THE NEW YORK STATE BIOTECHNOLOGY INDUSTRY

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CONTENTS

1. INTRODUCTION

The Canadian Government has identified biotechnology as one of the fields in which there appear to be opportunities for Canadian manufacturers to form strategic alliances with companies in the United States. The term "biotechnology" is relatively new and, therefore, not strictly defined. It generally refers to processes that apply man-made technology to living systems. According to the federal government's *U.S. Industrial Outlook 1993*: "biotechnology refers to biological processes and techniques that use organisms or their cellular, subcellular, or molecular components to make products or modify plants and animals to carry desired traits."

Biotechnology firms are classified primarily under SIC 2835: *In vitro and in vivo diagnostic substances*, and SIC 2836: *Biological products, except diagnostic substances*. Both are part of SIC Major Group 28: *Chemicals and allied products*. Because the field is so new and so broadly defined, bits and pieces of the biotechnology industry are also classified in some other SIC Groups by the U.S. Department of Commerce:

TYPICAL BIOTECHNOLOGY PRODUCTS AND SERVICES

SIC	Group Name	Product/Service Examples
0279	Animal specialties, n.e.c.	Transgenic laboratory animals
2834	Pharmaceutical preparations	Recombinant DNA-derived (rDNA) drugs
2835	In vitro & in vivo diagnostic substances	MAb & rDNA-derived test kits
2836	Biological products, except diagnostic substances	rDNA-derived vaccines, blood derivatives, micro-organisms
2869	Industrial organic chemicals, n.e.c.	rDNA-derived enzymes except diagnostic substances
2879	Pesticides & agricultural chemicals	Insecticides, cattle dips
2899	Chemicals & chemical preparations, n.e.c.	Food contamination test kits
4953	Refuse systems	Bioremediation
4859	Sanitary services, n.e.c.	Oil spill cleanup
8731	Commercial physical & biological research	Contract R & D
8734	Testing laboratories	Forensic laboratories using DNA profiling

Of course, many firms classified in the SIC groups outside of the biological classifications are in businesses beyond the scope of biotechnology.

In order to assist in defining the market in New York State for Canadian biotechnology firms, the Canadian Consulate General in Buffalo engaged John Gartner & Co., Technical Marketing Consultants, (JGCO) to conduct a marketing research study during the winter of 1993.

2. PROJECT METHODOLOGY

JGCO conducted this study in three phases. First we conducted a literature search. After reviewing the files on biotechnology and data sheets on New York State biotechnology companies available at office of the General Consul, we reviewed materials at the Lockwood Library at the State University of New York at Buffalo (SUNYAB). This permitted us to determine the scope and breadth of the market in the U.S. as a whole, and in New York State in particular. Because of the extensive written materials available on biotechnology from a financial standpoint, and because of the limitation of our study interest in New York State companies, we did not undertake a computerized literature search. We felt that such a search might inundate us with data that would be meaningless from a strategic-alliance-development standpoint.

The second phase of the project consisted of contact with experts in the field in order to better determine the importance of New York State in the national biotech marketplace. The list of project contacts appears as Appendix A.

The third phase of the project involved two mail surveys. One was done to obtain annual reports and other financial information from publicly-held companies with operations in New York State (whether or not they are headquartered here). The other was done to obtain an indication from all New York State biotech companies of their interest in engaging in potential strategic alliances with Canadian companies.

The annual report request was sent out on John Gartner's personal letterhead to the corporate secretaries of 21 corporations. By the cutoff date of March 5th, financial data consisting of annual reports and/or Forms 10-K and quarterly data was received from 14 or 67 percent of them. Three replied that they were not publicly held firms.

A questionnaire was developed with the Consulate's approval and mailed out on JGCO letterhead on February 4th, 1993 to 58 identified biotech firms in New York State. The questionnaire identified the purpose of the study on behalf of the Canadian Government. A stamped reply envelope to JGCO and a "Buffalo Chicken Wing" recipe card were included as an inducement to reply. Two weeks later, a follow-up questionnaire was mailed that was identical, except it was on General Consulate stationery. Another stamped reply envelope to JGCO was included, but no recipe card. The list of firms contacted appears as Appendix B. The questionnaire appears as Appendix C.

By the cutoff date on March 5th, replies were received from 18 organizations, indicating a gross response rate of 31 percent, about average for this type of effort. Information on the 11 firms interested in a potential strategic alliance with a Canadian company are detailed in Section 5.2. Data on the two university center respondents are in Section 5.3. Data on the two respondents not interested in a strategic alliance are in Section 5.4.

2.1 Accuracy of the Data

The data presented in this report was obtained in a professional manner by a qualified technical marketing research consultant based in New York State. The information was gathered from sources thought to be reliable. Neither the Canadian Government nor its contractor, John Gartner & Co., can be responsible for any errors or omissions in the data, or in the veracity of data concerning respondents' readiness to engage in any sort of business arrangement with any Canadian or other companies.

3. THE U. S. BIOTECHNOLOGY MARKETPLACE

By government definition and count, there are about 1,300 companies applying biotechnology in the U.S. About 673 of them, mostly new and rather small, were founded to exploit scientific discoveries coming from academic research labs. About 440 companies supply materials, equipment and services used in biotechnology R & D. Nearly 200 established pharmaceutical, medical supply and chemical firms are also involved in biotechnology. These firms are sometimes linked together as the "biotech industry" because they share business alliances and concerns with regard to regulation, patent protection and R & D needs. About 57,000 people are employed in 572 mainly small biotechnology firms and an additional 13,000 people are employed in 147 supply firms. Because of the haziness of definition, total industry employment figures are unavailable.

The U.S. biotechnology market is thought to be very fast-growing. A lot of firms have entered the marketplace during the past few years with a great deal of fanfare, particularly from the financial community. However, many more products have been promised than delivered to date. Unofficial estimates indicate that shipments by U.S. biotechnology firms may have reached $4 billion in 1992, up from $3.1 billion in 1991.

ESTIMATED U.S. BIOTECHNOLOGY PRODUCT SHIPMENTS

Year	Shipments
1992	$4.0 billion
1991	3.1
1990	2.2
1989	1.5
1988	1.0
1987	0.6
1986	0.35

According to the Pharmaceutical Manufacturers Association, as of August 1991, there were 132 biotech-derived medicines in clinical trials, a 60 percent increase in four years. According to a February 24, 1992 article in *The Wall Street Journal* , the biotechnology industry appeared poised for rapid growth as it moved into its second decade. The industry had shown that it can deliver marvelous drugs and captivate Wall Street, and by some estimates, was projected to jump seven-fold in revenues to $40 billion by the end of the decade. The article went on to indicate that in the industry's early days, the main strategy was to "go with what science you have and hope you can get there first." But now, businesses had to be more selective, placing a smaller number of bets by carefully analyzing patent positions and market potential, which involved not just a drug's therapeutic value, but also how likely the federal government and other health insurers were to pay for it.

3.1 The Urge to Merge

Because of heavy regulation by the U.S. Food and Drug Administration (FDA) and other agencies, getting human and even animal health-related products to market is an extremely costly and time-consuming undertaking. To be successful, small companies require extremely heavy public financing and/or allegiances with larger, well-established firms. Because of this, mergers and acquisitions between biotechnology firms are on the increase. Many biotechnology companies are pursuing partnerships to further their goals of becoming big, independent drug companies. According to the *Journal* article, the secret to successful collaborations is "to make sure you have a champion at the larger company who believes in your product. And if the partnership doesn't work out, consider buying back the technology from the larger company before the project dies on the vine." In 1991, collaborations between biotechnology companies accounted for about half of all U.S. pharmaceutical research alliances, according to Ernst & Young, a major U.S. accounting and management consulting firm.

As a result of all the hype, stock prices of publicly-held U.S. biotechnology companies soared through 1991 and 1992. A year later, the bloom was off the biotechnology rose. According to an article in the February 26, 1993 *Buffalo News*, Wall Street analysts were warning investors to stay away from more than a dozen biotechnology stocks after industry leader Amgen, Inc. came out with a poor earnings forecast and had its shares plunge $9.25 to $37 in trading of 22 million shares. The shares have since dropped more. Five companies indefinitely postponed plans for their initial public offerings (IPOs) as a result of the debacle. Financial data received from some of the public companies for this study indicate some very unfavorable financial situations. This industry is far from stable!

3.2 U.S. Leadership / International Development

Due to its large investment in biotechnical research and its highly entrepreneurial environment, the U.S. has led in discoveries and the commercial introduction of biotechnology products during the past several decades. The nation is expected to continue to play a preeminent role in the introduction of innovative products, but commercial application of new biotechnologies is still in its infancy worldwide, according to *The U.S. Industrial Outlook 1993*. Six of the world's top ten leading pharmaceutical companies and agrochemical companies are European Community based, four are U.S. companies.

Although commercial development is primarily national in scope, product and process research and development are highly internationalized. Articles entitled "International Strategic Alliances" by Richard A. Schwartz and Mark D. Dibner and "International R & D is the Rule" by Cynthia K. Wagner in the May 1992 issue of *Bio/Technology* shed some interesting light on the question of internationalization.

In their work at the North Carolina Biotechnology Center, in 1991 Schwartz and Dibner conducted a survey of 750 U.S. biotechnology firms in order to measure international relationships in the biotechnology field. They received replies from top managers at more than 200 of these firms, identifying more than 1,000 past and current strategic alliances (an average of 8 per firm *[sic]*) that involved biotechnology products or technology transfer. The breakdown was as follows:

STRATEGIC ALLIANCES REPORTED TO SCHWARTZ & DIBNER - 1991

Reported Alliances	% of Respondents
With larger U.S. partner	38%
With European partner	29
With other U.S. biotech firms	21
With Japanese partner	13

Apparently none of the reported alliances were with Canadian partners. According to the authors, the sheer number of agreements validated the widespread attention garnered by strategic alliances. They observed interestingly that many of the alliances appeared to be within the biotechnology industry, rather than across industry lines. Downstream alliances such as marketing or licensing agreements (as compared with upstream alliances such as research contracts) increased from 51 percent to 66 percent .

The key reasons cited for seeking alliances with European or Japanese partners were market access, income and technology. The U.S. firms believed that their European and Japanese partners were seeking alliances with them with the same objectives, but in reverse order. The majority of the U.S. partners felt that their objectives were being met and vice versa.

Strategic alliances in the biotechnology field are enhanced by the use of Collaborative Research and Development Agreements (CRADA) made possible by the federal Technology Transfer Act of 1986, that was designed to keep U.S. technology competitive. It is likely that the Clinton administration will continue the impetus developed by the previous Reagan and Bush administrations in this field.

3.3 Who's Who in the Business

A table in the February 24, 1992 *Wall Street Journal* listed the top 20 publicly-held biotechnology firms in order of their stock market capitalization. Price fluctuation the past year has, no doubt, changed the order of the list and its composition, but it still gives an idea of the major independent factors in the industry.

