industry in-house labs, environmental consultants, agricultural producers and correctional institutes.

Technology of the company

Exclusive licensed technology for Elisa stability.

Products in development

Equine Drugs of Abuse Elisa Kits.

Desired alliance with other biotechnology firms

Currently looking for new Elisa kits for either the environmental and agricultural industry for distribution *or* monoclonals to such contaminants for E.L.I.S.A. development.

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Canada

Strategic partnerships

Biomation

335 Perth street
P.O. Box 156
Almonte, Ontario
K0A 1A0

Dave Hanneson

Telephone: (613) 256-2821
Fax: (613) 256-4707

Company history

Biomation is a product development company formed in 1988 to commercialize new products resulting from biotechnology research and to supply equipment and instrumentation for a range of bioscience and medical applications. The company has management and technical expertise in the design and marketing of environmental and analytical instrumentation.

Major products and services

Biomation supplies products and services in the area of environmental monitoring, medical diagnostics, analytical methods and process control. There is close association with overseas suppliers of unique advanced-technology products to provide innovative solutions for bioscience and medical instrumentation requirements. Areas of operation include environmental monitoring, protein separations, fermentation process control, purification of organic solvents, laboratory data management, electromyography, orthopedics, indoor air quality, radon gas monitors, biogas production and analytical instrumentation.

Technology of the company

Biomation has technology and skills in the areas of sensor manufacturing, microelectronics and instrumentation design.

Products in development

The company is in the planning and product formulation stages for several products using biosensors for pollution control and indoor air quality monitoring. Other areas of interest are medical diagnostics and radiation monitoring instrumentation.

Desired alliance with other firms

BIOMATION is looking for firms with growth oriented products and technology for licensing, particularly in the area of biosensors, radon gas mitigation, and trace gas measurement.The company is also seeking manufacturers of new and innovative products that are compatible with BIOMATION's area of operation and where there is an interest in developing Canadian markets through a distribution agreement.

Other comments

Researchers seeking entrepreneurial partners for products with good commercial potential are of particular interest. A variety of alliance structures are possible, depending on the needs of the particular venture.

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Canada

Strategic partnerships

Chair of Forest Products Biotechnology

Faculty of Forestry
University of British Columbia
2357 Main Mall, MacMillan Building
Vancouver, B.C.
V6T 1W5

John N. Saddler/Colette Breuil

Telephone: (604) 222-3200 (PAPRICAN)
Fax: (604) 222-3207

Company history

The Chair of Forest Products Biotechnology was established in the Faculty of Forestry at U.B.C. in September, 1990. The Chair involves a multidisciplinary group of researchers with backgrounds in the areas of microbiology, biochemistry, immunology and chemical engineering, applying their training and expertise to Biotechnology opportunities in the forest products and pulp and paper sector. The Chair receives core funding for 5-10 years from NSERC and several major forest products and biotechnology companies.

Major products and markets

Although several major products have been identified they are still in the development stage. The major markets that are being studied include short- and long-term wood preservation using biorational control agents, immunological assay kits applied to the forest sector, bioremediation of mill sites, biological pulping and bleaching, pulp effluent monitoring and treatment, and bioconversion of wood residues.

Technology of the company

The group does not currently own any specific patents or unique equipment. It is the intent of the group to demonstrate and patent technology in the previously described areas while the demonstration and marketing of the technology will be carried out in partnership with industry.

Products in development

There are several products in development, however they cannot be described at this time.

Desired alliance with other biotechnology firms

Biotechnology companies with a strong development and marketing background in the areas of diagnostics, industrial enzymes and environmental issues, would be complementary to our program.

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Canada

Strategic partnerships

Continental Amelioration Research Environmentalists (CARE) International Ltd.

#350, 2441 37 Ave., N.E.
Calgary, Alberta
T2E 6Y7

Paul Bercier

Telephone: (403) 291-1249
Fax: (403) 291-4359

Company history

CARE International Ltd. is a biotechnical research and development company incorporated in March, 1990. CARE was formed by a group of entrepreneurs, financial advisors and inventors whose mission is to identify and resolve environmental problems. The CARE group has identified and contracted a number of prominent and successful researchers to support this mission, including Dr. J. William Costerton of the University of Calgary. One of the more exciting new technologies that CARE is pursuing is the microbial technology ultramicrobacteria (UMB). This technology was invented jointly by Dr. J. William Costerton, and the Alberta Oil Sands Technical Research Authority. AOSTRA is the assignee of Patent #4,800,959 dated January 31, 1989 for UMB technology. This license is for an initial five year exclusive period (two-year prove-up plus three years for commercial development) and is exclusive to Canada and the United States. CARE also has the sub-licensing rights to the rest of the world.

Major products and markets

The principal product that will be developed and marketed is the ultramicrobacteria (UMB) technology for application to environmental alemioration (containment and remediation). The initial markets that will be developed are Canada and the United States followed by other areas throughout the world. The main market focus will be on the following activities:

1. Acid Mine Drainage – containment and pH reduction
2. Permeability reduction – earthen dams, irrigation ditches and landfills
3. Contaminated Site(s) Clean-up – containment and bioremediation
4. Proactive Systems – for containment and remediation, eg. underground service station tanks

Technology of the company

Research and development work is currently being contracted to various research groups such as the University of Calgary and Microbios Ltd. of Calgary, Alberta.The in-base research capability will commence in 1991.

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Continental Amelioration Research Environmentalists (CARE) International Ltd.

(continued)

Products in development

Ultramicrobacteria technology for environmental applications.
Consortia Technology.
Prevention of H_2S generation by Sulphate Reducing Bacteria.
All of these products have potential industrial applications.

Desired alliance with other biotechnology firms

Joint venture partnerships to participate in the above noted R&D activities and the subsequent technology transfer.

Research group profile

Principal Researchers are:

Dr. William Costerton
Dr. Cameron Wyndham
Dr. Hilary M. Lappin-Scott
Dr. Sandra Blenkinsopp

Canada

Strategic partnerships

Mycotech – For Research & Development

142 Whitchurch Mews
Mississauga, Ontario
L5A 4B3

Dr. Mujeeb H. Zoberi

Telephone: (416) 279-4154

Company history

Mycotech is a newly born organization and is concerned with the research and development of biotechnology for environmental protection. Its operations range from research in Agriculture, Forestry and Urban Entomology to the marketing of its services and products. Presently Mycotech is engaged in development of biopesticides which may control a number of forest, agriculture and house pests and keep their population below the economic injury level.

Major products and markets

Mycotech is involved in processing biopesticides and provides consultancy and contract services for research, development and training in the areas such as integrated pest management, biodegradation, microbial processes in tailings, methods for the destruction of organic substances in mineral deposits, plant diseases, regeneration of forest trees, and establishment of microbiological laboratories.

Technology of the company

Mycotech has professional skills in pest control systems, forest regeneration and microbial processes and has the capability of identifying micro-organisms, particularly fungi.

Products in development

Along with the development of biopesticides, Mycotech is also engaged in developing biofertilizers for the regeneration of forest trees.

Desired alliance with other biotechnology firms

Joint ventures with Canadian or foreign firm for research development and marketing biological products. Alliances to formulate biopesticides and biofertilizers as commercial products. Research alliances to provide access to work in laboratories equipped for microbiological research.

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Canada

Strategic partnerships

OHM Remediation Services of Canada Ltd.

2192 Wyecroft Rd.
P.O. Box 7010
Oakville, Ontario
L6J 6L5

Derk Maat, M. Eng., P. Eng.,
Director Business Development

Telephone: (416) 847-1700
Fax: (416) 847-1488

Company history

- 20 years in the environmental field
- Specializing in bioremediation of soils and ground water

Major products and markets

Onsite bioremediation of soils and ground water using insitu methods or external bioreactors using indigenous or imported microorganisms.

Technology of the company

Bioremediation using anaerobic/aerobic microorganisms for destruction of:

- organic waste
- hydro carbon wastes
- toxic wastes
- hazardous wastes

Products in development

- Highrate bioreactors for soil and water
- Insitu methods and techniques

Desired alliance with other biotechnology firms

Firms developing specific microorganisms for destruction of hydrocarbon wastes, toxic and hazardous wastes.

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Canada

Strategic partnerships

StressGen Biotechnologies Corporation

9865 West Saanich Road, R.R. #2
Sidney, British Columbia
V8L 3S1

Richard M. Glickman, President

Telephone: (604) 655-1882
Fax: (604) 655-3770

Company history

StressGen Biotechnologies is a privately held corporation incorporated in April of 1990. The company was founded by an international group of scientists with the primary objective of developing the environmental, medical and industrial applications associated with the stress response.

Major products and markets

StressGen currently markets an extensive line of biologicals to the international stress response community. These include purified heat shock (stress) proteins, mono and polyclonal antibodies and DNA probes specific for stress proteins and their respective genes. The company is also releasing a series of expression vectors which utilize heat shock gene control elements. Primary markets include medical and environmental research laboratories.

Markets are expanding to include clinical diagnostic and the environmental bio-monitoring sector.

Technology of the company

- Molecular diagnostic techniques for environmental bio-monitoring
- Recombinant DNA, hybridoma/cell fusion, protein purification

Products in development

- Molecular based diagnostics for environmental monitoring
- Stress response (heat shock protein) based medical diagnostics
- In-vitro toxicology assays based on stress or inducible genes and their respective translation products

Desired alliance with other biotechnology firms

StressGen is seeking joint venture partners to assist in the development of the clinical diagnostic and therapeutic potential of the corporation's stress protein based technologies. The corporation is also interested in acquisition or licensing-in of biologicals to expand the current research reagent business.

StressGen would also be interested in potential strategic alliances with environmental biotechnology companies involved in waste management, bioremediation or biological monitoring.

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Canada

Strategic partnerships

Thermo Tech Waste Systems Inc.

#203, 1120 Austin Avenue
Coquitlam, B.C.
V3K 3P5

Rene Branconnier, President

Telephone: (604) 937-3022
Fax: (604) 937-5274

Company history

Thermo Tech Waste Systems was incorporated in 1987, as a wholly-owned subsidiary of Consolidated Thermo Tech International Inc. to market, in areas outside Canada, the Companies waste treatment system, to recycle biodegradable wastes for reuse as animal feed ingredients, as soil conditioners or as organic fertilizer fillers.

Major products and markets

The Company produces a waste management system to recycle biodegradable wastes. These wastes will be reduced and the nutrients will be reused as valuable products for animal feed ingredients, soil conditioners or organic fertilizer fillers.

The process allows for the blending of biodegradable wastes prior to processing or after processing, depending on the incoming substrates being pasteurized. This unique feature allows for the best nutrient mixed product being produced and consequently for the nutrients from the biodegradable wastes being reused.

The Companies waste management system can either be installed at the central plant locations, where various biodegradable wastes are transported to a central location for processing and reuse, or at site locations, where a specific biodegradable waste is generated in large enough volumes to warrant a plant.

Technology of the company

The system is an aerobic thermophilic process for the pasteurization of biodegradable wastes. The process utilizes a simply designed, low cost system which operates at high temperatures using internal heat generated by the rapid growth of harmless bacteria.

In essence, the high temperature obtained in the reaction vessels pasteurizes organic waste materials thereby killing harmful pathogens and breaking down unwanted products to produce enhanced materials, which can be reused as animal feed ingredients, as nutrient soil conditioners or as organic fertilizer fillers.

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Thermo Tech Waste Systems Inc.

(continued)

Products in development

The Company is in the process of developing specific seed cultures to be used in specific biodegradable waste situations. For example, to reduce the biological oxygen demand found in the pollutants associated with the potato industry.

Desired alliance with other biotechnology firms

- Strategic R&D and marketing agreements in the development of seed cultures for specific substrates to reduce pollutant loads;
- the Company is marketing the technology by establishing both exclusive and non-exclusive licensing arrangements worldwide;
- to date, one exclusive license has been sold to use the technology in Taiwan;
- the Company is interested in pursuing and developing sales worldwide, with key target markets of the Pacific Rim and the European Community;
- the Company would welcome interested parties either as potential licensees, joint venture, manufacturing, raw biodegradable waste haulers or end product distributors.

Canada

Strategic partnerships

Worne Biotechnology, Inc.

32 Lajoie
Edmundston, N.B.
E3V 3G6

Charles Gauthier

Telephone: (506) 735-8284
Fax: (506) 739-7450

Company history

Worne Biotechnology, Inc. was founded in 1982 to conduct basic research on natural microbial cultures for use in industrial waste treatment including hazardous and toxic wastes. In addition, microbial products for use in biological agriculture have also been investigated with particular emphasis on nitrogen fixation.

Major products and markets

Worne Biotechnology, Inc. exports a group of microbial products worldwide for industrial hazardous and toxic waste treatment through licenses and an expanding distributorship network. We have firmly established markets in Asia, Europe and South America.

The significant increase in demand for microbial cultures to treat the rapidly increasing hazardous and toxic waste problems will require an increase in our production capability to meet expanding market. The development and field testing of new products for use in biological agriculture has opened new markets which are growing rapidly both here and overseas.

Technology of the company

Worne Biotechnology, Inc. maintains a large culture bank of natural adapted microorganisms with broad spectrum biochemical capabilities in the biodegradation of halogenated and nonhalogenated organic wastes. The company is continuously isolating and testing new microorganisms from contaminated sites throughout the world.

Products in development

The company has under development a biological process for nitrogen fixation which could eliminate the high temperatures and pressures required by the present process. New microbial products are under development for use as nematocides, insecticides and herbicides.

Desired alliance with other biotechnology firms

Joint ventures and licenses to use the microbial technologies being developed by the company in addition to strategic R&D and marketing agreements.

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Canada

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Food & Beverage

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Canada

Strategic partnerships

Canpolar East Inc.

P.O. Box 8414
1 Duffy Place
St. John's, Newfoundland
A1B 3N7

Dr. Ernest M. Relmer

Telephone: (709) 722-6067
Fax: (709) 722-1138

Company history

Canpolar East Inc. was incorporated in 1989 to carry out the business of Canpolar Inc. in Atlantic Canada. The company provides technology services to the fish processing and food industries. Its products and services focus on improved productivity, quality control and inspection.

- Annual Sales: $1M
- R & D expenditure: $250K
- Employees: 12

Major products and markets

Canpolar markets fish processing by-product recovery systems in North America and in Europe. Its flagship product is a Mince Washer System.

Technology of the company

Canpolar is a system integrator and hardware product manufacturer with extensive design and engineering capabilities relevant to food processing equipment and controls.

Products in development

The company is currently developing automated inspection systems which include advanced laser scanning imager and automated defect recognition software. Canpolar has carried out investigations of biosensor technologies for on-line food quality control and processing control applications.

Desired alliance with other biotechnology firms

Biosensor technologies. Canpolar is seeking strategic alliance with a partner capable of manufacturing biosensors which have specific applications in on-line food process monitoring.

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Canada

Strategic partnerships

Gelda Scientific

5466 Gorvan Drive
Mississauga, Ontario
L4W 3E8

Mr. A. Gelda, V.P. Technical

Telephone: (416) 624-2779
Fax: (416) 624-2469

Company history

Since 1978 Gelda Scientific has endeavored to develop new techniques in the Food and Beverage sector. Our activities include identification of potential technology, development of business plans and the successful transfer and adaptation of international technology for our client companies.

- Annual Sales: $ 1M.
- Annual R & D Expenditure: 200,000
- Number of Employees: R&D: 5
  Manufacturing & Marketing: 6

Major products and markets

Gelda Scientific manufactures Lactic acid cultures and a line of Bifidobacteria products that include Bifido Tablets, Bifido Skim Milk Powder, Bifido Ice Cream and Bifido Yogurt.

Technology of the company

Complete Biofido technology for manufacture of dairy and confectionary products.

Products in development

Microencapsulated cultures of Bifido-bacteria.

Desired alliance with other biotechnology firms

Strategic R&D and marketing alliance for the complete exploitation of the market potential of Bifidobacteria products.

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Canada

Strategic partnerships

Pegasus Biotechnology Division of Pegasus International Specialties Ltd.

Box 319
Agincourt, Ontario
M1S 3B9

Mr. Ron Trent

Telephone: (416) 298-3141
Fax: (416) 291-4948

Company history

Pegasus has been developing since 1986 a novel animal cell bioreactor with the National Research Council, and has a patent on this device. Respecting biosensor development, Pegasus has commercialized MICROFRESH™, a freshness analyzer, in March 1990 with patents held by the National Research Council. Further development of proprietary immobilized enzyme technology opens up possibilities of several more biosensors. Another biosensor will be on the market during the first half of 1991. A glutamate, glutamine sensor as well as a cyanide, phosphate and sulphite sensor. The Company has management experience in building and marketing biotech related equipment.

- Annual Sales: $2M
- Annual R & D Expenditures: $150,000
- Number of Employees: R & D: 2
  Manufacturing: 4
  Marketing: 2

Major products and markets

Pegasus aims to sell the biosensors through worldwide distributors for the food-related industries as this is the first target market. Other markets will be opened depending on biosensor development. The other market for the bioreactor is Biotech instrumentation. We also have a biosensor for this market that fits in with the bioreactor.

Technology of the company

Pegasus has developed a proprietary method of immobilizng enzymes for biosensor development. Pegasus management has experience in developing biosensors and animal cell bioreactors. The company has programs in these two areas with the partnership of the National Research Council.

Products in development

Pegasus is developing a salmonella and listeria sensor and a water purity testing device which should be ready in 2.5 years. In 1991, Pegasus will commercialize glutamate and cyanide sensors.

Desired alliance with other biotechnology firms

Strategic marketing alliance with biosensor or bioreactor firms in Asia and/or Europe. Strategic alliance in biosensor R & D and/or animal cell bioreactor development and associated devices.

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Pegasus Biotechnology Division of Pegasus International Specialties Ltd.

(continued)

Other comments

The above alliances must have value added potential to offer Pegasus for these two markets, as company product commercialization has begun. If it is marketing, then they must be active in the related market, provide equity as well as provide active participation in the growth of Pegasus.

Canada

Strategic partnerships

POS Pilot Plant Corporation

118 Veterinary Road
Saskatoon, SK
S7N 2R4

Roy Carr, President
Don Hrytzak, Director of Administration
and Business Development
Ron Mantyka, Business Development Officer

Telephone: (306) 975-7066
Fax: (306) 975-3766

Company history

The POS Pilot Plant Corporation is a not-for-profit research, development and pilot-scale processing facility serving the food/drug industry. Since opening in 1977, POS has committed its resources to being a "practical world-class research and development facility for Canadian and international industry so that Canadian agriculture can be diversified and so that secondary and tertiary industry can be started and developed in Canada."

POS specializes in developing and testing new ideas in the processing of proteins, starches, fats and oils. Our well-equipped plant and labs allow for a wide range of process, research and analytical possibilities. We have successfully developed new products and process technology using such materials as canola, soybean, sunflower, peanut, palm, flax, jojoba, mustard, marine oils, pharmaceuticals, essential oils and botanicals.

In 1990, POS incorporated Nuvotech Ventures International to commercialize developments from POS's expanding in-house research program. As a wholly-owned subsidiary of POS, Nuvotech will help facilitate the transfer of technology, as well as provide more opportunities for economic diversification for Saskatchewan and Canada.

- Annual Sales: $1 – 5M Revenues in R&D services
- Number of Employees: 55-65

Major products and markets

An internationally experienced staff and world-class facilities allow POS to provide a turnkey service including information and patent searches, research, analysis, pilot-plant testing, custom processing, and test-market production. POS provides project co-ordination services, assembling a package of skills, equipment and management tailored to the specific needs of each client. All projects are handled with complete confidentially. Ownership of research resides fully with the client.

