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1970

Background Study for the Science Council of Canada



1970 Special Study No.11

Background to Invention

By Andrew H. Wilson

ANALYZED

Background to Invention

A Summary of Views on the Canadian Patent System and on Industrial Research and Development Activities in Canada

Contraction 10

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Price \$1.50 Catalogue No. SS21-1/11 Price subject to change without notice

Queen's Printer for Canada Ottawa, 1970

Design: Gottschalk+Ash Ltd.

Foreword

This Special Study has been based upon material gathered and analysed by the author during 1967 and 1968 when he was participating in the research program of the Economic Council of Canada. Mr. Wilson, an engineer /economist, joined the staff of the Science Council of Canada in 1968 and has since been directing his attention principally to problems associated with scientific and technical activities in Canadian industry.

As in all other Special Studies, the views expressed and the conclusions reached in this report are the responsibility of the author and do not necessarily represent the views of the Science Council. Neither do they necessarily represent the views of the Economic Council, but the Economic Council retains the right to make use of the material presented in whatever way, and at whatever time, they feel may be appropriate. We are grateful to the Economic Council for their permission to publish this Study.

The publication of the Study by the Science Council at this time has been occasioned by the need to add new material to the current public discussions of science policy. It will also be an essential background document for the work which several members of the Council's staff will be undertaking during the coming months.

P. D. McTaggart-Cowan, Executive Director, Science Council of Canada.

Acknowledgements

The author wishes to express his thanks to the many people in industry and government and in the universities across Canada who, during the program of interviews arranged to gather the basic material, cordially received him and participated in discussions which were seldom short, frequently stimulating, and always useful. He also wishes to thank staff members of the Science and Economic Councils and others who participated in the preparation of the Study.

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Part I Introduction

The main purpose of this Study has been to assess the effectiveness of the Canadian patent system and its administration and to receive suggestions with regard to improvements in both the policy and the administration of the system. The Study has also enabled the author to look into the performance of research and development (R & D) activities in certain Canadian companies, with particular reference to the effectiveness of certain direct and indirect incentive measures. The basic material for the Study was gathered during a program of interviews which began in August 1967 and ended in April 1968. The breakdown of these interviews is as follows:

Manufacturing and Service Companies		80
including:		
Pulp and Paper	5	
Pharmaceuticals	5	
Petroleum /Petrochemicals	4	
Food & Beverage	7	
Mining/Metallurgy	11	
Other Chemicals	8	
Rubber /Textiles /Glass	7	
Machinery /Transportation	5	
Electrical-Electronic Capital Goods	12	
Nuclear /Aerospace /Instrumentation	12	
Miscellaneous	4	
Fed. Govt. Departments and Agencies		10
Provincial Research Councils and Found	lations	7
Universities		8
Professional Trade and Research Assoc	iations	7
Others		4
Total		116

The 80 companies were selected so that the major industry groups and the principal regions of the country could be represented. The selection was also based on company size, laboratory size, corporate structure, ownership and age. Companies known to have participated in federal government R & D incentive programs were included, as were three crown corporations with manufacturing and service responsibilities. The remaining 36 visits were made to agencies, institutes and individuals able to provide some insight into specific programs and problems or able to review, in broad perspective, the performance of an industry with regard to the growth and development of its R & D and "inventive" activities. All the interviews were conducted on a confidential basis.

Between them, the 80 companies have performed between one-half and twothirds of all the research and development performed in Canadian industry in recent years. On the question of size, one-half of the companies could be considered large, with recent annual sales volumes of over \$50 million. A further 24 could be considered medium-sized, with sales volumes between \$10 million and \$50 million, and the remaining 16 companies were small-and predominantly science-based. Just under half were resident owned, and the remainder were foreign owned.* Most of the companies were located in Quebec or Ontario.

In almost all cases, the initial written contact with each company was with the director or manager of research or with the senior technical officer. As the visit program progressed, it was not always possible to meet with the initial contact. Companies frequently had more than one official present during the interviews. However, the principal contacts in 50 of the companies were with the senior managers responsible for research and development or engineering and a further 12 were with company presidents. While the interviews with each company were designed to follow a similar pattern and to cover the patent system first and industrial R & D second, the actual discussions seldom dealt with the same aspects of these topics to the same extent. The interviews gave rise to very little statistical data because their main purpose was to elicit views and experience rather than figures.

The material obtained during the interview program has been organized, in what follows, to reflect the two principal topics of discussion and the broad conclusions

^{*}Foreign-owned companies were those which were known to have the majority of their voting stock held outside Canada or which were known to be controlled by a parent firm abroad even though it held less than 50 per cent of the stock.

of the Study as a whole. Part II on the Canadian patent system has attempted to determine the strengths and weaknesses of the present system, the relationship between patents and R & D activities, and the continuing need for a patent system in Canada. Part III on industrial research and development has ranged quite widely into the question of the environment for R & D and invention in Canada, and has discussed the effectiveness of a number of relevant federal government measures other than the Patent Act. Part IV of the Study has attempted to draw the previous discussions together and to suggest how the main problems associated with the patent system and with industrial R & D activities might be approached. It has also said something about the connection between the system and research and development.

The Study has a number of important limitations. For example, the Report of the Royal Commission on Patents, Copyright and Industrial Designs has not been discussed at length, although a number of its major recommendations have been included for comparison with the conclusions of the Study.* There has been no discussion of the Public Servants' Inventions Act or the Combines Investigation Act which are related in some ways to the Patent Act. There has been, on the one hand, no clause-by-clause or rule-by-rule study of the Act itself or of the Patent Rules and, on the other hand, no extensive discussion of the definition of terms such as "research", "invention" and "innovation".[†] However, the use of the term "invention" requires some clarification. Throughout this report, the term has been used in the broad sense of being a new piece of technological hardware in some initial form. When used in the narrow sense of a patentable or patented invention, qualifying terminology has been added.

Not surprisingly, the experience which the managers of research and engineering have had with regard to the Canadian patent system varied widely and the value of their contributions to the discussions was correspondingly affected. Their experience of foreign systems-with the exception of the U.S. system-was generally sketchy, as was their knowledge of recently proposed changes in the international administration of patent applications. In many cases, therefore, the foreign systems and the changes were outlined by the author and initial reactions to them were sought. But precedence has always been given to informed opinions.

This report was submitted in draft form in August of 1968 on the basis of material that had been gathered until the end of May of that year. Since then, there have been a number of developments related to the subject matter. For example, the provisions of the Patent Act affecting pharmaceutical products have been amended and a few changes have been made to the federal government's R & D incentive programs.[†] However, with the exception of some recently published statistics related to the period during which the interviews took place, it has been decided that no new material should be added to the report.§ The developments in question have not altered the environment which was under discussion in any fundamental or pervasive way.

*The Ilsley Commission which sat from 1954 to 1960.

†These are discussed in the author's report, Science, Technology and Innovation, published in 1968 by the Economic Council of Canada as Special Study No. 8 (Queen's Printer, Ottawa).

[†]These programs have also been under close study by an Interdepartmental Committee and by the Senate Special Committee on Science Policy (the Lamontagne Committee).

§The statistics referred to are estimates of industrial R & D expenditures for 1967, patent statistics for fiscal year 1967-68, and statistics for this fiscal year pertaining to the operations of Canadian Patents and Development Ltd.

 Part II
 The Canadian
Patent System

A Thumbnail Sketch of the System

At present, letters patent for an invention are issued in accordance with the Patent Act-an Act which has continued in force with only minor changes for the last 30 years.

The development of the structure, provisions and administration of the Canadian patent system as a whole has been strongly influenced by the systems in the United States and the United Kingdom. For example, grants of patent rights in the three countries are made only after an extensive examination has been made of every application filed-unlike patent grants in Belgium where the registration system is administratively and technically simpler and permits issue after several months rather than after two to four or more years.* As in the United States, patents in Canada are granted to the first inventor rather than to the first person to disclose the idea by means of a patent application or provisional filing.[†] And, as in Britain, the Canadian system incorporates compulsory licensing provisions to curb abuses and to encourage patentees to "work" their inventions as soon as possible.

The Canadian system is subject to certain duties and constraints because of Canada's membership in the International Convention for the Protection of Industrial Property, which is also known as the Paris Convention, and which dates from 1883. More than 70 countries are now members. Its basic purpose is to secure for foreign applicants in each member country. the same rights as its citizens receive. Canada's membership is reflected in the provisions of Section 29(1) of the Patent Act. If an application for a patent is made in Canada within 12 months of being filed in another member country, the Canadian Patent Office is obliged to recognize this prior filing as the Canadian filing date. The percentage of Convention filings in this country is normally high, particularly as regards applicants who file in the United States before filing in Canada. The Paris Convention has been administered since 1885 by the United Bureaux for the Protection of Intellectual Property– usually known as "BIRPI"–which is located in Geneva. Recently, this organization has been working towards the preparation and approval of a Patent Cooperation Treaty designed to provide for the internationalization of the filing, search and examination procedures for patents.[‡]

For the purposes of the Canadian Patent Act, an "invention" means:§

"... any new and useful art, process, machine, manufacture or composition of matter, or any new and useful improvement in any art, process, machine, manufacture or composition of matter."

The administration of the Canadian Patent Act is the responsibility of the Patent and Copyright Office which is now a branch of the federal Department of Consumer and Corporate Affairs. The functions of the Office and the duties of the Commissioner of Patents are set out in the Act and in the Patent Rules. The main activity of the Office is the examination and disposal of each application. This includes a novelty search, consideration of the inventiveness of the subject matter of the application, and a decision on whether or not the invention, as described, is patentable. The Act provides for a patent term of 17 years from the date of issue, in return for the public disclosure of the invention.¶ With regard to the content

The remaining countries use a "first-to-file" approach. ‡It has been estimated that about half of the recent worldwide annual total of about 650 000

However, Section 41(1) of the Act contains the following modification of Section 2(1): "In the case of inventions relating to substances prepared or produced by chemical processes and intended for food or medicine, the specification shall not include claims for the substance itself, except when prepared or produced by the methods or processes of manufacture particularly described and claimed or by their obvious chemical equivalents."

¶Section 49(1).

^{*}France also had a *registration* system until a new patent law was enacted on January 1, 1969.

[†]Only one other country in the world-the Philippines-has adopted a "first-to-invent" approach.

patent application filings were duplicates. §Section 2(d) of the Act.

of an application, Section 36(1) of the Act reads as follows:

"The applicant shall in the specification correctly and fully describe the invention and its operation or use as contemplated by the inventor, and set forth clearly the various steps in a process, or the method of constructing, making, compounding or using a machine, manufacture or composition of matter, in such full, clear, concise and exact terms as to enable any person skilled in the art or science to which it appertains, or with which it is most closely connected, to make, construct, compound or use it; in the case of a machine he shall explain the principle thereof and the best mode in which he has contemplated the application of that principle; in the case of a process he shall explain the necessary sequence, if any, of the various steps, so as to distinguish the invention from other inventions; he shall particularly indicate and directly claim the part, improvement or combination which he claims as his invention."

Since the patent system in Canada is based upon the first-to-invent approach, there are several provisions in the Act-in addition to Convention filing-dealing with the question of possible prior disclosure. In Canada, a patent cannot be obtained for an invention which was previously known or used by others, was described in any patent or publication printed in Canada or in any other country more than two years before the application for the Canadian patent was made, or was in public use or on sale in Canada for more than two years prior to the Canadian application.*

If an inventor prefers not to disclose his invention to anyone while he proceeds to perfect it, he may, under Canadian law, file a document with the Patent Office which describes his invention as far as it has been developed. The contents of this document-or Caveat-are not disclosed by the Office, but the person filing it must make a formal patent application within one year. The law also allows an applicant 12 months to complete the submission of all documents relevant to a formal application.[†]

Decisions made by, or in the name of, the Commissioner of Patents may be appealed before the Exchequer Court of Canada in accordance with its own rules and procedures. The Exchequer Court may also declare invalid or void any patent or claim on the basis of a case initiated and presented by the Crown or by any interested person. Under normal circumstances, conflicting claims contained in two or more current patent applications are resolved in the first instance by the Commissioner of Patents and his Office in accordance with the Patent Rules. With regard to the infringement of an issued Canadian patent, legal action will take place before the appropriate provincial court or before the Exchequer Court in Ottawa.[‡]

The Patent Act requires that the inventor or inventors associated with a patent application must be identified. This may be done through the signing of the petition or through the assignment of the invention in those cases in which the petition is signed by the representative of the assignee company. Employed inventors, generally speaking, are usually prevented by their conditions of employment from taking patent action on their own behalf for inventions developed in the course of their normal duties unless specifically permitted to do so. The Patent Act is also explicit about the regulation of attorneys entitled to represent the petitioners in the presentation and prosecution of applications and other business before the Patent Office.§

A person who has invented an improvement to an invention which is already patented-or the assignee company-may obtain a patent for the improvement provided all the requirements of the Act are met. But, by so doing, the right to make use of the original invention is not

Section 28(1). †Sections 74 and 32. ‡Sections 47, 62, 45, 56. §Sections 28, 33, 15. granted, nor does the original inventor or assignee obtain the right to use the improvement patent. Both inventors or their assignees must come to terms about usage if exploitation of both the original and the improvement together is contemplated.

This brief review has not dealt with a number of other important aspects of the current Canadian Patent Act-for example, the compulsory licensing provisions. These aspects are discussed later in the report.

Some Statistics Related to Canadian Patents

According to the available patent statistics, it appears that Canadians have been relatively unprolific applicants for patents. Although the annual number of patent grants made in this country has risen from 4 500 at the beginning of the century to 26 000 at the present time, Canadian resident inventors have never received more than about one patent in every twenty, while U.S. residents have received two out of every three. An example of this kind of "imbalance" is provided by the following analysis of the 500 patents published in the Canadian Patent Office Record of September 19, 1967, as shown in Table 1.

Some idea of the more recent growth in the activities of the Canadian Patent Office has been provided in the Annual Report of the Department of Consumer and Corporate Affairs for the fiscal year ending on March 31, 1968. The following data were included[†] and are shown in Table 2.

The same Annual Report has noted that the residences of the *Canadian* inventors of patents granted during the year were as follows:‡

Total	1 263
Yukon & Northwest Territories	1
Saskatchewan	26
Quebec	369
Prince Edward Island	1
Ontario	659
Nova Scotia	7
Newfoundland	1
New Brunswick	2
Manitoba	35
British Columbia	92
Alberta	70

Finally, this Annual Report included detailed information on the subject matter of the inventions patented during fiscal year 1967-68.§ As a percentage of the total number of patents issued, these subjects were:

	Per Cent of Total	
Human Necessities:		
Agriculture	2.23	
Foodstuffs	1.27	
Apparel	2.62	
Medicine & Hygiene	2.41	8.53
Performing Operations:		
Separating & Mixing	4.12	
Shaping	9.14	
Printing	4.27	
Transporting	8.69	26.22
Chemistry & Metallurgy:		
Chemistry	24.14	
Metallurgy	2.07	26.21
Textiles & Paper:		
Textiles	7.39	····
Paper	0.55	7.94
Fixed Constructions:		
Building	2.23	
Mining	0.79	3.02
Mechanics, Lighting & Heat	ting:	
Engines	4.47	
Lighting & Heating	2.24	6.71
Physics:		
Instruments	8.91	
Nucleonics	0.29	9.20
Electricity:		
Electricity	12.17	12.17
	100.00	100.00

*Section 34.

†On page 41: "Transactions of the Patent Branch from 1958-59 to 1967-68".

tOn page 39: The figures include recipients of issued and reissued patents.

§On page 36: "Trend of Invention".

Table 1-Analysis of 500 Patents published in Canadian Patent Office Record of September 19, 1967

	Total	Prior U.S. Filing
Canadian Inventor:		
No Assignee	9	4
Assigned to a Canadian Company or Government Department	16	2
Assigned to a U.S. Company	3	1
U.S. Inventor:		
No Assignee	30	16
Assigned to a Canadian Company	13	8
Assigned to a U.S. Company	287	252
British Inventor:		
No Assignee	2	_
Assigned to a Canadian Company	2	-
Assigned to a British Company or Government Department	32	-
French Inventor:		
No Assignee	3	-
Assigned to a French Company or Government Department	16	-
German Inventor:		
Assigned to a German Company	25	-
Others:	62	3
Total	500	286

Table 2-Activities of the Canadian Patent Office

	Caveats Issued	Applications for Patents	Patents Issued or Reissued	Compulsory Licence Petitions
1958-59	296	22 912	18 293	8
1959-60	291	24 292	22 021	16
1960-61	281	24 529	22 014	11
1961-62	226	25 447	21 659	8
1962-63	256	26 409	21 225	10
1963-64	266	27 057	23 230	6
1964-65	250	27 811	23 476	9
1965-66	275	30 093	25 258	6
1966-67	258	29 618	24 432	3
1967-68	304	29 586	25 836	10

The Patent Policies and Practices of Companies

It became clear during the interviews with the representatives of the 80 companies that there were two dominant considerations behind the decision to apply-or not to apply-for patent protection: the companies' existing and potential markets, and the particular kinds of business they were in.

It also became clear that in comparison with American or British firms, Canadian firms took relatively little patent action. But this finding should not be construed as necessarily detrimental to the health and welfare of Canadian industry. The representatives gave support to the view that patent action was one of the instruments which they could use to make their way in the world. Some pointed to the growing sophistication of the Canadian market for technology-based products and said that patent actions should increase in the future. Others reported that patent policies had been changing since it had become evident that expanded research and development activities in Canada would lead to more opportunities to make inventions of commercial significance. Still others pointed to increasing opportunities-again as a result of expanded R & D-for the trading of new technical information, some of which would be patented.

The company representatives cited a number of other considerations which, when taken into account, might modify a market and business-based decision to apply or not to apply for patent protection. These covered many aspects of company operations and included the following: the desire to reduce the risk of litigation or to avoid it altogether; the physical difficulties involved in "policing" infringers; the costs of patent protection and enforcement; the risks involved in premature disclosure of new information, especially if an application was also filed in a registration country; the need to strengthen the company's "know-how" bargaining position and its technical prestige; the strengths and weaknesses of competitors' patent positions and the positions of parent and affiliate companies in Canada and abroad; and the rates of obsolescence of particular products or processes. The point was also made on several occasions that most companies had, at any one time, more patentable inventions than they had resources necessary to exploit them. In such circumstances, patent action would only be taken on those inventions which had the highest exploitation potential either as hardware or in an information trade.

Some companies made no secret of the fact that they had never owned patents and probably never would, while others reported that patent action would not be taken on inventions which were related to certain aspects of their operations. Besides the usual considerations of cost, time, and expertise required to obtain patents, a number of other interesting reasons were given for the complete or partial rejection of patent action as a matter of policy. For example, certain kinds of new and patentable hardware could be effectively hidden in "black boxes" or could be incorporated into custom-built equipment or into equipment produced in small quantities for a local market. Such policies were also to be found in industries in which technical information was widely shared among member companies because their equipment suppliers owned the patents or because there was a tradition of mutual technical assistance. They were to be found in small companies and in divisions of larger companies whose products were subject to rapid technological obsolescence or whose functions were to exploit unique natural resources. They were to be found, less frequently perhaps, in industries in which improvement patents were of so much less importance than were the initial or "basic" patents.

The size of a company could have an important bearing upon its approach to patenting and enforcement. While small companies seldom had the wish or the need to take frequent action in either direction, it was by no means unknown for them to own patents. Nevertheless, small size, lack of manufacturing and other physical resources, and lack of important market connections could work against a company in its attempt to exploit a technically and commercially valuable patent. So could the fact that there were often too many small companies trying to survive and to serve too limited a market. It became clear during the interviews that a number of the companies could trace their continued existence and growth to the tenacious exploitation and defence of a basic patent or group of patents. But it also became clear that a small company, as it grew into medium size, could pass from the stage at which patent activities were unrewarding and minimal to the stage at which a stronger patent position became desirable. At this latter stage, the "in-house" effort devoted to screening new inventions for potential patentability and the resources devoted to patent actions would be increasing. Subsidiary companies were undoubtedly more adept at making these changes, but mediumsized resident-owned companies also made them and often hired their own patent professionals or began to seek outside advice on a regular basis. All the large companies had patent policies, although in a few cases this policy was not to patent any inventions that might appear. The companies which took the most frequent patent action usually had their own staffs of patent professionals, and a few had highly qualified men practising on a specialized basis.