MAJOR PUBLICLY HELD U.S. BIOTECH COMPANIES

Company	Stock Market Capitalization	In Preclinical Trials	In Clinical Trials	Awaiting FDA Approval	Proprietary Drugs for Humans On Market
Amgen	$8,309.7 MM**	2	8	2	2
Genentech	3,080.2	N.A.	10	0	3
Chiron	1,509.6	7	14	0	3
Centocor	1,296.8	0	5	3	0
Synergen	1,205.4	6	3	0	0
Genzyme	935.9	1	1	0	1
Biogen	879.8	3	3	0	2
Gensia	860.1	8	1	0	0
Immunex	791.8	4	4	1	2
Alliance	644.0	7	2	1	0
US Bioscience	570.8	4	4	1	1
Xoma	489.5	7	6	2	0
Medimmune	448.8	6	1	0	1
Affymax	409.6	0	0	0	0
Immune Response	395.2	1	1	0	0
Genetics Institute	379.6	3	3	2	1
Molecular Biosystems	373.8	0	0	1	0
Cytogen	352.3	0	1	0	0
Immunomedics	337.1	1	2	0	0
Liposome Co.	334.9	2	3	0	0

** As of 2/23/92.

Besides the specialized firms listed above, many, if not most, of the major, publicly-held pharmaceutical companies have biotech subsidiaries and/or operations. In addition, several large diversified manufacturers that serve medical markets also have biotechnology interests. For example, Pall Corporation, whose specialty is filtration products, does close to $200 million worth of business in products for patient protection, hospital and blood bank use, biosupport, and OEM diagnostics. Their 1992 annual report indicates that they are "Maintaining Global Leadership through Pall Research & Development *and Alliances with other Outstanding Organizations.*" (emphasis added). Likewise, Corning, Inc., the famous glass maker, has organized a network of six acquired companies into a subsidiary called Corning Lab Services Inc., whose services include biological research and development, in addition to clinical laboratory analysis. Corning has developed strategic alliances for various aspects of its multinational businesses. Please see Appendix B for data on Pall and Corning.

4. THE NEW YORK STATE BIOTECHNOLOGY MARKET

New York State is an important center for the growing biotechnology industry in the United States, ranking third behind California (particularly the San Diego and San Francisco areas) and Massachusetts (especially the Boston area). According to Jack Huttner, executive director of the New York Biotechnology Association, Inc., (NYBA) the biotech industry employs about 6,000 people in the Empire State, accounting for 10 per cent of the national total.

Although New York is important to biotechnology, the field's manufacturing and R & D aspects are not very important factors in New York State's overall economy in terms of employment, payroll, or product shipments. On the other hand, biotechnology corporate finance is important to the state, because trading in biotech company stocks and bonds takes place on Wall Street exchanges and New York City-based stockbrokers make a lot of money on the turnover.

Interestingly, none of the top 20 independent, publicly-traded, biotechnology firms listed in the table on the previous page is headquartered in New York State. However, some important privately-held biotech companies are headquartered here. In addition, some other large, publicly-held, New York-headquartered firms such as Corning, Eastman Kodak, Pall Corporation and Pfizer, as well as New Jersey-based Cyanamid and several important foreign-owned firms, have major biotechnology interests here. They are not included in the top-20 list because their product diversification doesn't permit them to be classified as biotechnology firms in the financial world.

Not surprisingly, the biotech industry has a close working relationship with academia, primarily molecular biology (as opposed to medicine, per se). The key academic centers for biotechnology in New York State are The Center for Biotechnology at the State University of New York at Stony Brook on Long Island and the Biotechnology Program at Cornell University in Ithaca. See Section 5.3.

NYBA had 116 members as of January 25th, 1993, including a number of law and accounting firms, miscellaneous vendors, and some university components, in addition to the biotechnology firms themselves. The organization appears to have a diversified program that assists in market development and in legislative lobbying. It has had programs aimed at development of strategic alliances with Ontario concerns that, according to Huttner, have been only modestly successful.

> A detailed directory of NYBA membership is available only to those who belong to the group. Dues range from $250 to $2,500, depending on firm size and scope. *Contact: New York Biotechnology Association, Inc. One Penn Plaza, Suite 100, New York, NY 10119. TEL: 212-695-4077.*

New York's biotechnology companies are located primarily downstate, with pockets in upstate centers including Ithaca, Rochester and Buffalo and a few hidden away in the Adirondacks.

4.1 NYS Biotechnology Manufacturers

As previously mentioned, there is a considerable definitional question with regard to biotechnological manufacturing. Strictly speaking, biotechnology manufacturing would appear to be limited to SIC 2835 and 2836 (covering the manufacturing of biological materials). However, there are several firms in the biotechnology manufacturing field that manufacture other chemicals (e.g., in SIC 2899) or that produce equipment or instrumentation for handling biotechnological materials (e.g., in SIC 3821) with or without manufacturing the biologicals themselves. The number of biotech manufacturers in New York State then, depends on whose definition or enumeration you use (and, of course, on the date of your survey).

Based on the data supplied by the computerized Corporate Technology Database and several published industrial directories, there are 58 firms involved in the biotechnology industry in New York State. About three dozen of these are involved in manufacturing biologicals. The remainder of the firms are involved in biotechnology instrumentation manufacture or biotechnology services. A list of all firms by ownership and ZIP Code appears as Appendix B.

TYPES OF BIOTECH FIRMS IN NYS

Listed under SIC 2835, 2836 and/or 2899 only	18	
Listed under above SIC classes plus other classes	20	
Subtotal: listed in biological manufacturing		38
Listed in other SICs but not in above classes		16
SIC not specified		4
TOTAL NYS Biotechnology Firms		58

As far as the U.S. Bureau of the Census is concerned, much of New York State's biotech industry appears to be hidden away under other industry categories. According to the recently published and usually reliable County *Business Patterns 1990 - New York*, there were 18 establishments in the primary classifications for this business in the entire state in 1990.

NYS BIOLOGICALS MANUFACTURERS (1990 Data)

SIC	Definition	Employees as of 3/31	Annual Payroll	Total Establishments	Estab. with 100+ Employees
2835	Diagnostic substances	1,395	$42,617M	12	5
2836	Biologicals, except diagnost.	369	10,408	6	2
	TOTAL	1,764	$53,025M	18	7

5. POTENTIAL PARTNERS

5.1 U.S. Firms with Existing Canadian Operations

The computerized data bank and published information available on the 58 biotechnology firms in NYS indicated whether or not the firms engage in exporting. However, specific reference to involvement in the Canadian economy, via importing, exporting or direct operations, generally was not found. The following information was obtained from the annual reports received from publicly-held biotech firms regarding any foreign operations, joint ventures, and/or subsidiaries, including any in Canada. Those responding to the JGCO survey are indicated by an asterisk. Specific information regarding respondents' interest in a Canadian strategic affiliation is noted in detail in the next section.

NYS HEADQUARTERED BIOTECH COMPANIES WITH FOREIGN OPERATIONS AND/OR SUBSIDIARIES

Company	Headquarters	Foreign Operations
Bio-Technology General Corp.	New York	Israel
Corning Incorporated	Corning	Canada [1], Australia, Brazil, Great Britain, France, Singapore, Germany, Mexico, Italy, China, Malaysia, Korea, Belgium
Daxor Corporation	New York	Canada [2]
Enzo Biochem Inc.	New York	Europe (patent)
Exovir, Inc.	New York	Canada (patent), Europe (patent)
E-Z-EM, Inc.	Westbury	Canada[3], Puerto Rico, Netherlands, England, Japan
Genencor International*	Rochester	Finland, France, Germany
Lescarden Inc.*	New York	Canada[4]

[1] Canadian subsidiary not necessarily related to biotech interests.
[2] Firm has received Canadian product approval, will seek to begin operations there.
[3] Firm has Canadian subsidiary.
[4] Firm has Canadian licensing agreement.

Companies with foreign operations, continued...

Company	Headquarters	Foreign Operations
Oncogene Science, Inc.	Uniondale	Canada[1], Austria, Benelux, England, France, Italy, Japan, Korea, Portugal, Scandinavia, Spain, Taiwan, Germany
Pall Corporation	East Hills	Puerto Rico, England, Germany, Japan

5.2 Potential New York State Strategic Partners

Following is information from JGCO's survey respondents about their specific interests in potential strategic alliances with Canadian partners. The firms are listed alphabetically. The information is synopsized from the returned questionnaires which are on file for future reference at the Canadian Consulate General in Buffalo, NY. Additional information from published and computer data base sources on these and the non-responding companies can also be found there.

ACCURATE CHEMICAL & SCIENTIFIC CORP.
300 Shames Drive
Westbury, NY 11590

Contact: Mr. Rudy Rosenberg, Sr., President
516-333-2221

Accurate manufactures primary biotech products including monoclonal ABs, polyclonal ABs, antigens and complements at various plants outside of the U.S. They export product to Canada and import product as raw material from Canada. They also manufacture secondary biotech products abroad, export some to Canada and import some product components from Canada. They do not provide biotech services. They have existing Canadian strategic alliances for complements. They would be interested in additional strategic alliances in Canada "if it makes money and does not pollute."

BIONIQUE TESTING LABORATORIES, INC.
RR 1, Box 2
Saranac Lake, NY 12983

Contact: Mr. Daniel J. Lundin, President
518-891-2356

[1] Firm has Canadian distributor.

Bionique provides mycoplasmal testing services in New York State but not in Canada or any other country. They have no strategic alliances. They are seeking: 1) a marketing arrangement for increasing services to Canadian clients on a sales commission basis; and 2) a possible strategic alliance for providing testing services at a Canadian based facility.

BOYCE THOMPSON INSTITUTE FOR PLANT RESEARCH
Tower Road
Ithaca, NY 14853

Contact: Ralph W. F. Hardy, President and CEO
607-254-1300

The Institute provides research and development services for biopesticides, cell lines for production of vaccines and foreign proteins; herbicide testing systems, environmental impacts on plants; alternatives to N fertilizers. They have R & D support contracts in other countries for the licensing of patents and are interested in investigating a strategic alliance with a Canadian firm.

ERNEST F. FULLAM, INC.
900 Albany Shaker Road
Latham, NY 12110

Contact: Mr. Peter Fullam, President
518-785-5533

Manufactures secondary products and exports them to Canada. They have a Canadian representative for lab supplies and accessories: Micro Biological Supplies, 41 Maple Ave., Richmond Hill, ON L4C 6P4. They are not sure if they need additional representation. Fullam's business is laboratory supplies and accessories relating to light and electron microscopy. They are not a biotech firm per se.

GENENCOR INTERNATIONAL INC.
Subsidiary of Eastman Kodak
1870 South Winton Road
Rochester, NY 14618

Contact: Mr. Frank Rice, Director, Business Development
716-256-5229

Genencor manufactures primary biotech products including proteases, cellulases, amylases, lipases, Snomax™ ice nucleator (through a separate company at the same address), and oxygenases. They have plants in Rochester, NY, Cedar Rapids, IA and Finland and import some unspecified supplies from Canadian manufacturers. R & D is performed in the listed plants and at a facility in South San Francisco, CA where they also do some contract R & D, scale-up and manufacturing.

Genencor manufactures a biotech product under a multi-year agreement with a Canadian agricultural biotech firm. They have numerous R & D, manufacturing and marketing alliances worldwide. They are interested in licensing technology to improve their enzyme business and are very open to R & D / scale-up / manufacturing contracts with Canadian companies.

Note: Genencor's questionnaire was completed by Ed Robinson, V.P., Business Development.

INTERGEN COMPANY
2 Manhattanville Road
Purchase, NY 10577

Contact: Mr. Robert J. Beckman, C.E.O.
914-694-1700

Intergen manufactures GI cytokines and reagents at plants in Cambridge, MA, Illinois and Toronto. In addition, they export primary biotech products to Canada and import products as raw materials from Canada. They also manufacture albumin and sera, exporting these secondary products to Canada. They provide separator and purification services at their Toronto facility and at facilities in the U.K., France, Benelux and Japan. They have some licensing and marketing agreements abroad and are interested in discussing additional possibilities with Canadian firms.