The POS plant is specially designed for the processing and analysis of oilseeds, however we have the equipment and the expertise to work in most areas of food, feed, pharmaceutical, and natural chemical processing. POS can process materials from the raw state to a finished product and through our commercial subsidiary, Nuvotech Ventures International, we can arrange for the marketing and management expertise for any product. POS works with clients from across Canada and throughout the world.

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POS Pilot Plant Corporation

(continued)

Technology of the company

The variety of equipment available at POS means that virtually any processing system can be custom designed to provide the output a client requires. From beans, nuts or seeds, POS can produce oil and meal products. The oil can be further processed into shortenings, margarines and dressings to a clients' precise specification.

Dry-process cleaning capabilities include vibrating-screen rotating indent-cylinder separators. Rotating disc, impact and air-jet dehullers and classifiers produce seed material of the right quality. Cracking, flaking, or heat conditioning treatment may then be applied depending on the raw material. Extraction of oil from meal can be done on either shallow or deep bed extractor units. For degumming, dewaxing, refining, bleaching, filtration, hydrogenation, interestification, winterization, deodorization, vocation, and a variety of drying options, POS is equipped with the latest technologies. Exacting quality-control procedures are brought into play to monitor all processes.

The expertise of POS staff and wide-range of plant and lab equipment means that POS has a great deal of flexibility in the type of research and development work it can carry out. Contact POS for more information on the options available.

Products in development

POS guarantees confidentiality in all client projects. POS members have first "right of refusal" on all in-house developments, among a variety of other benefits. Contact POS for more information on memberships.

Desired alliance with other biotechnology firms

Besides offering contract R&D services, POS can handle small-scale custom manufacturing and has expertise in training, consulting, and the sale and transfer of technology. Thought Nuvotech Ventures International, POS seeks out joint venture opportunities, strategic partnerships and licensing agreement on POS-developed and other innovations.

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Canada

Strategic partnerships

ABI Biotechnology Inc.

40 Scurfield Blvd.
Winnipeg, Manitoba
R3Y 1G4

Dr. A.D. Friesen, President

Telephone: (204) 488-4090
Fax: (204) 488-4063

Company history

ABI Biotechnology Inc. was founded in 1984 as a research and development company by Dr. Albert Friesen. Since that time it has grown into a family of related companies known collectively as the "ABI Group":

ABI Biotechnology Inc. – research and development.
ABI Pharmaceuticals Inc. – manufacturing and marketing.
Rh Pharmaceuticals Inc. -research, development and manufacture of blood products.
BioClinical Research Limited Partnership – research and develop of SOD and EGF.
KAM Scientific Inc. – manufacture and marketing of specialty biotechnology products.

ABI is a widely held company with approximately 300 shareholders. Apotex Inc., a major Canadian pharmaceutical company, holds 11% of the shares.

Major products and markets

ABI is focused on the development of pharmaceuticals in three product groups:

1. Human growth factors such as Growth Hormone: Abitropin® is a human Growth Hormone produced by the application of recombinant DNA technology.
2. Fine chemical pharmaceuticals: ABI is a producer of fine chemicals bringing together biotechnology and state-of-the-art fermentation processes. ABI is developing and producing several alternative brand drugs to be manufactured and marketed by Apotex, the largest Canadian owned pharmaceutical manufacturing and distribution company.
3. Blood proteins: ABI is developing and manufacturing specialty blood products, some extracted from blood and others by biotechnology replacement of blood protein pharmaceuticals. WinRho, an Rh immune globulin extract from human blood plasma, is distributed in Canada for the prevention of Rh disease of the newborn.

Products on the market

WinRho – intravenous Rh Immune Globulin for Rh disease
UV-Chroma+® – a high volume ultraviolet monitor, KAM Scientific Inc.
IntoxiStick® – alcohol test stick, KAM Scientific Inc.
Virocidin-X® – spray disinfectant, KAM Scientific Inc.

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ABI Biotechnology Inc.

(continued)

Technology of the company

A recent review by outside experts of ABI's technical capacity found that the proposed pilot plant and full-scale production capacity now being planned and implemented by ABI meet or exceed world standards. The technical capacity to apply fermentation and recombinant DNA technology puts ABI in a strong position to compete in the Canadian and international markets. ABI has the ability to apply novel technology and quality assurance expertise to the development of unique master seed banks for use in the fermentation processes. Through genetic manipulation, ABI is in a position to introduce innovative and highly productive manufacturing techniques in the production of fine chemicals for pharmaceutical purposes.

The development of most biotechnology based pharmaceuticals occurs in two stages. The first is the laboratory stage in which a research idea is shown at laboratory scale to produce small quantities of a drug or compound for initial characterization and preclinical studies. This laboratory stage shows that the idea works.

The second stage is the "scale-up" of the process for pilot plant production of sufficient quantities of the drug for clinical trials and the establishment of a reliable manufacturing process. This stage involves large-scale reaction or fermentation facilities as well as large-scale process control and monitoring facilities and leads to full scale production.

ABI has a team of engineers and scientists with specialized expertise in the area of scale-up of biochemical processes as well as production operations and regulatory affairs personnel. This team has the capacity to move from a well-developed research idea to a scaled-up capacity to produce products for clinical trials and to achieve full-scale production once a product is licensed. This provides ABI with a unique opportunity to apply innovative technology to the production of pharmaceuticals.

Products in development

Growth Factors: Human Growth Hormone, Abitropin
Epidermal Growth Factor

Fine Chemical Pharmaceuticals

Blood Products: Rh Immune Globulin, WinRho
Superoxide Dismutase, AbiSod

Products Awaiting Licensure:
WinRho – Rh Immune Globulin for ITP indication;
Abitropin – Human Growth Hormone

Agreements:

- Bio-Technology General – DNA hGH – exclusive development and distribution rights in Canada;
- Apotex Inc. – Pharmaceuticals – $11.9 million project with 1992 production goal;
- Showa Shell, Sekiyu K.K. – Diagnostic kits – research agreement.

Desired alliance with other biotechnology firms

- Marketing partners outside of Canada for WinRho, an Rh Immune globulin used for prevention of Rh disease of the newborn and treatment of Idiopathic Thrombocytopenia Purpura (ITP).
- Marketing partner for recombinant human superoxide dismutase.
- Partner which could utilize ABI's expertise in scale-up of fermentation-based processes of manufacturing pharmaceuticals.

Canada

Strategic partnerships

ADI Diagnostics Inc.

30 Meridian Road
Rexdale, Ontario
M9W 4Z7

Mr. Jeff Greenberg

Telephone: (416) 674-0863
Fax: (416) 674-2992

Company history

ADI Diagnostics was formed in 1988 as a spinoff of Allelix Inc. It is one of a few fully integrated diagnostics companies in Canada. Products focus on infectious diseases. In 1989 ADI purchased the Hepatitis Diagnostics business unit of Connaught Laboratories. Collaborative agreements have been established with universities, hospitals, government labs and commercial firms in several countries.

- Annual Sales: $8M
- Annual R & D Expenditures: $2.5M
- Number of Employees: R & D: 25
  Manufacturing: 40
  Marketing: 12

Major products and markets

Major products include Hepatitis A and B markers, as well as diagnostic kits far Syphilis Antigen, Syphilis screening, Chlamydia Antigen, and Strep A detection. Several other products in blood screening and STD detection are under development. Products are marketed through a direct sales force in Canada and through distributors in USA, Europe, Japan, Australia, India and Southeast Asia. Products are designed for use by clinical labs, blood banks and eventually for decentralized test locations.

Technology of the company

Particular expertise in hybridoma technology, mammalian cell culture, cellular microbiology, clinical microbiology, molecular biology and immunoassay development.

Products in development

R & D focussed on improved delivery devices, hepatitis portfolio expansion, HPV, CMV, Syphilis serology and gonorrhoea.

Desired alliance with other biotechnology firms

Looking for technology input to be scaled up to commercialization, collaborative research in areas of mutual interest, product cross licensing.

Other comments

Companies with instrumentation for ELISA's or other immunoassays are of particular interest as joint venture partners or other bases.

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Canada

Strategic partnerships

Allelix Biopharmaceuticals Inc.

6850 Goreway Drive
Mississauga, Ontario
L4V 1P1

Mr. Jerry Ormiston, Business Development Coordinator

Telephone: (416) 677-0831
Fax: (416) 677-9595

Company history

Pharmaceutical operations started in early 1987 as a division of Allelix Inc. (founded 1983). R & D in pharmaceuticals became the sole business after divestiture of non-drug sectors. Company name revised October 1989. The company uses genetic engineering to develop and manufacture therapeutic proteins as drug products and has over 25 patent applications with several granted. Allelix collaborates with academic researchers and pharmaceutical companies. Revenues come from strategic alliances and contract research. Collaborators include Glaxo Canada, Eli Lilly, Rhône-Poulenc, Gist-brocades, McGill University, University of Toronto, McMaster University, University of Western Ontario, University of Waterloo, and others.

- Annual Revenue: Over $5 million U.S.
- Number of Employees: R & D: 65
  Manufacturing: 12
  Marketing: 5
  Others: 26

Major products and markets

- Bone Repair Program: Growth factors for osteoporosis, bone growth (Partner – Glaxo).
- Soft Tissue Repair Program: Growth factors for wound healing, GI Disease and ophthalmics – includes EGF, and novel growth factors.
- Anti-inflammation: Cytokines and steroid delivery – IL-6, corticosteroid binding globulin (transcortin).
- CNS Receptors – Cloned receptors (serotonin, glutamates, opioids, GABA) for pharmacological screening.
- Anti-viral: Agents to inhibit viral (HIV) replication.
- Contract R & D – cloning, expression, protein production in recombinant systems.

Technology of the company

- Gene Expression Systems – especially fungal *(aspergillus)*, but others available.
- DNA Chemistry – oligonucleotides and gene synthesis.
- Protein Biochemistry – protein purification and sequencing.
- Fermentation Process Development with Scale-up (to 300 litres).
- Protein Engineering and Biophysics.

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Allelix Biopharmaceuticals Inc.

(continued)

Products in development

- Parathyroid Hormone – therapeutic for osteoporosis (Partner – Glaxo).
- Epidermal Growth Factor – accelerated wound healing and other applications.
- Corticosteroid Binding Globulin – novel, targeted delivery of steroids.
- Serotonin Receptor Subtypes – pharmacological screening of candidate CNS drugs (anxiety, schizophrenia, depression).
- AIDS – novel class of anti-viral compounds which inhibit transactivation of HIV.

Desired alliance with other biotechnology firms

- Strategic alliances (R&D/Marketing) to develop soft tissue growth factors for use in wound healing, ophthalmics, GI.
- Research collaborations to apply cloned CNS receptors to libraries of small molecule compounds (potential therapeutic candidates).
- Research contracts for cloning and expression of proteins in appropriate host systems.

Other comments

The company is also interested in opportunities for corporate alliances, in-licensing, and equity investment.

Canada

Strategic partnerships

Alta Genetics Inc.

Site 12, Box 12, R.R. #4
Calgary, Alberta
T2M 4L4

Mr. Ted Mitenko, Vice President

Telephone: (403) 239-8882
Fax: (403) 239-8886

Company history

Alta Genetics Inc. is a full service livestock genetics company formed by the merger of two of Western Canada's longstanding companies in embryo transfer and artificial insemination. The company's R & D division pioneered a number of advancements in developing embryo transfer as a practical reproductive technology for livestock breeding. A number of the company's R & D projects are at the leading edge in this area of agricultural biotechnology.

- Annual Sales: $10M
- Annual R & D Expenditures: $.5 - 1M
- Number of Employees: R & D: 6
  Manufacturing: 54
  Marketing: 20

Major products and markets

Elite livestock genetics in the form of semen, embryos and live cattle are marketed domestically and to 34 countries. Technology and consulting services are also offered internationally, especially to areas pursuing improvement of dairy and beef production by enhanced reproduction.

Technology of the company

Alta Genetics' basic embryo transplantation techniques (non-surgical collection and transfer and embryo freezing) are well established. Associated areas involving embryo micromanipulation (e.g. embryo sexing, twinning, cloning by nuclear transplantation) are considered to be leading edge. *In vitro* systems (such as maturation and fertilization of cattle oocytes and embryo culture) are being incorporated into the company's production techniques.

Products in development

Production of groups of genetically identical "clone" calves is proceeding very successfully (suitable for genetic improvement programs or for "animal model" research projects). Application of freezing technology to sexed and cloned embryos is aimed at developing an efficient delivery system for these products. With its animal and embryo systems in good order, the company is well positioned for production of transgenic livestock by gene insertion into early embryos.

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Alta Genetics Inc.

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Desired alliance with other biotechnology firms

Strategic marketing/business alliances with groups possessing parallel/complementary interest in enhancement of animal productivity (as licencee, technology distributor, etc.).

Strategic R&D alliances with pharmaceutical/molecular biology groups whose corporate aims include potential production of biologically active proteins in transgenic animal systems.

Other comments

Willing to explore various alliance possibilities from joint venture to contract research, licencing, equity participation, etc.

Canada

Strategic partnerships

Bioscan Continental Inc.

350 boul. Industriel, 2e étage
St. Eustache, Québec
J7R 5V3

U.K. Banik, D.Sc.
Vice President & C.E.O.

Telephone: (514) 491-5807
Fax: (514) 491-3069

Company history

BIOSCAN is primarily a pharmaceutical/biomedical research and development (R&D) laboratory. It has developed two over-the-counter (OTC) products for gastrointestinal (GI) disorders and one OTC product for gum care and bad breath. It has also developed a few diagnostic hormones, antigens and reagents with the financial help of the governments of Quebec and Canada and its parent company. BIOSCAN has unique expertise in bringing forward new ideas and technologies for launching biomedical products to the marketable stage.

Major products and markets

PANACIL® and RESTORIN™ are preventative and curative GI – OTC products and ORADENT® is a gum care and bad breath product. These three products are made up of all natural ingredients. BIOSCAN's more than 30 diagnostic hormones and other agents are gaining access to national and international markets.

Technology of the company

1. Manufacturing of diagnostic reagents.
2. Manufacturing of products of natural origin:
   a) Panacil® for promoting bowel movement and relieving acidity and heartburn;
   b) Restorin™ for gastrointestinal and resulting colic; and
   c) Oradent® for gum problems and halitosis.

Products in development

1. Other harmones and diagnostic products
2. BIOAMP: New solid amphiphilic adsorbent for removing fat globules, mucins, cellular debris and colloidal particles from biological fluids, thus facilitating further purification of proteins.
3. Products of natural origin.

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Bioscan Continental Inc.

(continued)

Desired alliance with other biotechnology firms

Yes, for preparing some of the above materials biotechnologically e.g.,

1. To conduct clinical studies of Restorin as it is.
2. To prepare the active fraction(s) of Restorin using *in vitro* cell culture at the Biotechnology Research Institute (BRI) of Montreal. Should this project become successful, Restorin along with Panacil would be excellent preventative and curative products for GI-ailments which cost the health care system millions of dollars annually.

Other comments

Bioscan Continental Inc. is a private R&D company supported by its parent company – 135952 Canada Inc. and one of its directors, i.e. U.K. Banik. It does not have any marketing or sales force as yet. For this reason its sales figures are very low; however it has developed a few potential products.

Canada

Strategic partnerships

Biostar Inc.

Box 1000, Sub P.O. #6
Saskatoon, Saskatchewan
S7N 0W0

Dr. Stephen Acres, President

Telephone: (306) 966-7473
Fax: (306) 966-7478

Company history

BIOSTAR Inc. was incorporated in 1983 to conduct research and development testing, praduction and marketing of animal and poultry health care products and technalogy developed at the Veterinary Infectious Disease Organization (VIDO) at the University of Saskatchewan. Since then, BIOSTAR has focussed on strengthening the technology base at VIDO, and in building commercial contracts with animal and human health care biotechnology companies. BIOSTAR has acquired the first right of refusal to commercialize all technical developments at VIDO.

- Annual Sales: $750,000
- Annual R & D Expenditures: $350,000
- Number of Employees: R & D: 8
  Marketing: 1

Major products and markets

In collaboration with VIDO, several animal health care products have reached the developmental phase, two of which are currently being field tested. These products include vaccines for BHV-1, *Pasteurella, Actinobacillus, E. coli*/Rota/Corona, BVD Virus and Shipping Fever. These products will be marketed internationally. Current products marketed in Canada include HEVLAN TC, ECOLAN and ECOLAN RC.

Technology of the company

BIOSTAR's technical strength is the field of immunobiology. This involves the use of a variety of techniques to manipulate the immune system of mammals and birds. Through concentric diversification around the basic disciplines of molecular biology and immunology, BIOSTAR has patented all unique technology with a commercial opportunity.

Products in development

BIOSTAR'S primary focus is products to improve animal health and production. Its immediate focus is the use of active and passive hormone immunoneutralization to improve growth, lactation and reproductive efficiency.

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Biostar Inc.

(continued)

Desired alliance with other biotechnology firms

BIOSTAR is seeking a strategic ally(s) with strength or needs in the following areas:

- International marketing strengths in the area of recombinant DNA vaccines for animals.
- Complementary technology to build a critical mass of products.
- A partner who will fund a major collaborative R & D effort.
- Production requirements.

Other comments

Alliances can take on many forms – distinct marketing/sales distribution agreements with R & D funding support and rights to market products – or as equity partners in joint ventures.

Canada

Strategic partnerships

Bocknek Ltd.

165 Bethridge Road
Toronto, Ontario
M9W 1N4

Ms. Gail Bocknek, Export Manager, Vice President

Telephone: (416) 745-0796
Fax: (416) 745-8843
Telex: 06-989319

Company history

Bocknek was established in 1973 as a leading custom collector of animal by-products, for pharmaceutical purposes. Bocknek has continued to diversify its product base to include by-products for edible, research, educational, as well as pharmaceutical applications. During the past 11 years, the laboratory division of the company has specialized in animal sera and tissue culture products, and is recognized worldwide as a leader in this field.

- Annual Sales: $10M
- R&D Expenditures: $200,000
- Number of Employees: R&D: 2
  Manufacturing: 25
  Marketing: 5

Major products and markets

Bocknek animal sera are exported worldwide through a series of exclusive agency agreements. We have firmly established markets within the pharmaceutical, biotechnology, and research institutions, throughout Europe, the Middle East, and Japan. In 1989, we established our direct marketing department for sales and service throughout North America.

The increased demand for Fetal Bovine Serum and stringent quality specifications required by pharmaceutical, vaccine and biotechnology manufacturers has lead the way to the successful expansion of our markets. Low endotoxin Fetal Bovine Serum and Bocknek's unique Donor Bovine Serum has been the foundation of the business.

Technology of the company

Unique collection and processing methods, as well as strict control of clean rooms and sterile processing.

The control of our donor animal herds, improved processing techniques, and custom testing service, have allowed us to develop custom product serum to optimize cell growth promotion and production efficiency.

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Bocknek Ltd.

(continued)

Products in development

Bocknek is currently developing an IGG-free Donor Bovine Serum specifically tested for Hybridoma cultures, monoclonal antibody production systems, and special animal vaccine production. We have also started research and product development of growth factors and serum reduced media for mammalian cell culture.

Desired alliance with other biotechnology firms

We are looking for:

- strategic R&D and marketing agreements for tissue culture products, to link our international marketing experience with unique technologies;
- strategic contract development and licensed manufacturing arrangements to utilize our expansive clean room manufacturing facilities. Facilities are registered with the United States Department of Agriculture (USDA), the US Food and Drug Administration (FDA), the Health Protection Branch (HPB) of Health and Welfare Canada, and Agriculture Canada;
- contract collection, manufacturing, or joint venture development and manufacturing of biological products extracted from animal plant origin raw materials.

