Special Study No. 8

Scientific and Technical Information in Canada

Part II

Chapter 1

Government Departments and Agencies

Prepared for

The Science Council of Canada

SCIENTIFIC AND TECHNICAL INFORMATION IN CANADA

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GOVERNMENT DEPARTMENTS AND AGENCIES

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This chapter of the report

SCIENTIFIC AND TECHNICAL INFORMATION IN CANADA

is submitted by the Governments Subgroup.

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FOREWORD

This Report on the Study conducted by Mr. J.P.I. Tyas and his colleagues is published as one of the series of Special Studies commenced by the Science Secretariat and now being continued by the Science Council of Canada.

The origin and status of this report are somewhat different from others in this series. The study was originally proposed by the Department of Industry in 1967, was by agreement taken over by the Science Secretariat and is now being considered by the Science Council of Canada's Committee on Scientific and Technical Information Services as an important background study.

As in all other special studies, the report represents the opinions of the authors only and does not necessarily represent the opinion of the Science Council of Canada, or the Science Secretariat.

This publication contains Chapter 1 (Government Departments and Agencies) of Part II. Part I of this Special Study has already been published. The other chapters of Part II are

Chapter 2–Industry
Chapter 3–Universities
Chapter 4–International Organizations and Foreign Countries
Chapter 5–Techniques and Sources
Chapter 6–Libraries
Chapter 7–Economics

and will be published separately. Each of these seven separate sections contains the report of a major subgroup, thus providing background data and considerations to complement the recommendations in Part I

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

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Section I

SUMMARY

The efficient communication of scientific and technical information is a prerequisite for the advancement of science and technology. The well-being and economic growth of Canada depend on utilization of this information by all sectors of the economy. Since many government department and agency missions are based upon, or related to, science, their effectiveness can be greatly enhanced by the greater use of modern methods for information transfer. They also have a major role to play in the transfer of scientific and technical information to industry, to centres of learning, and to the general public.

The major scientific and technical information resources in Canada are supported largely by the Federal Government and, to a lesser extent, by the provincial and municipal governments. They consist of libraries, data files, specialized information centres, and field services: all of them created and operated in support of the endeavours of the particular department or agency concerned.

These resources have developed largely on a piecemeal basis to service the needs of individual groups. They lack co-ordination in their development and in the services they provide. Nevertheless, there is a growing awareness of the importance of the co-ordination of information services and of the benefits that can accrue from the improved utilization of known information.

The Canadian Government has no overall policy concerning the handling of scientific and technical information, and some government departments providing such services have no mention of the subject in their legislation. The need for a national information focus is now evident. It is a particularly appropriate time for a definite policy to be established and for plans to be made for putting it into effect.

The massive store of documents and data accumulated over the years, combined with the present high rate at which new material is being generated and the increase in numbers of users and the complexity of their needs, are overtaxing existing methods of handling documents and data. New technologies in the field of information transfer have developed to a point where their use can alleviate this problem; they must be applied as soon as possible. Means must be sought to reduce duplication of effort and ensure compatibility between systems.

If Canada is to improve its expertise in information-handling methods, the capability for research on information transfer, for the application of new technologies, and for training information personnel, must be significantly improved. Although the Federal Government must take a leading role in enhancing this capability, it must do so only in co-operation with all interested groups.

As a result of these findings the following recommendations are made:

1. The Government of Canada define a national policy with respect to scientific and technical information to stimulate and guide the evolution of nation-wide information services.

2. A central agency be established to implement government policy with regard to scientific and technical information.

3. Where appropriate, federal government departments and agencies be designated as responsible agents for information activities that are relevant to their missions.

4. The central agency review the many assessments made in this report and take appropriate action to develop an effective national information network.

5. Government departments accepting the role of responsible agents should assess the significance of scientific and technical information to their operations and take action to improve its generation, handling, and use.

6. An advisory committee for scientific and technical information, representative of all groups concerned with information, be established to advise the central agency.

Section II

INTRODUCTION

The Government of Canada has a responsibility to create an environment within which a healthy economy can develop. One of the most important features of that environment must be the ready availability of any information, old or new, that can be utilized in the establishment and growth of such an economy. In the face of world-wide emphasis on economic development and better education, no nation will be able to maintain its competitive position unless it effectively utilizes the vast and growing store of recorded knowledge. This is particularly the case with scientific and technical information, which is the life-blood of progress in a technically advanced society.

This view was emphasized by the late President John F. Kennedy in his foreword to the report *Science, Government and Information:*[1]

> "One of the major opportunities for enhancing the effectiveness of our national scientific and technical effort . . . lies in the improvement of our ability to communicate information about current research efforts and the results of past efforts . . . Strong science and technology is a national necessity and adequate communication is a prerequisite for strong science and technology."

It was also recognized by the Royal Commission on Government Organization, which commented:[2]

> "The dissemination of information as a service to the Canadian public is either the sole or principal reason for the existence of some departments and agencies and is an explicit or essential corollary to the operation of others. The purpose may be to develop and propagate a body of knowledge of benefit to the public at large, or to promote efficiency, economy or market opportunities in a particular industry . . . It is, therefore, essential that within reasonable limitations of security there be a free flow of the results of research both to other units of government and to the public at large. There may also be justification for the dissemination of research information that the federal government itself has not produced or sponsored, if this information is not otherwise available to potential beneficiaries in Canada."

The Canadian Government has recognized the importance of economic and scientific considerations in national decision making by establishing two advisory bodies—the Economic Council of Canada, and the Science Council of Canada. The Senate Special Committee on Scientific Policy is now considering the development of scientific and technical aspects of the economy. It would be appropriate to establish at the same time a policy for the creation of a system that will provide the best scientific and technical information with the required relevance and speed of response. As a concrete expression of this policy, and as a first step in its implementation, there should be created within the Federal Government an information system without equal, which would serve as the basis on which a national service could be developed. Lamontagne has stated:[3]

> "We desperately need a dynamic scientific policy . . . We should try to derive the maximum benefits from research conducted in other countries and avoid useless duplication. We should have a national centre of scientific information which would gather data on research in other countries and diffuse them to interested individuals and organizations in Canada."

II.1 Purpose and Scope of the Study

The purpose of the study of federal and provincial government departments and agencies was to:

(1) Examine the existing scientific and technical information services;
(2) Identify the potential growth and future requirements of these services;
(3) Consider the mechanisms for national and international exchange of information;
(4) Formulate guidelines for a long-term policy and program based on existing federal resources for the evolution of a co-ordinated national network.

Although this Study is limited by its terms of reference to a consideration of scientific and technical information (STI), it is difficult in many departments to separate information of a scientific and technical nature, on the one hand, from information and statistics related to the fields of economics and sociology, on the other. Thus, this report includes brief consideration of some of these areas of overlap since the methods used for information handling are applicable to many fields.

As an operational expedient it was necessary to divide consideration of the Crown Corporations between the two subgroups concerned with government and industrial organizations. The Crown Corporations that operate in competition with private industry, such as Canadian National Railways and Polymer Corporation, were studied by the Industrial Subgroup. Atomic Energy of Canada Limited, being non-competitive, was studied by the Governments Subgroup and is therefore included in this chapter of the report. For this reason, the data concerning government expenditure and manpower that are given in Section III do not indicate total government resources but only those of the government departments reporting, plus Atomic Energy of Canada Limited (AECL).

II.2 Method of Study

The material in this chapter was obtained from briefs presented to the meetings of an *ad hoc* panel comprising representatives of major federal agencies involved in work relating to science and technology, from discussions of the briefs, from visits to the various agencies by members of the Governments Subgroup, and from discussions with those involved in the generation, handling, and use of STI within the Federal Government. Visits were also made to all provincial governments and discussions held with their representatives. Formal briefs were submitted by a few provincial government departments. Particular attention was paid to the services received from the Federal Government and possible future requirements.

In view of the similarity of problems in the United States and Canada, the members of this subgroup are particularly indebted to the work of the Committee on Scientific and Technical Information (COSATI),[4] and to Carter *et al.*[5]

The members of the Federal Government *ad hoc* panel were as follows:

J.E. Brown	National Science Library National Research Council of Canada
J.B. Bundock	Special Projects Department of National Health and Welfare
L. Cameron	Information and Technical Services Division Department of Forestry and Rural Development
G.M. Carman	Information Division Department of Agriculture
A.C. Jones	Defence Scientific Information Service Defence Research Board
R.E. McBurney	Technical Information Service National Research Council of Canada
S.C. Robinson	Division of Economic Geology Department of Energy, Mines and Resources
J.C. Stevenson	Fisheries Research Board of Canada
A.H. Wilson	Economic Council of Canada

Section III

GENERAL CHARACTERISTICS OF GOVERNMENT INFORMATION SERVICES

Scientific and technical information services in different departments and agencies of the federal and provincial governments have emerged gradually over the last century. They have developed largely in response to specific user needs or the requirements of particular departmental responsibilities. In the postwar period, the Federal Government created new agencies and new departmental divisions to carry out its expanded program and scientific enquiry emerged as a major undertaking of government. The first steps were also taken at that time to provide technical information for secondary industry.

III.1 Organization of Federal Government Information Services

Federal government information services are of four general types: libraries, information services, specialized information centres, and data banks of various types. Lists of each of these are given in Appendices D, E, and F, along with descriptions in Appendix A of the resources of each of the major departments concerned with information transfer.

All departments have libraries which differ greatly in size, number, and qualifications of staff. Most departments have major collections in Ottawa and smaller collections associated with regional or branch establishments.

The foremost scientific library in Canada is the National Science Library, administered and operated by the National Research Council of Canada (NRC). It serves as the principal source for other libraries requiring material not in their own collections, and provides for the needs of the scientists in NRC. In addition to a main library, it operates five branch libraries situated in the major divisions of the Council, and maintains informal working relationships with other federal libraries.

Major collections have developed in the other departments according to their needs. For example, the main library of the Department of Agriculture contains documents related to agriculture and biology and supervises 19 branch libraries in the various research stations across Canada. The Department of Energy, Mines and Resources now has eight separate libraries in the Ottawa area serving different branches and, in addition, has smaller libraries at various establishments outside Ottawa. Similarly, the Department of Fisheries, the Fisheries Research Board, the Department of Forestry and Rural Development, and the Defence Research Board have libraries associated with their various establishments. There are no interdepartmental organizational ties between these libraries, and the transfer of documents depends largely on the co-operation of the staff. The heads of the libraries report at various levels in their respective departments and there is no consistent pattern of organization. Some smaller libraries are not authorized to manage their own budgets.

All departments have information services set up to furnish information to the general public or to groups particularly interested in or concerned with the work of that department. For example, the Department of National Health and Welfare furnishes information dealing with many aspects of the health and welfare of the general public. In the Department of Agriculture, information obtained in the research establishments is summarized and condensed to a form that is usable by the farmer or food processor. Similarly, information on forestry, wildlife, and fisheries is issued in a form that is usable by groups having practical interest in these resources. The Technical Information Service of NRC supplies information to secondary industry, and the Division of Building Research serves the building industry. Data and statistics released by the Dominion Bureau of Statistics (DBS) are used by government departments, industry, and universities. With the exception of the Division of Building Research and the Technical Information Branch of AECL, most information services are organizationally separate from the libraries of the departments.

In a few departments, specialized information retrieval centres have been developed to serve particular needs for the rapid retrieval of information in a specialized area. Examples of these are the Food and Drug Information Retrieval Centre; the Pesticide, Herbicide and Fungicide Information Centres; and the International Tree Disease Register (INTREDIS) (Appendix F).

In many departments there are collections of scientific data relating to measurements of various types. Most numerous and comprehensive are those files in the Department of Energy, Mines and Resources (Appendix F). The data in these files are utilized not only by the department concerned but in some cases by provincial governments, industry, and international agencies. Many are in various stages of computerization. In the development of these files it is important that they be made compatible with others in the same field, and information obtained in the Study indicates that this is generally being done.

Each department has developed its various information services largely in response to its special needs and independently of external services. Since there is no centralized control of library services in the Federal Government, interlibrary loans and other exchanges of documents or information depend largely on co-operation between personnel in the various organizations. To ensure that all personnel in government departments have information and documents available quickly, there must be a highly co-ordinated and user-oriented system.

In 1957, the NRC Associate Committee on Scientific Information (Appendix A) was established to consider all matters relating to the acquisition, organization, and dissemination of scientific and technical information in Canada. Although it has made several contributions, including the establishment of the National Science Film Library and the sponsoring of surveys of different aspects of information handling, it has not dealt with the fundamental problem of the co-ordination of existing government resources into a comprehensive system.

III.2 Statutory Authority for Information Transfer

A review of the statutory authority of the various government departments and agencies (Appendix G) indicates that there is considerable variation in legislation concerning authority or policy for the transfer of scientific or technical information. The National Library has been given authority, among other duties, to:

> " . . . compile and maintain a national union catalogue in which the contents of the principal library collections throughout Canada may be listed."

The National Research Council was given authority in 1966 to " . . . establish, operate and maintain a national science library."

The authority given to departments varies greatly, being clearly stated in the case of the Dominion Bureau of Statistics and the Department of National Health and Welfare, and entirely interpreted in the case of the Department of Agriculture and the Department of Fisheries. Although the Science Council has the duty to " . . . assess in a comprehensive manner Canada's scientific and technical resources, requirements and potentialities . . . ", there appears to be no general overall government policy on STI. There is need for a clearly defined government policy which would serve as a guideline in the planning and development of a comprehensive co-ordinated network and in the planning of future needs based on user requirements and the application of new technologies.

III.3 Personnel

Personnel for the fiscal year 1967-68 and for the five-year forecast are listed by training in Appendix C and summarized in Table 1. In the departments reporting, a total of 1 482 persons were involved in library work and information

TABLE 1.–

Approximate Budget and Personnel for Information Activities in Those Federal Departments and Agencies Reporting to the Study
(Details given in Appendix C)

	1967-68	Estimated 1972-73*
No. of Personnel		
Professional.	554	807
Support.	928	1 322
Total	1 482	2 129
Expenditures (Thousands of Dollars)		
Total Budget	18 000	29 000
Overhead (estimated)	6 000	9 700
	24 000	38 700
15% of time of 35 000 employees†.	51 000	61 200
Total Cost	75 000	99 900

*Estimates obtained in 1967, not adjusted for revisions in 1968.
†Chapter 7, Appendix B.

services. The proportion of professional to support staff varies greatly among departments, and many libraries lack sufficient technical assistance. Relatively few libraries have people qualified in science or engineering as well as in library science. A number of branch libraries do not have librarians in charge of their operations.

The five-year projection for total staff is 2 129, representing an increase in establishment of 746, or 50 per cent. Planning increases in staff also vary greatly among departments with most being about 30 to 60 per cent. Generally, the proportion of various types of staff projected tends to remain similar to present proportions. Discussions with several head librarians indicated that the proportion of technical school graduates should be increased to relieve qualified librarians of much routine work. With the exception of the National Science Library, the Fisheries Research Board, and Atomic Energy of Canada Limited, there was no indication from the figures that there was any trend toward greater use in library work of people trained in science or engineering. This situation may be related to the difficulty in recruiting such people.