LESCARDEN INC .
790 Madison Avenue
New York, NY 10021

Contact: Mr. Gerard A. Dupuis, President
212-794-8990

Lescarden manufactures secondary biotech products including cartilage powder in Ontario. They import secondary products from Ontario into the U.S. They are interested in investigating additional Canadian manufacturing facilities.

MEDICAL SYSTEMS CORP.
One Plaza Road
Greenvale, NY 11548

Contact Mr. Stuart Havel, Vice President
615-621-9190

Medical Systems manufactures micro injectors, micro incubators and temperature controllers in New York State. They also manufacture data storage systems, oxygen measurements, and electrochemical systems. They export products of several types to Canada. They are interested in a joint venture with a Canadian company.

NY GENE CORP.
One Odell Plaza
Yonkers, NY 10701

Contact: Mr. Frank Brunetta, President
914-964-8300

NY Gene manufactures membrane based separation devices and instrumentation. They do not export to Canada and are interested in a potential Canadian outlet.

OXYGEN ENRICHMENT CO., LTD.
145 Jordan Road
Troy, NY 12180

Contact: Mr. John Finley, President or Mr. Wynn Englisbe, Dir. of Marketing -- 518-283-5200

Oxygen Equipment manufactures membrane separation components and other separation components in NYS. They export products to Canada. They also provide services designing bioseparation systems. They have provided services in Germany, the U.K. and Belgium. They have current arrangements with the University of Waterloo and the University of Manitoba for the development of new separation media. They have various strategic alliances with universities and research centers in Europe as well as marketing alliances with commercial operations. They want to design and manufacture separation components in Canada. Most of their products are disposable components of large systems for medical testing and environmental sampling.

THE VIRTIS COMPANY
815 Route 208
Gardiner, NY 12525

Contact: Mr. S.G. Bart, President
914-255-5000

Virtis manufactures secondary biotech products including lyophilizers, homogenizers, aerosol photometers, fermenters and cell disrupters. It exports products to Canada but does not import components from Canada. It has a strategic alliance to distribute its products in Canada. It is interested in a strategic alliance to assemble, manufacture or distribute Canadian biotech products in the U.S.

5.3 NYS University Biotechnology Centers

Two of New York State's numerous institutions of higher learning have important centers of biotechnological research. Both are interested in working with Canadian companies.

CENTER FOR BIOTECHNOLOGY
State University of New York at Stony Brook
130 Life Sciences Building
Stony Brook, NY 11794

Contact: Ms. Diane C. Fabel, Assistant Director
516-632-8521

The Center is a State of New York agency that provides contract research, access to research facilities and technology transfer. They serve as a company "incubator." They can assist in joint ventures, provide incubator space for start-up biotech companies, assist in licensing technologies etc. All of the Center's services are available to Canadian firms.

CORNELL UNIVERSITY BIOTECHNOLOGY PROGRAM
130 Biotechnology Building
Ithaca, NY 148-53-2703

Contact: Lynn W. Jelinski, Director
607-255-2300

The mission of Cornell Biotechnology is to pursue programs in research, technology development, education and training, and technology transfer, that address economic development needs. These are applied in environment, especially biodegredation and bioremediation; agriculture,

e.g., pest management and improved breeding techniques; food science and nutrition; and healthcare. All of the program's capabilities are available to Canadian companies.

5.4 Other Resondents

Following is survey information received from a company indicating that they are not interested in pursuing Canadian strategic alliances:

DELTOWN SPECIALITIES
1712 Deltown Plaza
Fraser, NY 13753

Contact: Mr. William J. Lall, V.P.
607-746-6049

Deltown manufactures peptones for diagnostic microbiology and exports to Canada. DMV Holland is their parent company. They are not looking for any new arrangements in Canada at this time.

Survey responses were also received from the following companies without any information useful for Canadian firms:

Eastman Kodak Corp. (corporate office,
see Genecor International, page 13)
Gibco Laboratories / Life Technologies
Hetereo Chemical Corp
Snomax Technologies (see Genecor International, page 13).

6. CONCLUSIONS

The following conclusions regarding opportunities for Canadian biotechnology firms in the New York State biotechnology marketplace may be drawn from the data presented in this study:

1) New York State currently plays an important role in the developing biotechnology industry in the United States, ranking third behind California and Massachusetts.

2) Approximately five dozen biotechnology firms are located in New York State employing approximately 6,000 people. About a third of them manufacture primary biotechnology products (engineered biologicals). The remainder manufacture secondary biotechnology products (related chemicals, instrumentation, or equipment), or provide biotechnology services including contract research and development.

3) Some of the major players in the state's biotechnology industry are subsidiaries of New York-headquartered Fortune 500 firms such as Kodak, Corning, Pall, and Pfizer, whose primary business is something other than biotechnology. None of the top 20 publicly-held biotechnology-specific firms is headquartered in New York.

4) Biotechnology appears to be most important at two of New York State's numerous colleges and universities -- The State University of New York at Stony Brook and Cornell University.

5) Typical of the nationwide trend, New York biotechnology firms today are more likely to have existing strategic alliances with European firms than with Canadian firms.

6) A reasonable number of New York biotechnology firms will consider some sort of strategic alliance with a Canadian company as a supplier, distributor, and/or joint venturer.

7. CONSULTANT RECOMMENDATIONS

Based on the foregoing conclusions supported by the detailed findings in this report we offer the following recommendations for Canadian companies interested in forming a strategic alliance with a New York State biotechnology company:

1) Peruse the list of firms listed in Section 5.2. and make appropriate contact with the indicated executives.

2) Make contact on a "missionary" basis with one or more of the other firms listed in Appendix B.

3) Obtain more information about the programs of the New York Biotechnology Association. Contact:

Mr. Jack Huttner
Executive Director
New York Biotechnology Association, Inc.
One Penn Plaza, Suite 100
New York, NY 10119
TEL: 212-695-4077.

4) Further assistance may be obtained by contacting:

Ms. Mary Mokka
Commercial Officer
Canadian Consulate General
3000 Marine Midland Center
Buffalo, NY 14203-2884
TEL: 716-852-1247
FAX: 716-852-4340.

Appendix A

STUDY CONTACTS

Name	Organization / Location	Contact Type
Kevin Gray Audrey Smith	Association for Biotechnology Companies Washington, DC	phone
Douglas McCormack Susan Hassler	Bio/Technology Magazine New York, NY	phone
Emily Arakaki William Hurt	U.S. Department of Commerce Washington, DC	phone
Jack Huttner	New York Biotechnology Association, Inc. New York, NY	phone
Mark Dibner	Institute for Biotechnology Information Research Triangle Park, NC	phone
Dewey Rhu	State Univ of NY at Buffalo Amherst, NY	phone
Diane Fabel	State Univ of NY at Stony Brook Stony Brook, NY	phone
Richard Holsten	Cornell University Biotechnology Program Ithaca, NY	phone
Mary Mokka	Canadian Consulate General Buffalo, NY	interview

Appendix B

NEW YORK STATE BIOTECHNOLOGY FIRMS

(Listed in ZIP Code sequence by type of ownership)

Name	Title	Company	Street	City	ZIP	Type	SIC	Sales $MM	Phone	Export
Mr. Hans Lauterbach	Exec V.P.	Miles Inc. / Diagnostic Division	511 Benedict Avenue	Tarrytown	10591	Fgn	1836 2899 3841	350	914 631 8000	yes
Dr. Helmut Rabich	C.E.O.	Sartorius Corp.	140 Wilbur Place	Bohemia	11716	Fgn	3822 3826	5 10	516 563 5120	?
Mr. Rene Loser	Exec V.P.	Sulzer Biotech Systems	230 Crossways Park Dr	Woodbury	11797	Fgn	3821 3826	5	516 921 7373	ri
Mr. G. Moore	President	Unipath Co. / Oxoid Div.	P O Box 691	Ogdensburg	13669	Fgn	2835 2836	2	800 567 8378	yes
Mr. Lewis Weinstein	President	The Public Health Research Institute	455 First Avenue	New York	10016	Non Prf	2836	0	212-578 0800	?
Mr. Gordon Sato	President	W. Alton Jones Cell Science Center, Inc.	10 Old Barn Road	Lake Placid	12946	Non Prf	8071	9	518-523 1250	?
Ms. Josette Gadreau	President	Upstate Biotechnology, Inc.	89 Saranac Avenue	Lake Placid	12956	Non Prf	2836	1-2 5	518-513 1518	?
Dr. Ralph Hardy	President	Boyce Thompson Institute for Plant Res.	Tower Road	Ithaca	14853	Non Prf	8731	18	607-254-1234	?
Ms. Valerie Edwards	President	Alken-Murray Corp.	417 Canal St.	New York	10013	Priv	2836 2860 2899 2999	2 5	212-431-4944	yes
Dr. Samuel Waksal	President	ImClone Systems, Inc.	180 Varick St.	New York	10014	Priv	2836 3841	NA	212-645-1405	no
Mr. Williams Jennings	President	Crowley Chemical Co.	261 Madison Avenue	New York	10016	Priv	2836 2843 2865	25-50	212-682-1200	yes
Mr. J. Morse Smith	President	H.J. Baker & Brother, Inc.	100 E. 42nd Street	New York	10017	Priv	2834 2843 2873	10-25	212-867 0200	?
Mr. Robert Beckman	President	Intergen Company	2 Manhattanville Road	Purchase	10577	Priv	2836	4	914-694-1700	yes

	Name		Title	Company	Street	City	ZIP	Type	SIC	Sales $MM	Phone	Export
Mr.	Frank	Brunetta	President	NYGene Corp.	One Odell Plaza	Yonkers	10701	Priv	2835 3826	1	914-964-8300	yes
Mr.	Joel	Freeman	President	Freeman Industries, Inc.	P.O. Box 415	Tuckahoe	10707	Priv	2819 2833 28362851	1 2 5	914-961-2100	yes
Mr.	Alan	Pernick	President	EM Industries, Inc. / Center Laboratories	35 Channel Drive	Port Washington	11050	Priv	2836	14	516-767-1873	? *
Mr.	David	Guttman	C.E.O.	Applied Microbiology, Inc.	170 53rd Street	Brooklyn	11232	Priv	2834 2836	17	718-492-8100	no
Dr.	Daniel	Yarosh	President	Applied Genetics Inc.	205 Buffalo Avenue	Freeport	11520	Priv	2835 2836 2869	1-2.5	516-868-9026	yes
Mr.	Harry	Benedict	President	Medical Systems Corp.	One Plaza Road	Greenvale	11548	Priv	3826 3841 3846	10-25	516-621-9190	yes
Mr.	Ed	Wegman	President	Advance Biofractures Corp.	35 Wilbur St.	Lynbrook	11563	Priv	2869	4	516-593-7000	yes
Mr.	William	Geller	President	Hetero Chemical Corp.	P.O. Box 157	Valley Strm	11582	Priv	2834	.44	516-561-8280	yes
Mr.	Rudy	Rosenberg	President	Accurate Chemical & Scientific Corp.	300 Shames Drive	Westbury	11590	Priv	2836 2860	4	516-333-2221	yes
Dr.	Clifford	Yen	President	New York Biolabs, Inc.	30 Austin Boulevard	Commack	11725	Priv	2836 2869	1	516-543-3800	yes
Mr.	Russell	Whitman	President	Curative Technologies, Inc.	Box 9052	E. Setauket	11733	Priv	2836 3843	6	516-689-7000	no
Mr.	Imre	Pinter	President	Diagnostic Technology, In.	240 Vanderbilt Motor	Hauppauge	11788	Priv	2836 3841	9	516-582-4949	?
Ms.	Nancy	Lacey	Bus. Manager	York Biologicals International	24 Old Wood Road	Stony Brook	11790	Priv	2835 2836	.61	516-751-6553	yes
Mr.	Peter	Fullam	President	Ernest F. Fullam, Inc.	900 Albany Shaker Rd.	Latham	12110	Priv	3821 3826 3827	1.5	518-785-5533	?
			Director	Virogenetics Corp.	465 Jordan Road	Troy	12180	Priv	NA	NA	518-283-8389	yes
Mr.	S.G.	Bart Jr.	President	The Virtis Company	815 Route 208	Gardiner	12525	Priv	2836 3559 3821	10	914-255-5000	yes
Mr.	I.K.	Kudrnac	President	Anachemia Chemicals, Inc.	3 Lincoln Boulevard	Rouses Point	12979	Priv	2819 2896	5	518-297-4444	yes