Canada

Strategic partnerships

Cangene Corporation

3403 American Drive
Mississauga, Ontario
L4V 1T4

Mr. James Rae

Telephone: (416) 673-0200
Fax: (416) 673-5123

Company history

Cangene was founded in 1984 by two industrial genetic engineers, Drs. Eric James and Robert T. Garvin, with the goal of solving two key problems in biotechnology: namely gene expression and gene detection. Initial funding came from three Canadian investors, led by the Manufacturers Life Insurance Company. In 1989, Cangene entered into a partnering agreement with Organon Teknika (part of the Pharma division of the AKZO Group) based on rights to certain applications of Cangene's diagnostic technology for commercial development. Cangene has successfully developed two original processes in diagnostics and protein expression, and patents have been applied for worldwide. Cangene retains its Canadian ownership and recently won a gold award in the "Canadian Awards for Business Excellence", Invention category for the diagnostics technology.

Major products and markets

Cangene has no commercial products as yet, however two products are nearing introduction; a nucleic acid amplification-based diagnostic technology called NASBA™, an immunomodulating drug for concomitant use with cancer chemotherapy and possibly in conjunction with AZT therapy for AIDS treatment.

Future products will focus mainly on the biopharmaceutical field.

Technology of the company

Cangene has focused on the processes driving biotechnology, rather than the products themselves. The first of these proprietary technologies is the nucleic acid amplification system NASBA™ which has applications in many fields including research, human *in vitro* diagnostics, forensics and food testing.

Cangene's other technology is a proprietary protein expression system called Cangenus™. Using the Cangenus system, Cangene has expressed at commercially feasible levels, several bioactive proteins which are of major importance to the pharmaceutical industry.

Products in development

NASBA™ technology for human clinical use is currently under co-development with Organon Teknika.Leucotropin™ the first of the biopharmaceuticals to be produced in the Cangenus™ system is nearing Clinical Trials and several other biopharmaceuticals are in various stages of development.

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Cangene Corporation

(continued)

Desired alliance with other biotechnology firms

Congene seeks to out-license its NASBA™ technology for uses other thon humon *in vitro* diognostics (olreody licensed to Orgonon Tekniko). Congene olso seeks distribution in Europe ond Asio-Pocific for its Conodion monufoctured biophormoceuticol products.

Canada

Strategic partnerships

Cosem Neurostim Ltée

105 Abraham Martin, Suite 510
P.O. Box 4070, Station
Quebec City, Quebec
G1K 8H5

Mr. Jean-Marie Gauthier, President

Telephone: (418) 694-9983
Fax: (418) 694-1770

Company history

COSEM NEUROSTIM LTEE was founded in September 1986 by its promoter, Mr. Jean-Marie Gauthier. As part of his activities to set up the company, Mr. Gauthier had access to neurostimulator technology. Meetings with the various scientific partners responsible for the development of new technologies in this sector, the findings of a comprehensive market study, and the support of public institutions such as the National Research Council of Canada encouraged him to commercially exploit neurostimulator technology. In 1989, COSEM NEUROSTIM LTEE obtained $1 million in private funding through a public issue.

Major products and markets

Neurostimulation is the stimulation of nerve centres through controlled external excitation. One application of this technology is used to excite the auditory fibres of the cochlea through electric stimulations configured on the basis of sounds perceived by the environment. This is known as the cochlear implant, the company's first product, which enables totally deaf persons to hear. The Canadian cochlear implant system has three major components: the modulator, the implant and the electrode carrier.

Over the last five years, commercial interest in this products has grown. There are now eleven companies involved in the research, production and marketing of cochlear implant devices, six of which are in the United States. Nearly 2,700 cochlear implants have been performed to date. Surgeons have recently begun to perform cochlear implants in children. The current North American market is estimated at 250,000 units. COSEM NEUROSTIM LTEE plans to introduce a system based entirely on Canadian technology which will outperform the systems currently being marketed.

Technology of the company

ORINO is a system based on a standard micro-computer equipped with a system for acquiring data measured by a number of sensors specific to various otorhinolaryngology tests. It will include various levels of tests needed for cochlear implants: pre-operative tests, tests during the operation and post-operative tests. It will also include patient re-education programs.

The COSEM neurostimulator technology is used in both the cochlear implant and the ORINO support equipment.

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Cosem Neurostim Ltée

(continued)

Cochlear implants enable persons with severe hearing loss to hear again. the device has an external component, the speech analyser, which is based on commercially available microprocessors. The results obtained are transmitted via antennae through the skin to the implanted stimulator. The stimulator is composed of a chip mounted on a hybrid circuit, about the size of a nickel, which captures information from the speech analyser and transmits electrical impulses to the electrode carrier which stimulates the patient's auditory fibres.

Products under development

- Cochlear implant

Other potential products:

- Neurostimulator for pain relief

The device produces electrical impulses, generated by a completely self-contained portable electronic stimulator, which are transmitted through two pairs of electrodes attached directly to the patient's skin.

The electrical impulses stimulate the secretion of natural endorphins (endogenous morphine) which act as an analgesic on the nerve fibres which transmit pain signals to the brain.

- Orthosis for patients suffering from incontinence

Neurostimulator technology can be applied to the control of urinary incontinence. The use of neurostimulation in this field is even more recent than in the treatment of hearing impairments. Professor François Duval of the University of Sherbrooke has already developed, using cochlear implant technology, an orthosis for patients suffering from incontinence which has been undergoing clinical trials on animals for more than two years. The results are positive according to Dr. Alilali who heads the testing at Montreal's McGill University. According to the promoter, only one American company is marketing such a product – Avery Laboratories in New York State. This company has sold 500 of its devices since 1972, with approximately 50 being distributed worldwide annually. The company has only received US Federal Drug Administration (FDA) approval in the last few years.

Two versians of the product are available, one costing US $9,000 (unilateral) and the other casting US $17,000 (bilateral).

Desired alliance with other biotechnology firms

COSEM is seeking co-operative agreements with other companies with related and complementary activities, resources and markets. It is hoping to develop an international network of clinical and scientific teams and production and marketing groups to enable it to cover international markets.

Canada

Strategic partnerships

HSC Research and Development LP

88 Elm Street
Toronto, Ontario
M5G 1X8

Ms. Barbara Lavers, Manager, Technology Licensing

Telephone: (416) 598-5982
Fax: (416) 598-7163

Company history

HSC Research and Development Limited Partnership (RDLP) was established by The Hospital for Sick Children as its technology transfer agent with the exclusive right to solicit, negotiate and conclude licenses. The Hospital for Sick Children is one of the world's leading pediatric institutions. The Hospital and its staff of more than 300 specialists in pediatric medicine and surgery serve as a tertiary referral centre for much of the western hemisphere.

The mandate is to develop the commercial potential of devices and technologies conceived by the staff of the Hospital and its Research Institute. RDLP has the first-right-of-refusal on new technologies and medical devices. The commercialization strategy targets the licensing of technology based on proprietary rights and direct sales of biological products.

The company has two operating units, Technology Transfer and Bioproducts. The Technology Transfer Division is responsible for patent licensing activities, including new project assessments and contract negotiations. The Bioproducts Division provides opportunities for technology transfer through direct product sales.

Major products and markets

Technology Transfer Division
Technology licensing opportunities based on proprietary rights are offered for medical instruments (for example, devices applied to anaesthesia, cardiology, neurosurgery, ophthalmology, orthopedics) and in the market area of biotechnology (for example, clinical diagnostics, drug testing, DNA probes).

Bioproducts Division
A unique line of research biochemicals is manufactured and sold internationally to genetic services, microbiology, virology, pathology and cell biology laboratories. It includes enzyme substrates for the investigation of rare genetic diseases, monoclonal antibodies, and rare biochemicals for basic research.

Technology of the company

Our close association with The Hospital for Sick Children and its large, dynamic Research Institute makes available an extensive variety of new technologies to industry.

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HSC Research and Development LP

(continued)

Research biochemicals are manufactured either in conjunctian with the Research Institute (e.g. the production of novel monoclonal/polyclonal antibodies), or in our own laboratories. The manufacturing facility focuses on the organic synthesis of new biochemicals.

Products in development

Basic and applied research is conducted in a diverse range of biological, medical and healthcare areas.The Bioproducts Division is currently developing antisera directed against 14 serovars of *Ureaplasma urealyticum.*

Canada

Strategic partnerships

Hybrisens Ltd.

4700 Keele Street (York University Campus)
Farquharson Building, Suite 104
Toronto, Ontario
M3J 1P3

Dr. Ezekiel Y. Shami, President

Telephone: (416) 736-5504
Fax: (416) 736-5698

Company history

Hybrisens Ltd. is a privately held Research and Development company, established in November 1986. The company is situated on York University campus, where it occupies over 2,000 sq. ft of well equipped laboratory space. The core scientific staff has been working as a team since 1982, initially at the R&D branch of The Hospital for Sick Children in Toronto, and as of November 1986, at Hybrisens. Currently we carry out R&D contracts for scientists at the University of Toronto, York University, The Hospital for Sick Children and several biotechnology companies in the Toronto area.

Major products and markets

- Monoclonal Antibodies Generation and Production
- Polyclonal Antibodies Generation and Production
- Immunoassay Development
- Protein Conjugation and Immobilization
  - Hapten conjugation to carrier protein
  - Antibody or antigen labelling (Radio, Enzyme, Fluor.)
  - Antibody or antigen immobilization on affinity matrix
- Protein Purification and Analysis of:
  - Antigens
  - Monoclonal and polyclonal antibodies
  - Biologically active proteins
- Stabilization of:
  - Enzymes, hormones and growth factors against: heat, freezing and thawing, lyophilization, pH, oxidation, solvents and detergents, and proteolysis
- Bioassay Development and Service
- Custom Synthesis of Fine Biochemicals

Technology of the company

Hybrisens Ltd. has developed a novel method (world wide patent pending) that increases, up to 300-fold, the resistance of biologically active proteins, such as enzymes, hormones and growth factors, to inactivation due to heat, freezing, lyophilization, oxidation, pH, alcohol and proteolytic enzymes. The method can improve the efficacy and economy of active protein usage in therapy, industry and research.

The stabilization method utilizes specifically generated and selected, non-inhibitory protective antibodies to protect certain vulnerable sites on their biologically active antigens, resulting in stabilization of these proteins.

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Hybrisens Ltd.

(continued)

Products in development

Hybrisens is currently developing an extensive R&D program that is designed to append (via recombinant DNA technology) the single chain version of the protective antibodies to the target protein to form fusion genes, that upon expression in the appropriate microorganism, will produce stabilized chimeric protein, potentially at the same cost as the native protein.

Desired alliance with other biotechnology firms

Hybrisens is seeking financial support through collaboration, R&D contracts, joint ventures, partnerships or equity financing.

We are looking for:

- licensing agreements based on proprietary rights
- distribution arrangements for our line of research biochemicals
- companies interested in incorporating our antisera into clinical diagnostics

Canada

Strategic partnerships

IAF BioChem International Inc.

2550 Daniel Johnson, Suite 600
Laval, Quebec
H7T 2L1

Jim McDonald, Vice-President, Business Development

Telephone: (514) 681-1744
Fax: (514) 681-4207

Company history

In 1986, scientists formerly with Ayerst, along with scientists from McGill University and the Canadian National Research Council, worked with the Institute Armand-Frappier to take public the BioChemicals Division of the Institute, forming IAF BioChem. In February 1990, IAF BioChem took a 50% interest in the company North American Vaccine, Inc., which is involved in the development of new vaccines such as meningococci, Haemophilus influenzae b, group B streptococci and pertussis. This company operates in Maryland, USA. Also, in May 1990, IAF BioChem purchased the vaccines division of Institute Armand-Frappier, which is involved in the production of classical vaccines such as tetanus, flu viral, measles and rubella.

Major products and markets

- HIV-1/HIV-2 Synthetic Peptides – Diagnostic corporations
- Detect AIDS Diagnostic Kit – Blood banks, AIDS screening centres
- Detect HTLV-I/HTLV-II Diagnostic Kit, Canada, blood banks, retrovirus screening centres
- Select HTLV-I/HTLV-II Diagnostic Kit, Canada, blood banks, retrovirus screening centres
- Human vaccines – Government Health Service
- Bacterial vaccines: d2T5, Tetanus Toxoid-absorbed, Tetanus Toxoid-fluid
- Viral vaccines:
  - Engerix-B: recombinant hepatitis B
  - Fluviral: influenza virus vaccine
  - Measles: Schwartz strain
  - Rubella

Research Use

- Select HIV-1/HIV-2 – AIDS screening centres and blood banks
- Detect Rubella-G Diagnostic Kit – Provincial laboratories and hospitals
- Research biochemicals (peptides and related products) – Universities, research centres and laboratories

Diagnostics – Technology to identify biding sites (peptide epitopes). They are then synthesized and modified so as to mimic the three dimensional shape present on the protein.

Vaccines – Polysaccharide – protein conjugate vaccines: the polysaccharides are chemically bonded in a very specific manner to carrier protein molecules.
– Microcarrier technology

(continued)

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IAF BioChem International Inc.

(continued)

Therapeutics – Combination of the principles of rational drug design with new and imaginative routes of chemical synthesis:

- nucleoside analogs (anti-viral)
- anthracycline (anti-cancer)
- immunomodulatory compounds (arthritis)
- novel opiate peptides (analgesics)

Products in development

Diagnostic Kit:	Group B Streptococci
Therapy:	BCH-189 (AIDS)
Vaccines:	Whooping Cough – Meningitis A + C – Meningitis B – Group B Streptococci

Desired alliance with other biotechnology firms

Therapeutics:	R&D alliances
Vaccines:	Develop and commercialization alliances
Diagnostics:	Manufacturing and marketing alliances

Other comments

In its short history, IAF BioChem has made major progress in the financial, scientific and business sectors. As a result of its investment decisions, various agreements and alliances, the Company has positioned itself for further development. At the same time it has strengthened its infrastructure and the operations of its three business segments: diagnostics, vaccines and therapeutics.

In each of these activities, the Company relies on leading-edge technologies that it has developed in order to meet its growth objectives. With respect to development, manufacturing and marketing, the Company has concluded diverse types of agreements, including acquiring strategic alliances, distribution agreements, licensing, all tailored to fit with the specific requirements of a given segment.

Canada

Strategic partnerships

Ibex Technologies Inc.

1625 Sherbrooke St. West
Montreal, Quebec
H3H 1E2

Mr. Robert A. Heft, President

Telephone: (514) 935-4004
Fax: (514) 935-5370

Company history

Ibex was established in 1989 with laboratories at the Biotechnology Research Institute in Montreal. Her parent company, Continental/Pharma Cryosan Inc., had for several years been funding a research project at the Massachusetts Institute of Technology (MIT). As the MIT technology matured, Ibex was spun off and mandated to commercialize a line of products for cardiac surgery and hemodialysis. Ibex has received approximately $3.5M in grants and loans from various government agencies.

- Annual R & D Expenditures: $800,000
- Number of Employees: R & D: 10

Major products and markets

Ibex's initial products are focusing on various aspects of heparin monitoring and control. Diagnostic assays enabling the clinician to assess the hemotological status of a patient while on heparin, and heparin filters to remove heparin from a patient's blood in conjunction with extracorporeal procedures will be Ibex's primary product lines.

Technology of the company

Ibex has developed an economical system for producing large quantities of high purity heparinase. This enzyme is capable of rapidly inactivating heparin and is the critical reagent in Ibex's products. Our ability to immobilize this enzyme and other proteins to biocompatible material constitutes our basic technology.

Products in development

Heparinase based diagnostics and extracorporeal blood detoxification are Ibex product niches. Fermentation and purification as well as protein immobilization and biocompatible materials are the focus of our R & D. Additionally, we are developing other enzymes derived from the same organism as heparinase for use in glycosaminoglycan engineering.

Desired alliance with other biotechnology firms

Ibex is flexible in structuring a full spectrum of alliances with other companies active in hematology diagnostics, cardiac surgery, hemodialysis and other extracorporeal procedures. Ibex has further interest in collaborating in the area of glycosaminoglycan and glycoprotein engineering using our line of enzymes from *Flavobacterium heparinum*.

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Canada

Strategic partnerships

Immunocorp Sciences Inc.

5800 Royalmount Avenue
Montreal, P.Q.
H4P 1K5

Dr. Pierre Du Ruisseau, Vice-President

Telephone: (514) 733-1900
Fax: (514) 733-1212

Company history

Immunocorp, an early pioneer in immunodiagnostic testing, was acquired by Medicorp Sciences in 1988, and is Canada's largest manufacturer and distributor of immunodiagnostic products. Immunocorp is a fully integrated company whose operations range from research to the marketing of its products across Canada. The resources of Immunocorp, which include a fully automated manufacturing process approved by the U.S. Food and Drug Administration, an ultramodern laboratory, and advanced technologies, support an outlook of strong Canadian sales growth in the short term and penetration of export markets in the medium term.

- Annual Sales: $3M
- Annual R & D Expenditure: $100,000
- Number of Employees: R & D: 2
  Manufacturing: 10
  Marketing: 8

Major products and markets

Immunocorp manufactures and distributes immunodiagnostic test kits in Canada. It markets a full line of RIA and ELISA tests for hormones, therapeutic drugs and vitamins, and a full line of latex agglutination tests for infectious diseases. Both these product lines are directed at the clinical laboratory market. It also distributes a growing line of genetic engineering reagents to molecular biologists and research reagents to the microbiologist/immunologist. Additionally, Immunocorp sells its solid phase radioimmunoassay kits through distributors in Europe, and produces solid phase antibody coated tubes for other firms on an OEM basis.

Technology of the company

Immunocorp has the capability of doing isotopic labelling and tube or 96 well plate solid phase coating of antigens or antibodies. It also can produce, from immunization, to cloning, to large scale manufacturing and purification, monoclonal antibodies.

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Immunocorp Sciences Inc.

(continued)

Products in development

Immunocorp, with the introduction of a line of bispecific monoclonal antibodies, is developing a series of enzyme immunoassays for hormone determinations.

Desired alliance with other biotechnology firms

Strategic marketing/R & D alliances to develop commercial products in clinical chemistry (mainly non-isotopic automated immunoassays), microbiology and molecular biology, strategic business alliances to provide access to Immunocorp's expertise in OEM antigen or antibody solid phase tube or 96 well plated coating.

Canada

Strategic partnerships

Integrated Protein Technologies Inc. (IPT)

350 Victoria Street
Toronto, Ontario
M5B 2K3

Dr. Ian S. Clarke, President
Dr. Michael H.P. West, Director of Research

Telephone: (416) 979-5158
Fax: (416) 979-5157

Company history

Integrated Protein Technology Inc. is a wholly Canadian owned company, and was incorporated in 1988.

Major products and markets

IPT offers full-service protein chemistry capabilities to the international biotechnology community in the areas of protein sequencing, peptide synthesis, and antibody production.

Since its inception, IPT has performed protein sequence analysis, manufactured synthetic peptides, and produced custom antibodies for over 130 research projects for laboratories in Canada, USA, Europe and the Pacific Rim.

IPT is currently manufacturing peptides involved in neurochemistry, signal transduction and immunology, as well as antibodies to Protein Kinase C, Phospholipase C, and the O subunit of G-proteins. The corresponding synthetic peptides are also available.

IPT's products are now being distributed in Europe by MedProbe A.S. (Oslo, Norway).

Technology of the company

Integrated Protein Technologies Inc. specializes in the determination of the amino acid sequence of proteins, the synthesis of biologically active peptides, and the generation of synthetic peptide-based antibodies (both monoclonal and polyclonal). Integrated Protein Technologies Inc. performs all of its protein sequencing on an Applied Biosystems Inc. model 477a/120a Pulsed Liquid Phase Sequenator, and synthesizes all of its peptides on a Pharmacia Biolynx™ Peptide Synthesizer, using Fmoc solid-state polyamide chemistry.