Most U.S. subsidiary companies among the group visited had evident preference for filing applications first in the United States. In most cases this was a matter of deliberate policy but the rationale behind the decision was not always insistence on the part of the parent companies. There was, for example, a feeling of greater confidence in the quality of the search and examination procedures carried out by the U.S. Patent Office. This same feeling of confidence was also found in many of the resident-owned companies. A U.S. patent was a strong patent. Indeed, it was sometimes difficult to avoid the conclusion that Canadafirst and Canada-only applications were made for traditional reasons, for reasons of local prestige, or because the issued patent would actually be of little commercial or technical value. It was clear, however, that confidence in the procedures carried out by the Canadian Patent Office was somewhat higher than it had been. A suggestion made by a number of company representatives to help cure the initial filing "imbalance" was to have Canada-first filing made mandatory for all Canadian-resident applicants, as is done in Britain for example. The suggestion found little favour in other companies.

However, the "U.S.-first" preference was strongly influenced by two other factors. One was the size of the U.S. market and the opportunities it presented to those companies that wished to try out new products. Both foreign- and resident-owned companies in Canada had to take this factor into account. The second factor applied to companies with parent or with subsidiary companies in the United States. Under U.S. law-and unless modified to some extent by a Convention filing-the date applied to an invention made by a non-U.S. resident is, effectively, the date on which his application is filed with the U.S. Office and not the actual date of invention.* Only U.S. residents may claim the actual date and, by so doing, may possibly defeat an application made by a non-U.S. resident. This second factor goes some way towards explaining why U.S.-owned companies do less research in Canada than they otherwise might. It also shows that the Canadian Patent Act, by recognizing foreign invention dates, may bring about the defeat of patent applications by Canadian residents.

^{*}Section 104 of the U.S. Patent Act.

On a quantitative basis, the patent practices of the companies visited may be summarized as follows. Thirteen of the eighty companies apparently had no patent activities or no regular application assessment practices. Of the remainder, 47 companies normally applied for a U.S. patent first, followed by a Canadian application, and 20 adopted the reverse procedure. Just 5 companies reported that they would occasionally apply for a Canadian patent only. Applications in the United States, only, were made more frequently. At least half of the 67 companies with patent activities made applications on a regular basis for patents in countries outside North America. but their preoccupation with the North American market was obvious. International applications could, of course, be traced in many cases to membership of the Canadian companies in international corporations or to participation in groups of more loosely affiliated companies. However, it appeared that only in about a dozen cases did the parent or senior affiliate lay down rigid procedures for the patent applications made by the Canadian companies. In most cases, the advice of these companies was sought at an early stage in the processing of all applications affecting them or concerning the processing of petitions to be made by the U.S. companies in this country. About one-third of all the Canadian companies with regular patent activities had their own full-time patent departments, agents or engineers and in many of the others there was a parttime committee, engineer or administrator assigned to co-ordinate and screen possible patent applications and advise on the processing of them with the assistance of an outside attorney or agent.

On a broad industry-by-industry basis, the patent policies and practices of the 80 companies may be summarized as follows.

Pulp and Paper: About half of the patent applications are made in Canada first, and half in the United States. A company which is a subsidiary usually

receives guidance and assistance from its parent. Patent strength is important, but not for woodland, or unique resource, operations. Most patenting activities are defensive initially.

Pharmaceuticals: Patenting activities have a very marked international orientation, and firm policy guidance is usually given by parent companies. Strength is very important but since Canada restricts the grant of drug patents to manufacturing processes, patent portfolios in this country are weaker than they are in countries such as the United States.

Petroleum/Petrochemicals: Almost all applications are made in the United States first. However, most of the companies visited have their own patent agents and engineers. A great many applications are made on a worldwide basis. Opinions appear to be split on the need for patent strength. More emphasis is placed on the quality of the *Canadian* research effort.

Food and Beverage: This is the only industry group which seems to adopt a "Canada-first" approach to patenting. Five of the seven companies feel patent strength is important. Licence fees and royalties can be useful sources of income.

Mining/Metallurgy: The metallurgical companies are much more active in the patent field. Mining companies tend to view the relative lack of technical secrecy in their industry and the uniqueness of the natural resources they are using as factors which reduce the need for patent action. When applications are made by any of the mining or metallurgical companies, they are usually filed first in Washington.

Other Chemicals: Half of the companies usually apply for Canadian patents first. Some have their own patent staff, while others use attorneys attached to parent or affiliate companies. However, most of the applications result from work done by these parents and affiliates.

Rubber/Textiles/Glass: U.S. applications are made first, in most cases. Parent and affiliate companies often lay down the patent policies and provide professional assistance. The operations of the Canadian companies are significantly influenced by the technical competence and the patent portfolios of their parent or affiliate companies. A great deal of "know-how" is also acquired with the purchase of new equipment. Generally speaking, none of the companies have very strong patent positions in Canada.

Machinery/Transportation: About half of the initial patent applications made by these companies are made in Ottawa. Once again, a significant amount of "know-how" is acquired with the purchase of new equipment, or is "sold" with it. On the whole, the transportation companies seem unconcerned about their patent positions because of the relative lack of technical secrecy among the operating companies. Also, each tends to go ahead and solve its own problems.

Electrical-Electronic Capital Goods: Filing is predominantly in the United States first. Many of the companies are large and have their own patent staffs. Most feel the importance of patent strength. Parent companies influence the policies and practices of Canadian subsidiaries.

Nuclear Aerospace Instrumentation: There is not much patenting activity in any of these companies, particularly in the smaller ones. The fields are too fastmoving, and there are the problems of policing against infringement and of getting a return on even the basic costs of taking patent action. Infringement is often all too easy-and it works both ways. Some companies say they will take more frequent patent action when they are bigger or when they have a basic invention which is worth protecting. When patent action is taken, it is taken aggressively and the U.S. filing is usually the first. Not infrequently, the U.S. filing is the only one.

Miscellaneous Manufacturing: Normally, the first filing is done in Washington. Policies vary considerably between companies.

Specific Aspects of the Patent System and its Administration

The previous section of this Study looked into some of the business-or economicconsiderations related to the workings of the Canadian system. This present section deals with technical and legal aspects and draws attention to the arguments for and against some of the propositions discussed during the industry interview program. The discussion has been restricted to basic aspects of the system.

First-to-File versus First-to-Invent

If it is assumed that Canada will continue to have an *examination* system rather than a *registration* system, then the basic problem is to choose between staying with the present first-to-invent basis for granting patents or changing to the more widely used first-to-file basis.

The principal arguments given for retaining the first-to-invent basis were the following:

1. It is the current basis, and therefore the one with which Canadians are most familiar.

2. It is also the basis of the current U.S. system.

3. The first-to-invent basis allows the inventor time to improve his invention, and to assess its commercial potential better, before filing an application for patent. There need be no "rush to the Patent Office with embryonic ideas", and there will be little speculative filing-provided that the claims to be the rightful first inventor can be satisfactorily substantiated.

4. First-to-invent also discourages industrial espionage in ideas and inventions. For this reason, a change to firstto-file may mean that industrial secrecy will increase.

The principal reasons given for making the change to first-to-file were as follows:

1. All other major industrial countries in the world–expect the United States– have it and are unlikely to change to first-to-invent.

2. First-to-file eliminates conflict proceedings and generally reduces the opportunities for litigation.

3. First-to-file eliminates the need for extensive record-keeping and other supporting documentation.

4. First-to-file may also reduce the cost of applying for, and owning, patent rights.

5. The backlog of applications-and the average pendency period-will be reduced because delays due to conflict, for example, will be eliminated.

6. At the present time, Canadians can lose opportunities to patent abroad because of their reliance on the domestic first-to-invent provision.*

The proposal that Canada should change to first-to-file did not, however, have the unqualified support of all the representatives of the 80 companies visited. Their reactions were as follows:

Unreservedly in favour of the change in 22 cases;

In favour, "on balance" in 25 cases;

Unreservedly against the change in 9 cases;

No firm conviction or preference in 24 cases.

Almost all of the industry people who favoured the change to first-to-file added the rider that Canada should make it only if the United States is likely to make the change at the same time or may make it in the near future. Otherwise, the North American patent application and issue situation will be confusing, to say the least.

It was interesting to find that the enthusiasts for the change included representatives of companies in the Mining/Metallurgy, Electrical-Electronic Capital Goods and Other Chemicals groups, all of which have a high proportion of foreign ownership. It was equally interesting to find that most of the convinced opponents to the change were people with extensive experience of the U.S. system *in* the United States. The two dozen "no firm conviction or preference" views came mainly, as might be expected, from the Nuclear/Aerospace/ Instrumentation group and from a number of small resident-owned companies in other groups which made little or no use of the existing patent system.

A consensus view among those who favoured the change unreservedly or "on balance" was that a Canadian first-to-file system should also include a provisional filing or some alternative grace period provision which would allow a "consolidation and exploitation assessment" breathing space. Several proposals for new systems of this kind were made during the interviews. The following is an outline of one of them.

Provisional filing would be permitted with up to one year to file the final application, but with the possibility that additions to the provisional application could be made during this year. Conflict would be possible only on the basis of the dates of filing of conflicting facts in each of the additions. No private records would be admissible, and there would be no opposition proceedings after issue. The examination would begin with the final application and work backwards only if the possibility of conflict had arisen. In the provisional, additional and final applications, claims would be made. The effective filing date would be the date of receipt of the provisional application at the Patent Office. One consequence of this proposal would be the elimination of the Caveat.

The Period of Pendency

At the present time, the average period between filing an application with the Canadian Patent Office and the subsequent issuance of the patent is about three years. This period is about the

^{*}For example, the two-year pre-application grace period, which is allowed at present in the Canadian system, is typically not allowed in first-to-file countries, although there may be a one-year provisional filing stipulation. This factor can have important implications for Canadian companies which hope to manufacture in Canada for world markets and need protection abroad to make this worthwhile.

same length as the pendency period in the United States, but shorter than in Japan, Germany and the United Kingdom. Applications in conflict may take considerably longer to resolve. Most national Patent Offices have been experiencing larger numbers of applications each year but have been attempting to keep up with the increases without lengthening the average pendency period. This has normally been done, as it was in Canada, by increasing the number of examiners.* However, the number of applications is expected to continue to increase in the foreseeable future and there will also be some further problems related to the complexity of certain fields of technology, to the sophistication of inventions generally, and to the amount of the prior "art" which the examiner in the Patent Office must take into account.

The process of obtaining a patent in an examination country such as Canada involves a number of uncertainties for the applicant and also for the companyassignee. For example, they will be concerned that the patent may not issue at all and will worry about how long issuance will take. In Canada, under Patent Rule 38, the Commissioner is empowered to advance the examination of an application out of its routine order when the proper procedure has been observed, but the Commissioner is not bound to do so. And even if the application is advanced, there is no certainty that it will issue sooner or that it will avoid conflict.

A number of other general points regarding pendency must be made. For example, while the patents issued in the United States or Canada may not always represent the most useful sources of the state of a particular art, they do reveal to a company the up-to-date strength or weakness of the patent positions of its competitors and help to guide the company in information trading and "know-how" transactions. Another problem in Canada stems from the fact that until a patent actually issues, no action for infringement may be taken by the potential patentee against an individual or company which makes and markets the invention. Moreover, Section 58 of the Act allows the individual or the company to sell any inventory accumulated before the date of issue without action being taken against them. This could ruin the inventor of a shortlife product. But compulsory publication of an application after, say, two years will not necessarily help in this kind of situation unless such publication carries with it the status of an issued patent. The designation-"patent pending"-has no status in law.

The various aspects of the pendency problem were discussed in detail with most industry representatives. There was general sympathy for the view that the present average period of pendency in both Canada and the United States is too long, but there was no support for eliminating the problem by having either country adopt a *registration* system. It was the unanimous opinion of those who favoured the retention of the patent system that the short pendency period of the Belgian system is unsatisfactory because the information contained in the patents is disclosed too soon, often in a form that had received an inadequate consolidation and exploitation assessment and with the additional uncertainty that the validity of the issued patents would have to be proved in court-a process which could take even longer to resolve than issue through examination.

In the view of the majority, the *average* period of pendency in Canada should be, ideally, between eighteen months and two years from the priority filing date of the application, based on the present first-to-invent system and on the Convention filing requirements. It was also the view of the majority that additional legal and regulatory provisions should be designed to speed the resolution of conflict proceedings and to penalize

^{*}The average period of pendency in Canada has been dropping during the past year or two.

parties using conflict proceedings to prevent or delay the issue of particular patents.*

Prior Art

The prior art which is searched by patent examiners in Ottawa is based on the principal claims contained in each of the relevant issued Canadian patents. Prior art searched by examiners in Washington, on the other hand, takes account of some published material as well as larger numbers of relevant issued patents. The prior art searched in the Canadian and U.S. Patent Offices, therefore, is not necessarily the same, and both are different from art searched in the German, Dutch or Japanese Patent Offices. A patent application could fail to issue in Germany but could issue in Canada or the United States, or both.

It was clear from the interviews that Canadian companies are generally anxious that prior art searches made in Ottawa and Washington should include the same basic material. There was also a feeling that in the longer term, it would be preferable to have patent grants dependent on a search of worldwide art but that the practical problems, the costs and the international political agreements required to bring this situation to pass could put it beyond reach in the near future.[†]

Length of the Patent Term

If the present first-to-invent basis for granting patents is to be continued in Canada, none of the industry representatives objected to the continuation of the present 17-year term from the date of issue. But should the beginning of the term be changed for any reason to the date of the filing of the completed application, then two or three years should be added to the present term to allow for the period of pendency.

Patent Applications

The fact that the inventor or inventors still have to be identified in patent applications in Canada under the present system was considered by many industry representatives to be unfortunate and rooted in the heyday of the independent inventor which, in their view, was over. They made the point that employed scientists and engineers did not normally invent for a living but might make potentially patentable inventions in the course of their work. Also, in these days of industrial laboratories, team research and development, and fast-moving technology, it is not always possible to identify all those who should qualify as inventors or even to identify the individual or individuals who made the actual inventive contributions. Patent grants and litigation could be lost over technicalities associated with the identity of inventors. The industry representatives therefore felt that there should be a more direct way in which companies could petition for patents other than as companyassignees 1

Compulsory Licensing Provisions

These provisions are included in Sections 67 to 73 of the Canadian Patent Act but are also implicit in Section 41 which deals with chemical products and substances intended for food and medicine. These sections of the Act were discussed widely with the industry representatives. Since then, Section 41 of the Act has been amended by the passage of a Bill through Parliament.§ For this reason, the discussion of Section 41 in this report has been considerably shortened and the points actually made refer

†See also the section which follows on "Foreign and International Systems".

[‡]However, the identification of an inventor is necessary under a *first-to-invent* system.

§This was Bill C-102 which became law in July 1969. Actions under the new Section 41 have already begun. However, it should be noted that a similar Bill, C-190, received First Reading on December 10, 1967, but did not become law by the end of the Parliamentary Session in April 1968.

^{*}The period of pendency can also be affected through the use of Rule 39 by patent examiners. This problem is discussed in the section on the "Administration of the System". The rule requires that an applicant for a Canadian patent must, at the request of the Commissioner, furnish information with regard to applications filed abroad for patents on the same invention.

to the section as it was before amendment.

Under Section 67 of the Act, "... any person interested may at any time after the expiration of three years from the date of the grant of the patent apply to the Commissioner alleging ... that there had been an abuse of the exclusive rights ... and asking for relief under the Act."

It became clear during the interviews that most of the industry people had had little or no experience with compulsory licensing. As the statistics quoted earlier in this report have shown, very few petitions for licences of this kind have been received by the Patent Office in Ottawa. Also, the U.S. Patent Act has no provisions for compulsory licensing. Nevertheless, it was strongly suggested that Canada should retain the three-year licensing provision and should not, in this instance, follow United States' practice. It was felt that this provision was one way in which small companies with limited research resources might be able to break into the market-even though they did not appear to have taken much advantage of it in the past. The pharmaceutical companies which so strenuously opposed Section 41 appeared to be reasonably satisfied with Sections 67 to 73 in principle.

There were, however, a number of reservations on matters of detail. For example, the award of licences on the grounds of "abuse" was considered unfortunate. The economic, social or security interests of Canada were considered to be more appropriate grounds. Second, experience has shown that the financial terms of compulsory licencesas negotiated by the Commissioner-were usually set at inappropriately low levels as far as the patentees were concerned. Admittedly, some patentees had little reason to expect any return at all from their patents, but as was pointed out on a number of occasions, there were no simple rules or formulae which could be devised to overcome the royalty problem because no two patents were the same.

Third, government initiatives or, better still, private institutional initiatives needed to be exercised with regard to promising inventions owned by the "independent inventors with inadequate means" who at present turned frequently to the United States for financial backing.

Before it was amended, Section 41(3) of the Patent Act read, "In the case of any patent for an invention intended for or capable of being used for the preparation or production of food or medicine, the Commissioner shall, unless he sees good reason to the contrary, grant to any person applying for the same, a licence limited to the use of the invention for the purposes of the preparation or production of food or medicine but not otherwise; and, in settling the terms of the licence and fixing the amount of royalty or other consideration payable, the Commissioner shall have regard to the desirability of making the food or medicine available to the public at the lowest possible price consistent with giving to the inventor due reward for the research leading to the invention." Manufacture of any substance licensed in this way had to take place in Canada. Under the Bill C-190 proposals-and Bill C-102 which became law-this subsection remained unchanged with regard to food substances. For medicines, however, new subsections were added which extended the authority of the Commissioner to remove the restrictions on the importation of manufactured substances.

With regard to the original Section 41 of the Act as a whole, the companies in the food and beverage industry group had had no adverse experience of it. However, they felt that the Patent Act ought to permit the granting of patents for food products and "compositions of matter" as well as for manufacturing processes. The pharmaceutical companies were opposed to the retention of the original Section 41 of the Patent Act and were even more firmly opposed to the kinds of amendments which were being proposed under Bill C-190. Their reasoning-and the reasoning of their opponents-has been amply covered in Parliamentary records. It must therefore suffice in this report to repeat only a few of the points made with regard to the original Section 41 and to Bill C-190 amendments during the interviews, as follows:

1. The limiting of patent protection to manufacturing processes places undue emphasis on searching out and patenting all possible ways of making a pharmaceutical product and distracts attention from the business of developing new products.

2. Further reductions in patent protection may not eliminate drug research in Canada, but it will most probably limit its real growth.

3. The safety aspects of the manufacture of pharmaceuticals will be more easily controlled if both research and manufacture can be encouraged in this country.

4. The pharmaceutical industry in Canada, as in other countries, has to follow rules and submit to inspections laid down by the Food and Drug Directorate of the Department of National Health and Welfare. But before a new drug can be licensed for manufacture by other than the patentee or his company, it has to be included in the new drug list of the Food and Drug Directorate until its properties and side effects have been checked out. It could remain on this list for as long as five years.

5. The proposed changes are in conflict with other provisions of the Patent Act which are designed to provide *incentives* for research and invention.

Perhaps the most significant point about Section 41 of the Act emerged from discussions of the Bill C-190 proposals with non-pharmaceutical companies. This was that similar legislation could easily be framed in order to permit further government intervention in any other industry. It was argued that while the principle of government intervention has already been accepted, the methods of intervention should be designed to fit each situation appropriately. A patent, it was pointed out, is granted because it represents a particular kind of *technological* advance. In the normal course of events, a patent may become an asset to a company or to an individual, but it may equally well remain just a costly piece of paper. As an asset, it is only *one* element in the setting of a selling price for the invention. The basic problem is to distinguish between the technology-based patent *grant* and the business-based *sale* of an industrial product.

The Administration of the System*

The material in this section has been based on 50 out of the 80 industry interviews. In the remaining companies, the executives or managers disqualified themselves from comment because their patent work was handled almost exclusively by agents or attorneys or because it was the current policy of their companies not to file applications at all. Some of the topics touched upon have been discussed in other sections of this report, but not from the administrative point of view. In this particular section, the repetition of specific comments and suggestions has been kept to a minimum.