	Name		Title	Company	Street	City	ZIP	Type	SIC	Sales $MM	Phone	Export
Mr.	Daniel	Lundin	President	Bionique Testing Laboratories, Inc.	RR1 Box 2	Saranac Lake	12983	Priv	8071	.5	518-891-2356	yes
Mr.	Jack	Herz	President	Deltown Specialities	1712 Deltown Plaza	Fraser	13753	Priv	2836	10-25	607-746-3082	yes
Mr.	Subir	Chanda	President	Pro-Cons Labs, Inc.	25 Woodbridge Drive	Amherst	14228	Priv	3841	1	716-691-3978	yes
Mr.	Fayyaz	Hussain	President	American Bioorganics, Inc.	2236 Liberty Drive	Niagara Falls	14304	Priv	2836	4	716-283-1434	?*
			President	Clark Laboratories	215 PineStreet	Jamestown	14701	Priv	2835	NA	716-483-3851	yes
Ms.	Sarla	Aneja	President	Nutrimed Biotech	270 Langmuir Lab Cornell Univ. Res. Park	Ithaca	14850	Priv	2836	.44	607-257-1166	?
Mr.	G.	Collins	V.P., Finance	Sanofi Winthrop Pharmaceuticals U.S.	90 Park Avenue	New York	10016	Pub	2833 2834 2836	500	212-907-2000	no
Mr.	Ron	Bendavid	C.F.O.	Bio-Technology General Corp.	1250 Broadway, 20th Fl.	New York	10001	Pub	2833 2834 2836	4	212-239-0502	yes
Ms.	Robin	Sitver	Controller	Pfizer Inc. / Animal Health Division	235 E. 42nd Street	New York	10017	Pub	2834	6950	212-573-2323	yes
Mr.	Gerard	Dupuis	President	Lescarden, Inc.	790 Madison Avenue	New York	10021	Pub	2836	0	212-794-8990	?
Ms.	Patty	Conforti	Secretary	Daxor Corp.	350 Fifth Avenue	New York	10118	Pub	3841 8000	2	212-935-1430	no
Dr.	Harry	Meyer, Jr.	President	American Cyanamid/Medical Research Div.	North Middletown Road	Pearl River	10965	Pub	2830 2834 2836	4900	914-732-5000	yes
Mr.	John	Svitek	Controller	Modulations Optics, Inc.	100 Fgn st Drive	Greenvale	11548	Pub	3826 3663	1	516-484-8882	?
Mr.	Stanley	Wernick	Sr. V.P.	Pall Corporation	2200 Northern Boulevard	East Hills	11548	Pub	3821 3826	656	516-484-5400	yes
Mr.	Robert	Van Norstrand	V.P. Finance	Oncogene Science, Inc.	106 Chas Lindbergh Blv.	Uniondale	11553	Pub	2833 2835 2836 2869	10	516-222-0023	yes
Mr.	Dennis	Curtin	V.P. Finance	E-Z-EM, Inc.	717 Main Street	Westbury	11590	Pub	2819 3826 2841	88	516-333-8230	yes

LE SECTEUR ISRAÉLIEN DES BIOTECHNOLOGIES

1. LA POLITIQUE NATIONALE

Le gouvernement israélien reconnaît les avantages économiques que pourrait lui apporter l'expansion de son secteur des biotechnologies et a en conséquence inscrit celui-ci au rang de ses principales priorités. Les ministres des Sciences et de la Technologie et de l'Industrie et du Commerce ont adopté les recommandations exprimées par deux comités d'envergure nationale chargés d'étudier la recherche et le développement en général et les biotechnologies en particulier.

Le premier de ces deux comités, qui était dirigé par le professeur S. Yiftach, s'est attaché aux politiques nationales de recherche et de développement. Dans son rapport publié en 1984, il recommandait que les biotechnologies et le génie génétique soient considérés comme étant des domaines pouvant procurer de considérables avantages à Israël et devant en conséquence recevoir une attention prioritaire dans l'élaboration des programmes de financement gouvernementaux.

Le second comité, dont la présidence était assurée par le professeur E. Katzir, s'est intéressé aux moyens disponibles pour faire progresser la recherche et le développement en matière de biotechnologies en Israël. Dans ses recommandations, qui ont été achevées à la fin de 1988 et officiellement approuvées par le gouvernement en 1989, il proposait notamment :

1. que l'on reconnaisse l'importance des biotechnologies et de leurs applications industrielles et agricoles pour la croissance de l'économie du pays;

2. que l'on fixe un objectif d'exportations annuelles de 200 millions de dollars américains, à atteindre en dix ans au maximum;

3. et, dans ce but :

   a. que l'on augmente l'aide financière accordée par le ministère de l'Industrie et du Commerce à la R-D à 9 millions de dollars américains pour l'exercice financier de 1989 et que l'on accroisse cette enveloppe de 20 p. 100 dans chacune des années suivantes; on s'attend d'ailleurs à ce que l'industrie consente des investissements à tout le moins équivalents dans la recherche biotechnologique;

   b. que l'on amène les établissements d'enseignement à porter leur aide à la recherche et au développement à 4 millions de dollars américains au plus tard l'exercice financier 1989 et à continuer d'accroître leur soutien annuel au besoin. Les fonds nécessaires devraient être prélevés à même les deniers publics, en faisant appel au Conseil de la recherche et du développement, qui relève du ministère des Sciences et du Développement.

4. que l'on crée un comité public d'orientation chargé de veiller à l'application de la politique, ainsi que de mettre à jour et de coordonner tous les programmes et politiques adoptés par le gouvernement dans le domaine des biotechnologies, au chapitre de la recherche et du développement;

5. que l'on favorise l'expansion des secteurs suivants :

   a. méthodes innovatrices et efficaces de greffe et d'expression génétique;

b. techniques et procédés nouveaux pour la fermentation et la production;

c. techniques de culture des cellules animales et végétales;

d. nouvelles techniques de réalisation et d'utilisation de la catalyse biologique;

e. nouveaux biodétecteurs pour le diagnostic et les applications industrielles;

f. ingénierie protéique utilisant la mutagenèse provoquée et d'autres manipulations génétiques;

g. manipulations génétiques des plantes et animaux;

h. perfectionnement des différentes étapes des procédés en aval;

i. nouvelles techniques de croissance des algues et d'extraction des produits dérivés;

6. que l'on crée des centres d'excellence en biotechnologies dans les établissements d'enseignement, afin de favoriser la recherche et le développement et de nouer des liens avec l'industrie;

7. que l'on mette au point des programmes d'apprentissage des biotechnologies, afin que l'industrie puisse disposer d'une main-d'oeuvre technique et administrative bien formée;

8. que l'on crée des centres d'excellence spécialisés dans le domaine du génie phytogénétique;

9. que l'on fonde, au sein du Conseil de la recherche et du développement, un centre d'information sur les biotechnologies;

10. que l'on crée un fonds de bourses d'études, grâce auquel des experts du domaine des biotechnologies pourraient être invités en Israël;

11. que l'on imagine des incitatifs efficaces à l'investissement dans le secteur des biotechnologies, par la création de fonds de capitaux de risque et d'autres instruments financiers innovateurs.

Ces recommandations sont actuellement en voie d'être réalisées par le responsable de la recherche du ministère de l'Industrie et du Commerce, qui est le principal bailleur de fonds de la R-D industrielle, et par le Conseil de la recherche et du développement du ministère des Sciences et de la Technologie, chez qui les établissements d'enseignement trouvent l'essentiel de l'aide à la recherche appliquée. Toutes les parties font de sincères efforts pour suivre les recommandations qui ont trait à l'accroissement du soutien financier.

Ce sont les établissements d'enseignement supérieur qui s'acquittent de la plupart des travaux de recherche pure et qui jouent le rôle le plus important dans le domaine de la recherche biotechnologie appliquée et de la formation des chercheurs. Parmi ces établissements, on compte cinq universités (Université hébraïque de Jérusalem, université de Tel-Aviv, université Ben-Gourion du Neguev, université Bar-Ilan et université de Haïfa), un institut de technologie (Technion-Israël), un institut de recherche (l'Institut Weizmann des sciences) et un institut de recherche agricole (Agricultural Research Organization).

En 1990, l'enveloppe budgétaire consacrée à la recherche et au développement atteignait près de 36,4 millions de dollars américains. De cette somme, 21 millions provenaient du secteur privé, 9 millions du responsable de la recherche au sein du ministère de l'Industrie et du Commerce, 3,1 millions du

ministère des Sciences et du Développement (soit 500 000 dollars provenant du gouvernement israélien, le reste étant fourni par la CEE), 1,3 million de l'Académie israélienne des sciences (soit 800 000 dollars au titre de la recherche pure et 500 000 au titre de l'équipement) et 2 millions de quatre universités.

Il existe également deux centres binationaux, à savoir le Fonds binational pour les sciences et le Fonds binational pour la recherche et le développement industriels.

2. L'ADMINISTRATION

L'établissement des politiques nationales relève du Comité ministériel des sciences et de la technologie, dont les membres sont nommés par le Cabinet et dont font partie les ministres des Sciences et du Développement, de l'Industrie et du Commerce, de l'Éducation et de l'Énergie et des Infrastructures.

Les principaux organismes gouvernementaux qui s'intéressent à la recherche et au développement sont les suivants :

1. Le Conseil de la recherche et du développement, qui relève du ministère des Sciences et de la Technologie et a pour tâche de conseiller les autorités en ce qui concerne la formulation des politiques nationales dans ces domaines, de soutenir la recherche dans certaines disciplines scientifiques, de faciliter les rapports internationaux entre chercheurs

et de coordonner les activités scientifiques et technologiques intergouvernementales;

2. Le Bureau du responsable de la recherche du ministère de l'Industrie et du Commerce, qui dirige et soutient les travaux privés et favorise la conclusion d'ententes binationales diverses visant une action concertée pour le développement de la recherche, l'avancement de l'industrie israélienne et la mise en marché de ses produits;

3. Le Bureau du responsable de la recherche en agriculture, qui doit veiller sur toutes les initiatives de recherche en agriculture lancées en Israël.