III.4 Expenditures

Expenditures for those departments reporting are given in detail in Appendix C and summarized in Table 1. Most departments were not able to give a realistic allowance for overhead costs and it is estimated that an additional sum equal to 25 per cent of total costs represents overhead. It is also estimated that 35 000 of the 39 000 employees in the Federal Government classified in either the scientific and professional or the technical categories devote in excess of 15 per cent of their time to the procuring of information, and have a mean salary of $10 000. Salaries accountable in this way amount to $51 million, bringing the total cost of federal government STI activities to $75 million. Budgeted increases projected for 1972-73 indicate a 61 per cent growth in operating expenses and a 20 per cent increase in staff salaries. Thus, the total estimated expenditure for 1972-73 is about $100 million. In considering these totals, it must be realized that they do not include all government departments and agencies but only those reporting details to the Study. In other cases, such as DBS, it was impractical to separate the cost of STI and related services from the total budget.

The figures for individual departments and agencies vary considerably. The Department of Agriculture spends $2 033 000 on various information services and $692 000 for library operations. In the Department of National Health and Welfare, the corresponding figures are $1 882 000 and $156 000, respectively. NRC spends a total of $5 033 000, of which $754 000 is for the Technical Information Service, $2 884 000 for the Division of Building Research, and $1 395 000 for library operations. Other departments show a similar trend in that several times as much is spent on information services as on libraries.

III.5 Types of Output and Service Provided

Most of the Government's scientific information services concentrate their attention on the dissemination of recorded information rather than on the analysis and evaluation of information or services of a consultative nature. They spend the bulk of their budgets on accumulation, storage, and initial distribution of printed materials, and give relatively little attention to information analysis, information retrieval, or consultative and field services. Library buildings often lack adequate space for study purposes, and librarians find themselves increasingly short of room as the volume of acquisitions increases. The lack of a comprehensive plan regarding the acquisition and storage of little-used documents does not promote the best use of available space.

III.6 Provincial Government Information Services

Provincial government information activities include the same four types as occur federally, i.e. libraries, information services, specialized information centres, and data banks. Since many of the libraries and other services are considerably smaller than their federal counterparts, they are not funded separately and it was not possible to obtain details regarding their operation.

All Departments of Agriculture, Health, Natural Resources, Industry, and Economics have libraries to serve their own needs. They vary in size from very small ones with no professional staff and a very small collection of material to those of the Department of Health of Ontario, which employs six librarians. The largest of these libraries operates on a budget of $40 000.

Information services in the provincial departments also vary greatly in size and scope of operation, depending on the province. For example, the information service of the Department of Agriculture of Newfoundland depends to a great extent on the federal department for assistance, advice, and publications, while that of Ontario operates a large organization which publishes its own pamphlets and bulletins.

A few specialized information retrieval centres are being developed in provincial departments, and several departments in the larger provinces operate data banks of various types or co-operate with federal departments in this regard. The more important of these are listed in Appendix I.

III.7 Federal-Provincial Joint Operations

There are several fields in which there has been active collaboration between federal departments and their provincial counterparts in the development of systems for the transfer of information or data of a specialized nature. Some of those mentioned here are indicative of the present stage of development of nation-wide systems for information transfer. Many other systems are in the early stages of development. Further details of the mechanized systems mentioned here are given in Appendix F.

(*a*) In the Geological Survey of the Department of Energy, Mines and Resources, the concept of a national system of geological data files was developed in 1967[6] by an *ad hoc* committee made up of representatives of federal and provincial departments and industries. The functions of the system will include the conducting of pilot studies, the maintenance of the National Index to geological data, and assistance to potential users of such data.

(*b*) In the Department of Forestry and Rural Development, the Canada Land Inventory has developed the Geo-Information System as a basis for handling various types of location-specific information. The inventory is being carried on through co-operative arrangements between each province, the federal administration of the Agricultural Rehabilitation and Development Act (ARDA), and other federal departments. The system operates at the federal level to receive, store, and compare data on a national basis and at the regional level to serve the almost daily needs of provincial governments for information on which to base their plans and decisions. Each province maintains its own computer facilities for storing data taken from the inventory but a province may add other data strictly for its own use.

(*c*) Under the Health Resources Fund Program, administered by the Department of National Health and Welfare, $500 million is being made available over a 15-year period, 1966-80, for new educational and research facilities in the health field. Already about $50 million has been approved for facilities located in all provinces. The fund pays half the capital costs, which may include not only buildings but basic equipment and the cost of planning and design. The consultative and other services being developed federally include compatible equipment for handling various types of health information. For example, in British Columbia the federal department is supporting co-operative studies of mechanized systems for handling hospital records and clinical data. In Québec there is particular interest in developing a province-wide system of library services for all psychiatric hospitals coming under its general supervision. These plans are being developed in conjunction with federal objectives for a national system of health and welfare communications, organized on a regional basis.

(*d*) The Canadian Agricultural Services Co-ordinating Committee, composed of all the Deputy Ministers of Agriculture and the Deans of Agricultural Colleges and Veterinary Schools, has been concerned for some time with many problems affecting Canadian agriculture. Subcommittees have been set up to study specific problems such as pesticide use, agricultural engineering, research, agro-meteorology, diseases, and farm building plan service. Both the co-ordinating committee and its subcommittees have had important roles in various aspects of the communication of agricultural information. Recently the Canadian Electronic Farm-Record-Keeping Systems has been introduced as a comprehensive system to process, analyze, report, and store relevant farm management data. The Working Committee established by the Agricultural Economics Research Council of Canada is made up of representatives of the Canada Department of Agriculture, the University of Guelph, the University of Saskatchewan, and Université Laval.

III.8 International Relations

Several Government departments have working arrangements with their counterparts in other countries or with international agencies working in their particular field. These arrangements are of widely varying types—some formal, some informal—but they are all concerned with the flow of information in a certain field or type of activity. As in the case of federal-provincial relations, they represent the type of mission-oriented systems that must exist nationally and internationally and must be developed and expanded to other fields and disciplines. Many are in the developmental stage and should be expanded into effective functioning systems for information transfer. The following are some of the more formal systems.

(*a*) Atomic Energy of Canada Limited provides abstracts of Canadian articles on nuclear science to *Nuclear Science Abstracts* and has agreements with a number of countries for the exchange of STI by the transfer of documents and by visits and joint meetings. It is presently involved in negotiations with the International Atomic Energy Agency in Vienna regarding the input of Canadian information to a computer-based information retrieval system and the output of the system to interested scientists in Canada.

(*b*) The Division of Building Research, NRC, is linked through its library and through *le Conseil international du bâtiment pour la recherche, l'étude et la documentation* (CIB) with other similar organizations throughout the world. Questions that cannot be answered in Canada may be answered through these connections.

(*c*) The National Science Library has arrangements by which the publications of the National Aeronautics and Space Administration (NASA) and certain other organizations are deposited and made available to interested readers in Canada.

(*d*) The Defence Research Board participates in the Technical Co-operation Program (TTCP) with the United States, the United Kingdom, and Australia, and exchanges pertinent information through this channel.

(*e*) The Queen's Printer (Publisher) has assumed the role of the National Sales Agent for Canada for several international organizations, including the United Nations (UN); United Nations Educational, Scientific and Cultural Organization (UNESCO); World Health Organization (WHO); and the Food and Agriculture Organization (FAO), thereby making the publications of these organizations available in Canada.

Section IV

THE GENERATION AND PUBLICATION OF INFORMATION BY GOVERNMENT DEPARTMENTS

Scientific, technical, and related information is generated by government departments and agencies as a result of two distinct types of activity. Research and development organizations are maintained by some departments and agencies, and indeed in certain instances this type of work is the sole raison d'être of the organizations, e.g. National Research Council, Defence Research Board, and Atomic Energy of Canada Limited. Other departments and agencies, such as the Dominion Bureau of Statistics, have major responsibilities for the compilation of data and its presentation in some comprehensive form, or for some form of registry activity, e.g. the Patent and Copyright Office. Many of the research-oriented departments also find it necessary to operate extensive data-gathering services, e.g. Canadian Oceanographic Data Centre. The information generated by these organizations is disseminated to the public of Canada in two ways: through the submission of papers to the scientific journals of the various domestic and foreign professional societies, and through the publication of documents by the individual departments and agencies.

IV.1 Generation: Research and Development Activities

Federal government policies have resulted in the establishment of many different research and development organizations in government departments and agencies which undertake work for the general benefit of the people of Canada in fields where private initiative has been lacking or is inappropriate. The oldest and largest research establishments are associated with those departments concerned with assessing, preserving, or utilizing the natural resources of the country, as is the case with the Department of Energy, Mines and Resources, the Department of Agriculture, and the Department of Forestry and Rural Development. The pursuit of science as an end in itself was fostered in Canada by the formation of the National Research Council, and the work of the Council, both in its own laboratories and through its support of research in universities, has provided Canada with the essential scientific base in terms of facilities and manpower for the creation, appreciation, and utilization of scientific and technical knowledge. Finally, organizations concerned with technology based on scientific discovery have been created, such as Atomic Energy of Canada Limited, the National Aeronautical Establishment, and the Defence Research Board.

All these research organizations are supported by federal government funds and generate a substantial amount of new knowledge. Most of this is directly related to the furtherance of particular research programs and is not immediately applicable to endeavours in the private sector of the economy. Much of the information, however, does have eventual application in business, industry, and commerce and should be made readily accessible for exploitation by these sectors of the economy.

Federal government expenditure on scientific activities, which includes research and development, data collection, provision of scientific information and various research grants to industry and universities, was $463 million in 1966-67 and is increasing by approximately $60 million per annum. The figures shown below were obtained from DBS statistics.[7]

Year	Current Expenditure	Capital Expenditure	Total Expenditure
	$	$	$
1963-64.	262 401 000	37 345 000	299 746 000
1964-65.	283 586 000	50 268 000	333 854 000
1965-66.	346 413 000	54 953 000	401 366 000
1966-67.	402 430 000	60 448 000	462 878 000

Obviously, large sums of public money are being spent on scientific activities and a serious effort should be made to ensure that the public reaps the benefit of this expenditure. Approximately 4 per cent of the total funds shown above are employed in the operation of STI services. Since the results of research done in other parts of the world can be made available to Canadians for only a fraction of the cost of actually doing the research, Canada should spend a substantial part of its scientific budget on activities that facilitate transfer of the results of world-wide research and development to Canadian scientists, technologists, and engineers for exploitation.

IV.2 Generation: Registration and Compilation Activities

Growth of the economy results in the accumulation of large quantities of statistical information. The principal government agency responsible for the collection of data relevant to the different aspects of the country's development is the Dominion Bureau of Statistics. Data more immediately recognizable as having a scientific content are accumulated by the Department of Energy, Mines and Resources and issued to the public in the form of maps and charts. Some indication of the extent of this latter effort can be seen from the number of maps now available from the Map Distribution Office and the Chart Distribution Office of the Department (Appendix A).

Whereas the above organizations accumulate data and collate and transfer it into a form having new meaning or giving a fresh insight into the overall situation existing in a given field, the Patent and Copyright Office is concerned with checking the originality of inventions claimed by domestic and foreign inventors and granting patent rights for appropriate new inventions. The basic purpose of the patent law is to encourage inventors to disclose to the public the content of new inventions so that they may serve as a spur to further invention, and to encourage the utilization of new concepts.

IV.3 Publication: Papers Contributed to Scientific Journals

Scientific or technical articles submitted to journals for publication form the principal means of reporting the results of research and development originating in many government departments and agencies. Most contributed papers arise as a result of the desire of the professional staff to see their work published, although additional contributions result from an administrative decision that work on a certain subject should be publicly recorded.

The processing of a contributed paper before submission to a journal differs from one department to another. Since the needs of individual departments differ, there must be some flexibility in procedures for editing, reviewing, and submitting papers. However, all papers should be of the highest quality and submitted with descriptive titles, informative abstracts, and effective keywords (Section IV.5).

IV.4 Publication: Government Documents

IV.4.1 Scientific Journals

Some departments publish scientific journals which have achieved international recognition (Appendix H). In general, the articles in these journals record in some detail the results of scientific enquiry and are a source of knowledge that will be referred to for many years. As such, they are worthy of preservation by the recipients, whether individuals or organizations. Storage of these items would be facilitated if they were also made available in microform, e.g. microfiche, and the use of such microform would be simplified if separate full-size printed indexes were provided. Individual recipients of such journals might prefer to receive only copies of specific papers relevant to their immediate needs plus perhaps a microfiche copy of the whole journal and the printed index. The introduction of such services for scientific journals issued by government departments should be investigated by the respective agencies.

IV.4.2 Technical Magazines

Technical magazines are defined here as those publications which contain general information and timely articles on scientific and technical subjects. Those published by federal government departments are listed, along with scientific journals, in Appendix H. They are useful means of publicizing work being done in Canada and, since they are often comprehensible to people who are not specialists in the field concerned, could serve as a means of propagating knowledge between scientific and technical disciplines. These magazines should be offered for sale by the Queen's Printer Bookstores, partly to offset the cost of producing them but, more importantly, to extend their readership to interested members of the public.

IV.4.3 Technical Reports

Most government departments and agencies produce technical reports, but the proportion of information that is channelled into this format varies widely. It is greatly affected by the availability of means of printing and distribution, also by the need to produce documents of limited interest or with a restricted distribution. Nevertheless it is preferable that, whenever possible, material be published in the open literature rather than in the form of reports, since the information will then be subjected to more critical review and be more widely distributed, thus promoting its utilization in other sectors of the economy.

In the Defence Research Board and in Atomic Energy of Canada Limited, reports form one of the main vehicles of communication. In the former, many of the reports are classified for security, while in the latter about three quarters of the report output, though not classified for security, has some limitation on the distribution. In the Department of Energy, Mines and Resources, reports form an important medium of communication, particularly in the Mineral Resources Division, the Geological Survey of Canada, and in the Mines Branch. The Dominion Bureau of Statistics issues several hundred publications of various types ranging in size from one-page publications to the Canada Year Book containing over 1 000 pages. Some of the divisions of the National Research Council also produce technical reports, frequently as a regular series.

While many reports are made generally available, there is a large number for which the distribution is deliberately restricted because the information is classified under security regulations, or it has a commercial value and must be protected for the benefit of the owner, or it deals with matters which have political significance. The Royal Commission on Government Organization pointed out that:[2]

> "Even where the objective is to facilitate or improve Government operations . . . results are likely to be of wider interest. A project undertaken for defence purposes, for example, may establish a principle or technique that can be applied to improve a manufacturing process serving civilian needs."

Restrictions on distribution hamper the free exchange of technical information and should be removed when possible.

There is, however, a feature of certain reports that contain commercially valuable information which must not be overlooked. These reports are usually distributed to Canadian companies that can make use of the information. Since the restrictive marking prevents distribution to other countries, it provides for an exchange of information between the Canadian Government and its contractors which gives the latter a commercial advantage over foreign competitors. The value of such a restricted distribution is often short-lived and it may be replaced by patent protection in some cases. The restriction should be removed when it has served its purpose.