To ensure the highest possible quality of its peptides, IPT purifies them to 96% using Reversed Phase HPLC and authenticates the sequence of the peptides by Edman degradation on its protein sequencer.

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Integrated Protein Technologies Inc. (IPT)

(continued)

Products in development

Integrated Protein Technologies Inc. is continuing to produce custom and batch synthetic peptides of the highest possible grade. Its research will focus on peptides involved in the following areas: neurochemistry; immunology; cardiovascular biochemistry; and signal transduction. In addition to this, Integrated Protein Technologies Inc. will be producing a series of synthetic peptide-based antibodies specific for oncogenes.

Desired alliance with other biotechnology firms

Because of its diverse technologies, Integrated Protein Technologies Inc. is able to provide expertise in numerous aspects of protein chemistry. Integrated Protein Technologies Inc. is interested in: using its protein sequencer to perform quality control and product verification for companies involved in the production of recombinantly-expressed proteins; and using its peptide synthesizer to manufacture high quality synthetic peptides for use in diagnostic kits.

Integrated Protein Technologies Inc. is interested in establishing distribution agreements for its protein sequencing service, synthetic peptides and antibodies for laboratories in the Pacific Rim.

Canada

Strategic partnerships

Joldon Diagnostics

81 Finchdene Square
Scarborough, Ontario
Canada M1X 1B4

Dr. Don Segal, Colin Oster or Gary Slapack

Telephone:(416) 292-1699
Fax: (416) 293-2492

Company history

Founded in 1980 by a Ph.D. as a manufacturer of radioimmunoassay diagnostics kits. 1988 complimented manufacturers line with imported diagnostic kits for domestic marketplace. 1989 development of expanded OEM agreement with a U.S. based company to include marketing worldwide. 1989 development of partnership with a Canadian university involving technology transfer. Each year, growth has been experienced and each year of existence has been profitable.

- Annual Sales: $2- 4 M
- Annual R&D Expenditures: Significant
- Number of Employees: R&D: 5
  Manufacturing: 7
  Marketing: 5

Major products and markets

Joldon manufacturers radioimmunoassay products employing magnetizable particles, these products are currently being sold to domestic consumption. Joldon manufacturers T.D.M. (Therapeutic Drug) fluorescence polarization kits for sale around the world. Joldon imports esoteric diagnostic kits from Nichols Institute Diagnostics in California.

Technology of the company

Joldon is capable of manufacturing: Radioimmunoassay Diagnostic kits or components; Flourescence Immunochemistry kits or components; Enzyme Immunoassay kits or components; currently developing Chemiluminescent Immunoassays.

Products in development

Autoimmune diagnostic kits quantitative and qualitative; Elisa tests thyroid and type 1 diabetes related; screening kits for autoantibodies; chemiluminescent diagnostic kits.

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Joldon Diagnostics

(continued)

Desired alliance with other biotechnology firms

Joldon Diagnostics is interested in the development of their OEM/Private Label client base and is interested in producing the immunochemistries, chemistries or other diagnostic reagents under contract for major equipment manufacturers. As Joldon is currently involved in the research and development of auto-antibody assays in the areas of thyroid disease and diabetes, Joldon would welcome possible development related opportunities in either of those areas. Joldon as well welcomes technology transfer as it relates to enzyme immunochemistry, fluorescent polarization, chemiluminescent immunochemistry and radiochemistry. Joint ventures with other diagnostic kit or capital equipment manufacturers would as well be of interest to Joldon.

Other comments

Joldon is a small but very professional, flexible, and profitable international company having great capability with international OEM project.

Canada

Strategic partnerships

Kronem Systems Inc.

554 Parkside Dr.
Waterloo, Ontario
N2L 5Z4

Allen Nichols

Telephone: (519) 886-8440
Fax: (519) 996-8442

6850 Goreway Dr.
Mississauga, Ontario
L4V 1P1

A. Pollak

Telephone: (416) 612-0411
Fax: (416) 612-0412

Company history

Kronem was formed in June 1989 as a commercial entity to exploit the DNA detection system research that had been undertaken by the Hospital for Sick Children in Toronto. The technology was a follow-on to work on Time Resolved Fluorescence done for CyberFluor Inc. for immunoassay systems. Kronem is owned by the employees, HSC, and CME Telemetrix (a medical electronics company).

- Annual Sales: $450,000
- Annual R&D Expenditures:$370,000
- Number of Employees: R&D: 6
  Manufacturing: 1
  Marketing: 1

Major products and markets

- High purity custom oligonucleotides; nonisotopically labeled custom oligonucleotides; both sold to research laboratories.
- Rapid Enzyme Amplified Lanthanide Luminescence (REALL™) kits; for nonisotopic detection of DNA hybridization assays and other bioassays using alkaline phosphatase labels.
- TRP100 Camera to measure time-resolved fluorescence.

Technology of the company

- Production of high purity, nonisotopically labeled and thioated oligonucleotides.
- Time-resolved fluorescence camera system.
- REALL detection for ultrasensitive DNA hybridization and other bioassays.

Products in development

- REALL Kits for detection of other enzymes and for improved detection of alkaline phosphatase.
- Quantitative Time-Resolved Fluorescence camera system for accurate determination of nucleic acid concentrations.

(continued)

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Kronem Systems Inc.

(continued)

Desired alliance with other biotechnology firms

We are seeking a joint venture with an established diagnostic or pharmaceutical company that can assist with applications and probe development, camera development and production, and marketing.

Other comments

Patents have been granted on the TRP system. Patents have been filed on the REALL system.

Canada

Strategic partnerships

Langford Inc.

400 Michener Road
Guelph, Ontario
N1K 1E4

Dr. R. Charles Povey

Telephone: (519) 837-2040
Fax: (519) 837-1876

Company history

Langford Laboratories was established as a partnership in 1976, was incorporated in 1978 and in 1985 amalgamated with Armitage-Carroll to form Langford Inc. Langford is an animal health products manufacturer and marketer with a broad line of pharmaceuticals and vaccines sold through the veterinary profession by a field staff of 12. Langford has particular emphasis on the development, production and international marketing of animal vaccines for farm and companion animals. Langford is 49.9% owned by Cyanamid Canada, a subsidiary of American Cyanamid of Wayne, New Jersey, a Fortune 500 company with emphasis in human medical products, agriculture and chemicals.

Major products and markets

Langford is producing a wide range of viral vaccines, bacterins, bacterial extracts, toxoids and subunits for a variety of infectious disease agents in pigs, cattle, dogs, cats and other species. Langford markets under its own or the manufacturer's labels antibiotics, anti-inflammatory drugs, generic pharmaceuticals of many types, diagnostic test kits and surgical supplies. Distributions are on an exclusive Canadian market basis. Langford is a major player ranking in the top ten of Canadian animal health companies. In addition it has a strong export market representing more than 25 per cent of sales. Through the Cyanamid connections and with independent local distributors markets are being built in many parts of the world.

Technology of the company

Langford has a modern vaccine production facility which is just being expanded. A highly trained staff has been assembled drawing on expertise gained in major international biotechnology companies. The research and development team are adept at interacting at late-discovery/early development stage with university, institute, or independent scientists. They facilitate development for regulatory approvals, including production scale-up, quality assurance test development, and field trials.

Products in development

Improved animal vaccines are being developed, many in conjunction with universities. Particular interests are the areas of bovine respiratory and enteric diseases, bovine mastitis, respiratory diseases of pigs.

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Langford Inc.

(continued)

Desired alliance with other biotechnology firms

Companies that have innovative products for the animal health market, including but not limited to vaccines. Particularly companies that wish to link with a company of moderate size, friendly entrepreneurial atmosphere, but with big company resources and know-how to bring products to market successfully.

Other comments

Langford Inc. was a winner in the Entrepreneurship category of the Canadian Awards for Business Excellence, 1990.

Canada

Strategic partnerships

Medicorp Inc.

5800 Royalmount Ave.
Montreal, P.Q.
H4P 1K5

Dr. Pierre Du Ruisseau, V.P., R & D

Telephone: (514) 733-3000
Fax: (514) 733-1212

Company history

Medicorp was founded in 1985 to use the latest methods in immunology, immunochemistry and biochemistry to develop and commercially exploit improved sophisticated systems for cancer diagnostics and therapeutics, transplantation antigens, and bispecific hybridomas. Medicorp's research staff works in close collaboration with scientists at major research institutions, especially at McGill University in Montreal and the University of Cambridge in England.

- Annual R & D Expenditure: $1.5M
- Number of Employees: R & D: 8
  Marketing: 3

Major products and markets

Medicorp distributes primarily to physicians' offices rapid ELISA tests for the detection of infectious diseases and pregnancy. Medicorp is positioned to manufacture and distribute medical products in Latin America through its wholly owned subsidiary in Argentina, Medicorparg. Ltda.

Technology of the company

Medicorp has a patent to a treatment for AIDS and ARC called "Passive hyperimmune therapy" or PHT. Medicorp has also developed various lines of bispecific monoclonal antibodies that are useful in immunoassays, immunohistochemistry and immunocytochemistry.

Products in development

Medicorp has the world-wide rights to the PHT treatment for AIDS and ARC patients developed by Prof. Abraham Karpas of Cambridge University. Clinical trials are under way at St. Stephens Hospital in London and at the Bronx Veterans Administration Hospital in New York. Medicorp is also developing, using bispecific monoclonal antibodies, a CEA assay specific to colorectal cancer. Additionally, Medicorp is developing a series of monoclonal antibodies against transplantation antigens.

Desired alliance with other biotechnology firms

Strategic marketing/R & D alliances to develop commercial products for doctor's office market, new tumor markers or new antibodies to transplantation antigens and licensing agreement for the PHT treatment.

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Canada

Strategic partnerships

Nordion International Inc.

447 March Road
P.O. Box 13500
Kanata, Ontario
K2K 1X8

Mr. J. Russell Redshaw

Telephone: (613) 592-2790
Fax: (613) 592-0440

Company history

Nordion International Inc., formerly Atomic Energy of Canada Ltd., Radiochemical Company, started the development of several radioisotopes useful for the detection and treatment of a variety of diseases in 1946. Major milestones include the introduction of Cobalt-60 for cancer therapy in 1958, and more recently the development of the process to produce the purest iodine-123 available (an important isotope used in radiopharmaceuticals).

- Annual Sales: Exceed $100M

Major products and markets

Nordion produces over half of the world's gamma radiation processing equipment and supplies most of the world's Cobalt-60 for sterilization of medical disposables, biomedical wastes and sewage. Nordion also provides approximately two-thirds of the world's supply of reactor isotopes as well as cyclotron (particle accelerator) produced isotopes. Nordion processes both types of isotopes primarily for use in nuclear medicine. Nordion also produces its own radiopharmaceuticals which are used in approximately 40% of Canadian hospitals.

Technology of the company

Nordion's technology expertise is focussed primarily on radiation processing and radioisotopes. Engineering of containment systems and containers, safety and regulatory licensing are other areas of technological expertise.

Products in development

Radiopharmaceuticals for diagnosis and therapy. Food irradiation, irradiation of biological wastes and sludges.

Desired alliance with other biotechnology firms

Nordion is interested to pursue opportunities which may enhance or protect its core business interests. Additionally, Nordion is interested to diversify into new business areas through proprietary biotech products or processes that fulfill market needs. The Company is open to consider joint ventures, technology transfer agreements, or development contracts.

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Nordion International Inc.

(continued)

Comments

Recently, as part of its planned approach to diversification, Nordion invested in an equity position in CyberFluor Inc. CyberFluor Inc. is a Toronto based clinical immunodiagnostics company. CyberFluor manufacture and distribute immunoassay kits which have a proprietary non-radioactive label, called EuroFluor S^{R}, and a time-resolved fluorescence analyser.

Canada

Strategic partnerships

Palliser Health Laboratories Ltd. (PAHL)

2825 – 12th Avenue North
Lethbridge, Alberta
T1H 5K9

Dr. Colin Darcel

Telephone: (403) 328-1844
Fax: (403) 328-1798

Company history

PAHL was started in 1986 to provide veterinary microbiological laboratory services across Canada. It is well equipped with all the necessary equipment for this type of work. In 1989 PAHL was accredited by Agriculture Canada to test for Equine Infectious Anaemia and Enzöotic Bovine Leukosis, both large markets.

- Annual Sales: $150,000
- Annual R & D Expenditures: $40,000
- Number of Employees: R&D: 1.5
  Services: 1.5

Major products and markets

PAHL has about 250 veterinary practices in Western Canada on its books as regular customers, and this number is steadily growing. In addition, PAHL services the three AI centres in Western Canada, and it has done contract research for commercial institutions and provides microbiological and other services to other federal and provincial government agencies. It also has clients in food processing businesses for which it does control bacteriology.

Technology of the company

PAHL has the capability of doing all types of serology, virology, bacteriology and parasitology. It has worked with Dimension Laboratories in Mississauga, Ontario, in the development of ELISA for progesterone and is developing ELISA procedures for IgG responses to leptospira and viruses.

Products in development

PAHL is developing ELISA procedures for IgG responses to leptospira and various viruses affecting farm animals and horses.

Desired alliance with other biotechnology firms

We are particularly interested in doing contract research for firms and institutions in the U.S.A. We are also interested in acting as agents in Canada for firms in countries outside Canada who wish to see their veterinary diagnostic products marketed here.

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Canada

Strategic partnerships

Paradigm Biotechnologies

45 Lisgar Street, Unit 15
Toronto, Ontario
M4E 3M7

Dr. Gordon Rosenblatt, President

Telephone: (416) 538-3362
Fax: (416) 538-7265

Company history

Paradigm Biotechnologies is a development-stage company conducting R & D on a monitor for improving the adequacy of treatment of haemodialysis patients and on new "designer" biomaterials for improving the performance and safety of implantable medical devices. The company was founded in 1988 and is now in the later stages of development for the haemodialysis product. The company has four patents and one patent application to protect its first products, which are expected within two years. The company has experienced management in building and marketing of medical instruments and devices.

- Annual R & D Expenditures: $500,000
- Number of Employees: R & D: 3
  Marketing: 1

Major products and markets

Paradigm aims to sell to haemodialysis clinics in hospitals and private clinics in North America, Europe and Asia. Sales will be carried out through distributors with access to the target markets. Paradigm's needs for the biomaterials business are not as well-defined, but we would welcome and anticipate strategic marketing partnerships with companies possessing dominant positions in catheters, implants, cell culture products, and medical membranes for our biocoatings.

Technology of the company

Paradigm has patents and technology in biocompatible materials and their coatings, as well as biosensors using its membrane technology. Paradigm's management have experience in developing instrumentation for the medical market. The company has programs in biocompatible coatings with experts at Victoria Hospital, London and National Research Council.

Products in development

- Haemodialysis monitors – development of a monitor for on-line analysis within dialysis machines, presently prototype monitor available for clinical trials
- Biocompatible coatings – research underway to develop coatings and coating technology for vascular and prosthetic implants, dialysis membranes to provide enhanced biocompatibility.

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Paradigm Biotechnologies

(continued)

Desired alliance with other biotechnology firms

- Strategic marketing/R&D alliances to develop commercial products in biocompatible materials, i.e. vascular and prosthetic implants using Paradigm proprietary biocoating technology, dialysis membranes, catheters, etc., requiring added biocompatibility
- Strategic business alliances to provide access to expertise in coating of polymer and metal surfaces in large-scale operations, OEM manufacture of instruments and instrument components.

Other comments

Alliances can be structured either as distinct marketing/sales distribution agreements with R & D funding support and rights to market product, or as equity partner with active participation in particular product groups.

Canada

Strategic partnerships

Precision Biologicals Inc.

11A Pettipas Drive
Dartmouth, Nova Scotia
B3B 1K1

Mr. Stephen L. Duff, President

Telephone: (902) 468-6422
Fax: (902) 468-6421

Company history

Precision Biologicals Inc. was incorporated in 1983 with the mandate to manufacture clinical diagnostic products for hospital and private laboratories. Since then, PBI has expanded both its product lines and its geographical area of distribution. Precision currently sells its products directly in Canada and through the aid of international distributors. PBI's products are sold in 10 countries internationally.

- Annual Sales: $500,000 to $1.0 million Canadian
- Annual R & D Expenditures: under $25,000
- Number of Employees: R & D: 1
  Manufacturing: 4
  Marketing: 1

Major products and markets

Coagulation: Reagents, Controls and Factor Deficient Plasmas – International
Microbiology: Prepared Culture Dish Media – Canada only
Parasitology: Fecal Transport Systems – International
Immunology: HIV IgG & IgM Quick Western Blot Kits – Canada only

Technology of the company

Areas of expertise are associated with R & D into human blood coagulation products. Also have capabilities to develop and implement novel manufacturing methods toward new product lines.

Products in development

Stabilization of human plasma & blood fractions.

Desired alliance with other biotechnology firms

PBI is interested in locating qualified distributors for its coagulation and parasitology lines in countries where it is currently not represented. Also interested in acting as exclusive distributor in Canada for novel diagnostic products.

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Canada

Strategic partnerships

Quadra Logic Technologies Inc.

520 West 6th Avenue
Vancouver, B.C.
V5Z 4H5

Kenneth Galbraith
Manager, Corporate Development

Telephone: (604) 872-7881
Fax: (604) 875-0001

Company history

- Formed in 1981.
- Principally engaged in the development and commercialization of photosensitive drugs that are activated by light and related medical devices (Photodynamic Therapy).
- Current strategic alliances with American Cyanamid Company and Baxter Healthcare Corporation.
- Common shares publicly traded in Canada and United States.
- Total equity capital raised to date – $60 million (Cdn.).

Major products and markets

Therapeutic drugs for oncology, sexually transmitted diseases, viral inactivation in blood and cardiovascular disease.Diagnostic drugs for fluorescence detection and radiopharmaceuticals.Medical devices for therapeutic and diagnostic applications.Major markets: United States, Japan, Europe.

Technology of the company

Photodynamic Technology can be used to diagnose and treat a variety of disease conditions because its key ingredients, light-activated compounds called photosensitizers, have a unique property of accumulating in abnormal tissue. The photosensitizer when activated by light delivered through a fibre optic probe produces a highly toxic agent that destroys the abnormal cells without damaging the surrounding healthy tissue.

Products in development

Photofrin	• advanced clinical trials in North America, Japan and Europe • filed for approval in Canada, Sweden, Norway, Finland, Iceland
BPD	• preclinical studies
Devices	• diode lasers • alternate light sources • fiber optics • power meters

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Quadra Logic Technologies Inc.

(continued)

Desired alliance with other biotechnology firms

- distribution partners for drugs and devices
- contract manufacturers for drugs and devices
- co-development of future products
- equity partners
- applications: Photodynamic imaging and cardiovascular disease
- acquisition of small biotechnology companies

Other comments

QLT also has a 50% interest in a bulk pharmaceutical manufacturing facility located in Vancouver, B.C.

Canada

Strategic partnerships

Richelieu Biotechnologies Inc.

5726, Laurier Blvd.
St-Hyacinthe, Quebec
J2S 3V8

Richard Parsons, President

Telephone: (514) 774-3505
Fax: (514) 773-7433

Company history

Richelieu began operations in 1986 as part of an outgrowth of research being conducted by the INRS Santé group in Pointe Claire, Quebec. The focus of its activities is in commercial production of peptides and reagents for peptide synthesis.

- Annual Sales: nearing $1 million dollars in 1990

Major products and markets

Richelieu manufactures and distributes peptides in milligram to kilogram quantities and reagents for peptide synthesis. Richelieu has now become the most important world producer of B.O.P. reagent, a leading coupling reagent used for peptide synthesis.

Richelieu has enjoyed early commercial success because of its combination of high quality and low priced products.