Afin d'unifier la politique technologique nationale et de surveiller son application, les ministres intéressés ont créé un comité d'orientation, placé sous l'égide du Conseil national de la recherche et du développement.

3. CARACTÉRISTIQUES DU SECTEUR

Israël ne possède aucune infrastructure industrielle importante dans le domaine de la fermentation, ni atout particulier dans celui des produits pharmaceutiques. Par contre, son agriculture est dynamique, de même que son secteur agro-alimentaire, et elle dispose de scientifiques compétents. L'opinion générale veut que l'on considère l'encouragement, financier et autre, aux applications agricoles des biotechnologies (végétaux et micro-organismes vivant dans le sol) comme comptant parmi les secteurs prioritaires. On vise aussi à favoriser la recherche dans le domaine des appareils de diagnostic médical, car la mise en marché des résultats ne nécessite que peu

d'investissement. Plusieurs entreprises se sont déjà lancées dans ce domaine. On accorde aussi beaucoup d'importance aux travaux qui ont trait à la santé, notamment en ce qui concerne les nouvelles entités biologiques et les infusystèmes, car il existe déjà au pays d'importantes infrastructures de recherche biomédicale fondamentale de pointe. On s'intéresse de plus en plus à l'aquiculture et aux algues et à leurs dérivés, ainsi qu'au traitement des eaux usées d'origine humaine et industrielle. Les pesticides biologiques reçoivent également une attention croissante.

4. LES LOIS

En 1976, l'Académie israélienne des sciences a mis sur pied un comité dirigé par le professeur I. Sachs, qui avait pour tâche d'établir un cadre réglementaire pour la réalisation des expériences utilisant l'acide désoxyribonucléique (ADN). Ce comité a fait siennes les lignes directrices fixées par le National Institute of Health américain à l'égard des travaux de recherche utilisant des molécules d'ADN recombinant et s'est assuré qu'elles soient acceptées par les chercheurs universitaires et industriels.

Le ministère de l'Agriculture a confié à un comité spécial la mise au point d'un projet de lignes directrices pour les expériences liées aux plantes transgéniques.

Un comité consultatif du ministère de la Santé s'intéresse de près à toutes les questions qui se posent relativement aux expériences utilisant la technologie de l'ADN recombinant sur les humains. Il doit donner son

autorisation à toute initiative de ce genre. Jusqu'ici, aucune autorisation n'a été accordée.

5. LA PROTECTION DE LA PROPRIÉTÉ INTELLECTUELLE

Israël a signé la convention de Paris sur la protection de la propriété intellectuelle et s'est dotée d'une loi sur les brevets qui s'apparente à celle de plusieurs pays d'Europe de l'Ouest. À l'heure actuelle, la législation israélienne ne protège que les micro-organismes artificiellement fabriqués. Ce sont les droits du phytogénéticien qui prévalent dans le cas des plantes. La loi est actuellement en voie de révision et on s'attend que, une fois l'exercice terminé, les plantes et les animaux fabriqués par manipulation génétique soient également protégés.

6. LES RESSOURCES GÉNÉTIQUES

On a créé en 1978 une banque de gènes pour fins agricoles, qui est chargée de recueillir, de conserver et d'analyser les variants génétiques des plantes appartenant aux groupes suivants : céréales d'hiver et d'été, légumineuses, légumes, variétés ornementales, grandes cultures, plantes médicinales, épices et réserves génétiques naturelles. On s'attend à ce que les cellules pour la culture tissulaire s'ajoutent éventuellement à cette liste. Cette banque est logée au Centre de recherche agricole Volcani et fait partie d'un réseau international de banques de végétaux. Elle est en mesure de répondre aux

demandes de matériel génétique, sous réserve de l'approbation d'un comité spécial. Il n'existe aucune collection microbienne nationale.

7. LE DÉVELOPPEMENT COMMERCIAL

Il existe actuellement en Israël près de 20 entreprises spécialisées dans le domaine des biotechnologies, dont le personnel total avoisine le millier d'employés et la production réunie atteignait en 1990 environ 50 millions de dollars américains.

La plupart de ces entreprises oeuvrent dans le secteur des appareils de diagnostic médical (Orgenics, Savion-Diatech, BioHyTech, Hylabs, Virohim, EldanTech). Deux autres produisent des médicaments (Interpharm et Biotechnology General) et deux encore du matériel de recherche (Makor et BioMakor). Une autre (Gadot) se spécialise dans la production d'acide citrique par fermentation. Quatre établissements sont consacrés au secteur agricole (G.G. Animals, P.B. Industries, Gedera Seeds et F.R.M.). Certains fabriquent des produits pour l'aquiculture et d'autres des additifs alimentaires et des substances diverses («deoresins»).

L'origine de ces entreprises est fort variée. La plupart ont été mises sur pied par des scientifiques ou sont intimement liées à une université ou à un institut de recherche. Quelques-unes ont été fondées par des multinationales (Miles et Serono). Dans certains cas, le lancement a été réalisé à l'aide de capitaux de risque (Biotechnology General et Diatech) et, dans d'autres, grâce à la participation de multinationales (Interpharm et Gadot), d'investisseurs

privés et d'entreprises existantes (Orgenics et Savion). Deux établissements ont reçu un financement considérable du public (OTC de New York) ou, comme la EldanTech, ont agi par l'intermédiaire de la Bourse de Tel-Aviv.

Certaines de ces entreprises ont vu le jour sous la forme de sociétés de gestion étrangères exploitant des filiales locales afin de disposer d'une plus grande flexibilité financière.

La plupart ont conclu des ententes de coentreprise avec des interlocuteurs étrangers, principalement pour les fins de la mise en marché de leurs produits, mais aussi dans le but de perfectionner ceux-ci et de réaliser des études cliniques.

Le gouvernement joue un rôle important dans le financement à long terme de la recherche et du développement et offre des bourses par l'entremise du responsable de la recherche au sein du ministère de l'Industrie et du Commerce.

P.j. : Les biotechnologies en Israël - Profil d'entreprises

Atalia Hausvater
Tel-Aviv, février 1992

ANNEXE A

Les biotechnologies en Israël

Compétences : Résumé des meilleures possibilités de coentreprise

1. Utilisation de l'ADN recombinant et de la manipulation génétique pour la mise au point de biomolécules et de médicaments.

   Hormones de croissance, vaccins antihépatite, interférons et cytokines.

2. Utilisation de l'ADN recombinant pour le diagnostic
   - Immuno-essais
   - Sondes d'ADN (maladies virales et héréditaires)
   - Biodétecteurs
   - Bioluminescence des bactériophages

3. Utilisation de la biomasse dans les produits naturels
   - Production de bêtacarotène
   - Applications agricoles
   - Culture de cellules végétales
   - Pesticides biologiques
   - Sondes d'ADN pour la détection des phytovirus

Biotechnologies[1] 174EA

IMPORTANCE OF THE SECTOR

A new industry made up of a mosaic of companies specializing in many areas with a wide variety of products.

The concept of **biotechnology** appeared in France in the early 1980s. In the past few years this concept has been based on the specific skills of biotechnologies such as genetic engineering, cell culture and enzymology.

It is difficult to describe the main characteristics of the biotechnologies sector in France or in other countries for that matter. They cannot be considered as one industrial sector since several industries are likely to use biotechnologies. They include techniques that are spreading to many industrial sectors and that are bringing about changes in them. Thus, discoveries in genetic engineering could benefit sectors as dissimilar as agriculture, agri-food, pharmaceutics or cosmetics. Companies that intervene in biotechnologies are relatively varied in size.

More than half of the companies employ fewer than 100 people and only 8% have more than 10,000 employees. This is due to the newness of biotechnologies which appeared only in the early 80s and to the number of subsidiaries created by the oldest companies.

In France, some of the large groups soon tested the advantages of the new biotechnologies by participating in the creation of small companies at the beginning of the 80s. Examples that attest to this are the participation of BSN and LVMH in the starting capital of Transgène that of Rhône Poulenc Mérieux in Immunotech and of Roussel Uclaf in Bioeurope.

This type of funding should give large groups an idea of how they could benefit from new technologies and give them incentive to establish biotechnology research units. The latter could be added to research units that already exist or specialized subsidiaries could be set up.

The hierarchy of activities will remain the same for the next five years. Only the environment and energy sectors appear to create permanent vocations.

The newness of biotechnologies, as well as their numerous applications explain why it is so difficult to characterize the resulting products. Companies sell two types of products: common consumer products that have resulted from biotechnological procedures and

[1]Source: Ernst & Young

biotechnological know-how, the latter being in the form of licences, biotechnological research material or Research and Development contracts.

Large companies, given that their initial activity was not biotechnologies, essentially sell products whether they are of biotechnological origin or not. Small companies generally focus on one or several applications of biotechnologies and can be divided into two groups:

- **recent companies** which have not yet marketed any products but which partially finance their activity by selling some of their research;

- **Research and Development companies** which sell their know-how. Typical examples of this type of company are Transgène and Bioeurope.

PRODUCTION AND MARKETING

Most companies wish to produce and market their products in an increasingly international market at the risk of being destabilized.

Small multifield research structures which primarily sell knowledge seem to be orienting themselves toward various forms of collaboration with companies that already have production units so that they only have to manage technical know-how through patents. Production requires financing and technical expertise that small structures do not usually possess.

Biotechnology companies consider it important to set up production structures during the development phase or, when required, while waiting for authorization. This is logical as marketing a product does not make sense economically unless industrial production procedures permit production at competitive prices.

The relative proportion of sales will decrease in the future and more emphasis will be placed on licences and patents as well as on collaboration in Research and Development. One of the main elements that affect sales is assigning a price to a product. Three factors are important when setting a price: the price of competitive products that already exist, production cost and the efficiency of patent protection.

Given that the current implantation of biotechnological companies is concentrated in the European Community (56%), a relatively high proportion of those being in France (57%), these companies predict a better implantation in the rest of Europe and also in Japan in the future.

To penetrate the various markets, biotechnological companies will have to favor direct sales for markets that are near them, foreign distribution channels, biotechnology companies in countries that are advanced in this field (United States, EEC) and, above all, other companies for Japan.

As direct sale is a method that is rarely adopted to enter foreign markets, marketing products does not require a prohibitive investment. However, the cost depends on the size of the market under consideration. If a small company, then, discovers a product for which

the market is big enough to attract leaders in that particular sector, investment would be consistent with this and perhaps too high for the small company to assume it alone.

Moreover, companies must acquire the expertise needed for production and marketing as they are different from those required for research. Companies that embark on the production process must overcome obstacles in 78% of all cases. There are several types of problems:

- **the problem of financing**, the cost of materials and the cost of expertise it must acquire as production is different from research;

- **the problem of entering a different field**, finding a decisive size, the standstill point, the scale of the economies and the respect of certain regulations, the problem of finding an adapted tool and adopting new regulations.

Production problems encountered by companies are mainly those of finding the adapted tool (20%) and finding financial resources (18%).

ADDITIONAL SOURCES OF INFORMATION

Useful address:

BIOFUTUR
15, rue Buffon
75005 Paris
Tel: (33-1) 47.07.11.22

This magazine is in contact with companies involved in this sector and publishes a monthly report of all new biotechnological developments.

Biotechnologies[1]

IMPORTANCE DU SECTEUR

Une industrie jeune, composée d'une mosaïque d'entreprises aux domaines d'activités multiples, aux produits hétérogènes.