The markings that indicate the restriction on distribution are fairly well understood when they are a security classification, but for the other types of restriction various terms are used by different departments, and a given term is not always interpreted in the same way. Examples of such markings are "Commercial Confidential", "Limited", "Official Use Only", "Confidential", "Not For Publication". Uniformity of definition and usage of restrictive markings would enable them to be better understood and more surely observed.

Progress reports are usually issued at regular time intervals to give an account of work performed by an individual, a group, or an organization. Some of them contain little, if any, useful information, whereas others may contain the only record of significant new work. When progress reports contain information on a variety of subjects they pose particular problems in the retrieval of information. The title is usually of the form "Progress Report of the . . . Division, January to

March 1966", and provides no useful keywords for retrieval. Each progress report should have an informative abstract which mentions all the subjects that are discussed therein. For retrieval by a keyword system, it would be necessary to select a set of keywords for each subject area. With reports that touch on many subjects, however, it may be preferable to arrange for the separate publication of information on the individual subjects.

All government departments and agencies organize conferences and they also contribute to such functions organized by others. Conference proceedings are frequently slow to reach publication, and often omit an account of the discussions following the presentation of the papers. Such discussion, when properly organized, may very well be as valuable as the papers and will most likely be lost unless recorded in some way at the time.

IV.4.4 Pamphlets

The generation of pamphlets is usually carried out by information staff specially assigned to the task. The pamphlet is the main vehicle of communication published by the Information Division of the Department of Agriculture. It is directed mainly to extension workers, farmers, food processors, and distributors who, although they are specialists in the use of the particular information, are non-specialists in terms of the theoretical basis of the information. The Departments of Energy, Mines and Resources; Fisheries; Forestry and Rural Development; and National Health and Welfare also publish substantial numbers of pamphlets directed to various segments of the general public.

IV.4.5 Books

Most government agencies publish books occasionally when the volume of material is sufficient and of a suitable nature. They are an important but small part of the information generated by the Government, and no evidence was found to suggest that more such publications are necessary. However, government agencies could provide the initiative for the publication of books dealing with certain aspects of science or technology that are peculiar to the Canadian scene. A good case in point is the plan of the Division of Building Research of the National Research Council to produce a series of technical books–Canadian Building Series–in co-operation with the University of Toronto Press.

IV.4.6 Patents

Patents for inventions are granted as the result of applications made under the Patents Act, which also calls for the publication of a specification of each invention. The specification, which must be sufficiently detailed that anyone "skilled in the art" may reproduce the invention, consists of: (*a*) disclosure, (*b*) claims, and (*c*) drawings, where applicable, and is identified by a serial number. Brief descriptions of patents that have been granted are published weekly in the *Canadian Patent Office Record* with alphabetical indexes of inventors and of patent titles. Thus, reference material is provided for anyone seeking a particular patent or invention, although lengthy searches through weekly indexes may often be required because of inadequate subject classification and cumulative indexing. It is not envisaged that present methods of titling and classification should be changed; they are presumably needed for the operation of the patenting procedure. Additional indexing is required to facilitate the efficient retrieval of information.

Since the Patent Act and other acts administered by the Commissioner of Patents are designed not only to encourage inventors to develop patents but also to promote the use of new technologies and developments in Canada, it is extremely important that information on patents be widely available much sooner that at present. Changes in the Canadian Patent Act designed to reduce the processing time, as recommended in the Report of the Royal Commission on Patents, Copyright and Industrial Designs,[9] should be implemented as soon as possible. Existing operations of the Patent and Copyright Office do not sufficiently promote the announcement and exploitation of new inventions. Thus, less than 1 000 copies of the Canadian Patent Office Record are distributed and the contents are not phrased in language that encourages perusal by other than patent attorneys.

IV.4.7 Statistics

The Dominion Bureau of Statistics is charged by statute:

> "... to collaborate with all other departments of the Government in the collection, compilation and publication of statistical records of administration according to any regulations;"

Many agencies, including both federal and provincial government departments, depend on these statistics for the planning of their scientific and technical programs. While these agencies are satisfied with the general format of the figures available, they point to delays of two years or more in their compilation. It was almost unanimously indicated that the value of the data would be immeasurably enhanced if it were made available more expeditiously and if reasonably accurate estimates were offered when final figures were not available. According to representatives of industry and provincial governments across Canada, there is a need for finer subdivision of data, both geographically and by subject. Confidentiality of data must be maintained and there are critical difficulties inherent in making figures available on such bases, but further consideration must be given to this point.

Although the bureau has regional offices, several comments indicated that there was a need for closer liaison between DBS and provincial authorities or university groups. It was suggested that if the bureau had more people in the field it would greatly facilitate the flow of information both into the bureau and out from it. A few comments were received that there was often need for more detailed explanation of the DBS data, and an ability to consult with regional representatives would promote better use of DBS information.

IV.4.8 Maps

Most of the official maps of Canada are generated by the Department of Energy, Mines and Resources, and nearly all other maps of Canada are based on their productions. The Department of National Defence also generates a large number of maps, primarily for its own use. Maps are useful to the general public and are of great value to specialist groups in such fields as mining, geology, and aeronautics. However, information on the availability of maps and on convenient outlets is not readily available.

IV.4.9 Films

The National Film Board, under authority of the National Film Act, is charged with responsibility for producing or authorizing the production of films for federal government departments and agencies. The National Film Board's primary role is the production of documentary films. Since these are often more elaborate than is required by a government department, many of these departments make their own scientific and technical films for internal use only. This is a practical arrangement which should be formalized.

The National Science Film Library was established by the National Research Council of Canada and the Canadian Film Institute as a service to the Canadian scientific, technical, and educational communities. A survey recently conducted by the National Science Film Library has indicated that about 200 scientists in Canada have made films on a variety of subjects and of varying degrees of sophistication. Information on these films and on those produced by some government departments in not generally available at the present time.

IV.4.10 Publications Needed

The principal activities of government departments and agencies are described in their annual reports and summarized in the *Canada Year Book.* The subgroup found, however, that the information services provided by various information groups within government departments and agencies are not sufficiently publicized. There is no comprehensive guide to information services provided by all departments, though individual departments issue pamphlets describing their own facilities. The Department of Agriculture publishes a *Guide to Federal Agricultural Services,* which lists in a handy form the sources of various types of information available within that department. Similarly, *The Division of Building Research–What It Is, What It Does* describes the information service provided by the Division of Building Research of the National Research Council. It would assist the scientific and technical public of Canada if each government department or agency were to issue annually, preferably in a common format, an appropriate description of their information services, which could be cumulated into a comprehensive guide with suitable indexes.

While the research and development work that has been completed is generally well recorded in the appropriate literature, there appear to be few agencies that publish comprehensive lists of projects or work in progress. The Department of Agriculture publishes annually a list of all agricultural research projects in both government and university laboratories in Canada. In other fields, from lack of knowledge of this kind, a section of one department may embark on a program of work without knowing that another department is doing work in a closely allied area. There are obvious advantages, in such a case, for the two groups to arrange a combined or co-operative program to eliminate duplication of effort. The first requisite for such co-operation is to enable all research and development groups to ascertain the present activities of all other groups. This could be done by compiling a register of projects broken down by subject area, with a detailed index. With the increased emphasis on the need to set priorities in research, such a register and an associated enquiry service would be of great value in the appraisal of research of various departments. Comments received from many provincial departments confirmed that an up-to-date register of all such operations going on in the various fields in Canada would be invaluable in planning their own work.

IV.5 Publication: Quality Considerations

Although government departments and agencies publish only a small proportion of the total information on a subject, it is desirable that they set a high standard of quality, particularly for reports and other documents which are not subject to external independent review. High quality can be maintained only by a system that provides for adequate reviewing of material before publication. However, such reviewing should not be carried to the extent that it causes significant delays in publication.

Many users of scientific and technical information have complained of the vast amount of literature available today and have pointed out that it is no longer possible to read all the material on a given subject—even a highly specialized subject. This is due in large measure to the exponential increase in the numbers of scientists and engineers generating information. It is aggravated, however, by the repetitive publication of the same material and the separate publication of fragments of an investigation. To assist in gaining better control over the proliferation of published material, it is most important that result of investigations are recorded only once and that reports of incomplete or inconclusive work are not permitted to clutter up the literature.

The present-day volume of recorded information has caused an extensive and rapidly increasing use of machine methods for facilitating the cataloguing, indexing, retrieving, and other processing of the published literature. Such methods provide a variety of ways for tracing publications. An effect of the use of these systems is to place a heavy reliance on titles and abstracts for retrieval purposes. It is important, therefore, that all published material be provided with titles and abstracts which truly describe the subject content. Further specification of the subject matter in terms of keywords or a classification code is also desirable. The author is the person who should be best able to do this, but he will often require guidance from an information retrieval specialist. As pointed out by Weinberg,[1] the individual author must accept more responsibility for subsequent retrieval of what is published. During the last year or so journals, such as the *Journal of Pharmaceutical Sciences* and the *Journal of the Textile Institute,* have begun assigning keywords to each of their articles. This is a trend that should be followed by the journals published by Canadian government departments and agencies.

IV.6 Printing Services

The Department of Public Printing and Stationery has been charged by statute with responsibility for conducting all printing of government publications. To facilitate some of the work, satellite groups have been established in some departments and, in certain cases, work may be contracted to commercial printers.

Nevertheless, many departments have found that there is too long a delay in making material available in printed form. Undoubtedly, much of this delay is caused by the higher priority which must be given to Parliamentary information and by the procedures which must be followed to have documents printed.

The value of much scientific information is often dependent on the speed with which it is made available. Furthermore, delays in publishing such information also have a discouraging effect on the originator. The Royal Commission on Government Organization recommended that:[8]

> "All Parliamentary papers . . . and all small orders (say under $1 000 for Ottawa delivery) continue to be printed with government facilities, without tender. . . "

but that:

> "All other work performed in the Printing Bureau be obtained by competitive tender, with the objective to 'break even' financially after taking account of all applicable costs".

This procedure would presumably permit departments to call for tenders competitive on timing, format, and cost for jobs of more than $1 000. With improved direction and control of departmental facilities, the bureau would still be in a favourable position to handle the greater part of the demand, but such a procedure would permit better service to departments on jobs that it could not handle in the required time.

Recent advances in technology have made available several supplements to printing as a means of publication, such as microforms and magnetic tape. In future, departments should consider the use of these in meeting their requirements for primary publishing.

IV.7 Unrecorded Information

By far the largest part of this chapter is concerned with the production and transfer of recorded information. However, it should be pointed out that many scientists and research personnel keep up-to-date in their fields primarily through close personal contact with each other. This is relatively easy in a specialized area where individual workers are well known to each other. In such circumstances information can be readily transferred informally by mail, by telephone, or by discussion if the workers have an opportunity to meet.

Menzel[10] pointed out very clearly that in spite of the current emphasis on mechanization in the handling of recorded information there is still a great deal of dependence on the part of scientists on informal contacts and unplanned events. He indicated that such contacts, which will continue to play an important role in the future, have several important advantages. Abelson[11] has termed this the "human network" and has pointed out that the effectiveness of such a network depends primarily on the attitude of custodians of the knowledge. They must co-operate closely if the system is to function effectively and be maintained. Particular problems arise when information in another field is needed. The personal contacts are not as close and a search may be necessary to locate the source of particular information.

Most government departments and agencies make quite extensive use of informal information transfer. Most research groups in the federal service sponsor a series of visiting lectureships to which outstanding specialists are invited to speak and then to spend a day or so in more detailed discussions with staff. Such meetings are usually open to interested members of other departments. A number of government scientists lecture on a regular or occasional basis to university staff or student groups. Some departments hold seminars which are of special interest to industrial groups with which they may be associated. One of the problems encountered in provincial government departments and in industries that depend closely on results of federal investigators was that published data required such a long time to be made available. The promotion of more informal discussions between federal and provincial departments on specific topics would do much to alleviate this problem.

IV.8 Provision of Information to Public Service Employees

The principal source of information for public servants is the departmental or branch library, which was created to serve the information needs of each individual in the respective organization but which probably has more prospective users than actual clientele in the department. Most libraries circulate journals to members of the department, but little attempt seems to be made to foster greater use of libraries or to promote more active involvement of departmental staff in the growth and efficiency of them.

The major libraries in the federal service are very good and the minor ones are very poor–hardly deserving the title "library" and not employing librarians. The existing multiplicity of libraries in the Federal Government is not undesirable, especially since government departments are scattered throughout so many buildings. The view was expressed that it is desirable for each building containing public servants to have a library or library service point through which the occupants of the building can gain access to the whole of the library holdings of the Federal Government. A large department may well require a number of library collections in different areas and associated with different groups of users, but integration of these separate groups is necessary for efficient and economic operation and it is not sufficient to depend on informal contacts between the staff operating these libraries. The need for the integration of services has now been recognized in several departments and detailed assessments of the problems have been, or are being, made.

Major needs in the federal library service include a referral centre which can respond rapidly to requests for sources of information, and specialized information centres or libraries serving specific areas, e.g. water pollution, information science. At present individual libraries are incapable of dealing adequately with requests for information when expressed in general terms and, although the National Science Library responds in a most positive manner to such requests, the user often needs to enter into a dialogue with a person knowledgeable on the subject. This means, at present, locating a specialist on the subject somewhere in the government service and requesting his assistance. Such requests are an undesirable interruption for the specialist and the information service should be able to cope with such requests from its own resources. To some extent, this capability is being developed within the government service but once again it is on an unco-ordinated basis with each department attending to its own needs without reference to the needs or experience of others.

IV.9 Provision of Information to the Public

Both federal and provincial government departments have established information service groups for the purpose of providing the public with information in a particular field. A directory of the information services provided by federal government departments is contained in the *Canada Year Book* and a list of the service is given in Appendix E.

Most pamphlets prepared by individual government departments are distributed by the department—usually free of charge. Publications of a more substantial nature are distributed by the Queen's Printer Bookstores situated in Halifax, Montréal, Ottawa, Toronto, Winnipeg, and Vancouver. If the Federal Government is to discharge its responsibility of making government information readily available to the people of Canada, it must operate bookstores in most of the principal cities of Canada.

Two types of publication which warrant better distribution facilities than presently employed are patents and maps. In addition to providing copies of Canadian patents, it has been suggested that the Patent and Copyright Office should also have available copies of foreign patents in Canada. This would be a most useful service since it is not easy for the average business firm to obtain such items, certainly not with the speed which is desirable. There is precedent for the Patent Office providing such a service since the Queen's Printer has assumed the responsibility for distributing official publications of many international organizations, e.g. UNESCO, and some foreign governments. It is suggested that the Queen's Printer Bookstores might also distribute patents—at least Canadian patents—and maps. With the addition of these two items, these bookstores would then be a source of supply of all material produced by government departments. Publications of government agencies, notably the National Research Council and Atomic Energy of Canada Limited, should also be made available through the Queen's Printer Bookstores. These organizations publish many technical reports which should receive greater publicity and wider circulation. The Queen's Printer should provide the same type of service with respect to technical reports as the Clearinghouse for Federal Scientific and Technical Information in the United States. In fact, it would be a most useful service if the Queen's Printer were to assume the responsibility for providing United States technical reports in Canada. Although it is suggested that all government publications should be available from the Queen's Printer, this does not mean that existing procedures for distribution should be abandoned. However, an expanded system of Queen's Printer Bookstores should provide a one-stop shopping place for all government publications.