Richelieu is currently selling its products both directly and through distributors, in Canada, United States, Europe, United Kingdom, Japan and Australia. Richelieu would prefer selling exclusively through distributors in order to expand its market share and therefore allow more time to develop new products and processes in-house.

The market for these products are pharmaceutical firms, private and public research laboratories. The peptides have both human and veterinary applications.

Technology of the company

Richelieu's biologically active peptides are prepared based on team technology developed from years of peptide involvement.

Richelieu's biologically active peptides are prepared using its own amino acid derivatives and coupling reagents in its own laboratories handling more than 20 peptides at a time; the accepted degree of product purity is no less than 98%.

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Richelieu Biotechnologies Inc.

(continued)

Products in development

New products commercialized are novel coupling reagents: HBTU and TBTU. The markets for these products are the same as Richelieu's existing products.

Desired alliance with other biotechnology firms

Richelieu would like to negotiate marketing and distribution agreements with firms currently serving pharmaceutical and research industries in the following countries:

USA: East Coast, West Coast
EUROPE: France, Germany
Eastern bloc
Australia
Japan

- Either equipment suppliers or marketing and sales divisions of manufacturers (specialized in peptides & reagents & other fine chemicals) whose clients are basically those of RBI would be prime targets to negotiate distribution outlets with.

Also, RBI would like to have access to the license issued by the SALK INSTITUTE in reference to the "GRF" peptide. This could be accomplished through a joint-venture or some other method.

Canada

Strategic partnerships

St. Joseph's Health Centre Molecular Microbiology Laboratory

268 Grosvenor Street
London, Ontario
N6A 4V2

Hanna Bialkowska-Hobrrzanska, Ph.D.
Ole Hammerberg, M.Sc., M.D., FRCP(C)

Telephone: (519) 439-3271
Fox: (519) 439-1325

Company history

Established in 1987 as a research laboratory at the St. Joseph's Health Centre. The laboratory is involved in development of new technologies for diagnosis and epidemiology of infectious diseases.

Major products and markets

1. Sandwich nucleic acid hybridization assay for detection of haemorrhagic colitis
   Reference: (1) Bialkowska-Hobrzanska et al (1990) ASM Abstracts; G220; p 380.
2. Molecular typing technology for epidemiologic examination of broad spectrum of nosocomial infections.
   Reference: (1) Bialkowska-Hobrzanska, H., Harry, V., Jaskot, D., Hammerberg, O., (1990) Eur. J. Clin. Microbiol. Inf. Dis. 9:588-5994. (2) Bialkowska-Hobrzanska, H., Jaskot, D. Hammerberg, O.(1990) J. Microbiol. Methods, 12:41-49.

Technology of the company

Sandwich nucleic acid hybridization using probes and enzyme-based chemiluminescent system.

Products in development

The major development concerns automation of the production of reagents for sandwich hybridization.

Desired alliance with other biotechnology firms

We are looking for collaboration with a commercial partner in medical diagnostics interested in developing diagnostic assays of infectious diseases.

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Canada

Strategic partnerships

Serdary Research Laboratories Inc.

2643 Kathryn Drive
London, Ontario
N6G 2R7

Dr. B. Serdarevich, President

Telephone: (519) 434-4419
Fax: (519) 673-3754

Company history

Serdary Research Labs. Inc. was initiated in 1969 at the University of Western Ontario, Department of Biochemistry, London, Ontario, Canada. After a few years of R&D, we moved from the university to our present location and established laboratory scale production of Lipid products. We now have over 400 products with distributors in USA, Europe and Japan. From our current production 15% is sold in Canada and 85% exported.

- Annual Sales: $150,000
- R&D Expenditures: $25,000
- Number of Employees: R&D and Production 3, with a 4th occasional Person.

Major products and markets

We specialize in the manufacturing of Fine Biochemicals in the Lipid field. Our products are Glycerides, Fatty acids, Phospholipids, Sphingolipids, Enzymes, TLC and GLC Standards, Labelled lipids etc. They are suitable for medical, pharmaceutical, diagnostic and food research. These materials could also be used as raw materials for pharmaceuticals and diagnostics. Our products are sold worldwide to universities, hospitals, pharmaceutical companies and other research institutions.

Technology of the company

Our products are either synthesized from chemicals or isolated from natural sources such as pork liver and brain, beef liver, brain and heart, eggs, yeast, soybeans, cabbage etc. To meet rigorous requirements, they have to be subjected to different chromatographic technique to obtain approximately 99% purity.

Products in development

Steady development of new biochemicals to meet up-to-date market requirements.

Desired alliance with other biotechnology firms

We have market and technology, however, we need financing for expansion. Therefore, we seek strategic alliance or similar arrangement with some pharmaceutical, cosmetic or diagnostic company.

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Canada

Strategic partnerships

Synthetic Peptides Inc.

355 Medical Sciences Building
University of Alberta
Edmonton, Alberta
T6G 2H7

Stewart MacAllister, Vice President

Telephone: (403) 492-3155
Fax: (403) 492-7168

Nature of research

- Development of peptide pharmaceuticals, peptide diagnostics and synthetic vaccines.
- Innovation in methodology for separation and purification of protein and peptide fragments using HPLC (High Performance Liquid Chromatography).

Major achievements

- Development of synthetic vaccine against pseudomonas aerugionsa for which patents have been applied for in Canada, U.S.A. and Europe.
- Development of novel methodology for separation of peptides including new HPLC column for which patent has been applied for in U.S.A.
- Development of a series of software programs for simulation of HPLC runs and for teaching students and technicians to use HPLC apparatus.
- Development of set of reference standards for monitoring HPLC column performance.

Description of research

- Synthetic Vaccine Development – using rational drug design techniques, S.P.I. is engaged in engineering a series of synthetic peptide vaccines which are effective against pseudomonas and related bacteria.
- Anti Bleeding Compound – S.P.I. has synthesized several analog of compound which will reduce blood loss during surgery.

Current industrial involvement

- Applied Biosystems Inc., Foster City, CA – joint project to develop and market new column for HPLC.
- Canadian Bacterial Diseases Network – collaboration on development of synthetic vaccine.
- Polymer Laboratories Ltd. – U.K. proposed joint development and marketing of new HPLC reference standards.

Industrial involvement sought

- Major participant (strategic partner) for synthetic vaccine development.
- Investor/partner for GMP peptide manufacturing facility (FDA approved) to be built in Edmonton, Alberta.

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Synthetic Peptides Inc.

(continued)

Research group profile

1) Principal Researchers are: Dr. Robert Hodges, Professor of Biochemistry, University of Alberta, Member Medical Res. Council of Canada Group in Protein Structure and Function.
2) University/Institutes Involvement: – University of Alberta,
   – Protein Engineering Network Centres of Excellence,
   – Canadian Bacterial Diseases Network.

Canada

Strategic partnerships

University of Toronto Centre for Bioethics

Tanz Neuroscience Building
6 Queen's Park Crescent West
Toronto, Ontario
M5S 1A8

Dr. Frederick H. Lowy, Director

Telephone: (416) 978-2709
Fax: (416) 978-1911

Nature of research

The Centre conducts both theoretical and empirical research into pressing bioethical issues. Our research team approaches from an interdisciplinary perspective. The various disciplinary perspectives include legal scholarship, philosophical analyst, and health sciences research.

Major achievements

Although opened only recently (October 1989), the Centre for Bioethics shows great promise. The Centre competed successfully for a $2 Million Health Systems-Linked Research Unit grant from the Ontario Ministry of Health. The Centre's principal researchers have published articles on specific bioethical issues in major medical journals including *Science,* the *New England Journal of Medicine,* the *Journal of the American Medical Association,* and the *Canadian Medical Association Journal.* The Centre's principal researchers have also received numerous awards including the 1988 Nellie Westerman Prize for Research in Ethics from the American Federation for Clinical Research.

Description of research

The Centre's research efforts are currently focused in three major areas:

1. Ethical issues in the Canadian health care system.
2. Elective use of life-sustaining treatments and advance directives.
3. Ethics of organ transplantation.

Current industrial involvement

None

Industrial involvement sought

The Centre's researchers have broad experience in clinical and research ethics. We are interested in analyzing ethical issues in biotechnology including the ethics of genetic diagnosis and therapy. We seek sponsorship from private industry to support our current research, as described above, or future research in gene ethics. We would also consider conducting under contract ethical analyses of specific issues of particular concern to the sponsor.

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University of Toronto Centre for Bioethics

(continued)

Research group profile

Principal Researchers are:

1. Dr. Frederick H. Lowy (Psychiatrist, former Dean of Medicine)
2. Dr. Peter A. Singer (General Internal Medicine, Clinical Epidemiology)
3. Professor Bernard Dickens (Legal scholar)
4. Professor Eric Meslin (Philosopher)
5. Professor Wayne Sumner (Chair of Philosophy)

Universities/Institutes Involvement:

Professor James Till (Biophysics, clinical decision making, former Gairdner Award recipient)

Other comments

The Centre for Bioethics aims to promote research and scholarship in bioethics in Canada.

Canada

Strategic partnerships

University of Toronto Centre for Biomaterials

170 College Street, Room 319
University of Toronto
Toronto, Ontario
M5S 1A1

Dr. D.C. Smith, Director

Telephone: (416) 978-1463/978-4470
Fax: (416) 978-1462

Nature of research

- Surgical implant design/characteristics
- Biocompatibility assessment – cell (tissue)/implant interfacial studies
- Orthopaedic and dental implants
- Cardiovascular implants and blood compatibility
- Tissue mechanics and modified natural tissue implants
- Biosensors and active devices
- Cell culture and tissue culture studies
- Surface science analysis of synthetic implants and modified tissue implants – protein interactions

Major achievements

Multidisciplinary programme within Ontario Centre for Materials Research – a Centre of Excellence. One of the largest groups in biomaterials research; world-wide network with six universities in Ontario and others outside. Major previous inventions in biomedical implants.

Description of research

A wide range of laboratory and clinical studies related to the areas cited above.

Current industrial development

Extensive with 12 companies within Ontario Centre for Materials Research.

Industrial involvement sought

Collaboration with any company in Research and Development related to biomaterials.

Research group profile

Principal Researchers are: Dr. D.C. Smith, Dr. R.M. Pilliar, Dr. J.E. Davies, Dr. J.M. Lee, Dr. M.V. Sefton, Dr., P. Lee

Universities/Institutes Involvement: University of Toronto, McMaster University, Queen's University, University of Western Ontario, Guelph University

Other comments

Brochure available on request Tel: (416) 978-1461; Fax: (416) 978-1462

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Canada

Strategic partnerships

University of Toronto The Centre for Cardiovascular Research

Office of the Director
Eaton North 13 – 208
Toronto General Hospital
200 Elizabeth Street
Toronto, Ontario
M5G 2C4

Dr. Michael J. Sole, Director

Telephone: (416) 340-3471
Fax: (416) 340-5985

Nature of research

Basic and Clinical research in cardiovascular diseases with a particular focus on atherosclerotic cardiovascular disease, heart failure and sudden death. Studies range from Molecular Biology to Clinical Trials and Health Services Research.

Major achievements

World renowned institution for cardiovascular care and research. Development and the first use of blood thinner, heparin, concept of lowering body temperature (hypothermia) for cardiac surgery, first use of cardiac pacemaker, establishment of first coronary care unit, development of flexible "U" arm system for cardiac catheterization (with Siemans), development of modern lung and heart-lung transplantation, first to sequence human cardiac myosin heavy chain genes, development and first clinical use of a universal enteroviral probe for PCR, first clinical application of PCR gene amplification for heart disease, development and first use of balloon electric shock ablation of cardiac arrhythmias.

Description of research

Atherosclerosis: lipid biochemistry, endothelial injury and repair, molecular and immunological studies of platelet – arterial endothelial interactions, vascular smooth muscle, several clinical trials including BARI (NIH), atherosclerosis regression (Merck), etc.

Heart Failure: molecular biology of cardiac collagen and myosin heavy chains, growth factors and protooncogenes in myocardial growth and development, pathogenesis, diagnosis and treatment of myocarditis, genetic detection of familial hypertrophic cardiomyopathy, neurochemistry of heart failure, sympathetic nerve traffic recording and neuroreflexes, several clinical trials including NIH Myocarditis Treatment Trial, SAVE Trial (Squibb) etc.

Sudden Death: antiarrhythmic drugs and cardiac membrane lipid metabolism, reflex regulation of arrhythmias, electrophysiology studies, amiodarone trial, pacemaker trials, balloon electric shock ablation of arrhythmias.

Cardiovascular Innovations: surgical solutions for myocardial preservation, free radicals and cardiac damage during surgery, biomaterials development for pacemaker leads and prosthetic valves, improved ventricular assist devices, development of coronary artery stents.

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University of Toronto The Centre for Cardiovascular Research

(continued)

Major Technologies Available: GC Mass spectrometer, Pharmacia Gene Sequencer and Gene Assembler, 2 human physiology laboratories with hydrostatic tank and lower body negative pressure apparatus, human autonomic nerve traffic recording, confocal microscopy, all electron & scanning microscopy modalities, NMR, nuclear cardiology including SPECT etc, all cardiovascular ultrasound including colour echodoppler, TEE, intravascular ultrasound, quantitative angiography, 6 animal operating theatres, full human electrophysiology laboratory, animal models, myacyte culture, all recombinant DNA technologies. Full Clinical Trials Unit with Epidemiologists, Statisticians, Data Analysts, Research Nurses, Unit Manager and Director. 6 cardiac catheterization laboratories including one human research catheterization laboratory.

Current industrial involvement

Hewlett-Packard	– Cardiac Echo-doppler development
Clinical Trials	– Multiple companies; largest current industrial trials sponsored by Merck Frosst, Squibb
Biomaterials Research	– Medtronics, Symbion, Abiomend, Novacor, Thermedics
Continuing Medical Education at the Centre	– Merck Frosst, ICI Pharma, Canadian Cardiovascular Products
BioChemical Innovation	– Eastman Kodak, Roche-Cetus
Health Methods and Services Delivery	– Government of Ontario

Industrial involvement sought

- collaborations sought for basic science and clinical programs relevant to the Centre's areas of interest
- clinical trials
- support for trainees and visiting scientists.

Research group profile

Investigators: 46 senior principal investigators all with professional appointments to the University of Toronto.

Discipline represented: Cardiology, Cardiovascular Surgery, Clinical Biochemistry, Endocrinology, Epidemiology, Haematology, Internal Medicine, Nephrology, Respirology, Thoracic Surgery, Vascular Surgery.

Investigators receive approximately $4 million annually from peer-review research agencies.

University Involvement: Strong linkages to Basic Science Departments and other centres (e.g. Diabetes Centre, Laser Centre, Drug Toxicity Centre, Playfair Neurological Institute, Hospital for Sick Children Cardiovascular Research Unit) at the University of Toronto. Clinical Trials Network of all Toronto teaching hospitals and some major peripheral hospitals.

Other comments

Established March 1989.

Canada

Strategic partnerships

University of Toronto Clarke Institute of Psychiatry

250 College Street
Toronto, Ontario
M5T 1R8

Dr. Gregory M. Brown, Director of Research

Telephone: (416) 979-6940
Fax: (416) 979-2243

Nature of research

The Clarke Institute of Psychiatry has a primary mandate to conduct research in psychiatry. Research activities occur across both clinical and basic science units. The research programs include: Behavioural Sexology, Biochemical Psychiatry, Biopsychology, Clinical Neurophysiology, Human Brain Laboratory, Molecular Psychobiology, Neuroendocrinology, Neuroepidemiology, Positron Emission Tomography, Psychiatric Neurogenetics, and Research Psychology.

Major achievements

Research projects have major sponsorship from the Medical Research Council of Canada, National Institutes of Health, Natural Sciences and Engineering Research Council, and Ontario Mental Health Foundation.

We were the first to demonstrate a reduced inositol triphosphate binding in Alzheimer's brains.

Clarification of the actual role of brain catecholamine systems in human cognition and in dementia of the Alzheimer's type.

Description of the regional distribution of dopamine loss in the striatum of Parkinson's Disease, which has significant clinical and therapeutic implications.

Developed a raioimmunoassay for melatonin which has been licensed and is widely used.

Descriptions of research

Biochemical Psychiatry Group investigates the biochemistry of neurotransmitter function in relation to affective disorder, with a focus on lymphocyte adrenoceptor changes and the regulation of brain signal transfer processes.

The Biopsychology group examines the biologic basis of eating disorders and body weight regulation in animal models with an emphasis on brain serotonin and interactions with other neurotransmitters.

The Clinical Neurophysiology group uses retrograde computer averaging and grey source analysis techniques to localize and determine activity profiles of infratemporal cortex in nerve cells in schizophrenics prior to and during neuroleptic therapy.

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University of Toronto Clarke Institute of Psychiatry

(continued)

The Human Brain Laboratory studies the relationship between neurotransmitter abnormalities in human autopsy brain and neuropsychiatric disorder.

The Molecular Psychobiology Section studies molecular mechanisms and the etiology and maintenance of schizophrenia.

The Neuroendocrinology Section studies chronobiology, circadian rhythm regulation, and pineal function in affective disorder and other psychiatric illness.

The Position Emission Tomography studies psychiatric illness including schizophrenia, manic depression, Alzheimer's Disease, and attention deficit disorder.

The Psychiatric Neurogenetic Section studies the molecular genetics of schizophrenia.

Current industrial involvement

Currently work is underway in collaboration with Cidtech Research Inc. developing immunoassays for clinically significant biological amines and precursors for positron emission tomography.

Industrial involvement sought

Collaborators with the desire to examine therapeutically important compounds in psychiatric patients or the need to examine actions of compounds in animal models using a variety of molecular techniques or in human subjects using positron emission tomography.

Research group profile

Principal Researchers are:	Referred Publications
Dr. K.K. Freund, Head of Behavioural Sexology	95
Dr. J.J. Warsh, Head of Biochemical Psychiatry	54
Dr. D. Coscina, Head of Biopsychology	54
Dr. W.G. Tatton, Head of Clinical Neurophysiology	48
Dr. O. Hornkiewicz, Head of the Human Brain Laboratory	174
Dr. H.B. Niznik, Head of Molecular Psychobiology	75
Dr. G.M. Brown, Head of Neuroendocrinology	178
Dr. R. Eastwood, Head of Epidemiology	75
Dr. J. Kennedy, Head of Psychiatric Neurogenetics	10
Dr. R. Langevin, Head of Research Psychology	61

Universities/Institutes Involvement:
The University of Toronto Department of Psychiatry, Department of Physiology, Department of Pharmacology, Department of Psychology, and Institute of Medical Sciences.

Other comments

The Clarke Institute is unique, as the entire facility is focused on psychiatric research. It seeks to increase the effectiveness and impact of its research activities and to train investigators within the broad area of psychiatric research.

Canada

Strategic partnerships

University of Toronto Connective Tissue Research Group (CTRG)

Department of Pathology
Mount Sinai Hospital
600 University Avenue
Toronto, Ontario
M5G 1X5

Dr. Kenneth Pritzker

Telephone: (416) 586-4453
Fax: (416) 586-8589

Nature of research

The Connective Tissue Research Group conducts research in collaboration with Canadian Industry, the Biomaterials Programme of the Ontario Centre for Materials Research and the Caribbean Primate Research Centre, Sabana Seca, Puerto Rico. The research programme focuses on mechanisms of pathogenesis and potential therapeutic strategies for degenerative joint and bone diseases, principally osteoarthritis and osteoporosis. As well, research is being conducted on cartilage and bone as a material, and materials which can be substituted for cartilage and bone.

Major achievements

- Leading Canadian group in biomineralization studies;
- Major industrial interactions established;
- Peer review grants and contract programme currently >$800,000 Canadian annually.