It was agreed that if Canada is to have a patent system, then the Patent Office has to be able to deal effectively with patent examinations and other procedures under the Patent Act and Rules. It was also agreed that the system should be administered as simply as possible and involve the minimum of delay, uncertainty and frustration. Few of the industry people doubted that Canada could afford to have a first-class Patent Office.

The most important criticisms made during the interviews with regard to the operations of the Patent Office had to do with patent quality and the period of pendency. The critics were concerned that the criteria of novelty, utility and unobviousness were not being applied sufficiently rigorously or sufficiently early in the examination of patent applications with the result that unsophisticated and

^{*}The search facilities at the Patent Office have been discussed in the section on "Patents as an Information Source" later in Part II.

technically trivial patents, or patents of obviously doubtful commercial potential, were being allowed to issue. The critics were concerned that only a limited amount of prior art was being examined and that relevant published but unpatented material was not being considered. On the other hand, they were concerned that while Rule 39 was being applied to take advantage of searches by examiners in the U.S. Patent Office, the rule was also prolonging the pendency of many Canadian applications unnecessarily. They were concerned that the Patent Office lacked the means to speed the resolution of conflict proceedings. And they were anxious that the time allowed for correspondence between the Office and the applicants should be reviewed and generally reduced.

The industry people viewed the quality and pendency problems as essentially interdependent, but disagreed with the premise that high quality should necessarily mean long pendency. They were concerned that the Canadian system of classifying patents seemed to have fallen behind. They were concerned not only about technical specialization among the examiners, but about their general level of business and industrial understanding. Poor examination and long delays could be costly for Canadian companies.

The industry people took the view that the Canadian taxpayer should not subsidize the Canadian Patent Office because over 90 per cent of all patent applications originated abroad. They favoured increasing the fee schedule for the various phases of the work of the Office if better work would be the result. They favoured closer North American co-operation and collaboration to reduce the costs of obtaining patent protection in both the Canadian and U.S. markets.

Litigation

The grounds for litigation under the Canadian Patent Act include the refusal by the Commissioner to grant a patent; conflict with another patent; the impeachment of a patent or one or more of its claims; the licensing of the manufacture of a chemical substance intended for food or medicine; the award of a compulsory licence; and the infringement of patent rights. The Exchequer Court is particularly concerned with the hearing of cases under the Patent Act.

Most companies visited had had little or no experience of litigation under the Canadian Patent Act. It appeared that the views of some of them on the subject were strongly influenced by feedback from the more frequent court actions in the United States and particularly from prominent interference or infringement suits in that country. The representatives were, however, unanimous in their support of the view that opportunities for litigation must be reduced. They also wanted to see provisions for appeal and settlement, in certain circumstances, outside the courtroom. There was sympathy for safeguarding the interests of the independent inventor and the disadvantaged small company caught up in litigation-or threatened with it. There was some enthusiasm for the fact that most of the newer members of the patent profession were qualified professional engineers or scientists. But the one very real fear, which was expressed by many of the industry people, was that patent litigation would be resolved too often on the basis of legal technicalities or of semantics rather than on the basis of *engineering* technicalities.

The Cost of Patent Ownership

The figure most frequently heard for the average cost to a Canadian company of making a patent application in Canada or in any of the 20 or so countries in which Canadian companies most often filed was \$1 000 *per filing*. Of this figure, the smaller portion covered the various Patent Office fees and the larger portion covered the fees of the attorneys and the associates employed to make searches and to process foreign applications.

This \$1 000 figure does not include the renewal fees charged by a number of European countries to maintain the patent during its lifetime. The intention of these fees is to speed the transfer of patented information into the public domain. In those countries which have a renewal fee structure, the majority of patents do not remain in force for the full term. As far as the Canadian system is concerned, the industry people were not in favour of the introduction of fees of this kind for the following reasons. Although usually moderate, these fees add to the costs of patent ownership. The collection of the fees has to be organized and administered, placing an additional burden on both the owner of a patent and the Patent Office, and the revenues gained by the Office from the fees are correspondingly reduced. It is not clear that the great majority of inventors who allow their patents to lapse will necessarily lose valuable royalties or that the general public will gain extensively. Also, the principal expense in obtaining a patent is incurred when the application is being examined. To cover some of these costs from high renewal fees is to encourage the submission of borderline applications. To institute a schedule of low renewal fees will be more of a nuisance than anything else.

The \$1 000 figure does not include the costs of "policing" a patent or the costs of litigation after issue, both of which can be very high. In the experience of most industry representatives, however, these costs are seldom incurred in Canada. They *are* matters of concern to companies which own foreign patents.

A Patent Tribunal, a Patents Council and an International Joint Commission

Proposals to establish these types of organizations were made at several of the interviews. A fair number of other people with whom the proposals were discussed favoured them, but with the exception of the Tribunal proposal, there were dissenters who felt that there are already too many organizations of the quasi-government or advisory kind and that the existing system works well enough.

The *Patent Tribunal* would be a continuing source of outside advice to both the Patent Commissioner and the courts and a "screen" through which certain appeals and disputes could pass, and possibly be settled, before going on to the Commissioner or to the courts. The principal functions suggested for the Tribunal are to be to conduct preliminary hearings on all matters relating to patents, with the exception of infringement, which are within the jurisdiction of the courts: to act as a source of scientific and technical advice to the courts and to the Commissioner in all matters within their jurisdictions; and to advise the Commissioner on equitable levels of fees on petitions for compulsory licences. Each member of the Tribunal should be appointed to serve for a period such as four years. There should be at least six members, most of whom should have technical rather than purely legal qualifications.

The concerns behind the suggestion to establish a *Patents Council* were as follows:

1. Examinations of the Canadian Patent Act and the patent system as a whole have been made too infrequently in the past.

2. Advice from outside experts and Patent Office "customers" on matters such as information handling, patent quality and the commercial aspects of the patent exploitation need to be communicated to the Office on a regular basis.

3. The government should have an alternative source of advice regarding patent policies.

The Council would resemble, in some ways, one of the Associate Committees of the National Research Council and would include industry, university and patent profession representatives. It would hear regularly from members of the Patent Tribunal, the International Joint Commission and the management and the examination staffs of the Patent Office. It would meet, say, twice a year and have access to a small research staff. It could make its reports public.

The International Joint Commission would include not only representatives of

the Patent Offices in the United States and Canada but also representatives from other parts of the patent field in both countries. Its main functions would be to study and advise on collaboration and co-operation between the two countries. A Commission of this kind would be especially valuable at a time such as the present when the U.S. and Canadian Patent Acts and the Patent Co-operation Treaty are under review.

Foreign and International Systems

As has been noted in Part I of this report, the majority of industry representatives had only a partial knowledge of foreign and international systems, with the exception of the U.S. system. Some of the companies did not patent at all outside of North America. Others that were active often followed the practice of having European patent applications handled by an American or European parent company or by an affiliate. These gaps have somewhat reduced the amount of material on which this section of the Study could be based. Nevertheless, the contributions of the more experienced people have made it possible to include a foreign and international section. Without it, a full review of the Canadian system would have been impossible.

European Systems

All Western European systems are based on a first-to-file patent grant, with no grace period, but with due allowance made in the case of Convention filings. The industry people rated the systems in Holland, West Germany and the Scandinavian countries higher than the British system and well above the registration system in Belgium. The strongest features of the systems in the first group are the apparent thoroughness with which the searches and examinations are made and the correspondingly higher probability that the validity of issued patents will be upheld by the courts. However, the average period of pendency in each of these countries is, on average, even longer than

the average period in the United States or Canada under present administrative practices. The principal objections to the registration system lie in the haste with which the contents of filed applications are publicly disclosed and the need for court-approved validity. The following additional features of particular European systems were mentioned several times during discussions: Switzerland allows patents only in certain fields; Italy allows no pharmaceutical patents at all; Britain requires that resident inventors file in London before filing anywhere else; Holland has a deferred-examination system; and there is some evidence that more European Patent Offices are now awaiting the outcome of U.S. examinations before issuing their own patents. None of these features received much support from the industry people.

A number of people saw advantages in the opposition procedures which the German and Dutch systems contain but the balance of opinion was against them because they required the premature public disclosure of unprotected applications. The European renewal fee practice for issued patents was another provision which received some favourable comment but which, on balance, was not generally endorsed for reasons given in the previous section of this report. There was no real support for the German two-patent provision by which the "petty patent" provides less protection than the principal patent. Although this provision has been designed to deal with the kind of patents that many of the Canadians feel are "clogging" the Canadian system, the idea of strengthening the principal patent holds more appeal. One feature which did receive support-in conjunction with a first-to-file approach-was the British provisional filing, which allows a year for the filing of the completed application.

There was a general feeling that foreign applicants for patents in Europe are sometimes placed at a disadvantage administratively in relation to applicants who are citizens of the countries concerned. But one of the biggest problems which concerned Canadian holders of European patents was not related to the application and examination procedures but to the difficulty of "policing" patents after issue. The assistance of an affiliated company or an agent often had to be enlisted. "Policing" has been found more difficult for process than for product patents.

With regard to the countries of Eastern Europe, none of the industry people had had experience of attempts to patent there, and few knew about "inventors' certificates" which are in common use. However, it was pointed out several times that with Russia now a member of BIRPI, East-West patenting and licensing could increase in the future.

The Proposed Revisions to the U.S. Patent System

The initial proposals were based on recommendations made by the Presidential Commission which reviewed the U.S. patent system. Its report, *To Promote* the Progress of ... Useful Arts, in an Age of Exploding Technology, was published in December 1966. The Commission identified the following as its objectives:

1. To raise the quality and reliability of the U.S. patent.

2. To shorten the period of pendency of a patent application from filing to final disposition by the Patent Office.

3. To accelerate the public disclosure of technological advances.

4. To reduce the expense of obtaining and litigating a patent.

5. To make U.S. patent practice more compatible with that of other major countries, wherever consistent with the objectives of the U.S. patent system.

6. To prepare the patent system to cope with the exploding technology foreseeable in the decades ahead.

The most far-reaching and controversial of the Commission's recommendations was that the United States should change from the present first-to-invent to a first-to-file basis for granting patents. The most important arguments in favour of this change were the use by every other country except the U.S., Canada and the Philippines of the first-to-file system, and the abolition of interferenceor conflict-proceedings. The Commission also took into account a number of other considerations. For example, it argued that a first-to-file system would encourage more prompt disclosure of newly discovered and useful technology. The first applicant to file was more likely to be the inventor who first appreciated the *worth* of the invention and acted promptly to make the invention available to the public.

As a consequence of the change to first-to-file, the Commission recommended that there should be no grace period between the date the new invention could be made public and the date of filing the application.* This change would speed the examination procedure within the Patent Office because affidavits submitted to establish earlier invention dates would not require time-consuming consideration. Also, applicants would no longer be required to maintain extensive records relating to the earlier stages of the invention. And with regard to foreign first-tofile systems, U.S. inventors would no longer forfeit foreign rights through disclosures made during the present U.S. grace period. However, the Commission's recommendations provided for the filing of a preliminary application to secure an early filing date. The applicant would have one year in which to file the complete application, as happens under the present British system. This was thought to be long enough to test the marketability of an invention. The Commission also recommended that the patent term be extended to 20 years from the priority filing date to take account of the present average pendency period.

The Commission recommended a number of other changes, for example: that foreign knowledge, use and sale be included as prior art; that the present practice of keeping patent applications secret until issuance be modified to permit publication of the application 18 to *The present grace period is one year. 24 months after filing even though the patent had not been refused or granted: that either the inventor or the owner of an invention might petition for a patent: that the Secretary of Commerce should have authority to establish a deferred examination system if he found that this was in the best interest of the public: that the applicant should have the burden of proving that a claim is patentable: that patent claims held invalid by one court should be treated as cancelled from the patent, thus preventing a patentee from pursuing another defendant for infringement in another court circuit: that Offices of "Civil Commissioners" should be created where justified by the volume of patent litigation to conduct pretrial hearings and generally to accelerate the whole process of litigation: and that a Statutory Advisory Council should be established to advise the Secretary of Commerce, on a continuing basis, on various aspects of the effectiveness of the Patent Office and the system.

The above-description by no means exhausts the points at issue in the reform of the U.S. Patent Act which the Commission, and later the Administration, proposed. Nor does it advance or discuss the arguments of the principal groups which are wholly or partially opposed to the proposed changes. Since the Commission reported, several Bills have been sent to Congress with regard to changes in the Patent Act. The appropriate Committees of Congress have also heard testimony. But it seems likely that any revisions to the present Act will not include a full first-to-file system but will adopt a number of provisions having a more "international" flavour.

Although there was widespread scepticism about the principal recommendations of the President's Commission ever passing into U.S. law, it was clear that Canadians who had worked mainly in the Canadian environment felt less strongly about arguments against patent reform than did those whose experience had been principally in the United States. But as a number of people pointed out, the adoption of a first-to-file system in the United States would remove one important inequity which has already been mentioned in this report and which now applies to Canadian and other foreign applications for U.S. patents. This is, of course, the provision whereby the effective date of invention for a foreign application is the priority filing date at the U.S. Patent Office and not the *actual* date of invention.

Steps towards a Single Worldwide Patent System: The Patent Co-operation Treaty* Hardly anyone was opposed to the idea of a single worldwide patent, based on a single application and on a single novelty search of worldwide prior art, but there was widespread scepticism about the possibility that this idea would be put into practice in the near future, if ever. Some people thought that *all* patent systems would be obsolete before the halfway stage to the worldwide system had been reached. But only those opposed to any patent system suggested that it was impracticable for some steps in the direction of a worldwide patent system to be taken soon. It was also felt that these steps could be taken more easily on the technical side of patents (search and examination) than on the legal side (infringement, etc.), or with regard to rules of administrative practice.

There was, therefore, general sympathy in industry for the Patent Co-operation Treaty. Under it, regional examination centres would be set up throughout the the world to do novelty searches and to issue, when appropriate, search and examination reports which could then be presented to national authorities in the countries in which patent protection was desired. There was, perhaps, more enthusiasm than soundly based opinion behind the thought that the Treaty might provide less costly but more widely based searches of prior art than are available at present to Canadian companies. Perhaps most of this enthusiasm was gener-

^{*}The "BIRPI Proposals" based on the situation up to the end of May 1968.

ated by the fact that the regional examination system for Canada would be the U.S. Patent Office which is already respected for its expertise by companies in Canada.

In the opinion of most of the industry people with whom the internationalization of patent systems was discussed, Canadian authorities ought to be working towards a single worldwide system and should support the "BIRPI Proposals" since these would contribute to a reduction in multiple filings and, hopefully, to a corresponding reduction of the overall costs of patent ownership. But should these proposals be unacceptable for some reason, or should delays develop, it was the opinion of these people that the Canadian authorities should press in Washington for consideration of a North American system of novelty search based on the combined facilities and expertise of the U.S. and Canadian Patent Offices.

Patents and the Federal Government

Two general points of principle on this subject emerged from the industry discussions. These were:

1. Governments should interfere as little as possible in the free flow of scientific and technical information-including information on patentable and patented inventions-which is of value to industry in the invention-innovation process.

2. The exploitation of patentable and patented inventions for economic purposes is the business of industry and of certain crown corporations with manufacturing responsibilities.

By no means had all of the 80 companies had first-hand experience of the attitudes and rules of federal departments and agencies in Canada with regard to the patents associated with, or resulting from, government-sponsored, -assisted or -performed research and development work. Quite a few apparently made a point of staying away from involvements of this kind. Of those companies which actually had experience, almost all had obtained it in one or more of these ways: from work performed for the government under an R & D contract; from participation in a procurement contract; from participation in one of the four special assistance programs*; or from a contract with Canadian Patents and Development Limited, the subsidiary of the National Research Council which is responsible for the exploitation of patents resulting from government and university research.

With regard to patents resulting from R & D or procurement contract work, the policy of government departments and agencies has generally been to retain title to any inventions on behalf of the Crown. For example, the regulations regarding ownership of inventions included in the Supplemental General Conditions of the former Department of Defence Production (DDP 36) contained the following paragraph (No. 4):

"Unless otherwise provided in the contract, all technical information, inventions. methods and processes conceived or developed or first actually reduced to practice in carrying out the contract, shall be the property of Her Majesty and shall be fully and promptly disclosed in writing to Her Majesty by the contractor, and the contractor shall have no rights in and to the same expect such rights therein as may be granted by Her Majesty, and shall not apply for any patent in regard thereto without Her Majesty's written consent. The contractor shall not, without written consent of Her Majesty, divulge or use such technical information, inventions, methods and processes, other than in the carrying out of the work and, in particular, shall not sell other than to Her Majesty any articles or things embodying such technical information, in-

^{*1.} The Industrial Research Assistance Program (IRAP);
2. The Defence Industrial Research Program

^{2.} The Defence Industrial Research Program (DIR);

^{3.} The Program for the Advancement of Industrial Technology (PAIT);
4. The Defence Development Sharing Program

⁽now the Defence Industry Productivity Program). These programs will be discussed in more detail

in Part III of this Study.

ventions, methods and processes or grant any licence to manufacture such articles or things without the written consent of Her Majesty."

The principle of government title has been a contentious one for a long time. In practice, however, the rigidity of application of the principle may be relaxed under special circumstances but these cannot be laid down in general terms. This principle was not upheld by companies because much of their own background knowledge and expertise-which the contracts were not paying for-went into the R & D work and because both background and new knowledge could be passed on to a competitor-at no cost to the competitor-if subsequent procurement contracts were not awarded to the company performing the R & D work. The rebuttal of these arguments was as follows: "He who pays the piper calls the tune"; most companies require their own engineers to assign patent rights to them as a condition of employment; each case is different; and, it has been found administratively easier in departments to start negotiations from the position of owning title to the patents. These various points by no means exhaust both sides of the argument. It is perhaps sufficient to say that problems exist with regard to the right to exploit patents resulting from R & D contract work sponsored and paid for by the federal government. Nevertheless, in a case in which the government has built up unique technical competence and market competitiveness in a Canadian firm by means of a research or development contract, it would seem wasteful to award subsequent procurement contracts to competing firms on the basis of price alone.

With regard to the *special assistance programs*, the onus for taking patent action rests with the participating companies. The lack of a patent policy is not a deterrent to participation in any of these programs. The government administrators actively encourage companies to apply for patents on any potentially valuable invention which may be developed during the course of a project. Since the government's share of the cost of a project is usually less than 50 per cent, and since there are pay-back-fromprofits conditions in the two development assistance programs, the government has less reason to claim title to any of the resulting patents and is therefore limited to the exhortation form of encouragement.

Canadian Patents and Development Limited (CPDL) was brought into being by the National Research Council in 1947 to handle inventions which had accumulated largely from research by the National Research Council during the Second World War. To this end, CPDL examined inventions for patentability and made filings for patents in various countries where the inventions seemed attractive to potential licensees, and promoted and licensed these inventions. Canadian Patents and Development Limited collected the royalties and, from these, provided cash awards to the inventors, defrayed the costs, and assisted in the further development of certain of the inventions. In 1948, CPDL was brought under the Government Companies Operation Act and, in the same year, accepted the handling of inventions arising from other government departments. In the same year, also, CPDL made provision for entering into agreements with universities, at the request of the university in each case, to handle their patentable or potentially patentable material. In 1951, CPDL concluded its first agreement to handle the patenting, development, promotion and licensing of inventions for a provincial research council. In 1952, CPDL entered into an agreement with the National Research Development Corporation of the United Kingdom whereby, in return for a percentage of any royalty income received, each would handle the promotion of certain inventions belonging to the other. Agreements have since been made with similar government organizations in Australia, India and South Africa. The creation of these latter

organizations was modelled largely on the Canadian company.

The enactment of the Public Servants' Inventions Act in 1954 specified that ministers were empowered to transfer the administration and control of inventions to CPDL, and opened the way for it to become the Canadian Government's prime patenting and licensing agency. Canadian Patents and Development Limited is now eligible to accept and handle inventions arising in all Canadian Government departments and agencies.* Over the years, inventions from 26 out of a total of over 100 such departments and agencies have been received. In addition, CPDL has agreements with about 20 Canadian universities and colleges and with 5 provincial research councils and foundations.