Section V

MECHANISMS FOR INFORMATION TRANSFER

Preceding sections of this report have described the way in which government departments and agencies deal with their own information needs and those of the public. Further description by department is given in Appendices A and I. In addition to maintaining one or more libraries, some of these departments and agencies carry out more specialized activities to facilitate further the utilization of available information. Description and comment on these are included here since it is felt that they represent the foundations upon which a comprehensive system to cope with the constantly expanding volume of literature should be based. The description has been arranged to reflect the problems faced by anyone who attempts to keep up-to-date with new developments and also desires to have access to recorded information from various national and foreign sources.

V.1 Current Awareness Services

The explosive growth of scientific and technological endeavour that began during World War II has had several effects on abstracting services. Firstly, many new abstract journals have been created and more are being started each year. Secondly, the number of abstracts included annually in a journal has grown steadily to the point that the sheer volume of abstracts prevents their perusal for purposes of current awareness, and the rising cost is tending to preclude purchase of the journal by the individual scientist. As a result of these developments, abstract journals are to be found more and more in libraries rather than in the personal collections of scientists. There is a tendency to use them only for retrospective searching of the literature and not for current awareness.

V.1.1 Production of Abstracts in Canada

Many scientists working for the Federal Government participate in abstracting activities. Atomic Energy of Canada Limited has assumed responsibility for reviewing all likely sources of nuclear information published in Canada (journals, patents, reports) and provides descriptive cataloguing and abstracts to the publishers of *Nuclear Science Abstracts.* In the Division of Building Research of the National Research Council, research officers prepare abstracts of articles dealing with building research that appear in Canadian journals. These abstracts are published quarterly in the division's *Canadian Building Abstracts,* which is exchanged for national abstract bulletins prepared by the other members of the international building research community through the *Conseil international du bâtiment pour la recherche, l'étude et la documentation* (CIB). Two other abstract journals produced in Canada are *Forest Fire Control Abstracts,* published by the Department of Forestry and Rural Development, and *Food Abstracts,* published by the New Brunswick Research and Productivity Council. Both these publications contain material drawn from world literature rather than merely Canadian sources.

Abstracts and descriptive cataloguing for all significant material published in Canada should be prepared in Canada according to agreed standards. This may require that some national body be assigned the responsibility for co-ordinating abstracting activities. Financial support may be needed by those organizations that have the expertise but not the funds to carry out this work.

V.1.2 International Publication of Abstracts

As Canadian literature constitutes less than 3 per cent of the total world information, there is little virtue in having abstracts of Canadian literature appear in an exclusively Canadian publication. Foreign literature, particularly that from the United States and the United Kingdom, is a major source of information. Consequently, abstracts of Canadian literature should be incorporated in appropriate international abstract journals.

Under the prompting of the U.S. Atomic Energy Commission, which currently bears the cost of compiling and publishing *Nuclear Science Abstracts,* the international community involved with nuclear science is moving toward the concept of a national responsibility for contributing abstracts of domestic literature to an international abstract service. The International Atomic Energy Agency in Vienna has been called upon to form an International Nuclear Information System (INIS) modelled on a computer-based index developed by the EURATOM organization in Brussels. Eventually this would require each country to scan its own literature, identify items that relate to the nuclear field, and submit abstracts, cataloguing information, and indexing terms. These would be submitted on magnetic tape and the organization in Vienna would merge the tapes and make a complete file available to each participant. It is a logical and desirable step to expand this type of activity to include all major scientific and technical fields.

As Canada develops a more comprehensive information service, it must be closely associated with international operations. There is probably no better way to ensure the supply of information from foreign sources than by taking a lead in promoting the acceptance of the principle of national responsibility for abstracting and indexing domestic literature in all major fields of science and technology.

Another aspect where international co-operation is needed concerns the coverage of abstract journals. Existing abstract journals deal with many subjects. Some are concerned with a very restricted field, such as *Vitamin Abstracts*, while others embrace all aspects of a scientific or technical field, e.g. *Chemical Abstracts.* Also, in many instances there is considerable duplication of coverage, e.g. *Textile Abstracts* and *Textile Technology Digest.* It is highly desirable that unnecessary duplication of abstracting be eliminated and that there be one, and only one, generation of the abstract which may appear in appropriate abstracting and indexing journals. There should be an abstracting service for each area of interest and abstracts which overlap interest may appear in more than one journal.

It may also be desirable that abstract journals become more specialized and less all-embracing. It is a reasonable task to search manually an index covering 10 000 abstracts per annum, but it is unreasonable and unduly laborious to carry out a similar search of an annual index covering 250 000 items per annum. More frequent issue of abstract journals of restricted scope may well still be the best answer to the present concern with current awareness services and the selective dissemination of information—at least until much more sophisticated electronic abstracting, searching, and communication facilities are developed.

V.1.3 Mechanized Abstract Systems

The cost of preparing abstract journals is steadily rising owing to the increasing number of abstracts involved. Acceptance of a national responsibility for the preparation of abstracts of domestic literature would help to keep down the cost of abstract journals. However, as the number of abstracts grows, systems employing computers will require sophisticated methods of extracting information from magnetic tapes and other media for exchange of information. This will be beyond the financial ability and technical competence of most of the establishments which should use the abstracts. Representations from industry and universities have emphasized that there is an urgent need for a national body to formulate plans whereby such services are readily available to all Canadian users.

V.1.4 Current Awareness by Titles of Articles

The inadequacies of abstract journals as a means of bringing new developments quickly to the attention of scientists and engineers have resulted in the introduction of new publications that list only the titles and authors of papers plus the relevant bibliographic details. *Chemical Titles* lists in this brief form the items that will appear later in *Chemical Abstracts.* The *Current Contents* series of publications issued by the Institute for Scientific Information, Philadelphia, consists of reproductions of the table of contents pages from selected periodicals. Many government libraries subscribe to *Current Contents,* but some departmental libraries reproduce the table of contents pages of journals received and circulate them to the professional staff in lieu of the actual journal or of a publication such as *Current Contents.*

The principal drawback to these services is that the reader must examine a large amount of irrelevant material during a search for items pertinent to his present interests. To overcome this problem, systems for selective dissemination of information (SDI) have been developed. In essence, an SDI operation:

(1) Defines the subject area of each item of information systematically; by keywords, subject code, etc.

(2) Defines the subjects of interest to each user (recipient of the service) according to the same system as used for (1), thus generating an "interest profile" for each user. Note that a "user" may be an individual or a group having common interests.

(3) For each item of information, compares the subject definition with all of the interest profiles and distributes the item only to those users whose profile includes the subject of the item.

The items of information in the system may be titles or abstracts or complete documents and, besides defining them strictly by subject, account may be taken of authors, place of publication, etc. The matching can be done manually but, in view of the volume of information handled, is preferably done by a computer. A simple version of the system defines the subject area of an item by taking each non-trivial word in the title. Interest profiles are drawn up by listing all the words or word-combinations which, if they occurred in a title, would indicate interest for the user. An SDI system of this type is offered by Chemical Abstracts Service, based on *Chemical Titles.* The National Science Library is presently evaluating this service in co-operation with chemists of the National Research Council, and consideration is being given to the possibility of extending the service to chemists outside the National Research Council. There is no doubt that with the increasing volume of information becoming available, it will be impossible in the very near future for scientists and engineers to maintain an awareness of new developments in their field without SDI systems.

V.2 Document Retrieval

V.2.1 Identifying Documents

The first stage in attempting to obtain information on a given subject is to identify documents containing relevant material. After examining the library catalogue the user of the average library has exhausted the immediate facilities for identifying books relevant to his information needs. If he is in no hurry his librarian can make a request to the National Science Library for a bibliography of the subject to be prepared by the staff of NSL, using the book holdings and the many bibliographies and reviews available. This service is not promoted by departmental librarians and if it were used extensively the facilities of the NSL would be overloaded. There is a real need for each library within a given area to form part of an integrated system and to have immediate access to an index or union catalogue of the complete holdings of the system utilizing modern technology, i.e. on-line to a time-sharing computer or closed-circuit TV with remote controlled scanning of the union catalogue. In the absence of such a system, the average library user has no means of quickly satisfying his need to identify relevant books.

Most journals are provided with annual indexes to their contents so that it is possible to search the contents of each separate journal for the information required. Many Canadian technical magazines, however, do not produce indexes and this prevents their usage for retrospective searching. This is a serious omission and significantly reduces the value of the journals. Certain commercial publishers produce combined indexes to many journals, e.g. *Applied Science and Technology Index, British Technology Index,* but none of these has very comprehensive coverage of Canadian journals. The Toronto Public Library produced the *Canadian Business and Technical Index* covering Canadian technical journals for several years but had to discontinue it owing to inadequate sales. Many abstract journals also provide detailed indexes to their contents. Indexes to abstract journals are particularly valuable to the specialist because they provide access to world literature in a fairly narrowly defined subject area.

No co-ordinated effort has been made to see that the journal, patent, and report literature is effectively indexed. Canada should take steps to put its own house in order with regard to indexing of the scientific and technical literature, and should then encourage other nations to do so, in much the same way that abstracting of articles needs to be rationalized and made more effective. Library users need access to indexes to world literature if they are to retrieve existing information in an effective manner. This can be accomplished by ensuring that each library holds copies of the appropriate indexes, possibly to the exclusion of holding any significant number of original documents which would be obtained on loan from other libraries, or by the establishment of special "reference centres" relating to specific subject areas.

A good example of a reference centre in the federal government service is the International Tree Disease Register (INTREDIS) (Appendix A). By applying to INTREDIS, a scientist can very quickly obtain a list of references to articles that deal with any particular aspect of forest pathology. The scientist is relieved of a time-consuming task and benefits from a more comprehensive search than he would probably have had time to undertake himself.

There are many fields of science and technology where similar specialized literature-scanning services could prove of immense value. They would rapidly identify previous work that has been carried out on a problem, and allow the scientist or engineer to spend his time more productively. One area that is in particular need of examination in this regard is the field of patents. Industry has pointed to the need for information on patents to be more readily available. Pilot projects have been carried out in West Germany and the United States, and the applicability of these to Canadian conditions should be investigated.

V.2.2 Locating Documents

The immediate result of a literature search based on abstract journals and indexes is a list of references. Assuming that the searcher has access to a library, he will probably find some of these journals in that library, but others must be obtained elsewhere. With the co-operation of approximately 200 public, university, and federal libraries, the National Science Library has compiled a list of their scientific and technical journal holdings on a computer and has recently issued a second edition of the *Union List of Scientific Serials* in two volumes. Such computer storage will allow very versatile manipulation of the information cheaply and rapidly. Thus, it is possible to list the holdings of an individual library or groups of libraries. It is also possible to produce lists by subject matter which indicate where journals in a particular field are held. Analysis of such lists should enable the National Science Library to bring together incomplete holdings of serials and suggest how individual libraries might amend their collections to provide a more suitable coverage in their geographical area.

The *Union List of Scientific Serials* is a major contribution to efficient information retrieval in Canada. This list should be kept up-to-date by the immediate input of new data concerning additions and deletions to individual library collections.

Some Canadian libraries have installed teletype equipment which should facilitate the rapid transfer between libraries of new information concerning library holdings. The next step should be on-line access to the computer store so that distant libraries can immediately consult the up-to-date union list maintained in the computer. It should be pointed out that, for maximum benefit to be derived from such a union list of serials, it is important that all significant library collections of journals be included and that any person seeking a specific journal should be able to acquire it quickly from the nearest source.

It is also important to be able to locate copies of books. This can be done through the union catalogue of books held by Canadian libraries, which is maintained by the National Library with the co-operation of libraries across Canada. It is similarly vital that this catalogue be completely up-to-date, and that rapid and complete attention be given to requests for information concerning the location of books. Greater use should be made of telephone and teletype* facilities to make and answer requests for such information. From the list of libraries* providing information on book holdings to the union catalogue as published in the annual report of the National Librarian, it is apparent that there are many libraries in Canada that do not participate. This is regrettable, for it means that the available library resources of the country are not capable of being exploited to the maximum extent. All significant library collections of books should be included in the union catalogue and arrangements made whereby the books can be made available to those who wish to use them. This requires firm agreements between libraries and may require legislation for implementation.

V.2.3 Obtaining Documents

The semi-formal arrangement presently existing in Canada for the interlibrary loan of books and journals is discussed in Section V.8.1. Many comments have been received to the effect that it was not uncommon for several weeks to elapse between a library user requesting a book and the book actually being provided. Most scientists and engineers find such delays frustrating and often carry on their work without the benefit of pertinent literature because of the poor service. It is most desirable that loans be handled expeditiously. For purposes of the present discussion, it is sufficient to say that an informal interlibrary loan service operates in Canada but the degree of participation and speed of response by individual libraries are a matter of personal choice on the part of the head librarians. This leads to erratic service which may be aggravated by lack of staff or funds. The no-charge nature of the co-operation also lends itself to abuses, and all librarians active in the scheme are aware of libraries which are constantly borrowing books from other libraries because of lack of funds to stock their own library effectively. Such practices militate against the effective transfer of information and tend to hide from management the true cost of information services. A formal, efficient, and cost-conscious interlibrary loan service using all the refinements made possible by modern technology should be instituted in the federal government service as a

*Current figures: 56 libraries on teletype and 293 in Union Catalogue.

model upon which further services outside the federal jurisdiction can be patterned and with which they can eventually be integrated.

V.2.4 Photocopying and Copyright

The very rapid improvement in photocopying processes and equipment during the past 15 years has resulted in the widespread use of such methods for making copies of library materials. This a logical extension of library reference services and has become a very beneficial factor in the dissemination of scientific and technical information (Section V.8.1). Much of the photocopying carried out in libraries consists of copying of complete articles or papers from the pages of journals and technical periodicals, without reference to the owner of the copyright. Whether this practice is legal and whether it is fair to copyright owners are questions that have been the subject of concern to both publishers and librarians for some years.[12] The Copyright Act[13] states that the following is not an infringement of copyright:

> "Any fair dealing with any work for the purpose of private study, research, criticism, review, or newspaper summary".

The usual interpretation of "fair dealing" applied by Canadian government libraries is based on the Royal Society's "Fair Copying Declaration".[14] This declaration, in brief, regards as fair dealing the production by a library of a single copy of part of a scientific or technical periodical for an individual who affirms that the copy is required solely for the purpose of private study, research, criticism, or review, and when the individual has taken all reasonable steps to secure the original from the author or publisher. With this declaration as a basis, the photocopying service of the National Science Library declines to copy material published within the past year in North America, which is normally available from the publisher, and requires a signed declaration from the requester regarding the use to which the copy will be put. Other government libraries follow a similar procedure.