Description of research

- CPPD crystal formation and dissolution in cartilage;
- Mechanisms of osteoarthritis using spontaneous primate model;
- Effects of drugs and other agents on cartilage cells signal transduction;
- Effects of drugs and other agents that induce modification of extracellular matrix by cartilage cells;
- Mechanisms affecting bone mineral quality and tissue mechanics in health and disease;
- Effects of drugs and agents on bone quality and quantity throughout the bone remodelling cycle;
- Studies of substitute materials for cartilage and bone.

Special techniques used

- Extensive particle size analysis capabilities;
- Crystallographic and spectroscopic techniques;
- High voltage analytic electron microscopy;
- Hard tissue histology;
- Histomorphometry;
- Cell and molecular biology of cartilage and bone cells.

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University of Toronto Connective Tissue Research Group (CTRG)

(continued)

Current industrial involvement

- Major contract for osteoporosis research with a multi-national pharmaceutical corporation;
- Active consultation, exchange of materials and exchange of expertise involvement with pharmaceutical and biotechnology companies.

Industrial involvement sought

Collaboration directed towards developing diagnostic or therapeutic strategies for:

- Osteoarthritis
- Osteoporosis

Collaborations directed towards developing new biomaterials related to cartilage and bone.

Research Group Profile:

Principal investigators: 6
Research associates: 8 graduate students
Scientific support staff: 15 technicians

Principal Investigators:

Dr. Kenneth Pritzker, Head	– (Publications 140)
Dr. Pei-Tak Cheng	– (Publications 71)
Dr. Tony Cruz	– (Publications 20)
Dr. Mark Grynpas	– (Publications 71)
Dr. Rita Kandel	– (Publications 17)
Dr. Howard Tenenbaum	– (Publications 18)

Universities/institutions involvement:

- Samuel Lunenfeld Research Institute, Mount Sinai Hospital
- Departments of Pathology, Clinical Biochemistry, Medicine, Surgery, Dentistry, University of Toronto
- School of Graduate Studies, University of Toronto
- Centre for Biomaterials, University of Toronto and Biomaterials Programme, Ontario Centre for Materials Research
- Bone and Mineral Group, University of Toronto
- Caribbean Primate Research Centre, Sabana Seca, Puerto Rico

Canada

Strategic partnerships

University of Toronto Department of Nutritional Sciences Faculty of Medicine

FitzGerald Building
University of Toronto
150 College Street
Toronto, Ontario
M5S 1A8

Dr. G.H. Anderson, Chair

Telephone: (416) 978-2747
Fax: (416) 978-5882

Nature of research

Research programs are in basic, clinical and community nutrition, and are directed in general to a study of the impact of nutrition and foods or food components on health and development or prevention of disease. There is extensive collaboration with other university departments, clinical departments and hospitals, research institutes, and industry, (particularly the food and pharmaceutical industries).

Major achievements

- Discovery of a highly predictive test for coronary artery disease in the mouse, and identification of 2 genes that control induced post prandial hypercholesterolemia.
- Identification of a control mechanism for food intake regulation
- Development of Glycemic Index or a measure of response to dietary carbohydrates.

Description of research

Current projects include behavioural studies (dietary control of brain neurotransmitt mediated effects; psychosocial effects); disease related studies (cancer, cardiovascular disease, lipid disorders, diabetes, eating disorders); nutritional assessment, adverse food reactions; normal metabolism (lipid and protein metabolism); dietary fibre; bioavailability and anti-nutrient effects; analytic methodology (of food and food components); population analysis in interpretation of intakes and requirements; methodologies in nutrition educations, community surveys and program assessment.

Current industrial involvement

Collaborative projects with and/or funding from industry include:

- Bristol-Myers Co/Mead Johnson – to stimulate research linking clinical and basic scientists.
- Kelogg's (Canada) – development of fibre-rich products with potential health benefits.
- H.J. Heinz Co. of Canada Ltd. – nutrition of the premature and developing infant.
- Baxter Healthcare Corp. – effect of peritoneal amino acid dialysate on appetite. Imperial Flavours-study of plant enzymes.
- Gelda Scientific and Industrial Development Inc. – Bifidobacteria and micro-encapsulation
- Nutra Sweet/Monsanto – Bifidobacteria technology

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University of Toronto Department of Nutritional Sciences Faculty of Medicine

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- EX Packers-medical applications of avidin
- Nutricia – clinical trials on linseed oil effects in diabetes and hyperlipidemia
- Flax Council of Canada – effect of flax seed on breast cancer-health benefits of flax in diabetes and hyperlipidemia
- Thomas J. Lipton Inc. – NMR analysis in lipid metabolism
- Ginseng Growers Assoc.of Canada – analysis of Canadian ginseng
- Dicofarm – dietary fibre research
- Nestec Ltd. – slow-release starch foods in management of hyperlipidemia
- Sandoz – medication use and dietary patterns in the elderly
- Servier Canada Inc. – dexenfluramine and appetite control
- Proctor and Gamble – fermentation of fibre
- Miles Canada, Inc. – acarbose in treatment of diabetes
- Unilever Canada Ltd. – NMR analysis in lipid metabolism
- Wyeth Ltd. – hypercholesterolemia in mice.

Industrial involvement sought

- Industrial partner sought to develop and market predictability test for coronary artery disease.
- Continuing collaboration with industry.

Research group profile

Department
Faculty members: 14 Ph.D's, 1 MSc.
Postdoctoral Fellows: 4 Ph.D's
Visiting Professors: 2
Cross Appointed Faculty: 12
*Scientific Support Staff: 13 support staff
Graduate Students: MSc/ PhD/

* of current industry-related projects

Principal Researchers are:
Dr. G.H. Anderson, Chairman
Dr. S.C. Cunnane
Dr. E.T.S. Li
Dr. T. Francis
Dr. A.V. Rao
Dr. D.J.A. Jenkins
Dr. L. Thompson
Dr. T. Wolever
Dr. G. Kakis
Dr. V. Vuksan
Dr. H. Maclean
Dr. G.H. Beaton

Universities/Institutes Involvement:
University of Alberta
University of British Columbia
University of Calgary
Dalhousie University
University of Western Ontario
Clinical Research Institute (Montreal)
St. Michael's Hospital (Toronto)
Toronto Hospital (Toronto)

Canada

Strategic partnerships

University of Toronto Faculty of Dentistry

124 Edward Street
Toronto, Ontario
M5G 1G6

Dr. Robert M. Pilliar, Associate Dean (Research)

Telephone: (416) 979-4336
Fax: (416) 979-4566

Nature of research

- Basic and clinical research on dental caries and periodontal disease
- Biomaterials research
- Dental implants – basic and clinical research
- Basic and clinical studies of pain control
- Cellular and molecular biology of bone, connective tissue, cancer etc.
- Health care services research
- Growth and development and aging

Major achievements

- The only MRC Group in Dentistry – Periodontal Physiology
- Leading studies on mineralization of tissues, regulation of bone and soft connective tissue remodelling, osteoblast lineage and differentiation
- Development of new methods for preventing dental caries
- Development of novel dental implant system
- Pathological studies of human disease, oncogenesis studies
- New methods of orthodontic treatment
- Basic studies of periodontal disease; treatment methods
- Clinical assessment of dental implants
- Major developments in dental restorative materials and methods of use

Description of research

- basic
- experimental
- interdisciplinary

Current industrial involvement

- Innova Corp. – dental implants
- Biotes – dental implants
- Q-Life – biomaterials
- 3-M – dental materials

Industrial involvement sought

- Collaborative research in the areas outlined below
- Licensing of patented technologies

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University of Toronto Faculty of Dentistry

(continued)

Research group profile

Principal Researchers are:

- Periodontal physiology – J. Sodek, J. Aubin, R. Ellen
- Dental implants – R. Pilliar, D.A. Deporter, J. Symington
- Biomaterials – D.C. Smith, J.E. Davies
- Neural mechanisms and pain – B.J. Sessle
- Dental caries prevention – H.J. Sandham, R.C. Burgess
- Dental health delivery – J.L. Leake
- Prosthodontics G.A. Zarb

Universities/Institutes Involvement:

- Dentistry

Other comments

Many interfaculty and interdisciplinary studies are ongoing.

Canada

Strategic partnerships

University of Toronto Faculty of Medicine

Room 113, 150 College Street
University of Toronto
Toronto, Ontario
M5S 1A8

Mrs. Eileen Deutsch, Co-ordinator, Research Development

Telephone: (416) 978-3669
Fax: (416) 978-5568

Nature of research

- Largest academic medical centre in North America. Established in 1887.
- 27 basic, clinical and community health departments.
- Ten fully affiliated teaching hospitals with 7,000 beds and research insititutes.
- Unique setting in North America for conducting clinical research (4 million population).
- 250,000 patients per year.
- Research is conducted in every discipline in the medical sciences and every disease and health problem.

Major achievements

1921	Banting, Best & Collip first to discover insulin. Nobel prize 1923
1930	Tisdall, Drake & Bron created pablum, first infant cereal.
1932	Burton, Dept. of Physics, builds first electron microscope.
1933	Heparin first used as an anti-coagulant
1945	Parker discovers a medium to grow cells which helps Salk develop polic vaccine.
1948	Bigelow first to use hypothermia to perform open-heart surgery. Designs first electrical cardiac pacemaker.
1957	Salter designs operation to correct congential hip dislocation.
1962	Johns develops cobalt therapy units revolutionizing radiation treatment of cancer.
1963	Mustard perfects method for correcting blue baby syndrome.
1974	Seeman discovers the dopamine receptor.
1984	Mak discovers the T cell receptor gene.
1988	Hudson & MacKinnon perform the world's first nerve transplant.
1988	Ling discovers the process which cancer cells use to resist drugs.
1989	Tsui & Riordan isolate the gene for cyctic fibrosis.

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University of Toronto Faculty of Medicine

(continued)

Description of research

Major areas of research/centres of excellence:
Genetics/gene regulation
Neuroscience/neurobiology
Cancer
Cardiovascular disease
Immunology/immunobiology/transplantation
Protein structure
Community health/epidemiology
Clinical trials
Geriatrics/gerontology
Developmental/fundamental biology
Membrane biology
Molecular and cell biology

Current industrial involvement

Research consulting agreements, collaborative R&D contracts and research grants with over 100 companies in the health care, food and industrial biotech fields. Value around $12 million in 1989-90 in clinical, basic and community health research: major collaborative agreements with Bristol-Myers Squibb, Ciba-Geigy, Sandoz, Allelix Biopharmaceuticals, Pasteur-Connaught-Merieux, Burroughs-Wellcome, Baxter, Hitachi.

Industrial involvement sought

Consulting, collaborative research at the basic and clinical levels, clinical trials in every medical discipline, technology available at many stages of development, partnerships both mini and mega, R&D contracts. Opportunities for pharmaceutical companies, biotechnology and medical device industry.

Research group profile

- Canada's largest scientific medical research community
- 850 scientists
- 900 graduate students
- 350 post doctoral fellows
- approximately 1,500 additional research technical personnel

Centres of Specialization:
Banting and Best Diabetes Centre
Centre for Cardiovascular Research
Playfair Neuroscience Unit
Centre for Research in Neurodegenerative Disease
Institute for Biomedical Engineering
Centre for Studies in Aging
Protein Structure Research Centre
Physician Behaviour Research Centre
Centre for Health Promotian
Membrane Biology Unit
Centre for Health Services Effectiveness
Centre for Bioethics
Primary Care Research Unit
Position Emission Tomography Facility

Research Infrastructure:
- 350,000 net square feet research space on the University campus
- 500,000 net square feet research space in the fully affiliated teaching hospitals.

Research Budget:
- $104 million 1989-90 indirect costs (grants and contracts)
- $80 milion 1989-90 direct costs (University budget)
- Largest research funding among Canadian medical schools and more than half of entire University of Toronto research budget.

Canada

Strategic partnerships

The University of Toronto Hospitals Cancer Cytogenetics Program

University of Toronto
Banting Institute
100 College St., Room B77
M5G 1L5

Dr. Ian D. Dubé, Program Director

Telephone: (416) 978-2628
Fax: (416) 340-3596

Nature of research

Currently, we are partially supported by the MRC-Canada and the Hospital for Sick Children Foundation to investigate:

1) The chromosomal (genetic) basis of human cancer.
2) Animal models for bone marrow transplantation in the therapy of human cancer and in applications for gene therapy.

Major achievements

1) Identification, cloning, and characterizations of the TCL3 oncogene involved in human T-cell leukaemia.
{Genes Chromosomes and Cancer 2:217-222(1990).}
2) Development of a method for transferring genetic markers into bone marrow progenitors suitable for bone marrow transplantation and subsequent demonstration of marker retention in vivo after transplantation.
{Experimental Haematology 18:995-1001(1990).}

Description of research

Current Projects Include:

1) The genomic organization of the TCL3 oncogene.
2) The mechanism of primary chromosome translocation in human cancer.
3) The applications of a large animal model for gene therapy.
4) The development of large animal models for bone marrow transplantation.

Current industrial involvement

None.

Industrial involvement sought

1) Help in the clinical application of the TCL3 gene probes in genetic based diagnosis of cancer.
2) Help with the clinical application of other cancer-specific gene probes in molecular-based genetic cancer testing.
3) Help in the clinical application of large animal models for human gene therapy.
4) Help in the clinical application of large animal models for bone marrow transplantation as therapy for human cancer.

(continued)

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The University of Toronto Hospitals Cancer Cytogenetics Program

(continued)

Research group profile

Principal Researchers are:
Ion D. Dubé, Ph.D.
Suzonne Komel-Reid, Ph.D.
Ronald F. Carter, DVM, Ph.D.
Ming Lu, Ph.D.
Universities/Institutes Involvement:
University of Toronto

Other comments

We hove the potentiol to develop genetic probes for concer testing ond would like assistance with funding, patenting, licensing etc.

Canada

Strategic partnerships

University of Toronto, Hospital Management Research Unit, Department of Health Administration

12 Queen's Park Crescent West
2nd Floor, McMurrich Building
Toronto, Ontario
M5S 1A8

Dr. Louise Lemieux-Charles
HMRU Program Director and Assistant Professor

Telephone: (416) 978-6963
Fax: (416) 978-7350

Nature of research

The Hospital Management Research Unit (HMRU) conducts research on the development, use and evaluation of organization and management practices employed by managers in Ontario's hospitals. The sponsor, i.e., the Department of Health Administration, University of Toronto, and the partner, i.e. Sunnybrook Health Science Centre, will conduct research which will lead to innovations in hospital management and organizational effectiveness.

Major achievements

The HMRU was established in the fall on 1989. In its first year of operation, the HMRU has developed a number of research proposals, eight of which have been funded to date. A large number of research proposals have health industry sponsors.

Description of research

The HMRU's research program focuses on five major themes:

- Delegation, Monitoring and Ethics
- Information Management and Systems
- Workload Measurement Systems
- Human Resources Management
- Quality of Care and Patient Outcomes

Five sub-groups have been formed and meet regularly in order to develop the five components of the research program.

Current industrial development

HMRU has a partner in research, Sunnybrook Health Science Centre, representatives of which assist in setting the Unit's research agenda.

Other hospitals in the province of Ontario will participate in and benefit from the Unit's research activities.

Industrial involvement sought

Collaborators with a need to improve hospital organization and management practices with the ultimate aim of innovation in hospital management and organizational effectiveness.

(continued)

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University of Toronto, Hospital Management Research Unit, Department of Health Administration

(continued)

Research group profile

Principal Researchers are:
Dr. Peggy Leatt, Department Chair; Dr. G. Ross Baker; Hildo Bolley, M.Sc.; Jan Barnsley, MES; Dr. Rhonda Cockerill; Marsha Cohen, M.D.; Dr. Louise Lemieux-Charles, HMRU Program Director; Dr. Michael Murray; Dr. Linda O'Brien-Pallas; Dr. George Pink; Dr. Toshiro Takahashi (Visiting Scholar); Dr. J.I. Williams, Deputy Director, Clinical Epidemiology Unit at Sunnybrook Health Science Centre.

Universities/Institutes Involvement:
Department of Health Administration, University of Toronto
Division of Clinical Epidemiology, Sunnybrook Health Science Centre
Clinical Ethics Centre, Sunnybrook Health Science Centre
Faculty of Nursing, University of Toronto (Dr. Linda O'Brien-Pallas)

Other comments

The HMRU seeks, through its research efforts, to increase and promote research into methods of hospital management and management practices in hospitals.

Canada

Strategic partnerships

University of Toronto The Hugh MacMillan Rehabilitation Centre – Research Department

350 Rumsey Road
Toronto, Ontario
M4G 1R8

Dr. Morris Milner
Telephone: (416) 425-6566
Fax: (416) 425-1634

Nature of research

The HMRC Research Department conducts research in collaboration with Canadian industry and international academic institutes. Research programs focus on development of new assistive device technologies paediatric physical and cognitive rehabilitation, augmentative communication, and psychosocial factors in physical disability.

Major achievements

- Preparation of a proposal submitted to the Ontario Ministry of Health to act as sponsor institution for a province-wide Rehabilitation Technology Research and Development Consortium, composed of leading researchers, clinicians and representatives from industry, service and consumer agencies.
- All major research projects are externally funded and/or have industrial sponsors.

Description of research

Rehabilitation technology including powered electric hands and elbows for children ages 15 months upward; specialized postural support and seating systems; specialized controls for wheelchair and access to computers; human movement analysis including gait and upper extremity movements; protective headwear; recreational devices: functional electrical stimulation, rehabilitation robotics. Augmentative communications systems and understanding interactions between communicators and listeners; computers in speech pathology; independent living issues; educational and cognitive research; motor functions research; electronic music and the disabled.

Current industrial development

- Responsibility for Variety Ability Systems Inc. which is our manufacturing and marketing arm.
- Industrial sponsorships and collaborative research ventures with IBM Canada and Apple Canada in the area of microcomputer applications.

Industrial involvement sought

Collaboration with wheelchair manufacturers; invite other small manufacturers to become involved.

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University of Toronto The Hugh MacMillan Rehabilitation Centre – Research Department

(continued)

Research group profile

Principal Researchers:12 (7 Ph.D's)
Research Associates: 4 Research Fellows
Post Graduate Students:10 Master's/Ph.D.

Principal Researchers:
Dr. Morris Milner, Department Director
Dr. Stephen Naumann, Associate Director of Rehabilitation Engineering
Ms. Penny Parnes, Director of Augmentative Communication Services
Dr. Patricia Johnson, Educational Research Specialist
Dr. Fraser Shein, Microcomputer Applications
Dr. Kathryn Boschen, Rehabilitation Psychology
Dr. Denise Reid, Paediatric Rehabilitation
Dr. Jeffrey Jutai, Psychopathology and Psychophysiology.

Universities/Institutes Involvement:
- Linked to the Institute of Biomedical Engineering, Institute of Medical Sciences, Mechanical Engineering Department and Department of Rehabilitation Medicine, University of Toronto.

Other comments

- Clinical service program involvement in R&D programmes.

Canada

Strategic partnerships

University of Toronto Laboratory of Bone and Joint Pathology

500 Sherbourne Street
Toronto, Ontario
M4X 1K9

V.L. Fornasier, M.D., F.R.C.P. (C)

Telephone: (416) 924-0671 ext. 5017 (office)
(416) 926-4849 (laboratory)
Fax: (416) 926-6579

Nature of research

The Laboratory conducts research and provides technical back-up for researchers both in Canada and in the United States for the examination of the biological response to implanted biomaterials. This includes orthopaedic, cardiovascular and cardiac implants both in the human and in the experimental animal.

Major achievements

- All projects are individually supported.
- The facility is based on the hospital research programmes.
- It is the first in Canada to provide full cross sections of implanted biomaterials both metal and polymeric.
- It has been recognized by industry for the assessment of biocompatibility and tissue response assessment.