Le concept de **biotechnologies** est apparu en France dans le début des années 80, et est devenu un sujet très médiatique depuis quelques années. Les entreprises créées après 1980 se sont basées sur des compétences particulières des biotechnologies nouvelles comme le génie génétique, la culture de cellules ou l'enzymologie.

Il est difficile de caractériser le secteur industriel des biotechnologies, en France comme ailleurs. On ne peut parler d'un secteur industriel unique car plusieurs secteurs industriels sont susceptibles d'utiliser les biotechnologies. Les biotechnologies sont un ensemble de techniques diffusantes qui peuvent induire des changements dans de nombreux secteurs industriels. Ainsi, les découvertes du génie génétique pourront profiter à des secteurs aussi dissemblables que l'agriculture, l'agro-alimentaire, la pharmacie ou la cosmétique. Aussi, les entreprises intervenant dans les biotechnologies sont-elles de tailles relativement variées.

Plus de la moitié des entreprises emploient moins de 100 personnes, et seulement 8% comptent plus de 10,000 personnes. Ce phénomène est dû à la nouveauté de la discipline des biotechnologies, qui n'est apparue comme telle qu'au début des années 80 et au nombre de filiales créées par des entreprises plus anciennes.

En France, certains grands groupes ont très vite testé l'intérêt des nouvelles biotechnologies en participant à la création de petites entreprises dans le début des années 80. En attestent les participations de BSN et de LVMH dans le capital de départ de Transgène, de Rhône-Poulenc Mérieux dans Immunotech, de Roussel Uclaf dans Bioeurope.

Ces participations devaient donner aux grands groupes un avant-goût des profits qu'ils pourraient tirer des nouvelles technologies et les inciter à se doter d'unités de recherche en interne, soit en les intégrant à leur recherche existante, soit en créant une filiale spécifique.

La hiérarchisation des activités reste la même dans les cinq années à venir. Seuls les secteurs de l'environnement et de l'énergie semblent susciter des vocations à terme.

La jeunesse des biotechnologies, ainsi que la multitude de leurs applications expliquent la difficulté à caractériser les produits issus de biotechnologies. Les entreprises vendent deux types de produits: des produits de grande consommation issus de procédés biotechnologiques ou un savoir-faire biotechnologique que ce soit sous la forme de licences.

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[1]Source: Ernst & Young

de matériel pour la recherche biotechnologique ou de contrats de Recherche et Développement.

Les grandes entreprises vendent en priorité des produits, issus ou non de la recherche biotechnologique, leur activité d'origine n'étant pas les biotechnologies. Les petites entreprises sont en général focalisées sur une ou plusieurs applications des biotechnologies. Elles se divisent en deux catégories:

- **les entreprises récentes** qui n'ont pas encore de produits sur le marché, mais qui financent une partie de leur activité en vendant une partie de leur recherche;

- **les entreprises de Recherche et Développement** qui ont pour vocation de vendre leur savoir-faire, Transgène ou Bioeurope en étant des exemples typiques.

PRODUCTION ET COMMERCIALISATION

Une majorité d'entreprises souhaite produire et commercialiser leurs produits dans un contexte de plus en plus international, au risque de fragiliser leur équilibre.

Les petites structures de recherche pluridomaines, qui vendent plutôt un savoir-faire, semblent s'orienter vers des formes de collaboration avec des entreprises déjà dotées de structures de production afin de ne gérer que le savoir-faire via les brevets. En effet, la production nécessite un financement et une maîtrise technique qui ne sont généralement pas disponibles dans de petites structures.

Les entreprises de biotechnologies jugent utile d'organiser les structures de production dès le stade de développement, ou, le cas échéant, pendant le délai d'obtention de l'autorisation. Cette situation est logique, car la mise sur le marché d'un produit n'a de sens économique que si le procédé de production industrielle permet une production à des prix compétitifs.

Le poids relatif des ventes va régresser dans l'avenir pour laisser une place plus importante aux royalties sur licences et brevets et, secondairement, à la collaboration en Recherche et Développement. Un des éléments essentiels conditionnant les ventes tient à la fixation du prix de vente des produits. Pour fixer celui-ci, trois indicateurs apparaissent importants: le prix des produits concurrents existants, le coût de production et l'efficacité de la protection des brevets.

Si l'implantation actuelle des entreprises biotechnologiques est centrée sur l'ensemble de la Communauté Européenne (56%) avec un poids relatif de la France très important (57% de cet ensemble), il semble que celles-ci envisagent pour l'avenir une meilleure implantation dans le reste de l'Europe, mais également au Japon.

Pour pénétrer les différents marchés, les entreprises biotechnologiques vont utiliser de façon privilégiée la vente directe pour les marchés proches, les canaux de distribution étrangers ainsi que les entreprises de biotechnologies dans les pays où elles sont particulièrement développées en tant que telles (Etats-Unis, CEE) mais aussi et surtout les autres entreprises pour le Japon.

Dans la mesure où la vente directe pour la pénétration des marchés étrangers est rarement adoptée, la commercialisation des produits ne demande pas d'investissement prohibitif. Cependant, ce coût dépend de la taille du marché considéré. Ainsi, si une petite entreprise découvre un produit dont le marché est suffisamment important pour intéresser les majors du secteur, l'investissement à faire sera conséquent, peut-être trop pour qu'elle puisse l'assumer seule.

Par ailleurs, le métier de production-commercialisation demande des compétences différentes de celui de la recherche, que les entreprises doivent acquérir. Les entreprises qui s'engagent dans le processus de production doivent affronter des obstacles dans 78% des cas. Ces difficultés sont de plusieurs ordres:

- **difficulté de financement**, avec le coût du matériel, mais aussi le coût des compétences dont elles doivent se doter, la production étant un autre métier que la recherche;

- **difficulté pour aborder un nouveau métier,** avec la recherche d'une taille critique, d'un point mort, d'économies d'échelle et le respect d'un certain nombre de réglementations, difficulté à trouver un outil adapté, problème pour intégrer de nouvelles réglementations.

Les problèmes de production rencontrés par les entreprises consistent essentiellement dans la difficulté de trouver l'outil adapté (20%), suivi de près par la recherche de ressources financières (18%).

MIEUX CONNAITRE LE SECTEUR

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Ce journal publie mensuellement tous les nouveaux développements dans le domaine de la biotechnologie et est en contact avec toutes les sociétés impliquées dans ce secteur.

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BACKGROUND ON BIOTECHNOLOGY OPPORTUNITIES IN:

Netherlands (The Hague)

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BIOTECHNOLOGY IN THE NETHERLANDS

Biotechnology in the Netherlands is rapidly expanding. Before 1985 some 20 major companies were involved in biotechnology; this number increased to more than 120 in 1990 (see table 1). Since 1981, the Netherlands has adopted a government policy aimed at creating a climate favorable to investments. The biotechnology stimulation programme comprises various activities, ranging from education through information dissemination, commercial incentives, cooperation and support for newly formed companies.

Biotechnology in the Netherlands is strongly related to main Dutch industries like agro-food, chemical and environmental industries.

The main application areas are:

1. Agriculture
2. Food and Feeds
3. Chemical
4. Environment
5. Health care
6. Equipment

1. Agriculture

World wide, the Netherlands ranks second as exporter of agricultural products; Dutch dairy products, meat, eggs, vegetables, fruits and flowers are particularly well-known.
In the past 15 years biotechnology techniques, for example vitro cell culture techniques used in plant breeding and propagation, developed rapidly.
Also the introduction of somatic cell hybridization and genetic engineering offers exciting potential to improve breeding programs. With genetic engineering techniques, important agricultural traits such as stress tolerance, resistance against pathogens and herbicides, and higher protein yields are introduced to plants.
MOGEN carried out the first field test with transformed potato plants.
Plant breeding and seed companies such as VAN DER HAVE and ZAADUNIE have by now adopted micropropagation techniques as a standard tool to facilitate their operations

2. Food and Feeds

The food production and processing industry is the oldest and largest industry using biotechnological processes.
In terms of expenditure, this sector is the leading market for biotechnical products. Beer, wine and cheese represents more than 75% of the turnover of all biotechnological products.
Several prominent companies and institutes employ biotechnological methods to supply and preserve food. Companies as HEINEKEN, GIST-BROCADES and UNILEVER produce yeast and enzymes for food and detergents on a commercial basis.
But also smaller companies and institutes such as NIZO (Netherlands Institute for Dairy Research) run extensive research programs to improve their production methods and quality of their products.
Research is done on the latest biotechnical techniques, such as genetic engineering, DNA-hybridization and monoclonal antibodies.

3. Chemical

The development of biotechnology in the chemical industry also has strong relations with the agricultural sector. Companies such as AVEBE, potato starch GLUCANA, gluconates use fermentation and enzymatic techniques. CCA BIOCHEM uses fermentation techniques to produce lactic acid, whereas DSM uses enzymatic production techniques to produce D-amino acids. DSM is also planning to use biotechnological methods to produce aspartame.

3. Environment

Biotechnological techniques have long been used to reduce pollution. At present, the Netherlands is regarded as a fore runner in this area.
Several years ago, DSM installed the industrial aerobic/anaerobic waste-water purification plant, specially designed to handle nitrogen compounds. The new trend in biological waste-water purification is in the anaerobic field: the biothane UASB reactor "Upflow Anaerobic Sludge Blanket" was jointly developed by several universities and sugar manufacturers. Well known in Canada is PAQUES, a company which markets waste-water treatment systems. GIST-BROCADES developed an anaerobic reactor using the fluidized-bed principle.

An excess of manure causes an enormous contamination of soil with respect to copper phosphate and ammonia. Since 1978, over 30 manure convertors have been installed.
Other companies like the VAM, RUTTE and ACEC are specialized in the area of anaerobic digestion of domestic refuse.
Various research groups and companies are trying to clean polluted soil with microbiological methods in laboratory or pilot scale experiments. Whereas DE RUITER MILIEU TECHNOLOGY, MOURIK and BIOCLAIR are using on-site landfarming techniques.

4. Health Care

The most important area of research in the pharmaceutical and medical field is the development of novel monoclonal antibodies for therapeutic and diagnostic purposes.
Among the major Dutch companies AKZO developed new peptide hormones by replacing the costly chemical synthesis with recombinant DNA techniques to some extent. ORGANON develops diagnostics for human viral diseases. GIST-BROCADES and DUPHAR, an affiliate of SOLVAY are active in vaccine production.
Smaller companies are also active in medical biotechnology.
BIOINTERMEDIAIR is engaged in the production of monoclonal antibodies on a contract base. DE ROVER CHEMIE produces kilogram quantities of fine chemicals, including optical isomers.

7. Equipment

The biotechnology process requires custom-made equipment. APPLIKON DEPENDABLE INSTRUMENTS and CONTACT-FLOW developed a range of fermentation and auxiliary equipment, together with computerized bioprocess control systems. WAFLIN is developing membrane installations for reverse osmosis, ultra-filtration and micro-filtration.
A small but important portion of research is devoted to the development of suitable biosensors.

In all fields of biotechnology the companies are cooperating with the Universities and the research institutes such as TNO (the Netherlands Organization for Applied Research), the RIVM (the National Institute for Public Health and Environmental Hygiene) and ATO (the Agrotechnical research Institute).

The Canada-Netherlands biotechnology pilot project

This project aims to promote collaboration in R&D between Dutch and Canadian biotechnology companies and is supported by the Netherlands Ministry of Economic Affairs and the Canadian National Research Council.
A number of Canadian and Netherlands companies have started new partnerships due to this project.