Although it has been assumed that the practice of providing single copies of extracts comes within the concept of fair dealing, the extent to which copying is practised today throws doubt on this assumption. An extensive survey of the whole question was made recently in the United States (where the situation is very similar to that in Canada) by the *Ad Hoc* Committee to Investigate Copyright Problems, supported by a grant from the U.S. Office of Education. In their final report[15] they estimated that during the year 1967 the professional copyrighted material reproduced on a single-copy basis by libraries in the United States exceeded one billion pages. Hence, although limited use of the single-copy principle would not affect a copyright owner, the cumulative effect of single-copy reproduction by many libraries is significant.

The interests of the users and the producers of information are in opposition to the extent that users find photocopying an increasingly valuable tool in the provision of information, whereas copyright owners are naturally disturbed by the wide use of their publications without benefit to themselves. The development of information and library services will aggravate the position and no mutually acceptable solution has so far been proposed. It is desirable that the growing problem be made the subject of comprehensive investigation and discussion, with the object of finding a workable system that will satisfy both sides, and the preparation of suitably amended copyright legislation to give effect to the findings.

V.3 Translation Activities

The National Science Library has a Translation Section which prepares translations of foreign-language articles into English or French for NRC scientists. A similar service is provided to other government departments by the Translation Bureau of the Secretary of State, while some departments have made their own arrangements with private individuals for translation work to be carried out. The National Science Library should extend its activities in this field by co-ordinating the translation services for scientific and technical materials within the government service and by making arrangements whereby any government scientist can have ready access to translation facilities. It should also consider the creation of a national list of translators so that users throughout Canada can have ready access to translation services. This list should state both the language and scientific subject capabilities of each translator.

The National Science Library maintains the *Canadian Index of Scientific Translations*. This index records the location of more than 200 000 English translations of foreign scientific papers prepared in Canada and other English-speaking countries. Many of the translations are on file in the National Science Library, while the rest can be readily obtained by the library. All libraries should be encouraged to check with the Canadian Index before undertaking any translation work, and to deposit a copy of any translations with the Canadian Index. The National Science Library should be encouraged to establish a similar index of translations into French.

There has been an increasing interest in the translation of foreign publications (particularly Russian) into English throughout the English-speaking world. The National Science Library prepares a complete translation of *Problemy Severa* (Problems of the North) and should be encouraged to translate other journals which deal with subjects of particular interest to the Canadian economy, especially those in Russian, Chinese, and Japanese.

V.4 Information Retrieval Centres

A library may or may not carry out some of the functions of an information retrieval centre. The National Science Library is an excellent example of a library that carries out considerable indexing of its material and employs subject specialists as well as librarians. However, information centres are developing which have more specialized functions. These centres rapidly identify and retrieve literature and data for scientific and technical workers. Where frequent reference is made to documents, the centres offer an effective means of reducing the labour expended by users when seeking information. They are of particular value and importance in certain types of work, e.g. technical decisions relating to legislation where it is important that previous decisions or other pertinent information be made available quickly. Some of these centres in the Federal Government which may retrieve publications or data are described in Appendix F.

V.5 Information Analysis Centres

Information is of no value unless it is used. Consequently, not only must information be brought to the attention of the potential user but, to be exploitable, it must be in the area of interest and at a level of sophistication that the user finds acceptable or understandable. A logical extension of the service provided by information retrieval centres is the analysis and evaluation by experts of the items that are retrieved in answer to a particular problem. This further service is the basis of the concept of an information analysis centre, as developed by Weinberg.[1] The information analysis centre is thus distinguished from the information retrieval centre in that its staff includes well-qualified scientists who are experts in the special subject field. They are capable of carrying out the necessary analysis and evaluation to extract from the files a distillation of knowledge which represents the truly valuable information on the subject while excluding that which is unimportant or irrelevant. Because they are operated in conjunction with institutions where subject specialists are present, the information retrieval centres described in Section V.4 often operate as information analysis centres. The centre operated by the Food and Drug Directorate, for example, is backed up by the research scientists of the directorate who may, on request, evaluate and analyze the material selected by the information retrieval centre. However, this is not a continuous survey of the information as envisaged in the Weinberg concept. To our knowledge, there are no information analysis centres (as defined) operating within Canadian Government service at the present time.

A centre of the type described should operate as a world authority in its subject field, and it is undesirable that such centres be duplicated. The attention of the subgroup has been drawn to the need for such information analysis centres in the fields of mining technology and materials specifications, and for a national drug and therapeutic information analysis centre. It has also been suggested that other centres be established for those fields of scientific and technical endeavour that are important to Canada and in which Canada has some position of pre-eminence, i.e. pulp and paper technology, uranium production and refining, long-distance transmission of electrical energy, the aurora borealis, food production and processing, brewing, etc. Some of these subject areas are outside the immediate concern of any government department, and such information analysis centres would presumably be created by other agencies. However, others are very much the concern of specific departments, and serious consideration should be given by these departments to the establishment of appropriate information analysis centres that would serve either a national or an international need.

V.6 Consultative and Field Services

In the field of agriculture, the provinces have a staff of approximately 400 extension workers who are responsible for maintaining contact with farmers and satisfying the information needs of the farming community. These workers operate under the aegis of the appropriate provincial Departments of Agriculture which, in turn, depend to varying extents on the information resources of the Canada Department of Agriculture. For example, Ontario prepares practically all its own printed information for dissemination to farmers, whereas the Atlantic Provinces depend almost entirely on the federal department. On the other hand, the Health of Animals Branch of the Canada Department of Agriculture is responsible for the health of all animals in the country. Consequently, there are veterinarians of this branch in each county of the country from coast to coast who are, in effect, advisers to farmers on general matters of animal health.

Thus, the farmer concerned with vegetable and cereal crops and the farmer concerned with raising livestock each has an extension worker, or field man (provincial or federal), in his area who can be contacted in order to obtain advice on farming operations. This is not to say that every farmer is aware of and uses these services. However, since the size of individual farms and the technical complexity of farm operations are increasing, there will be a growing need for the effective dissemination of information concerning new and improved farming practices.

The Technical Information Service (TIS) was established in 1945 in the Department of Reconstruction and Supply, and transferred to the National Research Council in 1946 in order to have more direct access to the library and scientists of the Council. Its formation was based on the premise that there were many small companies in Canada at the end of World War II that did not know how to get information or were too busy to seek the latest STI with which to improve their processes and develop new products. Consequently, TIS supports approximately 34 field officers who visit small and medium-sized industrial companies, attempt to determine where there are problems or where the application of known information could improve productivity, and provide the necessary information to the company. Often the information has to be transferred to the responsible company employee through a conversation which involves conversion of the language of the written article to the everyday language of the plant floor. In such instances, personal contact is essential if the significant points in the information are to be thoroughly appreciated by the company management and adopted.

In eight of the provinces field services are provided by staff of the provincial research councils on behalf of TIS and as part of the provincial research councils' field services. In other provinces, the field officers respond directly to TIS in Ottawa. Wherever possible, requests for information are answered on the basis of the field officer's own experience and his immediate resources. If these are inadequate, the request is passed to TIS headquarters in Ottawa where resident specialists attempt to provide the necessary information from their own collective experience, from searching the literature, from other government departments or, in certain cases, from a company that has had experience with similar problems. TIS has been one of the pioneers in the field of industrial information service. It has established close working contacts with similar organizations in other countries and has served as a model for some of the newer services started by other nations.

Field services are a vital link in the chain of information transfer for the smaller manufacturing companies. The industrial man is far too busy with business problems to make a literature search. In many instances only the field services man has the familiarity with documentary and other sources of knowledge to be able to locate anything of value to the industrial worker.

The subgroup believes that for the field service function to operate most effectively it should be carried out by people who are familiar with and identify themselves with a specific industry. Indeed, they should be familiar with all the companies in the industry and the staff of those companies. A field service man must have visited the companies from which he receives requests for information and be able to understand a problem in the context of the company's operations and personalities involved. Unless the field service man has the appropriate technical stature in the industry he will not inspire confidence in his clientele, and thus his advice on a problem will not be sought. For these reasons, it is suggested that field services should be operated primarily on an industry basis (rather than on a regional basis as at present). There should be a major information centre for each industry, located geographically at the centre of the industry, from which the field service man would work. If the industry is widespread geographically, it might be feasible to operate several satellite information centres for that particular industry, but the responsibility for the management of the information services related to the industry should remain with the main centre.

Each company in the industry should be able to communicate with the information centre by using telephone or teletype for the same cost. Thus, some body—presumably the Federal Government—should subsidize the cost of these services. A company should not find itself at a disadvantage with respect to information service because it locates its operations away from the major industrial centres in Ontario and Québec. The principle of standard cost for transmitting messages is accepted in the case of letters; it should be extended to electronic means of communication.

Each major industrial information centre should be responsible for maintaining adequate information resources to satisfy the requirements of the technology practised by the industry. It should be the prime contact point with the nation-wide information services for anyone in that industry, irrespective of the problem. If the problem is not relevant to the resources of that information centre, then the most appropriate information centre would be immediately identified and the query passed on. Information centres should be supported by an annual fee from each participating company which would entitle the company to certain services. Extra services would be paid for at suitable rates. Thus, the amount paid to an information centre would largely depend on the amount of service requested. Industry-oriented information centres should be established with the encouragement of government funds, possibly with a subsidy for the first few years. However, the centres must become self-supporting; otherwise they are not providing a service that industry considers truly valuable. In the event that they do not become self-supporting, they should be carefully evaluated and not allowed to linger indefinitely, as is likely to happen under complete government subsidy. Making the information centres earn their own living will also make their management receptive to new ideas for better service and will provide a more aggressive management generally. These centres could usefully be operated as a partnership between trade publishing houses, professional and technical societies, and industry. The trade publications are already the basic current awareness vehicles used by much of industry and many of them operate a question-and-answer service. This should be developed considerably so that both the publisher and the field-service man have the backing of a first-class information service charged with serving an industry.

In those cases where there are insufficient companies to support an industry-oriented information centre, the needs of such companies should be provided for, as at present, by TIS. However, TIS should charge companies a nominal registration fee significantly less than that charged by an industry-oriented centre because of the less specialized nature of the services provided. This would require the renegotiation of agreements between NRC and the provincial research councils and the modification of the present subsidy arrangements. The provincial research councils may wish to continue to provide a free information service to industry, but any service required from TIS in support of this should be purchased and not provided free.

V.7 Library Operations

It was not the intent of this study to review in detail the operation of libraries in federal and provincial departments. The survey by Brown and Lamb[16] was designed primarily to evaluate the resources of federal government libraries in Ottawa and should furnish useful information in this regard. The recent report of *Resources of Canadian Academic and Research Libraries* by Downs[17] reviews in detail the operations of Canadian libraries with the exception of government libraries, but much of the discussion of library operations is applicable. A more recent review of Scientific Library Services [18] in Great Britain has made a number of recommendations.

V.7.1 Internal Library Operations

The Selection Function

In the past, government libraries have often left the responsibility for selection to a committee, but this is now recognized as an ineffective method which can waste much time of senior staff without producing any better results than selection by individuals. The preferred method is by co-operation between the library and the users. The ultimate responsibility for selection should rest with the librarian, as manager of the budget, but he is under an obligation to see that all users receive satisfactory service.

In the government departments visited there was no obvious deficiency in the selection of books and serials although some users complained that their needs were not given sufficient attention. There was a tendency to regard libraries in science-based departments as scientific libraries only; insufficient reference material was provided for management and administrative staff. There was usually a lack of material dealing with information science. The collections of reports were generally inadequate except in the libraries of the Defence Research Board, Atomic Energy of Canada Limited, and the National Science Library. Other less common forms of recorded information, such as standards, films, university theses, and maps, are also commonly overlooked in the selection process.

Acquisition of Material

Speed is essential in acquiring material because information is usually requested at the time it is needed; delays are frustrating and may seriously impede the work of the user. Several departments reported delays in acquisition of materials because of difficulties in obtaining authorization to purchase. They also indicated that librarians were not able to plan purchases effectively because they did not know what funds were available. For a librarian to exercise his responsibilities effectively he must be given a budget and the authority to approve expenditures and manage the budget.

When one useful publication is generated by an information service it can be exchanged with many libraries to acquire many other publications. The value of acquiring by exchange agreements, a method used extensively by the major libraries in government departments, lies not only in the saving of money but also in the establishment of rapport with other libraries and information groups. However, the bulk of library materials must be acquired by purchase, and the methods adopted by government libraries in the past have often been cumbersome. This variety of method was noted by the Royal Commission on Government Organization.[19] The Treasury Board subsequently initiated a survey of purchasing procedures in government libraries which was carried out in collaboration with the National Librarian. The results of this survey[20] indicate present difficulties and some possible ways to overcome them.

There is obviously a considerable multiplication of work involved in the process whereby each library orders its own material; in many cases the same item may be purchased by each of a dozen government libraries, each of which goes through a comparable ordering procedure. Attention should be paid to the possibility of centralized ordering of library materials, particularly serials, since most subscriptions are planned in advance to take effect at the beginning of a year. Such centralized ordering would presumably be an important feature of any integration of federal government library services in the future.

Machine methods of operation that are now commonplace for the purchasing of general supplies can also be applied to the purchase of library materials. The Department of Agriculture and Atomic Energy of Canada Limited already use mechanized procedures to order serials, and the National Science Library is taking steps to introduce a mechanized system for the same operation. Such methods should be integrated into a comprehensive library mechanization program embracing ordering, processing, and circulation control.

Processing

Only one part of the processing operation requires intellectual effort—the definition of the subject scope and the origin of an item. Most of the other steps can be handled by machines, and mechanization of much of this is economically justified with equipment now available, providing that the operation is on a sufficiently large scale.

Cataloguing of library material is a world-wide operation and there is no advantage in repeating in Canada what has already been done elsewhere.

Departmental libraries are fully aware of this fact, and some purchase sets of catalogue cards printed by the U.S. Library of Congress. This method provides for the cataloguing of a considerable proportion of the books purchased by most libraries. It has, however, the disadvantage that there is a delay of a month or more in obtaining the cards. To obtain speedier service, many libraries purchase proof sheets of the catalogue cards but then must reproduce copies to make the card entries in their catalogues. The Library of Congress, in keeping with its position as the operator of the world's largest cataloguing service, is now preparing, through its Project MARC, computer tapes containing bibliographic entries for all new publications received. It will soon be making these tapes, with suitable programs, available to all libraries so that they may use them to provide catalogue entries. Some Canadian libraries are now considering the use of this system to provide most of the entries for their catalogues. Departmental libraries should consider adopting this technique. A centralized cataloguing service for scientific and technical publications should be an essential part of a federal library network.

Many government libraries reported difficulties with the binding of journals. In some cases the problem was to obtain funds for the purpose; in others, it was the delay in the process, which was often as much as six months. Delays of this length are intolerable because the material is not available for use while it is away for binding. It is also largely unnecessary because a large number of commercial binderies can arrange to give a turn-around time of less than one month. Moreover, it has a detrimental effect on government collections in the long term, since it discourages binding and therefore encourages loss from wear and tear. The cost of replacing a journal far exceeds the cost of binding, and all journals should be bound when they receive enough use to justify their retention for more than one or two years. Consideration should be given to greater use of microforms, particularly where space is a problem.