Description of research

Research has been ongoing for twenty years.

Conjoint projects with other researchers at the University of Toronto, University of Guelph, Stanford University in California and Laval University in Quebec have been completed. All of these involve the assessment of cellular morphology and morphometry in the assessment of bulk and particulate biomaterials. This has included currently used materials such as titanium and new experimental materials such as poly acetyl, carbon triazine, hydroxyapatite coating and a variety of composites.

Current industrial involvement

The Laboratory has collaborated with research activities that have involved companies such as DePuy Orthopaedics, DuPont Chemicals, Bosch Chemicals of Germany, How Medica, Richards.

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University of Toronto Laboratory of Bone and Joint Pathology

(continued)

Research group profile

Principal Researchers are:
V.L. Fornasier, M.D., F.R.C.P. (C), (100 publications in peer review journals, 100 oral presentations at Scientific meetings, 30 presentations by invitation at Universities in Canada, U.S.A., Italy, Taiwan, Japan and China).

Research has been conducted with surgeons, veterinarians, internists at University of Toronto, University of Guelph and Stanford University.

The Laboratory is part of the teaching environment of the Department of Surgery and of Pathology of the University of Toronto and has trained orthopaedic residents (29), pathology residents (80), in addition to research fellows assigned to specific programmes and projects. The primary researcher has supervised Masters and Ph.D. programmes at the University of Guelph and University of Toronto.

Universities/Institutes Involvement:
The principal researcher is an Associate Professor in the Departments of Pathology and of Surgery of the University of Toronto.

Other comments

The Laboratory of Bone and Joint Pathology through its facilities and activities is endeavouring to maintain and further develop R&D activities in the field of biomaterials in Canada.

Canada

Strategic partnerships

University of Toronto
MRC Group in Periodontal Physiology
Faculty of Dentistry

Room 4384, Medical Sciences Bldg.
University of Toronto
Toronto, Ontario

Jaro Sodek

Telephone: (416) 978-8728
Fax: (416) 978-5956

Nature of research

Basic research in the areas of Connective Tissue Cell Differentiation and Regulation. Regulation of Bone Formation and Remodelling. Connective Tissue Cell Electrophysiology. Structure and Function of Bone Proteins and Gene Regulation.

Major achievements

18 years of support as a MRC Research Group. Approximately one-third of the research is supported by MRC/Industry Programme.

Developed *In Vitro* methods for studying bone formation, and bone resorption. Developed systems and methodology for studying cell differentiation. Isolated genes for several bone proteins, for regulation studies. Developed methodology for studying single ion channel activity in connective tissue cells. Published over 300 papers in Journals.

Description of research

Interdisciplinary (Cell Biology, Biochemistry, Endocrinology, Electrophysiology and Molecular Biology) research into the formation and repair of connective tissues with current emphasis on bone, and research related to periodontal disease and metabolic bone diseases. Technologies include cell/tissue culture, image analysis, EM, in situ hybridization, protein purification, sequencing analysis, enzymology, gene regulation, genetic engineering, patch clamp and whole cell electrophysiology.

Current industrial involvement

Currently supported by CIBA-Geigy/MRC with $200,000 per annum to study regulation of osteoclasts and glucocorticoid regulation of bone formation.

Industrial involvement sought

Collaborations with industry on basic aspects of connective tissue structure/function and regulation and development of clinical technology arising from these studies.

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University of Toronto
MRC Group in Periodontal Physiology
Faculty of Dentistry

(continued)

Research group profile

Principal Researchers are:

Dr. J.E. Aubin	(Cell Biology)
Dr. J.N.M. Heersche	(Endocrinology)
Dr. J. Ferrier	(Electrophysiology)
Dr. M.M.Y. Waye	(Molecular Biology)
Dr. J. Sodek	(Biochemistry)

(10 Graduate Students; 10 Scientific Support Staff, 4 with Ph.D.s.)

Universities/Institutes Involvement

CIBA-GEIGY CANADA

Canada

Strategic partnerships

University of Toronto & The Toronto General Hospital Natural Antioxidants Group Department of Clinical Biochemistry

Toronto General Hospital ES 3-404B
200 Elizabeth Street
Toronto, Ontario
M5G 2C4

Dr. T.W. Wu

Telephone: (416) 340-3261
Fax: (416) 481-2899

Nature of research

Our group focuses on the identification and characterization of novel cytoprotective agents from natural or synthetic sources. Such agents are useful for biomedical, food preservation, cosmetic or other industrial applications.

Major achievements

The group holds 40+ U.S. and foreign patents in innovative therapeutics, diagnostics and in diverse bioactive agents;

The group leader was awarded 30 U.S. & foreign patents key to multi-layered thin-film technology now used in 15,000 instruments in 55 countries and in over 50% of children's hospitals in North America;

In contract work with 2 multinational drug & diagnostic firms between 1988-90, we delivered to our contractors a total of 8 inventions, of which 3 have been patented in U.S. and several are being patented.

Description of research

Besides biochemical & molecular biology expertise, our major research tools include: Mammalian (esp. human) cell cultures & animal surgery.

We have been:

1. Synthesizing generic series of derivatives of a chroman analogue which protects cells against oxyradical damage and salvages organs from reperfusion injury;
2. Isolating and characterizing the structures of a number of plant-derived antioxidants that are more cytoprotective that vitamin C and E;
3. Studying a number of animal-derived bioactive agents that intervene in certain oxyradical-mediated organ diseases (e.g. in myocardial necrosis & liver pathologies).

Current industrial involvement

We have completed two contracted research collaborations with industry and are open to suggestions from other partners in mutually beneficial working liaisons.

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University of Toronto & The Toronto General Hospital Natural Antioxidants Group Department of Clinical Biochemistry

(continued)

Industrial involvement sought

We want specifically industriol portners to expand our fruitful antioxidant search progrom so as to:

1. Better define the potential therapeutic value of some or most of our finds from throw-away parts of animal/plants;
2. Better define the short-term and long-term toxicity, if any, of such finds;
3. To shore in the material as well as humonitarion benefits thot might emerge from the development of better drugs/processes in combating diseoses.

Research group profile

Principal Researchers are:
Dr. T.W. Wu, Professor of Clin. Biochem & Surgery, U. of T.; holder of 40 U.S. and foreign potents; with 14 years of industrial experience, 120 publicotions;

Dr. J.X. Au, MD surgicol researcher with 35 years experience; innovator of severol new surgical techniques;

Plus 2 other M.D. researchers with prize in medical research; 2 biochemists.

Universities/Institutes Involvement:
Member of Cardiovascular Institute, TGH & U. of T.
Member of Organ Transplant effort at TGH & U. of T.

Other comments

Our team seeks, through its research & licensing efforts, to increase its R&D funds and level of technologic sophistication within Canada & North America.

Canada

Strategic partnerships

University of Toronto Ontario Cancer Institute/ Princess Margaret Hospital

500 Sherbourne Street
Toronto, Ontario
M4X 1K9

Dr. R.N. Buick, Vice-President, Research

Telephone: (416) 924-0671, Ext. 5362
Fax: (416) 926-6529

Nature of research

The Ontario Cancer Institute/Princess Margaret Hospital is one of the largest institutes for cancer research and therapy in North America. It conducts research diagnosis and therapy. Principal activities in basic and applied research in cancer include:

- Molecular and Cellular Biology in cancer biology, genetics, molecular biology, (Emphasis on Gene Expression and Differentiation)
- Structure of Macromolecules, (Emphasis on Protein Interactions)
- Experimental Therapy (Radiation and Chemotherapy)
- Epidemiology and Statistics (Emphasis on Cancer Prevention)
- Physics of Radiation Delivery and Oncologic Imaging
- Clinical Trials Methodology, Phase I, II, and III Clinical Trials in Medical and Radiation Oncology

Major achievements

A history of achievement in fundamental research in cell/molecular biology and cancer therapeutics, e.g., Dr. H. Johns, "Co cancer therapy"; Drs. J. Till and R.A. Mcculloch, "spleen colony" technique for blood-forming cells; Dr. V. Ling, cloning and characterization of human T-cell antigen receptor; Dr. V. Ling, elucidation of mechanism to chemotherapy based on P-glycoprotein.

Description of research

- Chemical Carcinogenesis
- p53 Gene Expression in Leukemia
- Colon Cancer Prevention
- Studies on Epithelial Growth Control and Carcinogenesis
- Structure-Function Relationship of Biologically Active Polypeptides
- DNA-Protein Interactions Involved in Transcription, Replication, Recombination
- Tumour Biology
- Regulatory Mechanisms in Hemopoietic Precursors
- P-glycoprotein and Multidrug Resistance
- Molecular Biology of T-Cell Antigen Receptors; Activation of Cellular Genes in Human Immunodeficiency Virus Infected Cells
- The Blast Stem Cells of Acute Myeloblastic Leukemia
- Development of Cytotoxic T Lymphocyres
- Regulatory Mechanisms in Human Leukemia
- The Logistic and Log Linear Models in Biomedical Applications
- Molecular Mechanisms Regulating the Expression of Eukeryoric Genes
- Chromatin Structure, Macromolecules, Image Processing and Microanalysis

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University of Toronto Ontario Cancer Institute/ Princess Margaret Hospital

(continued)

- B Lymphocyte Development
- Mechanism of Action of Cancer Chemotherapeutic Agents
- Biology and Experimental Therapy of Solid Tumours
- Research on Decision – Making in Oncology
- Influence of the mind on Cancer
- Research in Biostatistical Methodology
- DNA Repair in Mammalian Cells
- Ultrasound Imaging; Hyperthermia
- Chromatin Structure, Macromolecules, Image Processing and Microanalysis
- Radiation Dosimetry
- Cancer Prevention; Primary and Secondary trials of dietary influence in breast and colon cancer

Current industrial involvement

(a) Licensing Agreements- T-cell Sciences- Centocor
(b) Collaborative Research- Allelix- Novapharmaceuticals- Centocor- Cyanamid- Bristol-Myers

Industrial involvement sought

- Research and venture licenses
- Opportunities for contractual services and consultative agreements.

Research group profile

Principal Researchers: 24 Ph.D.'s, 6 M.D.'s
Post-Doctoral Fellows: 50 Ph.D.'s
Graduate Students: 90 Masters/Ph.D.
Scientific Support Staff:180 Scientific Support Staff
Scholarships and Fellowships
Studentships: 59

Principal Researchers:

Dr. M. Archer
Dr. N. Boyd
Dr. W. Bruce
Dr. C. Erlichman
Dr. R. Gronostajski
Dr. J. Hunt
Dr. V. Ling
Dr. E.A. McCulloch
Dr. R. Miller
Dr. S. Minkin
Dr. P. Ottensmeyer
Dr. M. Rauth
Dr. I. Tannock
Dr. D. Trichler
Dr. A. Varghese
Dr. S. Benchimol
Dr. R.N. Buick
Dr. A. Cunningham
Dr. J. Gariepy
Dr. R. Hill
Dr. N. Iscove
Dr. T. Mak
Dr. H. Messner
Dr. M. Minden
Dr. N. Miyamoto
Dr. C. Paige
Mr. J. Rawlinson
Dr. J. Till
Mr. J. VanDyk
Dr. G. Whitmore

Universities/Institutes Involvement:
The majority of the faculty of the Department of Medical Biophysics of the University of Toronto are located in the Ontario Cancer Institute.

Canada

Strategic partnerships

University of Toronto Primary Care Research Unit Department of Family and Community Medicine

Sunnybrook Health Science Centre
Room E-354
2075 Bayview Avenue
North York, Ontario
M4N 3M5

Dr. L. Dempsey

Telephone: (416) 480-4753
Fax: (416) 480-6038

Nature of research

- Primary prevention through behavioural interventions.
- Clinical Trials in the areas of hypertension and menopause.
- Quality of Life Issues.
- Resource utilization and health care delivery.
- Stress in health care deliveries.
- Health promotion research.

Major achievements

- Quality of Life Measurements.
- Foundations of Primary Care Research meetings with published monographs.

Current industrial involvement

Cooperative research with various pharmaceutical companies in the areas of hormone replacement, hypertension and stress reduction.

Industrial involvement sought

- Clinical trials in many disciplines
- Collaboration with the pharmaceutical industry
- Collaboration with health care providers to study issues related to resource utilization and health care delivery.

Research group profile

Principal Researchers are:
Dr. Peter Norton
Dr. Earl Dunn
Dr. Fred Tudiver
Dr. John Wilditch
Dr. Laurel Dempsey
Dr. Jacqui Lewis

Universities/Institutes Involvement:
University of Toronto

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Canada

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Multiple Sectors

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Canada

Strategic partnerships

Bio-Expert Inc.

3055 Hamel Blvd., Suite 225
Quebec, Quebec
G1P 4C6

Mr. Alain Marchand, Ing., M.Sc.

Telephone: (418) 877-5711
Fax: (418) 877-5713

Company history

Bio-Expert Inc. was founded in 1988. Since then we have developed, manufactured and commercialized the state-of-the-art BIO-EXPERT I.D. SYSTEM. It's a new combination of software and hardware components for interactive and dynamic bio-process control. The company has management expertise in biotechnology process engineering and development of instruments dedicated to the biotechnology sector.

Major products and markets

The BIO-EXPERT I.D. SYSTEM line includes two products dedicated to bio-process control, the Processor and the Operator. Both provide a powerful software and a logical hardware arrangement.

The Processor enables taking charge and complete direct digital bioreactor control. All probes or sensors normally used in fermentation process may plug-in directly to the Processor unit without the use of any amplifier or analog module. The system also includes a power unit and a relay unit to supply a wide range of actuator types.

The Operator provides data acquisition of analog signals coming from control modules of four bioreactors. Unconditioned analog signals are driven to the computer. Signal standardization is software done.

Bio-Expert sells the BIO-EXPERT I.D. SYSTEM to governmental, institutional and private research institutes, to major pharmaceutical and all potential biotechnology companies using bioreactors/fermentors in their production/R&D facilities. Sales are carried out by distributors on the Canadian market. We are looking for strategic marketing partnerships for the American, Asian and European markets.

Technology of the company

Bio-Expert's management has experience in developing instrumentation for the biotechnology control process. We integrate computer science, electronic devices and biochemistry knowledge to design a real innovative instrumentation for the development of a global strategy of bioprocess control. We have developed close relationships with major research institutes in Canada to complement our expertise.

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Bio-Expert Inc.

(continued)

Products in development

Our R&D department is working on the development of an in-situ photobiodensitometer. This probe, using laser and optical fibre technologies, will perform on-line measurement of cell density in the bioreactor.

Our BIO-EXPERT I.D. SYSTEM is continuously in progress to integrate bioreactor's upstream and downstream processing.

Desired alliance with other biotechnology firms

Bio-Expert is interested in strategic R&D alliances with scientific centres or firms involved in electronic, software and photonic areas or any technology oriented to the instrumentation to improve the control of the bioprocess. (sensor, control system, analytical instrument ...)

Bio-Expert is ready to conclude strategic marketing alliances like supplying technical expertise for service after-sales and/or engineering support on technology transfer's activities on the Canadian market. Bio-Expert is also looking for agents, distributors or instrument's manufacturers to penetrate the American, Asian and European markets.

Bio-Expert offers to manufacture on Original Equipment Manufacturer (OEM) for a strategic business alliance with manufacturers producing instrumentation for the biotechnology field in their respective market.

Canada

Strategic partnerships

National Research Council Biotechnology Research Institute

6100 Royalmount Avenue
Montreal, Quebec
H4P 2R2

Maurice Brossard

Telephone: (514) 496-6100
Fax: (514) 496-6232

Nature of the research

BRI conducts research in collaboration with Canadian and international industry and academia. The institute pursues, in collaboration with Canadian industrial and university partners, leading edge biotechnological research oriented towards industrial application.

The research programs include:

- Molecular Immunology
- Protein Engineering
- Genetic Engineering
- Biochemical Engineering

Major achievements

- 90% of research groups have industrial sponsors
- license of meat and fish freshness tester
- transfer of process optimization data to five companies which has been applied in upgrading existing processes and in instituting new ones
- 34 patent applications in 1989

Description of research

Genetic Engineering: The Genetic Engineering Section focuses on the enabling technologies of molecular genetics that form the basis of modern biotechnology: gene synthesis, gene expression and the genetic manipulation of host-vector systems. Subunits of this section include: Gene and DNA Synthesis, Yeast Genetics, Mammalian Cell Genetics, Virology, Prokaryotic Cell Genetics.

Molecular Immunology: The Molecular Immunology Section concentrates on the market potential of products that derive from hybridoma technology's capacity to produce large quantities of homogeneous antibody. Because of the high specificity of antibodies, they are finding widespread medical applications as therapeutic agents, assay and purification tools, detection devices, and structural probes.

Protein Engineering: The Protein Engineering Section produces novel enzymes, hormones, antigens and other proteins or polypeptides with industrial or pharmaceutical applications. Subunits include: Protein Chemistry, Enzymology, Macromolecular Structure, Biomolecular Interactions, Receptors.

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National Research Council Biotechnology Research Institute

(continued)

Biochemical Engineering: The Biochemical Engineering Section concentrates on the fine tuning of production technologies and the development of products that offer strong commercial potential. Research subunits include: Biosensors & Instrumentation, Environmental Engineering, Process Engineering, Applied Microbiology, Separation Technology.

Pilot Plant: Staff of the Pilot Plant assist clients in process development and scale up of key technologies.

Current industrial involvement

ABI Biotechnology Inc.
Agropur Crop Agro Alimentaire
Allelix Biopharmaceuticals Inc.
BBL Consultants
BioExpert Inc.
Biomega Inc.
Biomira
Biostar
Boeringer Mannheim
Bristol Myers
Cangene Corp.
Canpolar Consultants
CBM Bioventures
Chembiomed
CIL Inc.
Domtar Inc.
Genetech Inc.
Glaxo Canada
Groupe Sanivan
Hypercube Inc.
Kyowa Hakko Kogyo
Labatt Brewing Co.
Lallemand Inc.
Pegasus Ind. Spec. Ltd.
Rhizotech Inc.
Rosell Inst. Inc.
SNC
Stepan Co.
Syntex Inc.
Zenon Environmental Inc.

Industrial involvement sought

- collaborators with a need to identify or improve the function of therapeutically relevant or industrially important proteins
- licensees for technologies

Research and support staff profile

Researchers: 69 Ph.D.s
Technical Officers: 94 M.Sc.'s/B.Sc.'s
Pilot Plant project managers: 6
Ventures Group: 4
Guest Workers:
Industrial 80
Universities 44
Research Institutes 7
Government Departments 8
Scholarships & Fellowships 9

Principal Researchers:
Dr. Gérald André, Director, Bio-Engineering Sector
Dr. Andrew Storer, Director, Molecular Biology Sector
Dr. Luis Martin, Section Head, Molecular Immunology
Dr. David Thomas, Section Head, Genetic Engineering
Dr. Myroslaw Cygler, Section Head, Protein Engineering
Dr. Réjean Samson, Section Head, Biochemical Engineering
Mr. Niels Lützen, Manager, Pilot Plant

Universities/Institutes Involvement:
Universities:
Concordia U., Cornell U., Dusseldorf U., Ecole Polytechnique de Montreal, McGill U., Ottawa U., Queen's U., U. of Alberta, U. of California, Berkely, U. of Dundee, U. of Laval, U. of Lyon, U. of Saskatchewan, U. of Sherbrooke, U. of Toronto, U. of Western Ont., U. of B.C., U. of Guelph, U. of Montreal, U. of Strasbourg, U. of Vermont.
Research Institutes and Research Organizations:
BC Research, Cancer Inst. Montreal, Clinical Res. Inst. of Montreal, Environment Canada, Forestry Canada (FPMI), Forintek, Inst. Armand Frappier, Jardin Botanique de Montreal, Montreal Neurological Institute, MRC (U.K.), NIH, Nova Husky Research Corp., Pittsburgh Cancer Centre, Saint Hyacinthe Food Research Centre, VIDO, Weston Research Centre, Xerox Research Centre, Biocide, Can. Forestry Service, Can. Red Cross.