For more information about biotechnology in the Netherlands please contact Prisca Haemers Technology Development Officer in the Netherlands.

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November 1990

List of Netherlands Companies and Organizations in Biotechnology (1990)

Agec
Akzo
Akzo pharma
Applikon Dependable Instruments
Artificial Insemination and Embryo Transfer Stations
Artu Biologicals
Avebe
Bejo Seeds
Bioclear
Bio-Intermediair
BIOMOS
Biores
Biotechnology Policy Unit (BPU)
BIRD Engineering
Bodemsanering Nederland
Brinkman
CCA biochem
CC Friesland
Cebeco
Cehave
Centocor Europe
Chambers of Commerce
ClairTech
Coberco
Cofok
Comprimo
Contact Flow
Co-operatuve Rennet Factory CSK
CSM
Dalton
Denka
Diagned
Diosynth
DMV Campina
Domo
DSM
DSM Andeno
DSM Special Products
Duphar
Dutch Venture Capital Association
Embrytec
Enza Seeds
Enzylin
Eurobrid
EuroCetus
Eurocione
Eurodiagnostics
Eurosequence
Flongene
Genpharm
Glucona
Gist-brocades
Haskoning
Heineken
Hendrix
Heybroek
Holland Biotechnology
Holland Sweetener Company
Holland Technology Systems (HTTS)
HyCult
Hypeco
Innovation Centers
International Bio-Syntheucs (IBIS)
Intervet
Joordens Seeds
Kennemer Luchtbehandeling
Kevgene
Könst Nurseries
Leiden Bioscience Park
Linde
Livestock Control
MCA-Development
Melkunie
Ministry of Agriculture, Nature Management and Fisheries (LNV)
Ministry of Economic Affairs (EZ)
Ministry of Education and Science (O&W)
Mogen
Mourik Groot-Ammers
Multiplant
Nefarma
Netherlands Biotechnological Society (NBV)
Netherlands Foreign Investment Agency (NFIA)
Netherlands Industrial and Agricultural Biotechnology Association (NIABA)
Nickerson-Zwaan
Nordic
Nunhems Seeds
Organon
Organon Teknika
Paques
Pharmacia
Phytonova
Plant Production Systems
Probicom Research
Procom
Promega
Rijk Zwaan
Royal Dutch Cattle Herd Company
Royal Sluis
Ruiter, De, Milieu Technologie
Ruiter & Sons
Rutte
RZ Research
Sanbio
SATT CONTROL
Schering AAgrunol
StiPT Executive Agency for Biotechnology Policy
Tauw Infraconsult
Technolution
Terra Nigra
TS Agro Research and Development
TTT
Quest International
Shell Chemicals
Suikerunie
Timmerman's Animal Feeds
Transfer Offices
Unilever
United Dairy Men
U-Gene Research
VAM
Van Banning Netco
Van der Have
Van Tongeren
Vitro Flora
Wafilin
Wageningen Agrobusiness Science Park
Wessanen
X-Flow
Zaadunie
Zegwaard
Zelder
Zernike Science Park

table 1

The Netherlands

A $1 Billion Sporting Goods Market

Canadian exporters looking for opportunities in sporting goods sales should take aim at the Netherlands market.

That advice comes from the Commercial Division of the Canadian Embassy in the Hague —it has identified a sporting goods market worth $1.1 billion.

The Market

The breakdown of that market scoreboard (for 1989) is as follows:

- sports clothing and sports-type casual wear, $365 million;
- sporting articles and accessories, $314 million;
- sports footwear, $225 million; and
- camping goods, $211 million.

Of interest to Canadian exporters, the following scores (figures in $ millions) of the leading sporting goods imported by the Netherlands in 1989 reveal that sports shoes topped the list, with ice skates coming in last:

- sports shoes, 72;
- camping equipment, 35;
- equipment for gymnastics, athletics and bodybuilding, 19;
- ski equipment, including boots, 19,
- boards for windsurfing, 10;
- tennis racquets, 8,5;
- golf equipment, 8;
- roller skates, 3; and
- ice skates (figure, speed, hockey), 1.8.

For 1990, the Dutch imports of sporting goods, including sportswear, sports footwear and camping equipment, is estimated to have reached close to $450 million.

The following were the top ten sports, in order of importance, in the Netherlands (population of 15 million) in 1989: soccer, tennis, gymnastics, volleyball, swimming and water polo, skiing, speed skating and figure skating, field hockey, badminton and korfball.

Foreign Suppliers

Major foreign suppliers to the Dutch market are countries of the Far East —both through direct contracting with major Dutch buyers and indirectly through imports from European countries of brand goods and equipment made on specification in the Pacific Rim.

These European sources include Germany, France, Italy, Austria and Switzerland, while Czechoslovakia and Romania are the chief suppliers of low-priced skates.

It is expected that the Far East will continue to dominate the local Dutch supply scene as long as wages there remain substantially below those paid in developed countries.

But the overriding factor that determines purchase decisions with Dutch buyers can be summarized as follows: the best quality at the lowest price —although there is a willingness to pay more for prestigious world-class brand names, especially in the case of sportswear such as Nike, Lacoste, and L.A. Gear.

Distribution Channels

The best way to cover the Netherlands, according to the Canadian Embassy, is through an importer/distributor buying for his own account and working on an exclusive basis —a number of local importers have inroads in nearby markets such as Belgium, and parts of Germany.

An agent should provide a suitable representational base for sports clothing and sports-look apparel. Direct sales are a recommended option only if the number of retail outlets is limited due to the nature of the product. Otherwise, direct sales would not provide full market coverage and would be of interest only if major orders are involved.

Trade Shows

As local shows SPOVAK Spring (January) and SPOVAK Fall (September) are just that —very much local in nature, held in Utrecht— many Dutch agents, importers and retailers visit such large international exhibitions as ISPO Spring and Fall in Munich, Germany. Canadian companies are encouraged to make themselves and their products known at such international trade shows.

Standards

Safety and legal standards applicable in North America generally are acceptable in the Netherlands. For specific information on European Community (EC) standards, contact the Standards Council of Canada, 350 Sparks St, Suite 1200, Ottawa, Ont. K1P 6N7. Tel.: (613) 238-3222. Fax: (613) 995-4564.

Import Duties

There are no restrictions on imports of sporting goods, sportswear and sports footwear into the Netherlands. Duties range from 14 per cent on sportswear and 20 per cent on sports shoes to 6 per cent on most sports articles and accessories.

The duties are payable ad valorem on the Canadian FOB cost plus the cost of freight and insurance. The local value-added tax (comparable to Canada's GST) currently stands at 18.5 per cent.

Language of Business

The Dutch widely use English as a second language, so there should be no problem in communicating with local agents and buyers. French is not commonly spoken except by firms doing business with French-speaking markets.

Contacts

For more information on the sporting goods market in the Netherlands, contact the Association of Sporting Goods Manufacturers and Wholesalers, P.O. Box 9230, 3506 GE Utrecht, Netherlands. Tel.: (0) 30-562611. Fax: (0) 30-562626.

Or contact F.W. Zechner, Commercial Officer, Commercial Division, Canadian Embassy, P.O. Box

Continued on page 10— **Netherlands**

Netherlands — *Continued from page 8*

30820, 2500 GV The Hague, Netherlands. Tel.: (0) 70-361-4111. Fax: (0) 70 356-2823.

For more information on trade opportunities in the Netherlands, contact LUC SANTERRE, Western Europe Trade, Investment and Technology Division (RWT), External Affairs and International Trade Canada (EAITC). Tel.: (613) 995-6440. Fax: (613) 995-6319.

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ENCLOSURES / ANNEXES: X

DISTRIBUTION

Enclosed is a complete report on Biotechnology in Israel.

Appendix A:

Canadian Biotech companies and matching Israeli companies who can join forces in various forms of industrial cooperation.

Appendix B:

List of Canadian scientists who are working or have worked in the past on joint R & D projects with Israeli scientists. These scientists serve in advisory capacity to industry in Canada and can give credence to planned outgoing mission.

Note: Bearing in mind the current situation in the Middle East it might be more logical to plan an Incoming Mission from Israel. Mission can be recruited from list in Appendix A (providing technologies are of interest to Canadian companies) and from Appendix B.
In case this plan is approved, assistance in funding travel might be required.

List of research projects was sent to GMT in October 1990.

BIOTECHNOLOGY - ISRAEL

1. NATIONAL POLICY

The Government of Israel recognizes the potential of biotechnology for economic growth, and accordingly gives high priority to its support and encouragement. The Minister of Science and Technology and the Minister of Industry and Trade have adopted the recommendations made by two national committees in connection with R & D in general and biotechnology in particular.

The first committee, chaired by prof. S. Yiftach, dealt with national policies of R&D. In its report, submitted in 1984, it was recommended that biotechnology and genetic engineering be regarded as areas having important advantages for Israel, and therefore be accorded high priority in governmental funding plans.

The second committee, chaired by Prof. E. Katzir, dealt with ways of advance biotechnological R&D in Israel. Its recommendations, contained in its report of late 1988 and officially adopted by the Government in 1989, include the following:

1. Recognize biotechnology and its applications in industry and agriculture as essential for economic growth in Israel.
2. Aim to achieve an annual export of US$ 200 million within the next decade.
3. In order to achieve this goal:

   a.Increase support for R&D by the Ministry of Industry and Trade to US$ 8 million

for fiscal '89, and raise this amount by 20 % each year. It is expected that funding of at least a similar order will be invested by Industry in biotechnological R&D directed towards industry and agriculture;

b. Increase support for R&D in academic institutes to a level of US$ 4 million by fiscal '89, and continue to increase the annual amount according to need. This support should come from governmental funds through the Council for Research and Development (NCRD) administered by the Ministry of Science and Development.

4. Establish a public steering committee to supervise implementation of the policy and to update and coordinate all programs and policies of the Government in R&D-related biotechnology.

5. Encourage and develop the following fields:

a. Novel and efficient methods for gene implantation and expression;

b. New techniques and processes of fermentation and production;

c. Culturing techniques for animal and plant cells;

d. New techniques for biocatalysis and its utilization;

e. New biosensors for diagnostic and industrial use;

f. Protein engineering using site directed mutagenesis and other genetic manipulations;

g. Genetic manipulation of plants and animals;

h. Development of the various stages of downstream processes;

i. New techniques for promoting growth of algae and extraction of algal products;

6. Establish centers of excellence for biotechnology within the academic institutes in order to promote R&D in biotechnology and serve as a link with industry.

7. Implement educational programs in biotechnology in order to provide industry with

.../3

manpower suitably trained in technical as well as in managerial skills.

8. Establish centers of excellence specializing in plant genetic engineering.

9. Establish an information center for biotechnology within the NCRD.

10. Set up a fund for fellowships and for visiting experts in biotechnology.

11. Find effective ways to encourage investment in the biotechnology industry by establishing venture funds and other innovative financial instruments.

These recommendations are currently being implemented by the Chief Scientist of the Ministry of Industry and Trade, which is the main funding source for industrial R&D, and by the NCRD of the Ministry of Science and Technology, which is the main funding source for academic applied R&D. A genuine effort is being made to increase financial support as recommended.