Staff for Library and Information Work

Without exception, government departments and agencies that are science-based are aware that there is much that could profitably be done to develop their library and information services, and five-year projections invariably show a marked increase in the number of staff required for this work. In many cases it was stated that additional services were known to be desirable now but could not be undertaken for lack of the staff to carry them out. In part this was because the establishment needed for the additional services was not approved, but it was also true that difficulties were encountered in hiring staff to fill existing positions.

This situation is affected by a national shortage of personnel trained in information science and librarianship. It is also affected by the fact that such staff do not, in general, enjoy status and salary scales equivalent to professional and supporting staff, and it is particularly notable in government service that there is little provision for library assistants at levels between the professional librarian and the junior clerk.

Physical Facilities

Library collections grow not only as a result of efforts to make the collection more complete, but also because the world output of literature is constantly growing. The housing of the collection is only part of the space taken by a library, which also needs areas for displays, catalogues, processing rooms, offices, and facilities for reading and study. However, as the collection grows there is a tendency for it to take up space which had originally been allocated for other purposes, and it is common to find libraries in which the collection has crowded out the study areas. As libraries operate more often than not as independent units, there is a tendency to try to acquire as much material as possible and not to rely on interlibrary loans. This tendency results in duplication of holdings in other libraries and exaggerated need for space.

A library is fully operational only if it is a centre for study. It is important, therefore, to provide adequate space and conditions that are conducive to study. This requires that noise be kept at a low level by segregating the operational areas of the library from the study areas. In the government libraries visited, it was evident that most were short of space and consequently made inadequate provision for study. This was particularly noted in the National Science Library, the Defence Research Board, and the Department of Forestry and Rural Development; and even in libraries that had recently been provided with new accommodation, such as the Department of Agriculture, study space was very limited. Only in isolated cases was a library observed to have a quiet, atmosphere-controlled area for study purposes.

Use of Collections

In discussions with groups of users of government libraries, it was concluded that the difference between user satisfaction and dissatisfaction was frequently dependent upon the attitude of the library staff and sometimes related to the status and attitude of the user himself. It is re-emphasized that it is vital for libraries to adopt a service-oriented attitude to all clients and to maintain a high standard of service. Some libraries considered that they were intended to serve only members of their department, some expected to serve other government departments but not the general public, while others gave service to all comers. Policy for the government library service as a whole should be defined. (This is discussed in Sections VI.1 and VII.1.)

The accessions list of the library of AECL announces items within about two weeks of their receipt, the time lag in the National Science Library list is about three months, and in some other departments the lag is sometimes considerably longer. The mechanization of processing operations provides a means for publishing announcement lists with negligible time-lag. Even without sophisticated equipment it should not be necessary for the time-lag to exceed a month.

Circulation control for book loans in all libraries was manual although at least two were investigating machine methods. All libraries used a system which reported the borrower's name for a given item but few, with the exception of the National Science Library, could report what items were on loan to a given borrower. Several well-developed machine methods for circulation control for books are in existence. These should be studied and the more effective ones made available for wider use.

It is part of the librarian's task to make literature searches and to retrieve documents. At the same time, the subject specialist must do much of his own searching of the literature because of his specialized knowledge. The librarian assists by providing the tools for such searches, namely, abstract journals, indexes, reviews, and other references. With the growth of the volume of literature to be searched, neither the librarian nor the subject specialist now has the time to carry out effective searches, and specialists in information retrieval are needed. The librarian's main tasks in this area will be to provide reference tools for searching and to locate and obtain the actual literature specified by the result of a search. The introduction of new information retrieval techniques and associated current awareness schemes will have a considerable influence on both the usefulness and the degree of use of library collections.

The development of reference centres and information retrieval centres by departments is as yet sporadic and has not been adopted on any comprehensive scale. Consequently, government scientists, engineers, and managers spend a great deal of time carrying out their own searches and are often unable to obtain more than a partial listing of the relevant literature. A survey by the Economics Subgroup (Chapter 7) shows that 15 per cent of a user's time is spent in procuring the information he requires. As the allocation of research funds becomes more critical it must be expected that the demands on government libraries for material will considerably increase and they will find it necessary to expand and amplify their services to users.

V.8 Interlibrary Operations

The present arrangements for handling publications within the Federal Government are characterized by the division of responsibility between departments and among different branches of each department. Although the National Science Library is the foremost scientific library in the government service, there are major collections of scientific and technical material in the various departments, each one autonomous or controlled by its own department, and associated with the National Science Library only with respect to the *Union List of Scientific Serials in Canadian Libraries* and participation in the interlibrary loan service.

V.8.1 Interlibrary Loan Service

Librarians, including most of those in government service, have long recognized the value of co-operation and have operated an interlibrary loan service which links libraries throughout Canada and also in other countries. The operation of this service, however, has been on a semi-formal basis, with the level of service from one library to another being a matter of agreement or mutual understanding between the librarians concerned.

In recent years, the availability of cheap and convenient photocopying equipment has modified the interlibrary loan service. Most libraries, on receipt of a request for a journal article, now send a photocopy of the article in preference to lending the journal. This has the advantage that it avoids the risk of the loss of the journal in transit and, as photocopies are normally sent for retention, eliminates the need for recall and return of the item. Although this service does not involve loans, it complements the loan service and may conveniently be considered as part of the interlibrary loan system.

The interlibrary loan service among government libraries suffers from several defects that retard the response. These often stem from a lack of appreciation by management of the value of this service, not only to each library that participates but also to the community as a whole. Consequently, departmental libraries have difficulty in justifying sufficient staff to handle the service and adequate funds to use rapid methods of communication. This lack of funds causes libraries to make requests by mail instead of by teletype or telephone, and to despatch requested items by the cheapest method rather than by first-class air mail.

It is most essential that the interlibrary loan service be put on a formal basis and made more efficient. All government libraries must participate in a nation-wide interlibrary loan service and respond promptly to requests from other libraries.

It is suggested that to help pay for the service provided by each library, to discourage indiscriminate borrowing, and to encourage purchase of frequently used material by libraries in preference to resorting to repeated borrowing, a service fee should be charged for each item loaned and a page charge instituted for copied material. Simple accounting methods should be used. To speed up such services, all participating libraries should use teletype equipment for requests and should send material by first-class mail.

V.8.2 Library Networks

Various library networks exist at the present time and are used in implementing the interlibrary loan service. However, if library resources are to be used more effectively in the future, a dynamic and formal network needs to be established. Recommendations to this effect have been made previously on several occasions as a result of surveys of library resources, but no real integration of library operations has yet taken place. For instance, Bonn[21] recommended the establishment of a voluntary science-service library network organized on a regional basis but ignored the role that could and should be played in any library network by the substantial resources of the Federal Government's many libraries. The Associate Committee on Scientific Information[22] supported the Bonn recommendation but has so far been unsuccessful in initiating any significant action designed to create such regional library networks. Leadership to this end should be provided by the Federal Government, beginning with a network of the government libraries in the Ottawa area, under the general direction of the National Library and the National Science Library. Once experience has been gained with the establishment and operation of such an Ottawa regional library network, other regional networks should be developed, if necessary with federal assistance.

The general concept of a regional library network that is now envisaged is one in which the individual libraries would work together to make the total resources of the participating libraries available to the user as though he were dealing with only one library instead of many libraries. All federal government libraries in Ottawa should be in the Ottawa regional network. A union catalogue of all holdings should be stored in a computer system, to which all the libraries would have on-line access, and all library transactions should be monitored through the computer. The operation envisaged would be analogous to the reservation system presently employed by Air Canada with the individual ticket offices being replaced by the individual libraries of the regional network. All participating libraries would be able to determine whether a given item was held by the libraries of the regional network, whether the item was on loan, when it would be available or, indeed, whether it was available for loan outside the holding library or was reserved for use by clients of the holding library. Once an item had been located, instructions for lending would be transmitted by the computer terminals from the requesting library to the lending library. Actual delivery of items would be carried out by a suitable delivery service similar to that presently operating between the university libraries of Ontario. Under such an arrangement, the individual libraries would maintain their autonomy but would give far more effective service to the user. To ensure that each library was able to provide the degree of service to the clientele for which it was established and still participate in interlibrary loan work, each library should have the right to designate some of its holdings for use only by its own clients and charge an interlibrary loan service fee to cover costs.

As similar regional networks are created in other parts of the country, they should be linked by telecommunications so that if a library is unable to locate an item within its own regional network it would immediately be switched to adjacent regional networks until the material was located. Delivery of the items between regions would take place by first-class mail. Operation of the computer system and the local delivery service should be the responsibility of the major library in each regional network.

Regional networks should not be restricted to libraries of a given type or coming under the control of one institution, e.g. the Federal Government. There would be great advantage for provincial government libraries, public libraries, and industrial libraries to work together in any regional network. It would not be mandatory for a library to be part of a regional network to participate in the interlibrary loan system, but any library should be able to borrow through interlibrary loan even though it may not wish to make loans of its own holdings, provided it is prepared to pay the charges associated with borrowing from other libraries. In this connection, it is interesting to note that in several regions visited there was great interest in establishing regional networks. One group from the Maritimes has made a formal recommendation to the Study Group for the establishment of a regional scientific information network for that area, which would include all major libraries in government, universities, and industry, public libraries, and data banks. The need for close association with a national system was also recognized. The proposal is described in detail in the chapter on Libraries. As expressed by Bonn,[21] participation in these regional networks would:

> "... in no way affect the long-established professional responsibility and desire of a particular library to service the needs of its own patrons, or the historical obligation and inclination of a community to support its library, whether it be in a university, an industry, a municipality, or a province. Hopefully, as more people become accustomed to better library service and fuller resources in science and technology they will realize the value of, and will give more support to, better library service and fuller resources in all subject areas".

The evolutionary development of the present major libraries into a national network as envisaged above would make the document resources of the whole country readily and speedily available to all users with a minimum of reorganization. It might also make it unnecessary to develop a National Lending Library along the lines of that created at Boston Spa in the United Kingdom if a sufficient number of Canada's libraries participated in the network. The proposed network is suggested as a first step in developing an improved service. Whether or not a national lending library would be necessary would depend on user demand and needs in relation to the service supplied by the network.

To develop library networks it is necessary to have adequate libraries. Within the Federal Government, the responsibility for establishing and maintaining libraries to support the requirements of each department is the responsibility of the department. This arrangement should continue, but those departments playing a primary role in any particular field of endeavour should be charged with creating the necessary library resources on a nation-wide basis and ensuring that the literature needs of the workers in that field are adequately met. For example, the Fisheries Research Board should be concerned with meeting the needs of all workers involved in fisheries research; the Department of Energy, Mines and Resources should ensure that all persons working in areas of science and technology covered by the department are served by adequate library facilities; the Department of National Health and Welfare should foster the development of library resources that will meet the needs of the health sciences. In effect, the appropriate departments would be encouraged to develop their assigned responsibility for creating adequate information resources in their respective fields in a manner similar to the responsible agency concept recommended by Weinberg[1] and enunciated in greater detail by Carter *et al.*[5]

Creation of such resources could be accomplished by advice and persuasion and through the use of contracts or subsidies. The major resource library in each particular field of endeavour would be developed by the department intimately concerned, while the National Science Library would continue its present role of supplementing the holdings of other government libraries to ensure that broad coverage of all areas of science and technology is achieved by the Ottawa group of federal government libraries.

Section VI

GENERAL PROBLEMS FACING GOVERNMENT INFORMATION SERVICES

The existing organization of government information services, the requirements they should meet, and the present and future environment in which they must operate, all pose problems for the design of improved services.

VI.1. Need for Government Policy

It was pointed out earlier in this report that the Royal Commission on Government Organization indicated that the dissemination of information to the public is either the sole or the principal reason for the existence of some government departments, and is an essential corollary to the operation of others. Nevertheless, the Study has indicated that, although a great variety of library and information services exist in government departments, their operations are not guided by an overall policy. There is an urgent need to establish and define a policy regarding the Federal Government's responsibility in making information available to its employees, to other agencies, to the general public, and internationally. It is suggested that the basis of such a policy should be that the pertinent world-wide scientific and technical literature must be readily accessible to all prospective Canadian users.

Without a clearly defined policy and the necessary leadership, it is impossible to co-ordinate the existing services into a more effective, dynamic system and to integrate plans for their evolution. It should be noted that the governments of the United States, the U.S.S.R., Great Britain, and France have realized that STI is a national resource and that its exploitation is a national responsibility.

Like many national resources, STI is also an international commodity. All nations import more of it than they produce, and this is particularly true of Canada, which produces less than 3 per cent of the world total. In meetings with other nations to negotiate an adequate supply of information, it is important that Canada should be able to speak with one voice and with the support of an established policy.

VI.2 Need for a Central Agency

The general accessibility of information can only be secured on an equitable basis by co-ordinated action on a nation-wide scale. Such action must be undertaken by the Federal Government. No other organization is qualified to act as the centre for the planning and guidance of such an operation. This is not to say that there is a need for the Federal Government to operate the total information services of the country, but it should provide the leadership, supervision, and co-ordination of services that are required. A central body is also necessary to act as a focal point for all of the nation's scientific and technical information activities and to represent Canada's interests in the development of international information systems. Such an organization is needed to guide and plan the implementation of established policy. This need was clearly identified at the recent meeting of the science ministers of OECD countries.[23]

VI.3 Need for Action Now

Several factors combine to make the consideration of information problems particularly timely and the need for action urgent. The population of Canada and its educational level are both rising rapidly and will cause a sharp increase in the quantity and complexity of user requirements, at the same time, the production of science-based literature is increasing. There is a rapidly growing awareness that existing procedures and methods are no longer adequate to accommodate the increasing user needs. The resultant pressing demands are causing the establishment of individual information services in many places and under many authorities. So far, such separate services have not become numerous, but the subgroup found that many are in the process of formation. Needless duplication of work, and the growth and proliferation of incompatible services, will occur unless a central body guides and co-ordinates such developments.

The increased information awareness in Canada is paralleled on the international scene. All technologically advanced nations are developing or planning the development of their STI systems on a nation-wide scale and in co-operation with international systems. It is a most opportune time for the Canadian Government to exchange views with other governments on the operation and compatibility of such systems, to enter into agreements for co-operation, and to participate in the development of international information systems.

VI.4 Environmental Factors

Some of the problems that must be solved to rationalize government information services stem from the unique features of the Canadian environment. Kurmey[24] has drawn attention to the ways in which the information problem is influenced by the geographical extension of the country east to west, by the 10 separate provincial entities, and by the population speaking two languages, spread in a ribbon along the southern edge of the country with large concentrations in the Montréal and Toronto areas.

The Canadian Government's resources, both of material and manpower, for information services are strongly concentrated in the region of Ottawa. Several departments, notably the Department of Agriculture and the Technical Information Service of NRC, operate regional information services. However, some of these are faced with operational difficulties because of their need to rely heavily on Ottawa for their material support. The central concentration of services has advantages for the dissemination of information to most of the Government's own staff, but it is a disadvantage in the interchange of information with the universities, industry, and the general public.