In marketing an invention, CPDL has to assess the nature and amount of development that will be required to put it into production. In many cases the licensee will be willing, or can be persuaded, to perform the necessary additional development work, and in these cases CPDL provides the opportunity for the licensee to recover his costs by granting him exclusive rights for an appropriate period or by making allowances in the royalty rates. On other occasions, CPDL will pay part of the development costs. The Development and Promotion Branch of CPDL can begin the active promotion of an invention as soon as the authority for administration and control has been transferred and the first application for patent has been filed.

As at March 31, 1968, CPDL:

-had received from all sources an accumulated total of 2 245 proposals for patent;

-had obtained directly or through agents, over the years, patents on 660 different inventions, and patents were pending on 350 others; and

-had licences in force on a total of 244 inventions, and was seeking licensees for 692 more inventions.[†]

During fiscal year 1967-68, 172 patent proposals were received, an increase of

14 over the previous year. Of these, 41 originated in the National Research Council; 30 in Atomic Energy of Canada Limited; 66 in other government departments: 29 in universities: and 6 in provincial research councils. During the year, patent applications were filed on 70 inventions; 185 further foreign filings were made; and prosecution continued on over 500 previously filed applications. During the year, 62 inventions became available for promotion, and 28 new licences were negotiated with industry. The settlement of infringement problems in the United Kingdom, Belgium, the United States and West Germany had been effected or was under active negotiation. The income of CPDL from royalties, licence fees, etc., for 1967-68 was just over \$368 000, out of a total income of \$386 000-down by about \$25 000 from the previous year. Only 120 out of the 244 active licence agreements produced revenue during the year. Of these, 80 were with Canadian manufacturing companies, 21 with companies in the United States, and 19 with companies in other countries. The amount spent by CPDL on development and promotion activities during the year was almost \$114 000.

The subject bias in CPDL's patent holdings is towards physics and electronics, and consequently is of little interest to the large chemical industry. The agency's desire is to foster Canadian innovation, but it cannot ignore exploitation possibilities abroad. Where possible, in Canada, non-exclusive licences are granted. Royalties are set at a level which will keep the product's selling price within reach of the market. Outside Canada, the agency is much more aggressive in ensuring the best possible financial return for itself.

^{*}The Department of National Defence, however, handles the patenting of all inventions arising in the Department but turns over to CPDL the commercial exploitation of those which can be released. CPDL also pays patenting and renewal costs for patents filed in countries beyond those required for military purposes.

[†]Canadian Patents and Development Limited: Annual Report, 1968.

Although the existence of CPDL was quite well known throughout industry, few of the companies visited had benefited from its work. Only three had actually licensed and developed patents promoted by CPDL. A number of other companies reported receiving CPDL's promotional publications on a regular basis. A half dozen or so of the people interviewed had never heard of the agency or of its relationship to the National Research Council. While it may be considered inevitable that CPDL's patent portfolio would not have "something for everybody", the general view of the agency which emerged from the interviews was that CPDL's work was underpublicized, undersupported, undersold and underfollowed-up. Many of the patents were in need of considerable further development and neither the original research nor the patent application seemed to have been undertaken with commercial exploitation in mind.

The industry consensus was that Canadian Patents and Development Limited was a useful federal government agency which, so far, had not achieved anything like its full potential. Two main reasons for this were identified. First, its efforts had been too thinly spread and too timid. Second, the raw material it had to work with was often quite unsuitable for exploitation in the marketplace. Some thought the agency should become, quite soon, part of an agency similar to the National Research Development Corporation in the United Kingdom, but adapted for the North American environment.

Patents as an Information Source*

Technical information is usually gathered, sold and exchanged in "packages". The publication of a single patent or of a group of patents will not necessarily constitute a package ready for use or sale. Other information will be required-some of it already freely available in published form, and some of it bearing a confidential or proprietary marking.

It was clear from the interviews that issued patents could be a valuable source of new technical information to Canadian companies. This was particularly true in companies that had their own resident patent agents or had assigned an engineer to be responsible for patent matters. The engineers, in particular, were usually responsible for bringing newly issued patents and information relating to older patents to the attention of colleagues on the basis of need or of interest. Most companies had built up a reference collection of patents, and the largest and most comprehensive collections were to be found in the largest, most diversified and most patent-conscious companies. But companies which never applied for patents themselves often made some use of information from issued patents from time to time.

On the question of the relative values of Canadian and U.S. patents as preapplication search material and as representative of the state of a current "art", the industry people unhesitatingly chose the U.S. patents on both counts. The reasons for this are not hard to identify. For example, there were more patents issued in the United States each year. The quality and reliability of U.S. patents was reported to be better. About half of the patent applications filed in Ottawa had already been filed in Washington.[†] The search facilities-and the people who can be retained to make pre-application or current art searches-were reported to be more abundant in Washington than in Ottawa. In those parts of Canada outside the Montreal-Ottawa-Toronto trianglewhere there are no public search facilities at all and where public collections of issued patents are few and far betweenthe use by attorneys and others of the Ottawa facilities cannot be assured. It

^{*}Part III of this report includes a section on "Scientific and Technical Information" which is a general discussion of the subject.

[†]When Rule 39 is applied, the U.S. and Canadian patents can be quite similar. As mentioned earlier, the Patent Office in Ottawa can request information with regard to foreign applications under this rule and may await the issue of the U.S. patent before issuing the Canadian one.

cannot even be assured in Montreal or Toronto.

The industry representatives reacted to the current patent search situation in Canada, as they saw it, by suggesting that the facilities within the Canadian Patent Office itself should be improved. For example, a separate public search room should be provided within the Office, and regional search centres should be established outside of Ottawa. They endorsed, enthusiastically, the suggestion that the improved Patent Office "network" should make use of electronic data information handling equipment. But they cautioned that the long-term solution would probably bring the Canadian and American Patent Offices closer together and that this factor should be considered in the design of any national patent information network.

The weekly publication of the Canadian Patent Office Record was discussed at length with several industry people. Most of those who expressed views said either that they made little use of it in comparison with the U.S. Patent Office Gazette or that it was quite satisfactory for their purposes. One point made with regard to the *Record* was that its impact would be improved if brief non-legal descriptions of each of the inventions could be included.* Those who felt strongly about this suggested, also, that the Record be published twice weekly if the addition of these descriptions led to a size problem. A second point was that the whole impact of the Record-and of the Gazette-in industry would be increased as the average pendency period for Canadian patents dropped and as the validity of Canadian patents, generally, improved.

With regard to patent searches in Europe or in Japan, industry people said that these were normally left in the hands of parent companies or of Canadian attorneys and their foreign associates. However, a number of companies reported that they made regular use of European patent search, information and abstracting services, some of which covered publications as well as issued patents.[†] Nearer home, several companies said they received the regular publications of Canadian Patents and Development Limited.

The industry representatives felt that issued patents, as sources of new information, played a relatively small part in the recent worldwide information "explosion". There were a number of reasons for this. For example, patent applications were not made in fast-moving fields because the pendency delay in examination system countries was too long and because there were potential validity and litigation problems in registration system countries. The fact that every patent issued, on average, in at least two countries halved the volume of new information contained in the world total of annual applications. In terms of significant new information, the volume might be reduced even further because most patents were issued for improvements rather than for basic inventions. And while the number of issued patents was increasing each year, the number of disclosures made in other forms appeared to be going up faster, even when duplication and the reporting of trivially important information were taken into account.

Patents and the Sale or Exchange of Scientific and Technical Information

As in any other business transaction, the buyer must know what kind of product is being offered for sale or exchange, and what its price will be in money terms or in terms of an equivalent exchange product. While holding patents is one way of advertising that *information* may be available for sale or exchange, not all patents are actually used for these purposes. Also, what patents disclose may only be a part of a larger information package. From the interviews, the following points emerged with regard to the sale or exchange of patented information.

^{*}Steps in this direction were initiated by the Canadian Patent Office in the summer of 1969. †For example, the services provided by the Netherlands Institute for Documentation and Filing (NIDER) provides patent search material.

What attracts buyers or traders of information is usually an amalgam of factors and circumstances. The information must, of course, be related to the business of the company that plans to acquire it. It helps, too, if the company which owns the information is well known, has a strong technical reputation, and has a reputation for getting good patents. The terms of the deal must include an element related to competition between the two companies, but sometimes they will not be in the same market. The confidence which companies have in an information deal will be strengthened if they have done business of this kind successfully before. The existence of an information "pool" between two companies will encourage exchanges, provided that a third company, affiliated with the second but in competition with the first. can be excluded if necessary. Normally, the owner of the information will not sell or exchange his property unless it is to the advantage of his overall business position. But it appears that the most important factors in an information sale or exchange are the relative technological bargaining strengths of the participating companies and the technical and commercial values which the parties place on the information itself.

The opportunities for the exchange of information between companies that belong to international corporations or to groups of affiliated companies are likely to be more frequent than between companies without such connections. The attractions of technical interdependence will also be stronger. But corporate ties and affiliations, however close, do not necessarily mean that information will be exchanged at little or no cost or even exchanged at all. In some cases, the companies are not all in the same business or even if they are, they may not have the same market or production technology requirements. Nor will the natural resources or raw materials which each of them uses necessarily be put through identical beneficiation processes.

Parent-subsidiary information exchange arrangements, the kinds of arrangements made between affiliated companies, and the terms of information sales for patents and packages vary considerably. Such facts are not new in Canada or in any other country in which sales and exchanges play a large part in the acquisition and transfer of "know-how". As far as the industry interviews were concerned, a few companies were willing to shed some light on their policies regarding information exchanges and sales, but most did not. This report therefore cannot say anything new on the subject of Canada's technological balance of payments.

There were also relatively few discussions on patent licensing and pooling during the interview program. Nevertheless, an observation or two on these subjects can be made. For example, patent licensing, cross-licensing and pooling do not appear to be pursued nearly so extensively in Canada as in the United States. This has to do with factors such as the size of the Canadian market and the interests of Canadian companies, as well as with the arrangements which foreign parent and affiliate companies are able to make on behalf of Canadian companies for the licensing and pooling of new technical information.

The most extensive formal patent "pool" in Canada has been Canadian Radio Patents Limited (CRPL) which covered companies in the home electronics industry.* The influence of CRPL has, however, declined considerably in the

^{*}Canadian Radio Patents Limited was incorporated in 1926 to act as a patent licensing agency in the administration in Canada of radio, television and and general electronics patents owned by the Canadian General Electric Company, Canadian Westinghouse, Northern Electric, Canadian Marconi and the Canadian Radio Manufacturing Company. It also acted as licensing agent in Canada for RCA Victor and the Hazeltine Electronics Corporation. CRPL acquired from such companies a non-exclusive licence with the right to grant sublicences. CRPL sought to distinguish itself as an agency and not as a patent pool. CRPL did not, however, grant licences to importers except under the condition that the specific equipment was not made by any company in Canada. Otherwise, it granted licences fairly freely.

last decade as a result of the expiry of several basic patents and the effects of certain consent decrees regarding competitive practices in the United States which also affected the members of CRPL in Canada. Nevertheless, in the opinion of certain companies, CRPL made possible the growth of the home electronics industry in this country and the decline of its influence has, in turn, helped to weaken the industry. But not all companies favoured the CRPL agency or "pool" type of operations.

Those Canadian companies which had no extensive backing from parent or affiliate companies abroad were particularly concerned about the terms of the licences which they could negotiate on the open market. Such terms usually placed them at a disadvantage in relation to the subsidiary and affiliated companies competing in their markets. The suggestion was made on a number of occasions that the federal government should find ways of eliminating or reducing this disadvantage through licence legislation. This suggestion was not at all well supported. Subsidiary companies were naturally opposed to it, but a number of the residentowned companies considered that a better answer to the problem lay in government action to facilitate the growth of their research and technical competence, their markets, and their information-bargaining strength on a worldwide basis.

It was also evident during the interviews that while licensing, cross-licensing and patent pooling among the member companies of international corporations were common, it was often very difficult indeed for companies outside the "family and friends" to license or trade information with companies inside. Some of the smaller resident-owned companies which found themselves in this kind of predicament would often "infringe and hope", while larger companies might infringe and adopt a "Sue me!" attitude. But, with regard to the Canadian patent system in particular, it was generally felt that the compulsory licensing provisions took something away from the strength of the

"family and friends". Also, the general speeding-up of technological advance reduced the long-term value of some issued patents, and a company with the research resources and the technical competence could make use of the everincreasing volume of published literature which was widely available at a relatively low initial cost.*

A number of other points were raised during the interviews and are worth noting as part of this discussion on patents and the sale or exchange of information. For example, companies did not particularly like agreements which might commit them to exchange information contained in *future* patents unless there was a considerable incentive to do so. Also company take-over operations could lead to time-consuming and costly complications between the purchaser and the companies with which the seller had concluded licensing arrangements. Some companies considered the development of "in-house" technical competence, skills and judgement to be more important in the longer term and were willing to accept shorter term restrictions on marketing under a licensing agreement in order to acquire all of these things. And, finally, to gain a foothold in a new and potentially valuable market, some companies were willing to "buy into" this market by taking a financial loss on the initial contract or contracts.

The Part Played by the Patent System in the Encouragement of R & D Activities in Canada

The granting of a patent is the last of a series of events whose progression cannot always be easily traced and whose beginning may not always be easily identified. Development activities will normally have had their place somewhere in the series, if it is assumed that the work of both independent and corporate inventors can be called "development" for the most

^{*}Still another factor is the attitude of the Department of Justice in the United States with regard to anti-trust matters.

part. Research activities may have had no place at all in the series of events.

In the opinion of the industry people with whom the question was discussed. patents play little or no part in the initiation of research programs or projects but may play a much larger part in the initiation of development work.* Scientific principles and discoveries cannot be patented, and there can be no certainty that the ideas which research and development activities explore and exploit will eventually be the subject of an issued patent. As far as the individual or the company is concerned, patents may be considered principally as by-productsand even windfalls-that may later accrue to them, but which have no *necessary* bearing on the quality or appropriateness of the research and development work that has to be done. However, the closer the R & D work comes to the interface between invention and innovation, the more care the individual or the company is likely to take in assessing the commercial, as well as the technical, merit of a new development. The decision to apply for a patent is, as noted earlier in this report, motivated principally by market and business factors outside of the laboratory rather than by technical and laboratory considerations. Research and development are two more of the many tools a company may use to make its way in the world.

The industry representatives reported that a significant proportion of their companies' own recent patent applications resulted from "in-house" R & D activities in laboratories or engineering departments. From the point of view of their overall patent positions, these applications were often supplemented by applications originating in parent, subsidiary and affiliate companies. The more closely bound the relationship between two companies, the sooner the originator of an idea in one company would be likely to pass along information about it to the other. But since there is a growing trend towards parent-subsidiary-affiliate specialization in R & D activities and in

production, the new information generated by one company will not always be in the same field of science or technology as the new information generated by another. Canadian subsidiaries of Canadian parents specialized in this way to a greater degree, perhaps, than did a Canadian subsidiary and its U.S. or other foreign parent. However, when it appeared that the results of a piece of Canadian work may sooner or later be patentable, the working relationship existing between a Canadian subsidiary and its U.S. parent may discourage further development, and subsequent patent action, in this country. The reason for moving the research to the U.S. is not always related to a desire to deprive Canadians of a new invention or to excessive corporate "closeness". It may reflect U.S. and Canadian views about the quality of Canadian patents. More likely, it will reflect the distinction which the U.S. patent system makes between effective invention dates of native and foreign inventions.[†]

The role played by the Canadian patent system in the encouragement of R & D activities in this country was strengthened indirectly, during the years 1960 to 1968 at least, by three particular changes in the industrial R & D environment. The first was the overall increase in research and development activities and in the numbers of management people associated with them who had had previous experience with patent applications and with the use of patented inventions. The second was that besides generating new information for "offensive" and "defensive" patents, companies were generating more new information for sale or for trade and some of it had to be patented to make it acceptable. The third change was the raising of the general level of technical competence in industry as a whole. This last change has been, at one and the same time, more pervasive and less noticeable than the other two.

^{*}They do, for example, if it is desired to "invent around" a competitor's patent.

[†]This particular point has already been mentioned in the section of this report on "The Patent Policies and Practices of Companies".
The following are broadly based summaries of the views expressed by the company people on the patents -R & D question on an industry-by-industry basis. These views should not be construed as necessarily representative of each industry as a whole.

Pulp and Paper: The patent system has had little or no effect on development work associated with woodland operations. The main emphasis is on the patenting of manufacturing processes developed in the laboratory. Even so, patents are usually considered to be by-products of the need to generate new and relevant information. The search for issued patents to discover the state of the art is done on a continuing basis by some companies.

Pharmaceuticals: The emphasis is on obtaining *process* patents in Canada since they are the only ones available. Although process patent positions do not "design" R & D programs in the pharmaceutical field, the fact that relatively few new and important pharmaceutical patents are granted each year means that there is an incentive to keep the possibility of patenting firmly in mind during the course of these programs.

Petroleum/Petrochemicals: Patents are considered principally as research byproducts, but the possibility of obtaining protection can be a significant factor in the planning of large and costly development or pilot-plant projects. Patents are frequently used by laboratory staffs to help them keep abreast of current art.

Food and Beverage: The consensus is that patents are relatively unimportant in the planning or initial laboratory stages of a research project. Usually, brief searches precede each project, especially the largest ones.

Mining/Metallurgy: Patents play little or no part in mining research and give little or no encouragement to development work associated with the exploitation of unique natural resources. Metallurgical companies view patents as important elements in their R & D strategy and occasionally as the main reason for undertaking particular projects. Other Chemicals: The availability of "composition of materials" patents is considered essential to R & D activities. Patents also help to encourage process R & D. Continuing patent search activities are common.

Rubber/Textiles/Glass: The processes whereby R & D programs are initiated vary considerably. Some of the companies use the patents of others as starting points for their own research and development. Generally speaking, patents are considered more as by-products than as essential program design elements because research and development in Canada tends to evolve more from the stimulus of productivity improvement needs, cost reduction and competition.

Machinery/Transportation: The art is generally slow moving and well known. Patents are a bonus.

Electrical-Electronic Capital Goods: Patents are not a primary consideration in R & D planning because the art can be revealed in a number of ways besides patents. The large worldwide corporations included in this group are much more enthusiastic about the connection between patents and the *findings* of R & D activities than about patents and the *initiation* of R & D.

Nuclear/Aerospace/Instrumentation: Generally, these fields are too fast moving for patents to be of much help in encouraging R & D activities. Also, most of the companies visited were small and highly specialized.

Miscellaneous Manufacturing: Patents are not an important factor in relation to research and development activities.

The Canadian patent system cannot be called a direct R & D "incentive" measure in the full sense. It usually affects R & Dactivities indirectly and its principal value lies in being available *after* the research and initial development work has been completed. But if the Canadian patent system is removed or is seriously weakened, the view of most industry people would be that the growth of R & D in this country-and improvements in the technical competence of industry as a

whole-would be affected adversely. At the same time, there appear to be several ways in which the patent system may be made into a more effective incentive for R & D-for example, if pendency periods can be shortened and validity subject to less uncertainty. But it has to be remembered that decisions affecting applications for patents are made somewhere around the invention-innovation interface. The value of a patent as an element in post-R & D business strategy is shown best with regard to the technical breakthrough -which seldom happens-and for which industry may have much less initial enthusiasm and understanding than the inventor himself.

The Retention of a Patent System in Canada

No clear, unequivocal, or statistically supported case couched in terms of past, present or future economic or industrial growth can be made from the material included in this report. Nevertheless, by a majority, the industry representatives recommended that the system be retained. This recommendation was based on experience, on the nature of business, on past successes and on future possibilities. Even the opponents of the system rejected strictly theoretical grounds as adequate to support their view.

The industry people were aware that a patent system would not benefit all companies to the same extent. Patents helped some companies to stay in business, but were responsible for the failure of others. It was also appreciated that the majority of Canadian patents rights are held by non-Canadian residents, as are the intellectual resources represented by these patents. But the counting of issued patents is only one way in which the available intellectual resources in Canada can be measured. Finally, it was considered obvious that no *simple* theory can possibly cover all the different aspects of patent laws and patent systems and their technical, legal, economic and other implications.