Canada

Strategic partnerships

National Research Council Institute for Biological Sciences

1500 Montreal Rd.
Building M54
Ottawa, Ontario
K1A 0R6

Ian C.P. Smith, Ph.D., Director General

Telephone: (613) 990-0884
Fax: (613) 952-0583

Nature of research

Mission: the Institute for Biological Sciences is to perform frontier research focused on areas of mammalian biosciences that require a multidisciplinary approach, hold good potential for application, and oriented towards Canadian social, industrial, and economic development.

Recent achievements

Research on the development of a potential biological therapeutic for osteoporosis, based on the use of biotechnology-derived human parathyroid hormone.

Development and patenting of a new cell culture bioreactor.

Conversion of residual cellulose material from pulp waste to alcohol, using a mutant yeast strain and large-scale fermentation techniques.

Use of unique NMR techniques to monitor non-invasively the brain damage due to stroke, and to develop methods for preventing or limiting the escalation of such brain damage.

The use of NMR to monitor and improve the success of heart preservation methods, using relevant animal models.

Discovery of unique proteins responsible for the onset of certain leukemias, providing insights for improving therapeutic modalities.

Development of a new method for targeting and destroying tumour cells using the normal immune responses within the organism.

Design of improved vaccines, diagnostic and therapeutic agents, combining molecular modelling, NMR, molecular genetics.

Description of research

Cell Systems: Cell signals, metabolic regulation, molecular cell biology.
Biomedical NMR: NMR technology (spectroscopy and imaging), and physiological applications.
Protein Structure and Design: Protein characterization and metagenesis, protein spectroscopy, crystallography, bioinformatics.
Structural ImmunoBiology: Carbohydrate antigens, antibody/antigen interaction, engineered antibodies.

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National Research Council Institute for Biological Sciences

(continued)

Industrial involvement sought

Collaborators in the following areas: diagnostics, vaccines, therapeutics for human and veterinary applications; specific antigens and conjugation techniques for vaccines; engineered antibodies as diagnostics or therapeutics; enzyme inhibitors as therapeutics; engineered proteins for therapeutic and diagnostic applications; specialty chemicals through fermentation processes; animal models and techniques for non-invasive drug testing and diagnostic procedures using NMR on live subjects.Licensees for technologies developed in the institute.

Currently available technologies include:

1. Parathyroid Hormone Assay/Diagnostic Kit.
2. Diagnostic Technology for swine pleuropneumonia.
3. Diagnostic kit E. Cell 0157.
4. Diagnostic kit for brucellosis in cattle.
5. Engineered-Protein Lanthanide Complex for Fluorescence Based ImmunoAssays.
6. In Vitro Assay for Protein Kinase-C.
7. Leukaemia & Anaemia Therapy based on Differentiation Inhibiting Proteins.
8. Production of Specifically Labelled (13C/14C) L-Amino Acids from Methanogens.
9. Engineered antibodies.

Research group profile

Principal Researchers: 77
Research Associates: 41
Post Graduate Students: 21
Scientific Support Staff: 43

Awards:
Dr. G.D. Sprott:1989 Award of the Canadian Society of Microbiologists
Dr. M. Zuker: Fellow of the Canadian Institute for Advanced Research
The institute is part of two Networks of Centres of Excellence: Bacterial Diseases and Protein Engineering.

Universities/research institutes involvement

Agriculture Canada, Carleton University, Centre National de la Recherche Scientifique France, Department of National Defence, Health and Welfare, Heart Institute, International Development Research Centre, Manitoba University, Ministry of Industry Trade, Technology Ontario, National Institute of Health USA, Ontario Cancer Institute, Ottawa University, Red Cross, University of Guelph, University of Montreal, University of Western Ontario.

Current industrial involvement

Allelix
Bruker Spectrospin
Chembiomed
Connaught
F&C International
IAF Biochem
Iogen/JRDC
LSR Industries
Nordion
Oxford Virology
Pegasus Biotechnology
Philom Bios
Rhone Poulenc Rorer
Syntex Inc.
Tembec/Temfibre
VIDO/Biostar

Canada

Strategic partnerships

National Research Council Institute for Marine Biosciences

1411 Oxford Street
Halifax, Nova Scotia
B3H 3Z1

Roger Foxall, Director General

Telephone: (902) 426-8332
Fax: (902) 426-9413

Nature of research

IMB conducts research in collaboration with Canadian and international industry and academia and Canadian Government Departments. The research program is divided into three sections Analytical Chemistry, Biological Chemistry and Marine Biology.

Analytical Chemistry	-Organic Analytical Chemistry
	-Marine Analytical Chemistry Standards Program
Marine Biology	-Aquaculture and Culture Development
	-Molecular and Cell Biology
Biological Chemistry	-Marine Microbiology
	-Natural Products Chemistry

Major achievements

In collaboration with scientists from the Department of Fisheries and Oceans Canada (DFO) and National Health and Welfare (NHW), IMB was responsible for identifying domoic acid as the toxic agent in PEI mussels in a record-breaking four days in 1987.

As a result of many years of close collaboration between Acadian Seaplants Ltd. (ASL) and IMB researchers, ASL has developed leading-edge technology for Irish moss aquaculture. ASL is now operating the world's most successful land-based seaweed aquaculture facility.

IMB scientists have developed sophisticated methods for analyzing a wide range of shellfish toxins. These methods assist Canadian agencies, such as DFO and NHW, to develop marine environmental monitoring programs. IMB's work also helps to protect Canada's aquaculture industry – one of Canada's fastest growing industrial sectors.

Since 1976, IMB has managed the Marine Analytical Chemistry Standards Program (MACSP) which it delivers in conjunction with NRC's Institute for Environmental Chemistry. MACSP provides analysts in industry, government and universities with internationally recognized reference materials and standards to monitor the marine environment.

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National Research Council Institute for Marine Biosciences

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Description of research

- analytical chemistry, including the use of mass spectrometry (including MS/MS) for determining the structures of unknown compounds, characterization of complex substances using gas chromatography, liquid chromatography, supercritical fluid chromatography, capillary electrophoresis, separately and in combination with MS, and the development of methods for the quantitative analysis of target organic compounds in marine and other matrices

- Marine Analytical Chemistry Standards Program, including the production and sale of certified reference materials for environmentol contaminants such as PCBs, PAHs and shellfish toxins

- aquaculture and culture development, including natural products from marine plants – especially algal polysaccharides, marine plant aquaculture and tissue, cell and protoplast culture techniques

- molecular and cell biology, including the genetic manipulation of marine plants, maintenance of a marine algal herbarium, and electron microscopy services

- marine microbiology, including the biology and biochemistry of marine micro-organisms the study of factors controlling toxin production by microalgae, and controlled cultivation of marine micro-organisms

- natural products chemistry, including the exploitation of chemical constituents of marine organisms for uses as pharmaceuticals and fine chemicals, and the isolation, characterization and analysis of marine toxins

- Special Facilities: Electron microscopy, FTIR, HPLC and other chromatographic systems, mass spectrometry including a SCIEX API LC/MS/MS mass spectrometry system, a Regional NMR Facility, microbiological culturing facilities, fermentation facilities, and an aquaculture research station on the Atlantic coast.

Involvement with outside organizations

SCIEX: IMB has acquired SCIEX's new Atmospheric Pressure Ionization (API) III mass spectroscopy system and is currently working with SCIEX, a division of MDS Health Group Ltd., and numerous Canadian government departments and universities to determine novel applications for this revolutionary new technology.

Fenwick Laboratories Ltd: IMB and Fenwick Laboratories are developing advanced techniques for analyzing three families of shellfish toxins-Amnesic Shellfish Toxin, the Paralytic Shellfish Poisons and the Diarrhetic Shellfish Poisons (DSP). The results of this research have resolved an outbreak of DSP toxin in Nova Scotia during the summer of 1990. In addition, methods for producing pure forms of one of the DSPs have been developed and commercial quantities sold to a local fine chemicals company for worldwide distribution.

Diagnostic Chemicals Ltd. (DCL): DCL is the licensee of a number of the fine chemical production technologies developed in IMB's laboratories, including pure Amnesic Shellfish Poison, domoic acid. DCL is also the distributor for one of the DSPs, okadaic acid, produced by IMB.

SynPhar Laboratories Inc.: IMB is undertaking a collaborative research program with SynPhar to undertake a range of sophisticated screening tests for pharmaceutical activity on IMB's collection of marine bioactives. IMB researchers will help to isolate and characterize active components in order to produce potentially useful therapeutic compounds.

Involvement sought

IMB is actively interested in: undertaking collaborative projects; licensing technology; or contracting-in work from industry, university and other government departments. Interactions with Canadian and international clients are encouraged.

Research group profile

Scientists and Engineers: 32
Scientific Support Staff: 30
Visiting Researchers: 10
Graduate Students: 10

Canada

Strategic partnerships

University of Waterloo Faculty of Engineering

200 University Avenue West
Waterloo, Ontario
N2L 3G1

E.B. Cross, Associate Director
Technology Transfer and Licensing Office

Telephone: (519) 888-4058
Fax: (519) 746-3575

Nature of research

The overall objective of the research is the development of new bioprocesses and biomaterials, and the improvement of existing ones for the provision of goods and services of socio-economic value. The programs focus on biotechnology issues in which engineering considerations are important. The activities include the use of genetically-engineered cells. Current generic program areas are as follows:

- Bioreactor systems design, control and scale-up.
- Bioseparation systems design, control and scale-up.
- Process optimization in the production of biopharmaceuticals, food ingredients, fuels and chemicals.
- Process optimization in the biotreatment of wastes.
- Development of materials for biomedical implant applications.

The budget for biotechnology-related research is over $1.5 million annually from grants, contracts, consulting, etc. with industry and government agencies worldwide.

Major achievements

Patented inventions for:

- Bioreactor devices (plug-flow, stirred-tank, solid-state types).
- Single-cell protein production form cellulosic materials.
- Enhanced production of microbial secondary metabolites via media additives.

Innovative developments for:

- Ethanol production by immobilized cells.
- Bioreactor/bioseparation integrated systems for recombinant proteins.
- Production of monoclonal antibodies in trickle-bed bioreactor systems.
- Production of key intermediates for the biosynthesis of morphinan alkaloids.
- Waste-water treatment techniques for environmental pollution control.

Publication of major works include:

- Comprehensive Biotechnology; 4 Volumes; 3,675 pp (1985).
- Advances in Biotechnology; 3 Volumes; 1,500 pp (1983).

Description of research

Currently under investigation are the following:

- Bioreactor systems: air-lift, packed beds, stirred tank (especially for non-Newtonian and fragile cell cultures).
- Bioseparation devices: membranes, cell disruption, HPLC, electrophoresis.

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- Bioconversion processes: microbial, animal and plant cell cultures for the production of enzymes (cellulase, lipase, TLC, MAO), amino acids (lysine, glutamic acid), SCP (Neurospora sp.), MAb's (for cancer therapy); biodegradation of toxic chemicals (phenolics, aromatics) and BOD-generating materials.
- Biotransformation processes: interesterification of Canola oil, L-dopa from catchol, sugars from cellulose.
- Biocompatible materials for body implants and attachments.

Specialized research facilities and tools include:

- Flexible 1,000 L fermentation pilot plant.
- 20 + 20 L 2-stage continuous bioreactor pilot system.
- Large scale FPLC unit (Pharmacia BioPilot).
- High precision process mass spectrometers (VG MM 880; Pegasus).
- Computer-aided process control protocols.

Current industrial involvement

Many of the research projects have industrial involvement through:

- Confidential research contracts.
- Confidential consulting service.
- Collaborative and joint ventures.
- Industrial visiting affiliateships.

Industrial involvement sought

- Licensees for inventions (see "Major Achievements" above).
- Collaboration on research projects (see "Nature of Research" above).

Research group profile

Principal Investigators: 11 Ph.D.'s (Faculty Members)
Research Associates: 9 Ph.D.'s (including postdoctorates)
Postgraduate Students: 26 M.Sc./Ph.D. candidates
Support Staff: 4 Technicians.

Primary Research Contacts:

Dr. M. Moo-Young, Chemical Engineering Professor (all aspects above).
Dr. C.W. Robinson, Chemical Engineering Professor (all aspects above).
Dr. J.M. Scharer, Chemical Engineering Professor (all aspects above).
Dr. R.L. Legge, Chemical Engineering Professor (all aspects above.)
Dr. G.J. Farquahar, Civil Engineering Professor (waste management, groundwater contamination).
Dr. E.A. McBean, Civil Engineering Professor (environmental monitoring, hazardous wastes).
Dr. G.W. Brodiand, Civil Engineering Professor (biological materials, biomechanics).
Dr. G.M. McNiece, Civil Engineering Professor (orthopaedic bioengineering).
Dr. John Medley, Mechanical Engineering Professor (biomechanics).

Research collaboration in the Science Faculty include:

- Dr. N.C. Bols, Biology Professor (immunology).
- Dr. B.R. Glick, Biology Professor (molecular biology, gene splicing).
- Dr. W.E. Inniss, Biology Professor (microbiology).
- Dr. V. Snieckus, Chemistry Professor (natural products chemistry).

University/institutes involvement

Individual researchers are associated with

- The Industrial Biotechnology Centre, University of Waterloo
- UNESCO MIRCEN (Microbiological Resource Centre).
- IOBB (International Organization of Biotechnology and Bioengineering).
- IUPAC Biotechnology Commission

Other comments

The researchers seek, through the University's research and licensing efforts, to increase process biotechnology R&D and manufacturing in Canada by providing personnel training and technology transfer.

Canada

Strategic partnerships

University of Waterloo Faculty of Science

200 University Avenue West
Waterloo, Ontario
N2L 3G1

E.B. Cross, Associate Director
Technology Transfer and Licensing Office

Telephone: (519) 888-4058
Fax: (519) 746-3575

Nature of research

Biotechnology related research within the Faculty is focused on a number of areas including:

- Development of recombinant microorganisms.
- Optimization of fermentation processes for production of mammalian and microbial cells.
- Applications of enzymes and microbial cells in biocatalysts.
- Environmental microbiology/toxicology and bioremediation.
- Insect physiology, biochemistry and pest control.
- Plant molecular biology, hormonal regulation and post-harvest physiology.
- Identification, extraction, synthesis and modification of bioactive natural products.

Level of research activity

The Faculty of Science has an annual research budget of $13 million of which about $2 million involves biotechnology related research.

Research Expertise and Facilities

- Recombinant DNA technology and protein engineering.
- Microbial mammalian and plant cell culture.
- Applied immunology and monoclonal antibody production/applications.
- Biocatalysts in organic synthesis and biodegradation.
- Chemical synthesis, modification and characterization of organic molecules.
- Molecular modelling.
- Toxicology.

Current industrial involvement

Many of the research projects have industrial involvement with

- Pharmaceutical industry.
- Agro-chemical companies.
- Specialized biotechnology companies.
- The food industry.
- Environmental and waste management.
- Venture capital funds.

Other Research Sponsors Include

- Natural Sciences and Engineering Research Council of Canada
- University Research Incentive Fund, Ontario
- Federal Centres of Excellence, Canada
- Canadian International Development Agency
- National Research Council
- Ministry of the Environment

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Industrial Involvement Sought

The University of Waterloo seeks to collaborate with the private sector in the biotechnology area in a variety of ways.

- Collaborations on basic, applied or developmental research on projects of mutual interest involving industrial grants or contracts.
- Implementation of R&D programmes aimed at further development of existing university based or industry based research.
- Technology transfer/licensing of university research.
- Development of research critical mass, creation of industrial research chairs and other forms of industrial research support.
- Provision of trained personnel.
- Consulting.

Specific collaborative opportunities can be identified by contacting the principal researchers described below.

Research Profile (Faculty of Science Estimate)
Principal researchers 30 (Ph.D./Faculty Members)
Post-doctoral fellows/research associates 10
Post-graduate students 40

Research Contacts:
Dr. N. Bols, Biology Professor (mammalian cell culture)
Dr. G. Dixon, Biology Chairman (toxicology)
Dr. G. Dmitrienko, Chemistry Professor (natural products synthesis)
Dr. R. Downer, Vice-president (insect biotechnology)
Dr. E. Dumbroff, Biology Professor (natural product biochemistry)
Dr. B. Glick, Biology Professor (molecular biology)
Dr. J. Honek, Chemistry Professor (enzyme chemistry)
Dr. W. Inniss, Biology Professor (environmental microbiology)
Dr. G. Lajoie, Chemistry Professor (peptide chemistry)
Dr. C. Mayfield, Biology Professor (environmental microbiology)
Dr. J. Pasternak, Biology Professor (molecular biology)
Dr. V. Sneickus, Chemistry Professor (natural products chemistry)
Dr. J. Thompson, Faculty Dean (plant biotechnology)
Dr. T. Viswanatha, Chemistry Professor (enzyme chemistry)
Dr. O. Ward, Biology Research Professor (microbial and enzyme biotechnology).

Canada

Strategic partnerships

University of Western Ontario

Stevenson-Lawson Building, Rm. 328
London, Ontario
N6A 5B8

Dr. Gregor Reid

Telephone: (519) 661-2161
Fax: (519) 661-3907

Nature of research

The university faculty are involved in a wide range of potentially commercializable projects. These range from biomedical devices, artificial organs, genetic techniques, diagnostic kits, to engineering devices, catalysts and procedures.

Major achievements

Many of Western's achievements have been made by individuals. The 100% ownership rights deems that faculty can develop these alone. The total number of patents held, technologies licensed and monies made per annum are thus difficult to verify but add up is one-100. The largest return on investment for one invention has netted over $3M. Suffice to say, we have over 20-30 technologies waiting at any one time for transfer.

Description of research

Some specific examples include: Riser simulator, spraying apparatus for orchards, two stage electrostatic precipitator, motor bearing cooling, plant freeze tolerance biological markers, human and plant genes responding to stress, gene transfer in plants, magnetic resonance imaging, and cardiac mapping devices, candidate vaccine for tropical diseases, artificial hip devices, water purification, computer programs, painting guns, microbial extracts, heavy mineral recovery, heart valves.

Current industrial involvement

We have over 200 annual contracts with medical, industrial, agricultural, and engineering related businesses.

Industrial involvement sought

For developmental stages as well as licensing of technologies. Wish to develop long and short term working collaborations with corporate partners.

Research group proposal

Universities/Institutes Involvement:
Faculty members work at University of Western Ontario, Robarts Research Institute, University Hospital, Victoria Hospital, Lawson Research Institute, St. Joseph's Hospital and in other centres.

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Strategic partnerships

Waitaki International Biosciences

55 Glen Scarlett Road
Toronto, Ontario
M6N 1P5

Mr. Roy Val, Sales/Marketing Manager
Mr. Elliott D. Young, General Manager

Telephone: (416) 763-3600
Fax: (416) 763-6666

Company history

The business was started in the mid 1940s by Canada Packers and grew to become the Fine Chemicals Division then the Biochemicals Group. It was sold to Waitaki in 1987.

Major products and markets

The company specializes in the extraction and purification of active substances from animal derived by-products for sale to the international pharmaceutical, cosmetic and mammalian cell culture segment of the biotechnology market.

Technology of the company

Key strength is in the ability to economically extract and purify low volume/high value biochemicals in large quantities from animal by-products.

Products in development

Confidential

Desired alliance with other biotechnology firms

Technology transfer.
Cross Licences for production/marketing.

Other comments

The company exports 95% of its sales to the USA, Europe, UK, Japan, Korea and Australia.

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