The activities of provincial government departments in the scientific and technical information field are on a relatively small scale and in some areas they are non-existent. Although the provinces are aware of the need for improved services and several are making plans to improve the situation, there appears to be little effort to co-ordinate them with the much larger local resources of the universities and the public library systems. The Study revealed considerable interest developing in certain areas in the formation of regional library networks combining university and other local libraries. For maximum effectiveness, these proposed networks must be integrated into a nation-wide system. In addition, the views and requirements of such regional groups must be taken into account in planning such a system.

VI.5 Difficulties for the Information User

Users of the government information services have several problems in common with all other information users. In varying degrees, they have difficulty:

(1) Keeping up-to-date with pertinent literature in the field;
(2) Finding out what information exists on the topic of immediate concern;
(3) Learning which packages of existing information are valuable and which are worthless;
(4) Finding where the useful items may be obtained;
(5) Obtaining a copy of the documents and other materials that give the information required;
(6) Getting information, recorded in another language, translated into their own.

It should be noted that all these difficulties produce delays in completion of work. This is particularly important in the case of applied scientists and engineers who require information rapidly to be of immediate practical use. The value of information is reduced and eventually destroyed by delay in delivery. The Study discovered that almost all users of government services experienced difficulties of the kinds indicated above. The chief complaint, particularly from users in the western provinces, was the long delays that occurred. For example, users in Vancouver found that the average delay in receiving a document on loan from a government library in Ottawa was over four weeks, and sometimes delays of twelve weeks occurred. Many potential users made no demands on government services because they found the response too slow and preferred to make use of limited but quicker local services.

Government information services at the present time are largely a collection of separate entities, developed individually to meet a need and depending on the goodwill of other similar groups to obtain information they themselves do not have. They are in general slow, manually operated, poorly co-ordinated, and devoted to serving only a relatively small proportion of the total potential users. Most of the time of the staff is spent in the collection and handling of documents, and not in the effective dissemination of information.

VI.6 Growth in Numbers and Awareness of Users

As scientific research and development and the production of information have increased, so have the number of users and the volume of user requirements.

Over 60 per cent of Canadians are under 35 years of age and the average level of education is about that of high-school graduation and is rising yearly. It has been estimated in Chapter 7 that Canada's labour force will increase by 50 per cent over the 15-year period 1965-80, a rate of expansion 60 per cent greater than that of the United States. Canadian users of STI, once primarily government, university, and industrial scientists, now include also many of the nation's managers, engineers, technologists, and technicians. The Federal Government must ensure that its services provide not only for the 39 000 scientific and technical personnel in the government service but also for the growing numbers of university and industrial personnel who require the information.

A vital aspect of this problem is the present difference between the number of actual users and the much greater number of potential users. Many people, whose work would benefit from the provision of fuller information, do not make use of the services that are available, either because they are unaware of the information that may be obtained or because they are impatient with the slowness of the services. Libraries and other information services have been, in general, fully occupied with efforts to supply the requirements of their existing users and have not actively looked for additional clientele, fearing that to do so would cause demands beyond their capacity. However, for the future realization of the full potential of information resources, it will be necessary to take a dynamic approach and encourage all possible users. This will result in a very great increase in the demand which future services must be planned to meet.

VI.7 Growth in Numbers of Documents

The world stock of scientific and technical information is increasing at an exponential rate and is likely to continue to do so for the foreseeable future. The present annual world production of scientific and technical journals has been estimated at 26 000 titles[25] containing over 2 million articles. The journals are estimated to be increasing in number at the rate of 5 to 10 per cent, annually, and the literature in them doubles in 10 to 15 years.[26] The problem of handling and disseminating this volume of material is acute.

As Kemeny stated:[27]

> "... the cost of building, of purchasing volumes, of cataloguing, and of servicing these gigantic libraries could eventually ruin our richest universities."

What is true for universities is equally true for government departments. Unless a radical change is brought about, merely to maintain the present level of service will require, by 1978, doubling the size not only of the National Science Library but also of all the libraries and information centres in each of the government departments and agencies. A further decade will require all of these organizations to become four times their present size. Obviously, new concepts of handling documents and information must be sought and a rationalized system developed quickly, or the whole process of information handling will become more and more inefficient.

VI.8 Need for Translations

It has been mentioned that scientific and technical information is an international commodity, and large numbers of documents are received in Russian, Japanese, Chinese, German, and many other languages. For the proper utilization of these, an effective scientific translation service is needed. Scientific material requires special treatment, as the translator must be conversant with the subject matter as well as the language. Existing translation facilities vary greatly between departments, but in most cases lack staff and consequently give slow service.

The *Canadian Index of Scientific Translations* (Section V.3) offers the means of avoiding the duplication of translations and of obtaining the fullest use of existing ones. However, many information services and libraries fail to co-operate in the compilation and usage of the Index.

The problem is complicated by the fact that translation may be required into either English or French. It is somewhat alleviated by the fact that many scientists are able to use both French and English but, in general, there appears to be a need for a French-English translation service available at the input-output points of any information system. This would allow for enquiries to be received and answered in either language, although the working of the system itself was in only one language.

VI.9 Need for Research

If Canada is indeed to "conceive, design and build the world's best and most imaginative national information system", as Solandt[28] has suggested, there must be an important commitment to research in this field. At the present time, research in Canada on information methods is extremely limited.

It has been generally recognized that to achieve the greatest benefit from Canadian research activities, they must be directed towards carefully selected subject areas. Research on information methods and systems is a comparatively new field and although some nations are applying considerable effort in this direction, a great part of the subject is as yet untouched. It is suggested that this is an area in which Canada should specialize.

In any case, it is essential that some information research activity be established in Canada to support the development of improved systems and to build up a group of information specialists who can appreciate and evaluate the research carried on in other countries and can apply the results of such research to our own problems.

VI.10 Need for Application of New Technology

Canadian government libraries have been slow to adopt modern technology and to make the best use of computer techniques. This situation, however, is not unique to government libraries nor to Canada and, as has been pointed out,[5] there are several reasons for it. Libraries have been limited in funds and thus unable to experiment with these new and often costly techniques. By their training, many librarians do not have a background which facilitates the application of such technology. Finally, automated techniques have not been developed for easy adaptation to library problems. There is a great need for librarians to appreciate the possible application of computer techniques, and for computer experts to take more interest in library problems.

Computer techniques are continually being developed and improved; some of these could be applied to many aspects of library and information work. To permit the most economical and practical application of these techniques to particular problems, it is necessary to set up pilot projects to illustrate and evaluate the new technology. Unless full advantage is taken of new techniques, it may be expected that, with the increasing load on libraries and increasing user requirements, the present rate of making information available will deteriorate rapidly. The present system will be less and less able to cope with the flow of documents and information, and thus becomes even more inefficient and uneconomical that it is at present.

VI.11 Shortage of Staff

All the government departments and agencies that co-operated in the Study pointed out the difficulty of recruiting suitable staff for the operation of information services. There appears to be a national shortage of scientific and technical librarians, information officers, and supporting staff. The situation may be relieved by integration and, where possible, the mechanization of the services, which should make them more effective, but the desired improvement in services will necessitate better training of staff for future positions.

Plans for the development of improved information services must include estimates of staff requirements and must ensure that adequate facilities exist for their training. Students must be encouraged to train for information and library work through recognition of the value and status of such work.

Section VII

THE APPROACH TO A NATION-WIDE INFORMATION NETWORK

VII.1 Federal Government Policy

A broad definition of policy by the Federal Government must be the starting point for the formulation of plans to improve the distribution of STI in Canada and for providing a basis for the evaluation of such plans. The policy should encompass:

(1) A commitment by the Federal Government to ensure that, as far as possible, the relevant scientific and technical literature is readily and speedily available to all individuals within Canada who have a genuine need for it. It is not necessary that all items be held in stock in Canada; only the most used part of the literature should be so held. For the remainder it is sufficient to rely on obtaining it as the need arises from other countries, providing that formal arrangements are established for obtaining the literature.

(2) Establishment of a single high-level focus for all national and international activity in the field of STI.

(3) Active participation by Canada in international affairs relating to the production, release, and communication of STI.

(4) Identification of potential users of STI within Canada so that they may be made aware of the resources that are available and offered assistance in the interpretation and application of the information.

(5) Early publication of all STI generated as a result of the activities of government departments and agencies (except that which must, in the national interest, be restricted in its distribution), and encouragement of the publication of information generated by other agencies in Canada.

(6) Introduction of a realistic cost-recovery principle for information services. The Canadian Government should not absorb the entire costs associated with future information systems. One of the major difficulties encountered in the present Study was that of estimating the value of an information service. The institution of suitable fees for information would encourage the development of services that were of real value and cause the elimination of those that were not. It would stimulate the development of commercial information services and, at the same time, would show much more clearly how the expenditure of public money on information services was divided between different departments and between services to other sectors of the economy.

VII.2 Concept of a National Information Network

Any national information network will require the organization of services on a nation-wide scale and must be based on an appropriate integration of the various libraries, information and communications services now existing. Consideration must be given to the requirements of all present and potential users and the rapidly changing nature of user needs, societal expectations, and information technology. This can be most logically accomplished by the further development of existing departmental mission-oriented and discipline-oriented services into integrated systems with appropriate cross-linking of individual service points on a regional basis. In those instances where a federal government department or agency has a responsibility for promoting the development of an information system within the confines of its interests, it would pursue these responsibilities according to the guidelines of an overall co-ordinating group. In effect, such departments would be assigned the role of national co-ordinating agencies for information activities in their respective fields. In a similar way, discipline-oriented systems would be developed under the auspices of professional and technical societies where possible.

The effect of these arrangements would be to create a network of systems that has direction primarily on the mission or discipline level but would provide local access by the user to all parts of the network. The network would provide the following services which it is believed would most effectively satisfy user requirements:

(1) Queen's Printer Bookstores in all significant centres of population across the country providing all federal government publications and probably provincial government publications. Where there is sufficient demand, these stores could also handle U.S. Government reports in microfiche form.

(2) Regional library networks across the country so organized that any participating library can rapidly locate and borrow any item. The principal regional network would be the one embracing all federal government libraries in Ottawa and district. The libraries within each regional network would employ common information handling procedures and would be linked to a computer for maintenance of a union list of all holdings within the regional network and for recording all library transactions. All regional networks would be organized in a similar manner and would be linked to adjoining networks so that any library could query the union lists and request loans from any participating library.

(3) Specialized information centres of all types, with emphasis in the early stages on reference centres capable of identifying material relevant to a particular topic. The gradual development of specialized information retrieval centres and information analysis centres would proceed as the need arises.

(4) Consultative and field services based on provincial research councils and foundations and, where necessary, on specialized information centres.

Any national network that is developed to provide the above services will have to include provision for the creation of the following:

–A central organization or focal point for information activities to interpret, co-ordinate, monitor, and, where appropriate, implement overall policy, including a specialist group to develop long-range plans, to advise on the planning of operations, to study the change in user needs as the network develops, and to examine the cost effectiveness of the various systems.

–Legislation providing a consistent legal basis for the design and operation of the network including matters of copyright.

–Training programs for librarians, information scientists, technicians, and other personnel who will staff the network. Also, training programs for all potential users to demonstrate how to obtain the maximum benefit from the network.

–A program of research and development to generate improved operating methods and equipment relevant to Canadian information systems.

In addition, the network must be developed in accordance with the following requirements:

–It must evolve from present organizations with a minimum disruption of services.

–It must provide services with equal effectiveness in all parts of the country.

–It must provide equally effective access in English or French.

–It must be designed to cope with an increasing number of users and the variety of information demands of all classes of users, including scientists, engineers, medical practitioners, managers, technologists, technicians, tradesmen, craftsmen, students, and teachers.

–It must remain continuously responsive to the needs of its users, so that changes in user requirements result in corresponding changes in the operation of the network.

–It must expect to handle at least a 7 per cent annual increase in the quantity of scientific and technical information.

–It must develop standard specifications for equipment and procedures to ensure compatibility between the operations of different parts of the network and between the network and other national or international networks.

–It must be capable of handling all media used for communicating STI and be able to transfer information from one medium to another as required.

–It must employ and support existing commercial or other information services providing indexing, abstracting, and literature searching services where these exist in Canada or elsewhere in preference to the establishment of new services, unless a significant cost reduction could be achieved by the latter course.

–It must avoid the duplication of operations except where such duplication is necessary to provide the required service.

VII.3 Alternative Approaches

It is obvious that if no action is taken by the Federal Government in the future, and individual information services continue to operate and develop without any central guidance, the problems outlined in Section VI will remain largely unsolved. Although increasing sums of money will be absorbed, the availability of material will probably deteriorate. At the other end of the scale, a completely nationalized organization with the Federal Government owning and disseminating all the nation's STI would be unacceptable—cutting across the interests of provincial governments, industrial companies, and professional and technical organizations—and would be an unwieldy and expensive operation.

Between these two extremes lies a range of possible organizations, each of which could be developed to provide a significant improvement in the present situation. Three variations in approach involving what have been termed, respectively, an advisory bureau, a co-ordinating agency, and a department, will be examined briefly. One of these approaches is preferred over the others. It should be noted that the points in the range of variation have been selected arbitrarily and other intermediate approaches could be adopted.

VII.3.1 First Approach: An Advisory Bureau

A central co-ordinating and advisory bureau would be established, within the Federal Government but outside the normal departmental structure of the public service, to serve as a focus for national and international information activities and to monitor and advise on the implementation of government policy as outlined in Section VII.1. In effect, the bureau would augment and continue the work of the present Study and that of the NRC Associate Committee on Scientific Information, but would be established as a full-time body composed of a small group of experts in information handling. It would not have direct responsibility for the operation of any service but would act in an advisory capacity to those departments and organizations responsible for STI activities. It would have a limited budget for its own operating expenses.

The evolution of a national information network would be approached by the fostering of co-operation between existing services, and by the bureau acting as a catalyst with regard to the development of new services by public and private organizations. The bureau would work, by negotiation, toward the adoption of standard methods of operation and format, and would encourage all existing information services to participate in a nation-wide network.

VII.3.2 Second Approach: A Co-ordinating Agency

A co-ordinating, advising, directing, and operating agency of the Federal Government would be established to implement government policy (Section VII.1) and develop a national information network, as discussed in Section VII.2. If it were decided to establish a central authority for science and technology, it would be logical for the agency to report to this authority. The exact position of the agency in relation to the structure of the public service is a matter for further advice and study. The agency would serve as a focus for national and international information activities and would have authority to influence departmental operations by reviewing budget estimates and making recommendations to the Treasury Board. By so doing, the agency would attempt to determine the equitable and effective use of public funds by federal departments and agencies for purposes of acquiring, publishing, and disseminating STI.

It would also have authority to (*a*) disburse funds in support of operations considered vital to the provision of an equitable, nation-wide information service, (*b*) subsidize special information activities during the development stages, (*c*) support research and development work in the field of information handling, and (*d*) support the training of personnel in information science and librarianship.