On the retention question, the principal representatives of the 80 companies "voted" as follows:*

In favour without qualification in 60 cases;

In favour "on balance" in 10 cases; Not in favour "on balance" in 6 cases; Strongly opposed in 4 cases.

These "votes" have also been broken down by industries, but it must be remembered, again, that they reflect the views of individuals and cannot be considered as necessarily representing the views of the companies or of the industries to which they belong. This breakdown is as shown in Table 3.

The following were the principal reasons advanced by the opponents of the patent system in Canada:

1. The original intent behind the grant of a patent has been eroded away until it has become little more than a "licence to threaten" or a "licence to litigate", particularly in the hands of larger companies whose power and numbers are increasing.

2. Small companies and independent inventors in Canada receive little more than a piece of paper for their investment of time, effort and money.

3. The real value of a patent system lies in the "right to exclude" protection that it can give with regard to basic inventions made by large companies which have extensive exploitation resources or which are able to reduce or even to suppress the manufacture or sale of an invention made by a small company.

4. Small companies usually have insufficient resources to "police" their patents. They also hesitate to apply for

*As a matter of interest, the non-industrial representatives were also "polled" with the following results:

The representatives of eight federal government departments or agencies were in favour, without qualification, and two were in favour, "on balance".

The representatives of four provincial research councils were in favour, without qualification, two were not in favour, "on balance", and one was noncommittal.

The university representatives were in favour in five cases and non-committal in the other three.

Eight of the representatives of trade and research associations, professional institutes and others were in favour and three were non-committal.

Table 3-Views on the Retention of the Patent System in Canada on an Industry-by-Industry Basis

	In favour, without qualification	In favour "on balance"	Not in favour, "on balance"	Strongly opposed
Pulp & Paper	5	_	-	-
Pharmaceuticals	5	-	-	-
Petroleum /Petrochemicals	4	-	-	-
Food & Beverage	6	_	1	-
Mining/Metallurgical	9	1	1	-
Other Chemicals	8	-	-	-
Rubber /Textiles/Glass	7	-	-	-
Machinery /Transportation	2	2	1	-
Electrical-Electronic Capital Goods	9	2	1	-
Nuclear / Aerospace / Instrumentation	2	5	1	4
Miscellaneous Manufacturing	3	-	1	-

compulsory licences. They may simply infringe the patents anyway.

5. A large percentage of the patents granted in Canada are applied defensively, that is, to build a fence round an earlier patent or to avoid suit being brought at some future date against an inventor for making use of his own invention.

6. If there is no patent system, there will be no opportunities for costly conflicts or litigation and no way in which a large company can put a small one out of business by these methods or by other abuses of the system. Even if the result is more secrecy, the technology which is actually disclosed will be available to everyone. It is also wasteful and often expensive to "invent around" someone else's patent. The least expensive versions of an invention are usually the first to be developed.

7. Secrecy can be used in defence of business positions involving custom-built products or involving inventions that can be effectively hidden inside, or disguised by, other non-patentable or patented products. Secrecy can also be used extensively in fast-moving technological fields or in fields such as foods and beverages in which the information need only be given to a handful of people. The incidence of secrecy is rising.

8. Not only do U.S. inventors receive many more Canadian patent grants than

do Canadians themselves, but Canadian companies and independent inventors do not even bother to make applications in Canada because the exploitation potentials of the United States-and even of the Washington-Chicago-New England and the Los Angeles-San Franciso regions of that country-are so much greater than the markets in Canada.

9. Canadians, and Canadian companies, are simply not patent conscious.

10. Patent literature is a relatively poor source of new information or ideas in comparison with other sources such as publications and personal contact.

11. The trend towards larger and more international companies, the extension of patent pooling, the trend towards more extensive cross-licensing and "know-how" agreements, and the increasing inability of small companies to survive will effectively eliminate any residual value and protection which a patent system can give. By the year 2000, patent systems everywhere in the world could be redundant.

The following were the principal reasons advanced by the supporters of a patent system in Canada:

1. From the business point of view, some form of protection is required for the kind of intellectual capital which is embodied in patentable inventions. In the absence of an alternative system which will be acceptable both in Canada and abroad, there must be a continuation of patent grants and retention of a patent system. It would be industrial suicide for Canada to do away with its patent system unilaterally.

2. The worldwide trend is towards the internationalization of patenting procedures and the streamlining of national systems to reduce costs and opportunities for litigation.

3. Manufacturing in Canada has, since the end of the Second World War, crossed the threshold from being that of a "small" country to becoming that of a "mediumsized" country. In "medium-sized" and "large" countries, manufacturing and industrial progress generally depend more on being able to protect, and to obtain, proprietary information. The patent is, in effect, "a licence to trade". Canadian capability to obtain and to use this information has increased with each stage in the improvement of:

a) the technical competence of Canadian industry as a whole;

b) the ability of many more Canadian laboratories to generate and apply new scientific and technical information; and

c) the availability of the capital and other resources associated with the innovation process.*

4. Patents are the basis of the majority of "know-how" trades, although they may not be the major or the most technically or commercially significant parts of each information package. Patents have also been indispensable in the successful establishment of certain companies, and there is no reason for this to cease to apply in the future in most branches of technology.

5. Although the patent system, by itself, has been of indirect value as an incentive in the growth and development of industrial R & D activities in Canada, the removal of the system or significant reductions in the protection afforded by it will discourage further growth in these activities and may even start off a serious decline in the present levels which direct government-sponsored incentives are unlikely to arrest or reverse. The slowing of the spread of R & D activities throughout Canadian industry cannot fail to affect the levels of technical competence in industry and the ability of Canadian companies to compete at home and abroad or to generate more jobs for Canadians.

6. Some of the old arguments in favour of retaining the patent system are still valid, including these:

a) even though the patent system does not encourage the disclosure of *all* new and useful inventions, the scrapping of the system would lead inevitably to more industrial secrecy and espionage and to more duplicated and wasteful R & D;

b) the patent system *does* protect information and it *does* reward inventors, although the degree of protection and the extent of the reward may vary considerably from one patent to the next;

c) the patent system *does* help to speed the disclosure of information;

d) the patent system *has* encouraged manufacture in Canada.

7. Even if, for one reason or another, all the patent systems in the world become redundant early in the next century, it is by no means certain that the patent system in Canada has already passed its peak of usefulness. For example, the two basic tactics in an overall patent strategy are to obtain strong protection for basic inventions and to apply sufficient resources at the appropriate rates to obtaining a satisfactory return on the investments. Such tactics do not appear to have been pursued with energy or with frequency in this country up to the present time. Also, since the Canadian Patent Act will allow a foreign inventor to defeat a Canadian inventor by accepting foreign dates of invention-which the U.S. Act does not do-the Act may now be much too generous in its provisions from the Canadian point of view.

^{*}The general view was that technical competence and information-generating capacity in Canada has increased significantly but that the availability of venture capital and of entrepreneurs is still quite inadequate.

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The Growth of Canadian Industrial R & D Activities

Not all of the companies which perform research or development work in Canada have formally organized laboratories. Some companies combine development and engineering activities in one division or department, and in small companies it is not unusual to find research, production and managerial responsibilities combined. Although formally organized **R & D** laboratories are recent additions to most of the companies in this country which have them, a few were set up more than 20 years ago. A recent centennial publication commented as follows:*

"The Steel Company of Canada Ltd. had laboratories in Canada as early as 1903; Shawinigan Chemicals Ltd. had done the same by 1915; Northern Electric Co. by 1916; and Consolidated Mining & Smelting Co. of Canada by 1917.

"International Nickel Company of Canada Ltd. had laboratories going in 1922, and Canadian Industries Ltd. by 1929. In the early 1930's, large laboratory facilities were in use in Canadian Breweries Ltd.; Ayerst, McKenna & Harrison Ltd.; and Imperial Oil Limited. The early 1940's saw large-scale facilities for research opened by Aluminum Laboratories Ltd. near Kingston; by Dominion Rubber Co. Ltd. in Guelph; by British American Oil Co. Ltd. at Toronto; and Canada Packers Ltd. at Toronto."

Some observers feel that the period 1958-60 was the "take-off" point for research and development activities in industry in this country. The available statistics certainly show considerable subsequent growth in aggregate expenditures, in the employment of professional and supporting personnel, and in the numbers of companies whose performance of research and development has been recorded.[†] Since that period, there has also been general acceptance of the need for improved technical competence in Canadian industry as a whole, with the result that increasing emphasis has been placed on upgraded and continuous education and training at all levels. Another very important element in recent years has been the growing recognition that scientific and technical information can be a commodity in trade. The result of this has been that an increasing number of Canadian companies are now consciously attempting to strengthen their "knowhow" trading positions.

As far as the 80 companies which were visited are concerned, the physical evidence of growth and development could often be observed. For example, in the past five years, about 30 of them had either completed new and significantly expanded laboratory facilities or had established formal laboratories for the first time. In the smaller, science-based companies in which formal laboratories could not always be separated from design or engineering or even production departments, the evidence of growth was more frequently an observed or reported expansion of total facilities and a significant growth or upgrading of the personnel employed. Not all of the interviews yielded hard statistics or provided guidelines regarding the behaviour of recent R & D expenditure and personnel levels. Those which did showed the following results: 1

Levels predominantly upward 60 per cent;

Levels steady 25 per cent;

Levels fluctuating (mostly in the small, science-based companies) 10 per cent;

Levels predominantly downward 5 per cent.

^{*}Dominion Bureau of Statistics. Canada one hundred, 1867-1967. Ottawa, 1967. p. 308.

[†]For example, in round figures, it has been estimated that in 1959 about 400 companies performed R & D costing \$110 million and employed about 10 000 professional and supporting personnel on it. By 1967, about twice as many companies performed R & D costing \$340 million and employed 18 000 people on it. (Estimates based on DBS catalogue No. 13-527 (1965) and DBS Daily Bulletin for September 5, 1969.)

These relate to the period between 1964 and 1967.

Most R & D expenditures were for development work. The research work that was done was predominantly applied research, according to the usual definitions, since companies seldom undertook R & D that was unrelated to some potential application.* Most research and technical management people who were interviewed professed to see little change in the percentage shares of basic research, applied research and development work performed over the past five years or so and little prospect of much change in the immediate future. But two important points emerged from discussions of recent research and development activities. The first was that companies with separate and formally organized laboratories were tending to concentrate their research in these laboratories but were continuing to support-or to add-development units located physically closer to their engineering and production divisions. The second was that a number of companies had extended R & D programs beyond their own production needs in a deliberate effort to improve their bargaining positions with regard to the sale and purchase of technical information. While this latter factor might result in increased aggregate R & D expenditures, it did not necessarily follow that there would be a shift towards the research end of the R & D spectrum because commercially useful "know-how" was usually bought or sold as a package and, to be attractive, had to show some savings at the more expensive development end of the spectrum.

Most of the companies preferred to support R & D activities that could be performed under their own supervision ("in-house") or under the supervision of companies with which they were closely associated ("in the family"). Only 28 of the companies reported giving support for extramural R & D in the form of sponsored contracts or in some other

direct way, although several more contributed indirectly through scholarships, grants and consulting fees. The 28 companies also indicated that the funds which had been allocated to work performed "in-house" or "in the family" had been growing more rapidly-if they had grown at all-than funds allocated to sponsored work. As a general rule, therefore, the closer the research and development was to the finished product, the less it was likely that the work would be contracted out. The reasons for this rule were easily found in the competitive business environment and in the desire of a growing number of companies to improve their "know-how" bargaining positions. But the rule was also strengthened by the increased awareness found in the companies that the technical competence related to their processes, products or services must reside "in-house" regardless of whether or not it was available in affiliated companies, in the Canadian universities, in government agencies or in research associations. Indeed, in several of the smaller companies it appeared to be a matter of policy to foster technical competence in the company as a whole, even if support for research and development projects had sometimes to be withheld.

The various elements in the present "environment" for industrial R & D growth in Canada were discussed in all the 80 company interviews. In response to the broad proposition that the environment has improved in the past 10 years, the following opinions were given:

There has been *considerable* improvement in 24 cases;

There has been *some* improvement in 18 cases;

There has been *no* improvement in 4 cases;

It is reasonably satisfactory now, whatever it may have been like 10 years ago, in 19 cases;

It is not satisfactory now, whatever it may have been like 10 years ago, in 15 cases.

^{*}Those companies which supported research in university departments and institutes did not appear to support *basic* research overwhelmingly or necessarily in their own laboratories.

Certain elements in the present environment were praised by some and criticized by others. Among these were the appropriateness and effect of the Canadian Government's general incentive and special assistance programs; the attitudes and initiatives of top industrial managements; the attitudes, training and output of the graduate schools; the attitudes of, and the assistance provided by, officials in particular government departments; tariff changes; export, and import-substitution opportunities; government-industry-university communications; the amount of influence exerted by foreign parent and affiliate companies; and the current industrial R & D environments in the United States and Europe.

Environmental elements which were consistently criticized included the lack of multiple professional challenges in industry in Canada as a whole; the disincentive effects of relatively higher net personal taxation, especially at the higher income levels; the lack of direct industrial R & D financing and subsequent venture capital from institutions in the private sector; the lack of attractiveness of some laboratory locations from the professional, educational and other points of view; the size and distribution limitations of the Canadian market; non-tariff barriers to exports; and the business climate since 1966. On the other hand, the principal areas of recent improvement in the environment included the increased output of the education systems; the relative effectiveness of the smaller Canadian industrial laboratories; the improved business climate between 1960 and 1966; the growing technical reputations of certain companies; the "research community" idea; and the growth in absolute numbers of industrial R & D laboratories.

In the context of a changed and changing environment, the factors which encouraged foreign-based companies to establish new laboratories in Canada were discussed with a number of research and technical managers. From these discussions, five particular environmental elements emerged. These were: 1. Canadian research must be less costly in comparison to the equivalent work done elsewhere.

2. There must be opportunities to develop products or processes that would be special to Canada or new to the international market.

3. There must be special skills available, or there must be scientists and engineers with unique qualifications and experience.

4. The Canadian laboratory must be capable of becoming viable and relatively self-sufficient in a reasonably short period of time.

5. Companies will not transfer an existing research laboratory or a significant part of its current program from another country to Canada except in very special circumstances.

With regard to the ability of Canadian companies to hire scientists, engineers and technicians for the growing volume of industrial R & D work, the majority view was that it had been possible to get most of the required personnel during the past two years or so. The supply of certain kinds of specialists had not always been adequate and projects sometimes had to be delayed, contracted out, or abandoned for this reason. The hiring activities of almost all of the companies were still centred in Canada, but some of the larger companies had been extending their activities to include the United States and a number of European countries. Canadians completing their education were usually the prime candidates overseas. Surprisingly, there appeared to be relatively few formal exhanges of R & D personnel between Canadian laboratories of foreign-owned companies and laboratories of their affiliated companies abroad.* The recent turnover rates for laboratory personnel were reported to have fallen within generally acceptable limits in most companies, although a few managers had experienced an acceleration in these rates compared with 5 or 10 years ago.

*This was not, apparently, the result of any changes in the United States Immigration laws.

In the context of the growth and development of industrial R & D manpower in Canada, four particular points arose from the interviews and should be given special emphasis. These were:

1. The number of scientists, engineers and technicians who are employed in industrial laboratories, but who were not born in Canada, has been growing steadily both in absolute terms and as a segment of total laboratory population.

2. There are *at least* two distinct markets for professional personnel-one for the new bachelor or doctoral graduate and another for the experienced specialist. It is not unknown for there to be, at one and the same time, a shortage of new Ph.D.s and a surplus of specialists in particular scientific or technical fields, or vice versa. Aggregate demand-supply statistics seldom make market distinctions of this kind.

3. The recent rapid expansion of the universities in all parts of Canada has made recruiting for industrial laboratories increasingly difficult. Research managers, therefore, view any continuation of this trend with some concern. Not only will they have problems in hiring new people and retaining existing people of high calibre, but many of the younger university professors, will have little or no industrial experience and little or no inclination to participate in work of significance to industry.

4. The four most important factors in the hiring and retention of good industrial laboratory personnel are, first and foremost, the challenge of the work, followed by the location and facilities of both the laboratory and the "extralaboratory" environment, the financial aspect, and reasonable continuity in the work program.

In contrast with a few years ago, research and technical managers were much more cautious in their estimates of possible $\mathbf{R} \And \mathbf{D}$ expenditure levels, levels of laboratory activity and employment, and so on, for the years immediately ahead. The most frequently mentioned reasons for this caution were the prospects for profits in the next year or two; the present cost of borrowed money; the lack of effective incentives to divert more of the available resources to R & D from other budgetary needs; competition in the domestic market; and non-tariff barriers to entry into export markets. The following is a broad summary of the expectations of the 80 companies visited for up-coming R & D activities:

Optimistic about a general expansion in the near future in 9 cases;

Cautiously expecting a modest expansion in 28 cases;

Expecting no change in 14 cases; Expecting a temporary decline in 6 cases;

No specific commitments in 23 cases.

These responses show that, in real terms, little growth in industrial research and development could be in prospect for Canada until 1970 at the earliest, after general cost increases and complexity and sophistication factors have been taken into account.

In the past, companies in Canada may have been extremely astute in their search for, and application of, new and useful technical information and may, on a dollar-for-dollar basis, have performed more effective R & D than their counterparts in most other countries. Although this assertion cannot be fully substantiated on the basis of the visits covered by this report, there was enough evidence to suggest that it is unreasonable to expect "in-house" R & D activities to take place in *any* company unless it has the need, the opportunity and the resources to perform the work-and the resources to exploit the results effectively afterwards.

Areas of Scientific and Technical Activity

The research and development program of each individual company is unique. Although certain projects may be broadly duplicated in the programs of several companies in the same industry, neither the new knowledge emerging from individual projects nor the use to which this knowledge may later be put will necessarily be the same. The so-called "science-based" companies are generally more active in research and development than companies in the "traditional" industries but, nowadays, the largest and the most diversified companies may include both science-based and traditional elements. Company interests change from time to time in response to a variety of external factors related to the market, to political, economic and social circumstances, and to internal factors such as the company's own growth rate, available capital, ownership and management structure. Intercompany relationships also have some bearing on the R & D activities. On the one hand, there are the large international corporations in which the parent company may be situated in any one of the major industrial countries of the world, and there are also the North American corporations in which the parent company is usually American but may be Canadian. On the other hand, there are the relatively "loose" affiliations of companies organized on a worldwide, North American, or even on a Canadian basis. Beyond these two main groups there are, of course, companies with no affiliations at all except for the arrangements which they may make with other companies from time to time to licence or trade "know-how".

From the interviews, it was clear that all of the resident-owned companies in Canada exercised either full control or a major share of the control over the origin and execution of their research and development activities. But foreign ownership did not necessarily mean that control over origin and execution passed to the parent company abroad. For example 14 of the companies visited belonged to international corporations which exerted extensive central control over the origin and execution of R & D programs in Canada and elsewhere. In 10 cases, there was evidence of considerable technical dependence by the Canadian companies on their foreign parent organizations although relative freedom in detailed R & D programming was permitted in Canada. In 12 other companies with foreign parents, extensive Canadian control over origin and execution was permitted.

In the context of company ownership and the origin and execution of $\mathbf{R} \And \mathbf{D}$ programs in Canadian industry, several important points that arose during the interviews must be recorded:

1. A number of small resident-owned companies whose products have a high technological content have found it necessary to establish subsidiary companies in the United States because they cannot otherwise overcome the tariff and nontariff barriers to the U.S. market and remain competitive. Origination and control of research and development, however, has usually remained in Canada.

2. In a number of cases, the special technical expertise developed by Canadian subsidiaries on their own initiative or with some assistance from abroad has been recognized and these companies have been made responsible for all related **R & D** and manufacture for the product or products in question. However, marketing and other related assistance has usually been provided by the parent organization.

3. In those cases in which there is strict "parental" control over R & D activities, the working level relationships built up between the R & D and engineering personnel in the Canadian and parent companies have become extremely important.

4. The terms and conditions under which Canadian subsidiaries and their parents and affiliates exchange technical information vary widely. While no firm general rules for such exchanges can be formulated, it is unusual for the research managers of the subsidiaries to play much of a part in exchange negotiations.