Most of the basic and much of the applied biotechnological research, as well as much of the training of scientific manpower, is concentrated in the institutes of higher learning. These include five universities (The Hebrew University of Jerusalem, Tel-Aviv University, The Ben-Gurion University of the Negev, Bar-Ilan University, Haifa University), one institute of technology (Technion - Israel Institute of Technology), one research institute (Weizmann Institute of Science) and one agricultural research institute (Agricultural Research Organization).

The budget for biotechnological R&D in 1988 was approximately US$ 17 million. The funds were provided by the industrial establishment (US$ 8 million), the Ministry

of Industry and Trade (US$ 6.5 million) and the Ministry of Science and Development (US$ 2.2 million). The funding figures for fiscal '89 are not yet known.

2. ADMINISTRATION

National policy in science and technology is determined by the Ministerial Committee for Science and Technology, which is appointed by the Cabinet and includes the Ministers of Science and Development, Industry and Trade, Education, and Energy and Infrastructure.

The main governmental executive bodies involved in R&D are the following:

1. The National Council for R&d (NCRD), which is part of the Ministry of Science and Technology. It advises the Government on the formulation of national science and technology policies, supports research on selected scientific topics, fosters international scientific relations and coordinates intergovernmental activities relating to science and technology.
2. The Office of the Chief Scientist of the Ministry of Industry and Trade, which directs and supports industrial R&D and promoted various binational cooperative agreements geared to the expansion of research and marketing of Israeli industry and its products.
3. The Office of the Chief Scientist of Agriculture, which is responsible for the overall agricultural research effort in Israel.

In order to coordinate national policy on biotechnology and supervise its implementation, the Ministers involved have appointed a steering committee, to be administered by the NCRD.

3. SECTORIAL INTEREST

Israel does not have any significant fermentation industry, nor particular strength in pharmaceuticals. It has, however, a dynamic agriculture and agro-industry and a strong research community. There is a general feeling that the development and funding of biotechnology related to agriculture (plants and soil microorganisms) should enjoy a high priority. Also considered worth promoting is medical diagnostics, since only modest funding is required to commercialize it, and since there are already several companies involved in this field. Activities related to health care are also accorded high priority, especially new biological entities and drug delivery technologies related to biological products, as there exists a significant and advanced basic research activity in the biomedical field. There is a growing interest in aquaculture and in algae and its products, as well as in sewage and waste-water treatments. Another growing field is biological pesticides.

4. LEGISLATION

In 1976 the National Academy of Sciences set up a committee, chaired by Prof. L. Sachs, for regulatory oversight of DNA experiments. The NIH guidelines for Research Involving Recombinant DNA Molecules were adopted by the Committee and accepted by scientists in the universities and in industry.

The ministry of Agriculture has appointed a special committee to recommend guidelines for experiments relating to transgenic plants. Its report will be submitted in late 1989.

Issues relating to human experimentation with recombinant DNA are supervised by a general committee of clinical experimentation, which is an advisory arm of the Ministry of Health. Any experiment involving human beings and using recombinant DNA technology must be approved in advance. so far no applications for approval have been granted.

5. INTELLECTUAL PROPERTY RIGHTS

Israel is a signatory of the Paris Treaty, which deals with patents. In addition, Israel has a patent law similar to that in many Western European countries. As it stands, the law allows for the protection of genetically engineered micro-organisms. Plants are protected by breeder rights. The law is currently being reviewed and once revised, is expected to allow also for the protection of genetically engineered plants and animals.

6. GENETIC RESOURCES

A gene bank for agriculturally important plants was established in 1978. The bank is responsible for collecting, preserving and analyzing genetic variant of plants in the following groups: winter and summer cereals, legumes, vegetables, ornamentals, cash crops, medicinal plants, spices, and natural gene reserves. Tissue culture cells are expected to be included in the future. the bank is located at the Volcani Research Center for Agriculture, and is part of an international network of plant banks. Genetic material is available from the bank, subject to approval by a special committee. No national microbial collections are available.

7. COMMERCIAL DEVELOPMENT

About 20 biotechnological companies are in operation, employing close to one thousand people. The aggregated production is of the order of US$ 50 million (1989).

The largest group of companies is involved in medical diagnostics (Orgenics, Savion, BioHyTech, Hylabs, Virolum, Diatech, EldanTech). Two companies are involved in pharmaceutical products (Interpharm and Biotechnology General), and two produce research materials (Makor and BioMakor). One company (Gadot) produces citric acid by fermentation. Four companies produce agricultural products (G.G. Animals, P.B. Industries, Gedera Seeds, F.R.M.). Some companies deal with aquaculture products, and other produce food additives and deoresins.

The origins of the companies vary. Most of them were initiated by scientists or have a strong links with a university or research institute. A number of companies originated in multinational corporations (Miles and Serono). Initial funding in some cases came from venture capital (Biotechnology General and Diatech) and in others from multinational companies (Interpharm, Gadot) or from private investors and operating companies (Orgenics, Savion). Two companies have raised significant funds from the public (OTC of New York), and (EldanTech) has raised funds on the Tel Aviv Stock Exchange.

Some of the companies were established as foreign holding companies with local subsidiaries, in order to enjoy greater financial flexibility.

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Most companies have joint venture relationships with overseas firms, mainly for marketing of products but also for product development and clinical studies.

The Government plays an important role in subsidizing long-term R&D and providing research grants through the Chief Scientist of the Ministry of Industry and Trade.

Atalia Hausvater

Tel-Aviv, February 1991

APPENDIX A

BIOTECHNOLOGY SECTOR - ISRAEL
STRATEGIC PARTNERING PROPOSALS

CANADIAN COMPANY	ISRAELI COMPANY	TECHNOLOGY
ALLELIX BIOPHARMACEUTICALS Dr. Man-Chiu Yang (Toronto)	BIOTECHNOLOGY GENERAL (BTG)	Growth factors for wound healing Human Mabs as therapeutics Antiviral modalities
	PHARMOS	New delivery systems
	SION	Biocyde dressing for wounds
	TECHNION	Angiogenesis factor accelerating wound healing
ALLELIX AGRICULTURE (Now part of ESSO Chemicals, Agricultural Chemistry Div.) Dr. Rob Rennie (Lethbridge, Alta) Dr. T.M. Wortel(Edmonton, Alta)	WEIZMANN INSTITUTE	Genetic engineering for herbicide resistant cr Improved crop varieti and new hybrids
	F R M - AGRICULTURAL SCIENCES PARTNERSHIP	Biopesticides Biofungicides
	TEL AVIV UNIVERSITY/ BIOTECH INSTITUTE	Biofertilizers
	TAMI - R&D OF ISRAEL CHEMICALS	Biofertilizers
	BEN GURION UNIVERSITY	Technology for producing tripoid plants
LES LABORATOIRES RHIZOTEC (Quebec)	TAMI - R& D OF ISRAEL CHEMICALS	Biofertilizers
	F R M - AGRICULTURAL SCIENCES PARTNERSHIP	Biopesticides Biofungicides
BIOTECHNICA Dr. William Scowcroft (Calgary)	WEIZMANN INSTITUTE	Genetic engineering Herbicide resistant cr
	TEL AVIV UNIVERSITY/ BIOTECH INSTITUTE	Technology for producing Biofertilizers

BIOTECHNOLOGY SECTOR - ISRAEL
STRATEGIC PARTNERING PROPOSALS

IBEX Dr. Robert Heft (Montreal)	HEBREW UNIVERSITY Jerusalem-Hematology Dept.	Heparinase
	KAMAPHARM	Bio-molecule separations for pharmaceutical industry
	VIROLUME (TECHNION-HEBREW UNIVERSITY-KAPLAN HOSPITAL	Essay for detection of HIV particals
ADI DIAGNOSTICS Mr. Jeff Greenberg (Toronto)	DIATECH	Medical diagnostic kits for bacterial antibiotic sensitivity
	SAVYON	Medical diagnostic kits for sexually transmitted diseases
	BIOHYTECH	Medical diagnostic kits for autoimmune diseases and kidney diseases
	WEIZMANN INSTITUTE	Diagnostic tools for intestinal parasites
IMMUNOCORP Dr. Pierre Du Ruisseau (Montreal)	DIATEC	Medical diagnostic kits for bacterial antibiotic sensitivity
	SAVYON	Medical diagnostic kits for sexually transmitted diseases
	UNITED MEDICAL	Gynaecology and fertility diagnostic kits
	WEIZMANN INSTITUTE	Diagnostic tools for intestinal parasites
	TECHNION	Novel tumor detection kit
I A F BIOCHEM Dr. Gervais Dionne (Montreal)	BIOTECHNOLOGY GENERAL (BTG)	Polypeptides derived from AIDS virus Human Mabs as therapeutic
	VIROLUME	Essay for detection of HIV particals

BIOTECHNOLOGY SECTOR - ISRAEL
STRATEGIC PARTNERING PROPOSALS

MICROBIO RHIZOGEN CORP. (AGRICULTURE WEST BIOTECH) Mr. J.H. Stephens (Saskatoon)	TEL AVIV UNIVERSITY/ BIOTECH INSTITUTE	Biofertilizers
	WEIZMANN INSTITUTE	Synergizing mycoherbicides to work with herbicides
	HEBREW UNIVERSITY	Use of Azospirillum sp. as a biofertilizer
GRIFFITH LABORATORIES (Scarborough, Ont.)	AROMOR TEL AVIV UNIVERSITY	Bioflavour production
	ANALYST	Protein G
BROOKSIDE LABORATORIES (Abbotsford, B.C.)	RAD CHEMICALS	Extraction of enzymes
	TEL AVIV UNIVERSITY/ BIOTECH INSTITUTE	Microbial polysaccharides
	WEIZMANN INSTITUTE	Flame retardant polymers
PEGASUS BIOTECHNOLOGY (Toronto)	HY-LABS	Test Systems for bacterial detection
	COMBACT	Rapid method for detection of bacteria and other micro-organisms in clinical, industrial & environmental specimen
SYNDEL LABS Mr. J.M. Little (Vancouver)	ISRAEL OCEANOGRAPHIC & LIMNOLOGICAL RESEARCH LTD. - Eilat	Aquaculture technology Induced breeding (hormones)

APPENDIX B

BIOTECHNOLOGY SECTOR - ISRAEL
STRATEGIC PARTNERING PROPOSALS

PROPOSED LIST OF CANADIAN SCIENTISTS TO BE INVITED

- Dr. Brian Jones - University of Toronto (Chemistry)
  Has contact with Tel Aviv University-Biotech Institute

- Dr. T.M.S. Chang - McGill University
  Has contact with Tel Aviv University-Biotech Institute

- Dr. Ronald Neufeld - McGill University (Biochemical Engineering)
  Has worked in Israel on sabbatical - Tel Aviv University

- Dr. David Cooper - McGill University (Biochemical Engineering)
  Has contact with researchers at Tel Aviv University

- Dr. Donald W. Westlake - University of Alberta, Edmonton (Microbiology)
  Has contact with Tel Aviv University

- Dr. Wally Beuersdorf - University of Guelph (Agronomy)
  Has contact with Weizmann Institute, Plant Biotech, Dr. Jonathan Gressel

- Dr. John Van Der Meer - NRC - Atlantic Research Lab. (Halifax) - (Algal Biotech)
  Has visited Israel and is in contact with Ben Gurion University - Dr. S. Arad.

- Dr. Constable - NRC - PBI (Plant Biotech Institute), Saskatoon
  Has contact with prof. Ezra Galun, Weizmann Institute, Plant Genetic

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