5. New products and processes developed and produced initially abroad often undergo further development before being used or manufactured by a Canadian subsidiary or licensee. This work can be extensive. Some reasons for doing it are related to the requirements of the Canadian market. Others may be traced to the desire, on the part of the Canadian company, to increase the Canadian content to the highest possible level consistent with its business goals.

In industry, as a whole, decisions to undertake particular intramural and extramural research or development programs are not normally made on the basis of fields of science or branches of technology but in response to problems, needs, opportunities, ideas, targets and aspirations. It became clear during the interviews that considerable attention is being given by all companies-regardless of their size, ownership or the business they are in-to increasing the productivity of labour and capital, to cost reduction, and to solving problems associated with existing products and processes. Relatively little emphasis is being placed in most companies on R & D work directed to completely new products or processes. This scale of priorities appears to have a great deal to do with the fact that products and processes tend to evolve and that revolutionary new ones are relatively rare and do not always reach the marketplace. However, two new trends were also evident; namely, that increased attention is being given in chemistrybased industries in particular to improvements in the utilization of raw materials and by-products and, in all industries, to the provision of problem-solving services for customers and clients.

In discussions of future research and development activities with the industry people, it became clear that the emphasis on productivity improvement and cost reduction will be intensified. In some subsidiary companies there will also be increased efforts made to take on more specialized work, if possible on the basis of the world market. In the Electrical-Electronic Capital Goods and in the Nuclear/Aerospace/Instrumentation industries groups, in particular, the twin problems of fast-moving technology and product obsolescence will be the primary factors in R & D planning and programming. In some companies, customers' problems will be given more adequate attention. And, for those resident-owned companies which are without the support of technically advanced foreign parents or affiliates, the overriding concern for the future will to be to develop the resources and the technological bargaining power to survive in business in an even more fiercely competitive world.

The following are, in very broad terms, the research and development program areas in which the 80 companies visited are currently interested. The breakdown is again by industries.

Pulp and Paper: Programs cover all phases of company activity except those associated with purchased equipment. There is a great deal of interest in work designed to improve productivity and to save money. Highly competitive product lines receive special attention.

Pharmaceuticals: Companies' programs closely follow the areas of products specialization with which each has become associated. A large percentage of the total effort, however, has to be devoted to work required under food and drug regulations.

Petroleum / Petrochemicals: There appears to be three main lines of work: the refining and processing of raw materials and main products; the development and processing of by-products; and the development of special Canadian lines of research. The companies are also doing work related to productivity improvement and in support of exploration activities. An increasing amount of effort is going into the solution of customers' problems.

Food and Beverage: The main emphasis is on process R & D and the improved utilization of by-products. Customers' problems are receiving increasing attention. Food and drug regulation work is not a particularly large part of the overall effort and is related mainly to food additives.

Mining /*Metallurgy*: Since the mining industry relies heavily on the federal

laboratories for general R & D support, company *programs* are nonexistent. Development work is done on the basis of need, to investigate a promising idea or to solve a local problem. The activities of the metallurgical side of the business, on the other hand, are formally organized and basically related to the extraction, processing and composition of the companies' products. Several of the companies have, however, expanded their research interests into areas peripheral to these products.

Other Chemicals: The companies, whatever their ownership, are principally concerned with product and process improvements and problem solving. There is a high degree of product specialization in each of the companies, determined largely by their markets and by their relations with parent and affiliate companies.

Rubber /Textiles /Glass: The principal areas of concern of each of the companies is with their Canadian production processes from the points of view of productivity, cost reduction and problemsolving. Again, there is evidence of product specialization in the foreign-owned companies.

Machinery /Transportation: Research and development programs cover a large number of areas, with the emphasis on development rather than research. Work is being done on new hardware and on increasing the Canadian content of products originally designed abroad. Some work is being done on customers' problems and other problems related to the physical environment in Canada.

Electrical-Electronic Capital Goods: Research and development work programs cover the following areas: the evolution and development of existing produced lines and, predominantly in resident-owned companies, new product lines; the development of *Canadian* technical competence and leadership; the adaptation of foreign-development products for the Canadian market; productivity and cost reduction; and customers' problems. Nuclear /Aerospace /Instrumentation: A significant part of the content of the R & D work carried out by the companies in this group is dictated by the kinds of contracts or subcontracts which they have been awarded. But there is also some effort devoted to the development of new products and to underpinning the search for viable new areas of business.

Miscellaneous Manufacturing: Two of the four companies in this group have active laboratories which are concerned mainly with providing back-up for the manufacturing divisions but which also have begun small-scale programs oriented to future *Canadian* products. While some of these activities may be classified as research, most are actually development. The remaining two companies undertake development work on the basis of need.

Markets and Competition

The markets served by the 80 companies visited may be broken down as follows:

Canadian markets principally or exclusively (company ownership: half resident, half foreign) in 39 cases;

North America markets (company ownership: mostly foreign) in 17 cases;

World markets (company ownership: half resident, half foreign) in 24 cases.

It became apparent during the interviews that the size of the U.S. market and its proximity, and the relative size of the Canadian market, were three of the most important considerations affecting the planning of the research and development programs of three-quarters of the companies visited. The remaining 20 or so companies were either committed to serving local markets in Canada, were handicapped by having limited resources with which to enter wider markets, or had limited access to essential "knowhow".

The size of the Canadian market was often cited as the reason why projects involving *new* products and processesand much of the prior R & D-were undertaken primarily in the United States or in Europe.* In such cases, Canadian development and Canadian production did not begin until the market in this country was estimated to be large enough to yield an appropriate return on the resources invested. In these circumstances, the advantage to a Canadian company of being part of an international corporation or of an affiliated group of companies could be considerable. But it should be remembered that the subsidiary companies in this country are often quite small in relation to the international corporations of which they are part, and that the Canadian market is only a small part of the corporations' worldwide market.

It was not surprising to find that the policies of the individual international corporations appeared to dominate the marketing activities of their Canadian subsidiaries. Nevertheless, two specific observations should be made with regard to certain kinds of resident-owned companies and their markets. First, a number of companies were unable to participate actively in the U.S. and other foreign markets because their products "did not travel well". In some such cases, it has been possible to make arrangements to sell or exchange "know-how" instead. Second, some small and medium-sized companies have been unsuccessful in entering U.S. and other foreign countries from Canada because of tariff and nontariff barriers and have been obliged to set up manufacturing or marketing subsidiaries of their own in these countries.

While a company's research and development programs are strongly related to the markets it serves and to the business it is in, the individual projects which a company undertakes are usually based on the best available information about its competitors and on commercial and technical information from other sources to which it has access. The research and technical managers emphasized that it is essential for the effective management of programs and projects that there should be awareness of what is going on both inside and outside the company and that the company's laboratory should be able to adapt quickly to unforeseen market changes. Another factor of importance to a company and to a research manager is the nature, location and ownership of the raw materials which go into production processes or products. Science and technology cannot always improve the quality of these raw materials no matter how extensively they may be applied.

Finally, it became apparent during the interviews that the importance of market research was well recognized but that the necessary resources were not always being allocated to this activity. Research and technical managers were also anxious that closer relations between their own personnel and the marketing departments should be fostered. In a few companies the integration of research, development and marketing activities was reported to be well advanced.

Size and Threshold Questions

Industry representatives were asked: "How should small, medium and large companies be regarded from the point of view of their effectiveness in the performance of research, development and innovative activities?" The consensus was that, for innovation, the advantages would tend to lie with medium and large companies, but that for research and development, company size was only one of many factors. The most important of the other factors were the company's business; its markets and market prospects; the initiative and foresight of its management; the foresight and imagination of its technical people; its overall technical competence; and the motivations of its key personnel in all sections. divisions or departments, including the non-technical ones.

Another question asked was: "What is the threshold level for the viable indus-

^{*}As has been pointed out in Part II of this report, Section 104 of the U.S. Patent Act has also had an effect in this regard.

trial R & D laboratory in terms of annual expenditures?" Put to the research managers, the answers given were anywhere from an upper figure of \$250 000 to a low of \$40 000 a year. On further discussion, however, it became clear that the threshold of viability has to be related to the work which the laboratory is required to perform and to the abilities of the people in it. Thresholds vary from company to company and between companies of the same size in the same businesses. Two companies of the same size in the same industry, with R & D budgets of the same size, will not necessarily be equally successful technically or in the marketplace. The threshold-expenditure relationship is not, therefore, a simple one. A possible "rule" which emerged from the discussions was that a laboratory should be staffed by enough people to ensure a communicative and productive working environment.

The discussion of laboratory sizes and thresholds gave rise to a number of other points. For example, it can take as long as 10 years to "grow" a viable laboratory. For much of this time the laboratory will be operating at a sub-threshold level from the point of view of its work program. But programs can also change and may carry threshold levels along with them. Even an established laboratory may revert to sub-threshold status if its role is significantly altered.

The sustaining of research and development activities-whatever the size of the "host" company, whatever the size and formal organization of the activities, and whatever the appropriate threshold figureis crucial and is normally dependent upon the overall performance of the "host" company and its profitability. The R & D activities of companies in which performance and profitability have fallen off are likely to be subject to uncertainty. While not suggesting that the survival of the ineffective or poorly managed company should be prolonged, the industry people repeatedly emphasized that flexible and easily administered government measures can be important

elements in an attempt to sustain industrial R & D activities through an unprosperous period.

In the view of many of the industry people, the size of a company's laboratory is more important for the effectiveness of its research and development activities than the size of the company to which it belongs. But this, too, is not a simple relationship. For example, some of the small, science-based companies are virtually "all laboratory" while the products of certain industries, such as aircraft, are not developed in "laboratories" at all. Also, in Canada in particular, it is possible for a large and successful subsidiary company to have a large laboratory and to fill most of its own requirements for new knowledge from it or, at the other end of the scale, to have a small laboratory which functions principally as a "listening post". From still another angle, there are, in certain sections of industry, no "small" companies at all because of the scale of the resources required just to stay in business.

The Independent Inventor and the Corporate Inventor

Most discussions on this topic revolved around the following points:

1. The independent inventor often has a valuable and creative talent. He can be a source of technically important new ideas. Ways must therefore be found to make the best possible use of this talent for the benefit of the Canadian economy and Canadian society.

2. The independent inventor is usually lacking in the kinds of knowledge, experience and facilities which the generation of new knowledge in many technical fields requires nowadays.

3. Being outside of the corporate environment, the independent is not in the best position to assess effectively the technical and other problems that companies face or to make a real and immediate contribution to their solution.

4. Invention is now, and always has been, a team effort over time. What the

independent inventor often does is simply, but ingeniously, to "put the cap on the bottle" which others have made and filled for him. Many of the world's outstanding mechanical ideas, for example, were first described by Leonardo da Vinci. With science and technology so much larger bodies of knowledge now than they were only 20 years ago, it usually takes a number of different talents to develop a good idea into a potentially marketable invention and a lot more work to make it commercially successful.

5. Genuinely talented independent inventors have to be distinguished from the "cranks".

Most of the companies visited had had no recent dealings with independent inventors. Management feelings towards the independents were neutral rather than hostile. The other companies often had fairly regular contacts with independents, and a half dozen or so had formal procedures that independents had to follow if they wished to interest the companies in their ideas or work. Usually, the independent was advised to obtain protection for his idea or invention before making any disclosures at all to the company.

It was generally recognized that there are in Canada a number of technically educated and experienced independent inventors capable of working in advanced fields, provided they have access to the necessary equipment and materials. Such people are often temperamentally unsuited for work in an organized environment, or feel uncomfortable and ineffective in it. The big problem for these independentsand for the less technically educated and experienced inventors-is to find companies in Canada with imagination, venture capital, development and production capacity, and access to markets in which the inventions may be exploited. It was pointed out several times that in the United States independent inventors with high levels of technical ability and inventiveness have become financially successful. The secret of this success seems to lie in being able to find a "patron" in the form of a large company which will

support the inventor on a retainer basis in exchange for the option to be first to take up each new invention.

As has been mentioned in Part II of this report, "inventing" is not a primary technical activity in the individual company. Scientists and engineers in the laboratories, development departments and engineering divisions are charged with problem solving, with unearthing new and useful information about materials, with making prototypes work and so on. In the business environment, an invention will not always be isolated as such unless the new information is potentially patentable, publishable or of proprietary interest. Nevertheless, to increase the probability that new ideas and inventions will be forthcoming, some companies have instituted internal "Inventor Award" programs. A half dozen of the companies visited had these programs, and awards had been given at two, different levels, namely, for technical merit per se and for ideas and inventions which had been the subject of successful patent applications. But the most frequent reward for technical excellence in corporate invention is not a patent, a published paper or even an Inventor Award. It is a raise in salary. On the other hand, some companies have recognized that their technical reputations rest, in part, on the professional recognition which their leading scientists and engineers receive outside of the company and especially in their own particular sections of industry.

In the small company, the continuous generation of new ideas and inventions can be the key to survival, and these activities can affect every technical employee on the staff. Some small companies do, in fact, exist as vehicles through which a particularly talented scientist or engineer may combine the roles of the independent and the corporate inventor. But whether he owns and operates a small company or is employed by a larger one, the technically trained corporate inventor is expected to make a contribution to the achievement of his company's goals. The efforts of technical managers must be concentrated upon encouraging good performance and increased competence on the part of individual staff members. As one manager put it, "Nowadays, most independents can't do research, and most researchers are not much good at invention!"

Scientific and Technical Information*

It became apparent during the interviews that, on a consensus basis, the main sources of new scientific and technical information could be arranged in three levels of descending importance as follows:

1st level: publications (including abstracting services); and personal contacts;

2nd level: parent /affiliate companies; licence and "know-how" agreements; and patent literature;

3rd level: contractors; suppliers; other companies; trade and research associations; government departments, agencies and information services; research councils; foreign abstracting and other information services.

It was in a way surprising to find the relatively low level of importance given to government information services. On the other hand, most companies visited were either large-in which case they took care of their own information needs-or they were small and sciencebased and had to move fast and therefore concentrated on personal contacts and publications. The large companies usually had libraries containing broadly based collections of periodical journals and books relevant to their particular interests. The libraries of small companies were necessarily more limited, with the emphasis on periodical journals.

It also became apparent from the interviews that companies, in considering the

new information needs of all their divisions or departments, were not so much concerned with the *cost* of this information as with the savings that could be effected. For freely published information, for example, there is no cost beyond an annual subscription or the price of a single copy. Licence and "know-how" agreements can be very much more expensive, but savings can result. Nevertheless, it was evident that a growing number of companies in Canada are planning and taking action to generate more new information on their own and to acquire increased competence and understanding by repeating or expanding the work of others. The rationale is based on "saving through knowing", and is considered as leading to better patent licensing and "know-how" deals as well as to faster reaction to changing market conditions. One company's view of these deals may be summarized in this way: "We buy new information when we think buying will save both money and time and when it will keep us out of court. While we know that not all the patents we license are good patents, we assume they are in any deal we make. This can work both ways. And we also know that a patent, by itself, contains only part of a total new information package. The rest will be proprietary knowledge, or it will have been published. It's the package we want-on the best possible terms. The trick is in knowing what will be needed in addition to what has been publicly disclosed."

Two of the important information dissemination problems which managers of research reported having to face in dayto-day project work were the training of **R** & D personnel in the search for the most likely and reliable sources; and encouragement of "cross-fertilization" from one branch of science or technology to another and from one institution or company to another. Both problems were bound with a third-the problem of avoiding the growth of the "NIH" or "not-invented-here" outlook which downgrades the value of all new information

^{*}The section in Part II, "Patents as an Information Source", considered published patents and patent search facilities in a more limited context than is the case in this present section.

that did not originate "in-house" or "in the family". Some of the industry people were quick to point out, however, that todays' scientists and engineers are generally overburdened with information in their language of customary use and would benefit from more effective screening and abstracting services. At the same time, there is a need for more effective multilingual translation-abstracting services.*

In the opinion of many of the industry people, the larger the company and the more extensive its international affiliations, the more likely it would be to search for its own sources of scientific and technical information, whether published, unpublished or human, and to arrange for its own screening, abstracting and translation services. Also, the more science- or technology-based the company, regardless of its size, the more likely it would be to have the capability to make use of scientific and technical information, whatever its source. The consensus, therefore, was that the information problem in industry in Canada does not warrant solution through the establishment of an immense national network for the collection, storage and translation of information from world sources for later retrieval and dissemination to manufacturing and service companies. Instead, the present institutional structure involving federal and provincial agencies might simply be enlarged. Essentially, it is not a problem of providing the 35 000 manufacturing companies of all sizes in all parts of the country with the kinds of information they might need, but it is the problem of serving the two or three thousand of these companies which have sufficient technical competence to ask for-and make use of- relevant material. The companies without the competence cannot use new information, however badly they might need it. They require, first and foremost, help of a different kind.

There was general agreement among the industry representatives that the latest information storage and retrieval equipment and systems should be applied as extensively as possible and as soon as possible. Companies and larger networks both have need of them. But during many of the discussions, the view was expressed that current systems and equipment have limited operating capabilities and that the largest of them have capital and operating costs which even governments should not consider. It was agreed that the encouragement of improved communications between scientists, engineers and non-technical people deserves as much, if not more, by way of allocations of resources at the present time than do costly attempts to encourage unduly rapid technological advance in the information field. And over and above any purely technical problems associated with information systems, there are the political problems of access and security which should be examined carefully.

Technological Forecasting

A "head count" showed that 6 out of the 80 companies visited could be considered as performing technological forecasting by using some of the techniques described in the reference book on the subject by the Organisation for Economic Cooperation and Development.† A further 14 companies reported that a technological element went into their corporate planning and anticipatory activities in a "time depth" averaging five years. In the remaining 60 companies, technological forecasting played little or no part in studies of medium- or long-term future.

At first glance, it would appear that Canadian companies were not interested in the forward planning of their technological activities, but it should be remembered that quite a few of the companies in the "Group of Sixty" were members of international corporations which have centralized corporate planning and anticipatory activities. However, *all*

^{*}For example, translation from Japanese, Russian and German into French and English.

[†] Jantsch, Erich. Technological forecasting in perspective. OECD, Paris, 1967.

members of the "Group of Six" were members of international corporations and were making their own contributions to future planning on a worldwide scale. The companies in the "Group of Six" and the "Group of Fourteen" belonged almost exclusively to the Mining/Metallurgy, Nuclear /Aerospace /Instrumentation, Machinery /Transportation and Other Chemicals groupings used in this study.

It was generally agreed that technological forecasting as an activity, is not without problems. For example, it cannot reveal when, or in what form, the next important scientific and technological breakthrough will appear in a particular field. Forecasting is extremely difficult, if not impossible, in fields in which randomness and chance play significant parts in progress. History and tradition may stifle the imaginations of forecasters. Political and sociological pressures can encourage or discourage promising new avenues of study. But, these difficulties apart, technological forecasting is helped by the fact that the development of most products and processes is evolutionary rather than revolutionary.

There was general support for the view that technological forecasting, by itself, cannot measurably assist in the growth of a company unless it is integrated with the other elements of corporate planning and placed on an equal footing-as an activity-with market, economic, profitability, political and other kinds of forecasts which companies use. Extending this point of view, many of the industry people felt strongly about the lack of technological and integrated forecasting in government departments and agencies at the provincial and national levels-and even with regard to university research. Some felt, also, that Canada should have, probably in the federal structure, a small organization whose task will be to integrate forecasting and which will attempt to define and assess the broad implications of future options, opportunities and possible pitfalls for the country as a whole.

Provincial Research Councils and Foundations

Seven of the Canadian provinces have these institutions, the first of which was established shortly after World War I. The Councils in Nova Scotia, New Brunswick, Alberta and Saskatchewan work in close association with their respective governments but also undertake or coordinate contract work at the request of industry. The British Columbia Research Council and the Ontario Research Foundation are principally concerned with contract work for industry sponsors both inside and outside those provinces. They also receive assignments and support from their governments. The Manitoba Council is the most recently established and is the only one which is part of a provincial department.* At the time of the interviews, its function was more or less restricted to the dissemination of technical information. The six older Councils are active in providing field liaison and technical information services in support of manufacturing companies and in some of these activities work in collaboration with, and derive some support from, the National Research Council. The scientific and technical interests of these Councils are related to the natural resources of the provinces and to the composition and structure of provincial industries. They are particularly concerned with applied research, with the improvement of their own "in-house" competence, and with the encouragement of industrial technical expertise throughout each province. The Councils' biggest problem, however, has often been to sell their services to the industries and companies in their own provinces.

During the last few years, the incomes of the six older Councils have been rising slowly but steadily, with industrial contract incomes usually growing faster than incomes from the provincial governments. The Councils' research and supporting personnel, however, have grown less rapidly. Two Councils-New Brunswick and Ontario-recently moved into new laboratories. The first Nova Scotia Foundation Laboratory building at Dartmouth is under construction.* The laboratories of three of the Councils-New Brunswick, Saskatchewan, Albertaare located on university campuses and the B.C. Council is located near the University of British Columbia. The Ontario Research Foundation laboratory is the "core" member of the industrial research community at Sheridan Park near Toronto. These Councils are permitted to act as contractors for development work to companies receiving assistance under the Department of Industry's PAIT Program, but not as research contractors under the IRA Program of the National Research Council.

As it happened, only a handful of the 80 companies visited had had first-hand experience of sponsoring work in the Research Councils. The companies with experience commented favourably on the quality of the Councils' work and on the speed with which it was done. Where work has been contracted out by industry to the Councils, the reasons for doing so have fallen under three main headings:

1. To take advantage of expertise which the companies do not have time to acquire themselves;

2. To make use of experimental facilities which they do not have and have no reason to acquire;

3. To concentrate on development work "in-house".

Industrial Research Associations

In contrast with the United Kingdom and a number of other European countries, few industrial research associations (RAs) have been established in Canada, or, for that matter, in North America as a whole. In this country, the largest research association is the Pulp and Paper Research Institute, now located at Pointe Claire, Quebec.[†] There are a number of other smaller associations in, for example, the metal fabrication and forest products industries that are also performing or fostering co-operative research and information dissemination activities on behalf of member companies. These smaller associations generally serve local or special interests. They do not always meet the U.K. concept of a research association, nor would they wish to do so. The growth and development of all these research associations have been dependent to a significant extent on the financial support given by member companies and on the terms of reference set by their boards of directors. The research associations may make use of both the PAIT and IRA Programs. The Pulp and Paper Research Institute has also had federal government help with capital expenditures in recent years. This Institute is most active in applied research related to some of the needs of its member companies. The smaller associations appear to be most active in development and standardization studies and in materials testing. Not all the member companies of the associations have laboratories of their own.

Again, only a half dozen or so of the companies visited had had first-hand experience of research associations in Canada or elsewhere. However, the general subject of associations of this kind was discussed with a good many other industry representatives. The consensus with regard to the establishment of more of them in Canada was generally unfavourable and was particularly unfavourable to any move towards the statutory establishment of associations for each of the major industries. The reasons given included the following:

1. The business environment in North America is intensely competitive. Research associations appear to flourish best in those industries in which competition is relatively less intense and the technology is slower moving.

*Scheduled for opening late in 1969.

[†]The Institute had its beginnings over 40 years ago as a joint venture between the Federal Forest Products Laboratory, McGill University, and the industry.

2. Research associations function most effectively when their members are concentrated in small geographical areas. Canada is so very much larger than any Western European country, and the fact that most of the manufacturing companies in this country are located in the Montreal-to-Windsor corridor does not apparently meet the concentration criterion adequately.

3. Some Canadian companies have access to the R & D work of international corporations or of groups of international affiliates. These companies are, to a significant extent, the principal manufacturers of science- and technologybased products. They have little need of additional outside help.

4. Although there are over 35 000 manufacturing companies in Canada as a whole, fewer than 1 000 actually perform research and development or support it extramurally. There is, therefore, some doubt as to the effectiveness of a network of research associations in this country because it is not clear that the technical competence of the remaining companies will be high enough to make use of much new technical information.

5. While some industry people welcome the suggestion that there should perhaps be additional industry-oriented laboratory help available in Canada, they take the view that this help is already available where there is a provincial research council or foundation or a federal laboratory.

Research Parks

The concept of the "research park" or the "research community" has been brought to life at or near a number of major cities in the United States. So far, the only one which has been formally organized in Canada is the Sheridan Park Research Community located some 17 miles from downtown Toronto. Sheridan Park was established and developed by the Government of Ontario and the Ontario Research Foundation and is governed by a Board which includes representatives from each of the members of the Community. The present members include the Ontario Research Foundation-the "core" member-and Atomic Energy of Canada's development laboratory, plus the research laboratories of seven companies, four of which have parent organizations in the United States.*

The research community concept was discussed with most of the industry representatives during the interview program. The consensus was that the research community seems to be administratively attractive and makes laboratory consolidation feasible. It was also felt that individual laboratories will be less costly to build and operate because certain installations and service facility costs can be shared. Companies can then afford laboratories of a higher standard than would otherwise be possible. The representatives of companies which are already members of the Sheridan Park Community were generally enthusiastic about having set up laboratories there. But, while looking forward to the growth and development of the community as a whole, they pointed out that no new laboratories or laboratory extensions were under construction and none appeared to be in the active planning stage.

Intersector Co-operation

The 80 industry representatives were asked for their views on the effectiveness of industry-government-univerity cooperation at the present time. They "voted" as follows:†

Good 5 per cent; Improved over 10 years ago 5 per cent;

*Sheridan Park is not the only research community in Canada, simply the only formally organized one so far. Informal communities already exist in other parts of the country. The two largest and best known are those in the Pointe-Claire - Senneville area west of Montreal, and at Sarnia. Smaller communities have also been growing up, for example, on the outskirts of Edmonton.

†It will be of interest to note that these views were more or less reflected in the responses of people in the research councils, the universities, government agencies and the professional, research and trade associations who were asked for their comments. Could be much more effective 70 per cent;

Not good at all 20 per cent.

A whole range of factors were cited as contributing to the situation. Some criticized industry for by-passing the universities. Some criticized the universities for ignoring industry, and others the government for not knowing very much about either industry or the universities. It was acknowledged that there had been more frequent, and more sympathetic, exchanges of views in recent years, but as many people pointed out, the success of a conference or meeting should not be measured by the quality of the papers and discussions *alone*. It must also be measured by the action, subsequently and expeditiously taken, on the resolutions or conclusions of the conference or meeting as a whole.

It was generally agreed that co-operation problems covered many fields of activity-communications, exchanges of personnel, co-sponsorship of projects, consultation and so on. The following were points arising from discussions with the industry people with regard to industry-university co-operation in particular:*

1. Twenty-five to thirty of the companies have had minimal or no contacts at all with the Canadian universities; six have recently made contacts for the first time and were expanding them as rapidly as possible; a dozen or so have limited their contacts to interpersonal professional relations; and the remaining thirty or so have had formal and continuing relationships with one or more universities.

2. With regard to contracts for research performed in the universities, several companies reported that in the present tight budget situation, and in the absence of strong government incentives to do otherwise, sponsorship of this kind of work was slowing up.

3. Industry's incentive to collaborate more fully with the universities has also been reduced by a number of factors unconnected with business constraints or with the lack of suitable government incentives. These are the multiple duties of most university staff members; the fact that research performed in the university itself cannot always produce results fast enough for company marketing or production requirements; and the problem of commercial security.

4. A number of companies have found that the most effective technique for using the talents of the university professor is to hire him full-time for a period of months or even weeks, rather than retain him as a consultant. Conversely, some universities have found it beneficial to invite industrial research scientists and engineers back to the campus for six months to one year at a time on the same "full-time, full-attention" basis.

5. A few companies have strong ties to particular universities and have developed, jointly, training and retraining programs as well as research co-operation. In the reverse direction, a few universities were now permitting thesis research to be done in industrial laboratories which had the necessary facilities.

6. Science-based industries have not necessarily enjoyed better relationships with the universities, but some small companies have had good interpersonal relations because their scientists and engineers were university staff members before going into business and still maintained contact with former colleagues.

7. Not many of the companies visited have used university professors as consultants. When they have, the professors were retained individually or as department- or institute-based groups. But a university's own particular location, environment and reputation have a great deal to do with the amount of consulting its staff members are able, and are asked, to undertake.

*Industry-government problems are discussed in the next section, "Federal Government Programs".

Federal Government Programs

Of the industry representatives interviewed, the research managers were well informed with regard to the government's **R & D** incentive or assistance programs. The engineering managers and the other company officers were generally not quite as well informed. In the "reverse" direction, the industry people were unanimous in their feeling that more government officials should be better informed about Canadian industry, about its problems, needs, markets, opportunities, and about the effects of particular laws and regulations on research, development and innovative activities.

In this section of the Study, the individual government programs have been discussed under nine subsection headings. As an indication of the overall effectiveness of these programs, the following broadly based summary of the views expressed in the 80 companies has been put together:

Programs considered generally good in 16 cases;

Programs considered insufficiently effective in 41 cases;

We do not have much/anything to do with government programs and have no views on the individual programs in 23 cases.

The National Research Council's Industrial Research Assistance Program*

Of all the government's cost-sharing programs, the IRA Program received the highest and most consistent praise for its usefulness. On several occasions, the program was described as "an indispensable part of our R & D growth pattern". The timing of the introduction of this program was fortuitous because it coincided with the beginning of the economic upswing in Canada in 1962. On the whole, it was felt by those familiar with the program that the administration of it had been quite effective and imaginative. National Research Council officials have been conscious of some of the shortcomings of the program and, during 1967,

some improvements were made. Others have been under discussion for some time.

The principal criticisms of IRAP were as follows:

1. The funding rule (the salaries and wages, etc., of the people employed) is too rigid. Company contributions normally exceed the theoretical 50 per cent, sometimes by quite a bit. Also, the smaller and newer science-based companies can have problems raising their own share of the money required.

2. Assistance under the programs depends on companies adding to their **R** & D staffs or hiring staff where none were employed before. This "additionality principle" has many good points but it is not always possible or desirable for companies to add to their staffs. In certain circumstances, additions to research equipment can be more effective. And, in the longer term, there has to be a limit to the size of every laboratory if good management is to be retained.

3. There has been too much emphasis placed on "basic" research or, by industry's definition, research which is remote from any potential process or product. Hardware, in some initial form, should be the required end-product of *any* assistance grant.

4. While not every industrial project is worthy of research assistance for more than a limited period, the present ceiling of five years can be too short, particularly for the smaller, newer science-based companies that are using the IRA Program to establish their research activities firmly.

5. Even if a company has finished the research associated with a particular assisted project within the five-year time limit, it will usually wish to proceed with the development work immediately. At present, the IRA Program has no provision for a continuation of this kind.

6. Liaison officers from the National Research Council and other laboratories are assigned to each company project

^{*}Initiated early in 1962.

[†]Since the time of writing, a number of changes to the IRA, PAIT and DIR Programs have been announced by the government.

but they work part-time on IRAP while pursuing their own research projects. Also, they generally limit their attention to the project and not to wider problems associated with the project itself or with the company's overall research program.

7. For the first five years or so, university professors and students and provincial councils and foundations were unable to assist companies with projects approved under the program. Recently, however, changes to the rules have been made to permit university participation and changes to permit a degree of participation by the councils and foundations are being considered. Nevertheless, research and technical managers are not satisfied that there is enough speed or flexibility in the mechanism for making changes to the rules.

The Department of Industry's* Program for the Advancement of Industrial Technology[†]

This program was extensively criticized by all sections of industry. Its disincentive effects and unrealistic provisions, in the view of some of the companies, seemed to outweigh any possible incentive effects. Other companies did feel, however, that the program had helped them with development projects which involved considerable technical uncertainty and commercial risk.

One of the principal intentions of the program is to encourage development work which will lead to subsequent manufacturing in Canada. The original brochure for the program said, in part: " ... companies will be required to give an undertaking that, if the project is successful, they will exploit the results in Canada within a reasonable period of time."

Such a provision has in practice made it impossible for many subsidiary companies to participate. But it has also made

†Initiated late in 1965.

participation difficult for Canadian-owned companies which have manufacturing subsidiaries or affiliates abroad or which have information exchange agreements with foreign companies and cannot always undertake to exploit the results in Canada. In practice, some flexibility in the application of this requirement has been allowed in specific cases. But two further points were frequently mentioned with regard to the commercial exploitation of work supported under the program. The first was that, unlike fully funded contracts, the PAIT Program offered only 50 per cent assistance, and companies viewed their subsequent freedom of action as being wider than under a fully funded contract. The second was that the United States would often be the preferred initial market because of its size and, in such circumstances, it would make better business sense to arrange for initial manufacture in the United States under a licence or under some other arrangement.

The PAIT Program was criticized on a number of other grounds. For example:

1. Since companies seldom go into development work without a good deal of confidence regarding technical and commercial success, most companies that take advantage of the program will also make use of the pay-back provision. Therefore, the assistance offered under the program is essentially an expensive form of *loan* and is not a *grant*. If companies want loans, there are non-government sources to which they prefer to apply.

2. The time taken to process applications through the Department is sometimes longer than the time available to the company to complete the development work itself.

3. The program covers development activities and therefore does not go far enough. Small, technically based companies, and many larger ones, need further help to build up their manufacturing capability and competence in Canada.

4. In the case of the small companies, assistance in the form of a grant of only

^{*}Since the time of the visits made in connection with this report, the Department of Industry and the Department of Trade and Commerce have been merged into a single department. For the purposes of this report, reference will be made only to the Department of Industry.

50 per cent may be quite inadequate. Development work normally costs much more than research. Also, small companies do not have the administrative resources to cope with extensive recordkeeping and approval procedures.

5. Approvals under the program appear to depend unduly heavily on the assessments of the commercial success potential of the end-products.

The view of most research and technical managers was that the PAIT Program should be phased out as soon as possible. But the view was also expressed in a number of instances that before any substitute program can be designed, the federal government has to study two specific aspects of the problem of special assistance programs; namely, various alternative ways and institutional arrangements for assisting companies to undertake research, development and initial manufacture as a continuous process; and the particular problems, needs and opportunities in the small, Canadianowned science-based companies.

The Defence Industrial Research Program and the Defence Development Shared Program*

These two programs are equivalent, in the defence sector, to the IRA and PAIT Programs. The DIR Program is still the responsibility of the Defence Research Board and DDSP was, at the time of the interviews, the responsibility of the Department of Industry.

Whereas assistance under IRAP has been predominantly in the various fields of chemistry, work in physics (including electronics) and aeronautics has received the majority of the support given under the two defence programs. The companies that had participated in DIR and DDSP acknowledged that the support had improved their overall technical competence and assisted in the growth of R & D capacity. But it appears that defence research and procurement contracts, as opposed to the cost-sharing grants, have had a greater impact in Canadian industry.[†] Three other comments were made by the companies and should be noted:

1. The DIR and DDSP Programs tend to favour the longer established companies and the subsidiaries of the better-known international companies rather than the newer, smaller Canadian companies.

2. The connotation of "defence $\mathbf{R} \& \mathbf{D}$ " appears to be fairly freely "stretched" on occasions and projects of questionable defence interest receive support.

3. The administrative procedures and other constraints, and the security regulations, are understandably more severe than in the case of the IRA Program. But are they always necessary?

The 1962 Tax-Based General Incentive Program

Although this program terminated with taxation year 1966, a fair number of research and technical managers had comments to make about it.

The program most certainly had an incentive effect, particularly when it was available to supplement an IRAP or DIR grant. Its introduction was also fortuitous because it coincided with the beginning of a general expansion in economic activity in this country. This combination was powerful enough to bring about the establishment of a number of new industrial laboratories in Canada, some of them in subsidiary companies. Capital expenditures, in particular, were encouraged.

However, the base-year provision led to considerable criticism from established laboratories. Those whose base-year expenditures were high had often to wait until taxation years 1965 or 1966 before qualifying for benefits. Reaction to the administration of the program and to the interpretation of the definition of "scien-

^{*}DIR was initiated lat. in 1961, but DDSP goes back to 1959, one year after the Canada-U.S. Defence Production Sharing Agreement was established. The latter program (DDSP) has recently been revised and extended and renamed the "Defence Industry Productivity Program". The Department of Industry, Trade and Commerce is responsible for its administration and operation.

[†]Including contracts from the United States and other foreign governments.

tific research" varied considerably. It was widely felt, for example, that it was wrong for a non-technical government department or agency to be administering a technically based program even though it could consult with technical departments.* It was widely felt that the exclusion of the term "development" from the definition had caused unnecessary interpretation difficulties in the government department concerned and had discouraged many companies from applying for benefits at all or at least until the experience of other companies had become generally known. This program was also criticized on the grounds that the R & D expenditures and the program's benefits had to be related to taxable income in the same year.

The Industrial Research and Development Incentives Act

The program covered by this Act replaced the tax-based incentive program in 1966. It was relatively new to most of the companies at the time of the visits and little experience was available. Many of the early applications were still in preparation or under consideration by the Department of Industry in Ottawa. There was, however, some mild enthusiasm for the program in some companies on the grounds of the change from the tax-base to the grant-base, but the effectiveness of IRDIA as an incentive program could not be assessed.

The most frequent critical comment heard with regard to IRDIA was the retention of a base-year provision for current expenditures, even though the provision is to be applied in the form of a "moving average" base, and even though capital expenditures are to be exempt from all base period calculations. Criticism was directed against the discriminatory effects of the use of the "additionality principle" and of the separation of capital and current expenditure benefits.

Another aspect of the IRDIA Program was already causing some concern, but again relatively little experience of it was available. This was the "benefit to Canada" condition. The Department's brochure describing the program included the following paragraphs:†

"Applications for grants under the Act must be submitted in retrospect and will be reviewed to determine that the expenditures claimed have been calculated in accordance with the Act and are for bona fide scientific research and development which, if successful, will be likely to benefit Canada.

"The regulations provide that scientific research and development work will be considered likely to benefit Canada if an applicant is free to exploit the results of research and development work, which it has financed in whole or in part, in Canada and in all export markets, and the applicant undertakes to exploit such results in Canada unless, according to sound business judgment, it would be uneconomic to do so. Where the applicant is not free to exploit such results in all export markets, an application will be considered on its merits. In such circumstances, a grant may be paid if the Department of Industry is satisfied that the corporation is actively exploiting the export markets open to it, or is taking steps to widen the markets in which it is free to exploit results. A corporation which is not free to exploit the results of research and development work in all export markets may obtain a prior opinion from the Department of Industry as to whether a grant may be payable in respect of such work."

The "benefit to Canada" provision in IRDIA appeared to most people to be similar to the "exploit in Canada" requirement included in the PAIT Program.

Before leaving the special assistance and general incentive programs, one further comment must be made. When asked for an assessment of the relative

^{*}The Department of National Revenue administered this program. It could, by law, seek help from the National Research Council or other similar agencies-and it did.

[†]Industrial Research and Development Incentives Act (IRDIA). Department of Industry, Ottawa, p. 2.

merits of these two types of government encouragement for industrial R & D, there was widespread preference among the research and technical managers for the general incentive approach. Two particular reasons for this view were put forward. First, a general incentive program allows companies to choose projects and to get ahead with them without spending time making submissions and seeking approvals. Second, the special assistance programs do not provide the comprehensive support of the fully funded research or development contract.

Fully Funded Contracts

Relatively few of the companies visited had had experience of operating under fully funded research or development contracts from federal government agencies. Those which did have it received their support principally from the Department of National Defence and Atomic Energy of Canada Limited. But many companies which had not received this kind of support expressed considerable interest in it and, as already mentioned, showed a preference for contracts over cost-shared, special assistance programs. The fact that a degree of deliberate discrimination is implicit in the award of a government contract for specific research or development was understood.* Among the reasons given for this preference for contracts were the following:

1. The government's case for exercising control over the use to which any results are put is less equivocal than under cost-sharing arrangements.

2. If government is providing full support, then the government agencies concerned will have to pay much more attention to questions such as the timing of the start of the work and the relevance of associated government "in-house" activities.

3. The government has to be alive to the need to support-at the appropriate

time and in the appropriate way-particular Canadian advances and potentials in science and technology through "seed money" in order that these advances and potentials can be achieved as often as possible, by Canadians in Canada. Costsharing rules at the present time do not permit the exercise of government initiatives since proposals have to come from individual companies or groups of companies.

4. In contrast with cost-sharing programs, contracts can be more easily extended to permit support of the "venture capital" type to be combined with support of the "seed money" type as the need arises. Procurement contracts often combine both types of support, but the emphasis in this kind of contract is not usually on research and development work.

The National Research Council

The National Research Council (NRC) is perhaps the most widely known of all the federal government's scientific and technical agencies. It has been both criticized and praised for its policies, its programs and the work of its laboratories. Many of the points made in the paragraphs to follow have been made before. They have been repeated here because no appraisal of research and development activities in manufacturing industries in Canada would be complete without them.

Generally, and with the exception of the IRA Program, industry has been disappointed in the support it has received from the National Research Council. While good work has been done by NRC, and while some industry people have built up very good personal relations with the NRC scientists and engineers, the Council as a whole has not been as influential in industry as it might have been. On the other hand, from the Council's viewpoint and from the viewpoint of a number of its divisions, considerable progress has been made in the last decade towards closing the gap between the National Research Council and industry.

To some, NRC's own laboratory research is too "blue sky", too "basic" and

^{*}Discrimination may, of course, be minimized when competitive bids have to be made first. But, in Canada, competitive proposals cannot always be obtained because companies do not always have the necessary initial competence.

to others, not basic enough. Some technical and research managers have found from visiting the laboratories that their own work has been further advanced than the Council's. But while NRC does not now have industry's confidence, there was general agreement that the disappearance of the NRC laboratories would be deplored. The hope for the future for most industrial research and technical managers lies in the strengthening of the NRC-industry relationship-but with flexibility as one of the principal guidelines to the new structure.

The industry people were seldom at a loss to be specific about how the NRCindustry relationship could be strengthened or about how the Council might choose and organize its own laboratory program. The following were among the points made during the interviews:

1. The industry- and university-support functions now combined within NRC should be separated. The present gulf between NRC and industry is one consequence of NRC's preoccupation with its leading role in the support of university research.

2. The Council should not give up its support of industrial research such as is now available under the IRA Program. The National Science Library and the Technical Information Service should also be retained. But these three services should not be considered subordinate in importance to the laboratories. In the immediate future, support for these services must be allowed to grow very much faster than support for laboratory activities. In addition, the Council should consider contracting out research to industry as one of its primary functions.

3. The National Research Council has a two-way role: basic research on behalf of industry; and support for work going on in industry.

4. There is no feeling in secondary manufacturing industry that it has a laboratory-based organization of international stature behind it. This lack of "presence" was stressed particularly by resident-owned companies which have to compete with foreign-owned companies which have the backing of international or other affiliated laboratories abroad.

5. The deliberations and recommendations of the many NRC Associate Committees are not being given sufficiently wide public exposure.

"Fall-out" from Other Federal Laboratories

Most of the companies visited were active in fields of science and engineering covered by federal laboratories but few of them had used "fall-out" from federal laboratories in the form of ideas, information or hardware, except as it came to the attention of individuals through personal contacts.*

The following comments were most frequently made:

1. There is an apparent lack of coordination in the activities of the various departments and agencies. This shortcoming can be identified in two particular forms. While one agency has a program of assistance or research to encourage the growth of research and development in a segment of industry. another is busy restricting the sale of the segment's products; and while half a dozen programs can easily be formulated and organized by half a dozen agencies to cover a complete area of required assistance, industry as a whole has little evidence to show that the co-ordination of these programs is taking place, that steps are being taken to reduce their number, or even that periodic reviews are being made.[†]

2. There is a general lack of experience among government officials at all levels about industry, about its actual structure, problems, needs for technology and so on. This gives cause enough for concern at the present time but without an effective basis for planning and anticipa-

^{*}If there was one exception to this rule it was the Mines Branch of the Department of Energy, Mines and Resources. There was general enthusiasm for the work of this Branch in the sections of industry which it serves.

[†]Since the time of the visits there has been evidence of co-operation and review at the federal level.

tion at the federal level, it will be an even more serious problem 10 years from now.

Industrial Research Institutes

Since the spring of 1967, the Department of Industry has assisted in the establishment of Institutes at the Universities of Windsor and Waterloo, at McMaster, and at the Nova Scotia Technical College. Basically, the Department is to provide funds for the organization and administration of Institutes under contract for a period of several years. The actual research work done in the universities is to be financed by industry, either from companies' own resources or with assistance under the PAIT Program, for example.

The timing of the program of visits was too early to receive comments from industry or the universities on the actual operation of the Institutes, but the program has obviously been designed to help bring industry and the universities closer together and to help solve some of industry's technical problems, particularly in the smaller companies.

	Part IV
	Comments and
	Conclusions

The author has noted in a previous paper that discovery and invention are principally the concern of scientists, engineers and technicians and that innovation is principally the concern of entrepreneurs.* Later in the same paper the following statement was made: †

"There have been elements of randomness and accident in the history of many inventions but, on balance, it would appear that the majority of inventions have been based on some aspect of the science or technology of the time. They have usually come about in a step-bystep-or evolutionary-fashion rather than than in a sudden, spectacular and revolutionary way. Increasingly, however, it appears that even 'revolutionary' inventions can also be traced back to particular scientific discoveries or demonstrations. But in the background to inventions of all kinds-however simple and obvious they may now seem-has usually been a great deal of hard and painstaking work to overcome difficult technical problems."

The present Study has looked into two aspects of the "business" of invention. Research and development activitiesparticularly those undertaken in the Canadian industrial environment-are not the only sources of new inventions in this country, but they are sources whose importance has apparently been growing. Similarly, the Canadian patent system is not the only means available to encourage the exploitation of inventions in the marketplace, but there have been occasions on which its employment has made the difference between economic success and failure. As this Study has made clear in its limited way, the link between industrial R & D activities, on the one hand, and patent system activities, on the other, is usually made indirectly. The pursuance of research

*Wilson. Andrew H. Science, technology and innovation. Special Study No. 8, Economic Council of Canada. Ottawa, Queen's Printer, May 1968. p. 17. †Ibid., p. 78.

work may be influenced remarkably little by the existence of the system, although it does have more effect on the choice and conduct of development work. As far as most industrial R & D laboratories are concerned, the patent is usually a by-product or bonus. The value of the patent system to the companies owning the laboratories is that it is *there* to be put into use after most, if not all, of the R & D work has been done, after an initial assessment for innovative potential has been made, and before additional resources are committed to further development or to design, production, marketing and sales activities. Patent action is a following, and businessoriented, activity and not a leading, or technically oriented, activity like research and development. In spite of the indirectness of the R & D - patent link-up and the fact that patent action is only one element in the business environment, it is clear from the concluding section of Part II of this Study that in the view of most industry people with whom the question was discussed, the patent system should be retained in Canada.

As might be expected, not all industries or companies make use of the present patent system to the same extent, and with this in mind, the following *pattern* of usage has been pieced together from the material collected for this Study:

Patent applications will usually be made: 1. by companies of all sizes and in all industries, when a rare "basic" patent with far-reaching innovation potential or high revenue-producing potential is likely

to issue: 2. by medium-sized and large companies in most industries, either

a) as a matter of policy;

b) through habit or tradition;

c) as a result of a policy change following a period of growth;

d) as a result of a policy change instituted by a new "patent-conscious" research manager, senior executive or board of directors:

e) to protect an existing patent portfolio or "basic" patent;

f) to help earn revenue from the sale of an information package;

g) to protect an expensive R & D investment;

h) to open up new market potentials;

i) to defend against the patent positions of competitors;

3. by companies in, for example, the metallurgical and chemical industries which have developed commercially valuable new materials and processes;

4. by some Canadian subsidiaries of U.S. companies, not because of the high potential of the issued patents, but because it is the policy of the international corporation to which they belong;*

5. by capital equipment manufacturers, whose products have high unit costs, are easy to copy, or have wide market potential.

Patent applications will not usually be made:

1. by companies of all sizes, when the invention can be hidden in "black boxes";

2. by companies of all sizes when the inventions are related to the exploitation of unique natural resources;

3. by companies of all sizes when the invention-product is likely to be the subject of rapid obsolescence;

4. by companies of all sizes in those industries which have a tradition of "open" technology, in which technological changes take place very slowly, or in which secrets can be easily kept;

5. by most small companies;

6. by companies which feel unable to "police" adequately against infringement;

7. by companies serving a local market in which product demands are likely to be erratic; and

8. by companies in their roles as *users* of capital equipment of high unit cost.[†]

Patent systems have been criticized because those who play the game do not always stick to the rules of good conduct. But it is clear that a perfect patent system cannot be designed for the real world and the actual systems are essentially compromises involving technology, business, law and the administration of the patent-granting mechanism. Regardless of what its provisions might be, the Canadian patent system will never be used by all the Canadian or foreign residents who wish to exploit-or defendinventions in the Canadian market. Nor can the Canadian system be defended adequately on the basis of the view which Professor Machlup expressed in 1958 and which was adopted as valid for Canada by the Ilsley Royal Commission two years later. The essence of this view was that "since we have had a patent system for a long time, it would be irresponsible, on the basis of our present knowledge, to recommend abolishing it". 1 In the past, new or revised legislation has often attempted to cure the problems of vesterday and today but has tended to discount the challenges and pitfalls of tomorrow because these cannot be experienced or effectively measured. One of the principal findings of this Study has been that for tomorrow's world, the Canadian patent system has to be put in an international context on a forwardlooking basis.

With regard to the internationalization of patent systems, it was the view of the industry people that the first step for Canada should be towards the development of a North American system, with Canada playing an equal rather than a junior part. In such a system, it would be an advantage if the Canadian and U.S. provisions corresponded closely. Nevertheless, Canada should not hesitate to defend parts of its existing system, such as the present three-year compulsory licensing provision, or to seek for Canadian-resident applicants in the United States the same rights as U.S.-resident

*As a rule, these companies apply first for a U.S. patent. They may not apply for Canadian patents in every case.

[†]These companies may, however, take patent action with regard to their own products.

\$Subcommittee on Patents, Trade-Marks and Copyrights of the Committee on the Judiciary, United States Senate, 85th Congress, Second Session. An economic review of the patent system. Study No. 15. Washington, 1958. p. 80.

See also the Report on Patents of Invention, Royal Commission on Patents, Copyright and Industrial Designs (The Ilsley Commission). Ottawa, Queen's Printer, 1960. p. 15. applicants now receive in their own country and in Canada. In this North American system, there should also be bilateral evaluation of such basic matters as the change from the first-to-invent approach to the first-to-file approach. In other words, an International Joint Commission on Patents would have much to discuss during the next few years.

Although favouring a North American first step, the industry people did not reject the Patent Co-operation Treaty. For them, it formed the basis of a second step towards internationalization. The Treaty might actually help to bring the North American system into being but, with 70 or so governments involved, the possibilities of the Treaty going very far towards the ultimate goal of a single worldwide patent seem remote. To the industry people, the North American market is very near and is the main target for many of those who are already assessing their business prospects in the next decade and beyond.

In its report, the Ilsley Royal Commission covered many of the aspects of the Canadian patent system included in this present Study. For example, the Commission favoured the change to the first-to-file approach. It also favoured the establishment of a Patent Tribunal, with quite a different composition-but with quite similar duties-to those outlined in this Study. The Tribunal was to be a "person appointed by the Governor in Council ... who shall have the rank of a puisne judge of the Exchequer Court".* The Tribunal was to deal with such matters as compulsory licensing applications, the revocation of patents, and the fixing of compensation when the Crown used a patented invention. It must be remembered, however, that the Ilsley Commission sat and deliberated before the "take-off" period for industrial research and development activities in Canada and before there was widespread interest in the innovation process or in science policy. As far as is known, the Commission heard little or no evidence from industrial research managements.

Its examination of the patent system was based on legal, economic and administrative aspects. The Commission was not in a position to know that within a decade of presenting its report, the environment in which the Canadian patent system would be operating would change significantly from the scientific and technical points of view-or that the United States would spark technological changes in a dimension hitherto unknown.[†]

From the material gathered for this report, it has been possible to put together a number of principles upon which future revisions to the Canadian system, by itself, should be based. These are:

1. The system must be administratively simple.

2. The standard of examination and the quality of Canadian patents generally must improve.

3. The present average period of pendency of a Canadian patent must be reduced from what it presently is.

4. The needs and opportunities for litigation must be reduced.

5. The overall costs of patent ownership, including Patent Office and other application costs and patent maintenance costs and fees, must be reduced.

6. Any changes that are made to the Canadian system must be related to what is likely to happen in the next two decades rather than to what has gone wrong with the system since its last major revision in 1935. These changes must also be related to the likelihood of a Canadian research and development effort in the future which will be considerably

^{*}Report on Patents of Invention, p. 113. †Additional note: At a more detailed level, the Royal Commission was in favour of renewal fees; product as well as process patents for chemical substances intended for food and medicine; applications for compulsory licences being made "at any time after the grant of a patent"; compulsory licences being granted "in the public interest and not on the grounds of abuse"; the "applicant" being the inventor, joint inventors, their legal representatives, and Her Majesty in right of Canada; provisional application, with complete specifications to be filed within 12 months; a complete application being open to public inspection one year after filing the complete specification. The Commission was NOT in favour of opposition proceedings; a grace period for prior publication; caveats; and compulsory licences "of right".

more effective than has been the case up until now.

7. Although changes to the Canadian system should take into account actual or very possible changes in the U.S. system in the near future, features such as compulsory licensing-which the United States does not have and possibly will not have-should be retained.

8. The Patent Office activities must not be subsidized from other government revenues.

9. While respecting Canadian duties with regard to Convention filings and treaties, the Canadian system should encourage the patenting of Canadianmade inventions as a matter of priority.

10. More must be found out about the problems which small science-based companies and independent inventors now face and are likely to face in the future before changes to the system are made.

It is perhaps fortunate that between 1958 and 1966, at least, circumstances combined to favour real growth in research and development activities of all kinds in Canada. Similar growth was also experienced in other industrialized countries of the world. But Canada, like Japan but unlike certain European countries and the United States, has had no strong tradition of discovery or invention or of scientific leadership, and Canada, unlike the older industrialized countries, has not had active administrative and advisory machinery related to science policy until quite recently.

From the body of this report, three particular guidelines relevant to future science policies in this country have emerged. First, there can be no place in Canadian policies associated with scientific and technical activities- including R & D in industry-for timidity or faintheartedness. The challenges of the future are going to be both immense and exciting. Second, there is no place for conflicting public policies where the research and technical competence of an industry or even of a company are concerned. While one department of government is attempting to build up such competence, another department may be placing difficulties in the way of the marketing of new products coming from the industry or the company.* And, third, government intervention in industry should be as direct and as appropriate as possible. If it is to encourage more Canadian invention, then the Patent Act should be amended to ensure that more *Canadian* residents apply for patents of invention.

Some comments have been made in this report with regard to the federal government's general incentive and special assistance programs designed to encourage industrial research and development activities. As has been noted in Part III, these programs have not been uniformly effective. Most of them were conceived and introduced when the Canadian economy was on the upswing, and when the going became tougher, the incentive elements in them became less attractive. It has also been noted that industry preferred the general incentive program and the fully funded contract to the costshared special assistance programs which are currently available. As regards the general incentive, many of the industry people appeared to favour the kind of tax-based incentive which the Economic Council of Canada recommended to the government four years ago and which was based on the background work of its Advisory Committee on Industrial Research and Technology.† This Committee's report discussed the principles which should govern the structure of a general incentive program, as follows: ‡

"While the main virtue of a general incentive program should be its breadth and wide availability, it is the Commit-

^{*}It has been assumed that when undesirable or dangerous products are involved, the departments will combine to discourage *both* the research and the marketing.

[†]The government chose to implement the IRDIA grant-based incentive instead.

[‡]Report to the Economic Council of Canada by the Advisory Committee on Industrial Research and Technology. A general incentive programme to encourage research and development in Canadian industry. Ottawa, Queen's Printer, December 1965. p. 12.

tee's view that the program should encourage companies in Canada, over a wide range of industries, to devote increasing resources to the improvement of their scientific and technical competence. The program should encourage the taking of risks on the development of new ideas and methods on the basis of widespread individual initiatives. The program should be as free as possible from centralized approvals, interventions and delays. It should encourage the forward planning of R & D activities and be available for a long enough period to enable this planning to be done in an orderly way. The definition of 'scientific research and development' to be used with the programme should be realistic, workable, and involve the minimum of administrative uncertainty.

"Lastly, in the Committee's view, the administration of a general incentive program must be simple, effective and adequate, and the qualification of a particular project for benefits under the incentive should be based solely on whether or not it meets the definition of 'scientific research and development'."

The industry representatives made it clear that, in many cases, development should follow research without delay. They also said that after the developmentor invention-stage of a project, there had to be adequate resources available to get a new product to the market or a new process into use. Federal assistance, therefore, might be more effective if both the research and development activities were supported by the same department or agency and if the follow-on, or innovative, support was closely linked to the R & D. This might mean, for example, combining the administration of the present general incentive and special assistance programs, the industrial research institutes, and Canadian Patents and Development Limited in a single independent agency and giving this agency the authority and the resources to enter into development, procurement and other innovation-support contracts.*

While changes in the existing programs and in the statutory operations of Canadian Patents and Development Limited would still be required, this new agency would serve to integrate, simplify, strengthen and spearhead government assistance in the fields of discovery, invention and innovation in industry in this country.

There are a number of alternatives to the single independent agency. For example, the various functions and programs might be grouped under the National Research Council, which has a laboratory capability of its own, or under the Department of Industry, Trade and Commerce which, however, has no laboratory capability. Another solution would be to concentrate defence interests under the Defence Research Board, and nondefence interests under the National Research Council. The effectiveness of this latter solution would have to be related to Canada's future defence role and to the procurement of the necessary military hardware. But it will be necessary to take into account the fact that the federal departments such as Energy, Mines and Resources, Forestry and Fisheries, and Agriculture also have an interest in the growth and development of Canada.[†]

Any government programs associated with industrial research and development and with subsequent innovative activities must be at a level appropriate to the needs, opportunities and problems which are here now or which are likely to appear in the foreseeable future. These programs have to be flexible, and they must be part of an enabling process whereby industry in Canada can achieve whatever economic, social or other goals may be explicitly defined for it-and by it-from time to time. Since excellence in research, development, invention and innovation appear to be achievable when the available human and material re-

^{*}The single independent agency will broadly resemble the National Research Development Corporation (NRDC) in Britain.

[†]Several other departments and agencies not mentioned at all in this report might also be included in any reorganization along the lines suggested.

sources are effectively employed and when the timing and the environment are right, it seems clear that government agencies and programs will have to favour companies with proven capabilities *or with exceptional promise*. But, however well the resources may be allocated initially, there will be failures as well as successes, and the outcome of each project will be subject to some uncertainty at every stage.

One particular problem on the Canadian scene will be difficult to solve. During the industry visits it was commonplace to hear foreign-owned companies defend their Canadian R & D and invention activities, and to hear resident-owned companies protest the advantages enjoyed by the subsidiaries of technically and commercially powerful international corporations. There is no doubt that resident-owned companies can be placed at a disadvantage, both technically and commercially, but subsidiaries can be disadvantaged too. In any event, it does not make good administrative sense to have more than one set of rules for research or for invention. Instead, both public and private support for industry should be concentrated upon raising technical competence in Canada as a whole and upon ensuring that good, solid backing is provided for promising Canadian discoveries, ideas and inventions. This support will have to be given early enough and for as long as it appears to be to Canada's overall advantage. If either the timing of this support or its adequacy are inappropriate, then the activities devoted to research and development-and to invention-may be wasted.

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Special Study No. 1, Upper Atmosphere and Space Programs in Canada, by J. H. Chapman, P. A. Forsyth, P. A. Lapp, G. N. Patterson (SS21-1-1, \$2.50). Special Study No. 2, Physics in Canada: Survey and Outlook, by a Study Group of the Association of Physicists headed by D. C. Rose (SS21-1/2, \$2.50). Special Study No. 3, Psychology in Canada, by M. H. Appley and Jean Rickwood (SS21-1/3, \$2.50). Special Study No. 4, The Proposal for an Intense Neutron Generator: Scientific and Economic Evaluation, by a Committee of the Science Council of Canada (SS21-1/4, \$2.00).

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