The agency would be assisted by an advisory committee composed of representatives of the principal groups of information generators, publishers, and users. It would pursue the creation of a nation-wide information network, and all that is involved therein, by recommendation, persuasion, and exercise of its fiscal powers. It would not, however, assume the responsibility for operating any existing or proposed information activity unless requested to do so by the respective government department, agency, or other organization in the private sector. The responsible department or agency would have authority, as at present, for the formulation, co-ordination, and implementation of policy concerning the operation of their mission-oriented systems, and for the provision of funds for training personnel and for research and development as applied to the particular needs of the department.

VII.3.3 Third Approach: A Department

A new federal government department would be created to assume responsibility for implementing government policy with respect to STI. The department would operate all federal libraries, information services, specialized information centres, etc., and would have funds to subsidize operations considered essential to the maintenance of an equitable, nation-wide service. It would also have funds to support new services during the development stage and to support research in information handling. Federal government departments and agencies would determine their requirements for library and other information services but would contract with the new department for the provision of such services. The first task of the department would be to organize the federal government libraries in the Ottawa area into a regional network. Based on the experience so obtained, other regional networks would be created incorporating both federally owned libraries and, where possible, libraries supported by provincial governments, local governments, and private industry.

The department would take whatever steps are necessary to ensure that the latest developments in information handling are introduced into the Canadian information network and that all legitimate users are provided with services that adequately satisfy their needs. This would involve the development of a country-wide library network as mentioned above, the creation of specialized information centres of all types, the introduction of current awareness and selective dissemination services. In short, the department would have the responsibility and authority to develop a national information network and to pursue the integration of that network with other national and international services as deemed appropriate.

VII.4 Review of Approaches

Comparison of the three approaches to the development of a national information network is chiefly concerned with the different degrees of authority to be exercised by the central body. It is believed that a bureau as discussed in Section VII.3.1 would have insufficient authority to influence the course of events unless it was particularly fortunate in gaining the voluntary co-operation of all concerned with information handling. On the other hand, a department as discussed in Section VII.3.3 would be an unwieldy structure, slow to respond to the needs of the time. Consequently, the subgroup believes that an agency as outlined in Section VII.3.2 is the most suitable vehicle to bring about the necessary co-ordination of present information services and to provide the stimulus for initiative at all levels of the economy that will result in the development of efficient and effective services. It would not usurp existing statutory authority of government departments but would be able to exert influence on their information operations by virtue of its ability to make recommendations to the Treasury Board, and could stimulate co-operative ventures and the introduction of new services by non-government groups through the provision of funds.

Section VIII

RECOMMENDATIONS

For Canada to reach its full potential and maintain its place among the technically advanced nations it must utilize the world supply of information as effectively as possible. Briefs submitted, discussions, and consideration of all other pertinent factors, indicated that direct action by the Federal Government is required if this is to be accomplished.

Need for Federal Government Policy

As far as can be ascertained, the Government of Canada has never stated a general policy with regard to scientific and technical information. It has given various government departments the right to acquire, generate, and disseminate information according to the requirements of their operations, and in 1966 it formalized the *de facto* status of the National Research Council's library by designating it the National Science Library. This fragmentation of responsibilities is unsuited to present needs. Comprehensive nation-wide information services are now basic to the efficient and rapid development of our science and technology, and the achievement of our socio-economic goals. The matter has become of sufficient importance to warrant the enunciation by the Federal Government of a national policy with regard to acquisition, storage, dissemination, and utilization of scientific and technical information as discussed in Section VII.1.

We therefore recommend that the Government of Canada define a national policy with respect to scientific and technical information in order to stimulate and guide the evolution of nation-wide information services.

Implementation of Government Policy

Once policy and guidelines for the future have been established, the development of facilities and services must be carried out according to a long-range plan with due consideration to priorities and needs. Maximum use must be made of existing facilities and services, but it is imperative that their operations be co-ordinated and related to a national plan by an appropriate body as discussed in Section VII.3.

We therefore recommend that a central agency be established to implement government policy with regard to scientific and technical information.

Designation of Responsible Agencies

Under existing legislation, government departments have responsibility for scientific activities including the production, accession, compilation, and analysis of data and information within their respective fields of operation. Many groups of scientists or engineers in these departments are engaged in mission-oriented projects which are an additional important source of information. It is now suggested that any nation-wide information service must be based on these mission-oriented services.

We therefore recommend that where appropriate, federal government departments and agencies be designated as responsible agents for information activities that are relevant to their missions.

Development of a National Information Network

Many features of a national information network have been alluded to throughout this report and will need to be considered in the creation of an effective organization. It is not proposed to reiterate all of them here in the form of recommendations, but attention is drawn to the following points which are felt to require the urgent attention of the central agency responsible for implementing government policy and developing a truly national information service:

(1) Concerted participation by Canada in international negotiations dealing with scientific and technical information;

(2) Creation of regional library networks starting with the federal government libraries in the Ottawa area;

(3) Establishment of Queen's Printer Bookstores in all significant centres of population in Canada;

(4) Development of specialized information centres and associated services concerned with specific branches of industry to complement the general information service provided by TIS;

(5) Development of standard operating procedures and standard formats for information transfer;

(6) Support of research in information handling so that the information network may develop in keeping with advances in the technology of information handling;

(7) Promotion of education and training in the field of information sciences.

We therefore recommend that the central agency review the many assessments made in this report and take appropriate action to develop an effective national information network.

Departmental Responsibilities

Although departments have authority to provide information services within their fields of operation, it has been found that there has not been general recognition of the importance of these services and only recent interest in their co-ordination. If departments are to fulfill their role as responsible agents, it will be necessary for existing services within departments to be integrated into an effective organization. Since these services are the cornerstone of any effective information system, it is important that they be reviewed and assessed in the light of developing needs.

We therefore recommend that government departments accepting the role of responsible agents should assess the significance of scientific and technical information to their operations and take action to improve its production, handling, and use.

Need for an Advisory Body

Scientific and technical information is a national resource that must be available not only to scientists and engineers in government, industry, and universities but also to the general public. It is the basis of decisions made in many segments of the business world. While it is felt that the Federal Government should take the lead in developing an effective national organization for the transfer of information, it will not wish to proceed without the assistance and advice of interested groups. The system must be responsive to the needs of all users.

We therefore recommend that an advisory committee for scientific and technical information, respresentative of all groups concerned with information, be established to advise the central agency.

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Appendices

publishes accession lists and carries out some dissemination of information for 1 000 scientists in the department. In addition, it furnishes information to other agricultural organizations and the public.

Information Division

The Information Division is responsible for the gathering and dissemination of information arising from research work and from the development and regulatory programs of the department. This division gives service primarily to agricultural extension workers and to the public, but also serves agricultural research workers both within and outside the departmental organization. It works in close collaboration with agricultural agencies in the provinces, some of which depend almost entirely on the federal department for printed information. The staff of 75 currently prepares and distributes about 1.2 million copies of publications, prepares 500 news stories, 200 press releases, 10 000 radio tapes, and 80 short films a year. Subject matter includes agricultural practices, home gardening, and items of interest to the housewife. The division issues a *Guide to Federal Agricultural Services* which lists information services of all types in the department and in related organizations.

Scientific Information Section

The Scientific Information Section, with a staff of 40, collects, indexes, compiles, and analyzes information in various specialties, primarily for the use of research workers in agriculture. It also provides assistance in preparing, illustrating, and editing scientific articles for publication, and aids in the preparation of publications for, and in the interpretation of research work to, the general public. The section maintains several unique files of information: one records observations from the Canadian Insect Pest Survey, another lists all active agricultural research projects in Canada. Plans are being developed for an improved indexing system for these projects which would aid research management in the department and improve the dissemination of information to outside bodies and to the public. The section also maintains "Peek-a-boo" systems for the rapid retrieval of information on insecticides, herbicides, and fungicides licensed for use in Canada. The section answers about 1 700 technical enquiries a year by letter, besides many thousands of telephone calls in all fields of agriculture.

Other Information Services

The Markets Information Section is responsible for the compilation, publication, and distribution of market information on livestock, meat, wool, fruit, vegetables, dairy products, eggs, and poultry products. Its staff of 20 publishes market news for the principal Canadian markets and detailed information on Canada's international trade in agricultural products. The group provides farmers and dealers with price trends and ensures stable marketing prices throughout the Dominion. Information is disseminated by radio tape and by periodic releases mailed directly. It also maintains a record of international trade statistics in co-operation with the Dominion Bureau of Statistics.

The role of the Consumer Section is to provide a national service to consumers on the purchase and use of Canadian agricultural food products and to develop markets for these foods. A staff of 21 carries out research in consumer preferences and methods of using and preparing foods. The section collaborates with commodity divisions in developing and evaluating grade standards for agricultural products. Information concerning the various products is relayed to the consumer through the department's press, radio and television services, and through publications. About 240 000 copies of publications are distributed annually.

The objective of the Prairie Farm Rehabilitation Administration, with headquarters in Regina, is to provide services for the rehabilitation of drought and soil-drifting areas in the Prairie Provinces and for the development and promotion within these areas of farm products, tree culture,water supply, land utilization, and land settlement. The Information Section of this agency works in close co-operation with the departmental Information Division in providing a full range of information and public relations services. These include press releases, exhibits, photographic coverage, radio, tapes, brochure information, and related activities.

Atomic Energy of Canada Limited

Technical information services in Atomic Energy of Canada Limited (AECL) are operated by four units, one at each of the company's establishments, which are administratively separate but function in close co-operation. They are described collectively as the Technical Information and Libraries group. In addition, considerable quantities of STI are disseminated to the general public by the Public Relations organization of the company.

Technical Information and Libraries

The largest unit in this group is the Technical Information Branch of Chalk River Nuclear Laboratories, which has been in operation about 20 years. It includes the CRNL Library, which is Canada's principal nuclear library and, although not so designated, operates with full national and archival responsibilities. This main library also supplies books, journals, and reports to a number of smaller branch libraries located in the various laboratory buildings, on the philosophy that frequently used material should be readily available to the users, even if this requires some duplication of material. The branch is also the company's main centre for the publication and distribution of scientific reports and journal articles.

At the Whiteshell Nuclear Research Establishment, in Pinawa, Manitoba, the Information Services section is organized on a somewhat similar basis to the branch at Chalk River. It includes a library which is being developed at the rate of about 6 000 volumes a year to be a reference centre for nuclear sciences in the West. The other two establishments, Commercial Products, in Ottawa, and Power Projects, in Toronto, are each served by libraries controlled by qualified librarians. The total technical information and library staff for all establishments, excluding printing and photography, consists of 5 librarians, 7 information officers with scientific or engineering qualifications, and 37 support staff. The total operating funds for STI services are $829 000.

The Technical Information and Libraries group provides services mainly to AECL research staff but also supplies information and documents to Canadian industry and universities, and to the world's scientific community. The libraries contain good working collections in all those sciences that impinge on the nuclear field and augment these collections by about 10 000 books and 20 000 reports annually. They also subscribe to about 2 000 scientific and technical periodicals. All material received is catalogued and listed in regular accession lists, the main list being published weekly. The catalogues are at present manual but steps are being taken to computerize them, and at the Whiteshell establishment the possibility of a computerized catalogue combined with that of the library of the University of Manitoba is being studied. At the Chalk River library two computer systems are in operation, for the control of circulation of material on loan and for the control of periodical subscriptions.

The Technical Information and Libraries group administers formal agreements between Canada and about 30 other countries for the exchange of STI in the atomic energy field. These countries include the United States, the United Kingdom, the Soviet Union, several countries of western Europe, India, and Pakistan. The group also has informal agreements for exchange of documents with a number of foreign libraries and institutions. As a result of these arrangements, the AECL libraries provide almost total coverage of nuclear science reports. The group provides a distribution service for Canada covering reports and other documents collected from the atomic energy programs of the world, and makes loans of about 7 000 items a year to people outside AECL. Most of the demand is from Canadian industrial companies with particular interest in the nuclear field, and there is also a substantial demand from scientists in Canadian universities.

The group is also responsible for the publication of information generated in AECL. It reviews, or arranges for experts to review, reports and journal articles before publication and provides editorial assistance when required. Each year about 100 papers are submitted to journals, and about 120 AECL reports are published, distributed to interested organizations, and deposited in libraries throughout Canada and most other countries. About 800 internal reports for limited distribution are also produced annually. The group also supervises the release of restricted information.

The main tool for information retrieval at AECL is *Nuclear Science Abstracts* (NSA), published by the United States Atomic Energy Commission and containing about 50 000 abstracts a year. AECL co-operates in the production of NSA by collecting and supplying abstracts of all nuclear science material published in Canada. Most of the scientists at AECL carry out their own literature searches by using NSA and other abstracting and indexing publications provided by the Technical Information and Libraries group, but the information officers of the group also give assistance with searches and provide liaison with other information centres.

The group is negotiating with the International Atomic Energy Agency, in Vienna, for the provision of a mechanized information system in Canada. The Agency is developing an international computerized information service and it is proposed that AECL should supply an input of all relevant Canadian material and receive computer tapes containing the total input of references to the world's nuclear literature. AECL would then operate an information retrieval service, using these tapes, and make it available throughout Canada.

Public Relations

The Public Relations organization of AECL has as its objectives the dissemination of information on activities and progress in nuclear research and development in Canada, and the provision to the Canadian general public of information on nuclear energy and the Canadian nuclear program. There is close co-operation at all levels between the Public Relations organization and the Technical Information and Libraries group. At exhibits and conferences, the two groups frequently operate in direct collaboration.

The Public Relations organization, consisting of 9 professionals and 14 support staff, prepares and distributes press releases, brochures, pamphlets, and photographs, and maintains liaison with all media for public information. It plans and supervises motion picture production, producing about one new film a year in both English and French, and arranges for the showing of films to interested groups. It arranges for conducted tours of AECL establishments for the general public and for news media representatives.

Exhibits, including models and displays, are provided to the public at exhibitions, fairs, etc., throughout Canada and at public information centres at AECL establishments. These are supported by the distribution of large quantities of explanatory literature and by verbal explanations from Public Relations staff.

Dominion Bureau of Statistics

The Dominion Bureau of Statistics (DBS), under the Statistics Act, has authority "to collect, compile, analyse, abstract and publish statistical information relative to the commercial, industrial, financial, social, economic and general activities and conditions of the people". Although the information with which the bureau is concerned is rather more of a social or economic nature than purely scientific and technical, it is used by managers, scientists, and engineers in university, industry, and government departments. DBS has a total staff of 3 197 and operates on a budget of $23 780 900 (1967-68). It is subdivided into four main branches: Economic Accounts, Financial Statistics, Economic Statistics, and Socio-Economic Statistics.

The sources from which DBS obtains information can be classified in four broad categories:

(1) Households and individual persons in them;
(2) Firms and companies, incorporated or unincorporated, and their head offices and factories, plants, warehouses, retail outlets, etc.;
(3) Institutions, both private and public, e.g. hospitals, schools, credit unions;
(4) Government at all levels.

Sources of information can usefully be described as primary or secondary. Primary information refers to surveys undertaken by DBS of persons, households, and business establishments. Hundreds of such surveys are taken annually to collect information on a wide range of characteristics and activities, including the following:

(1) Census type information such as age, sex, marital status, occupation, ethnic origin, language, birthplace;
(2) Labour force status, e.g. employed, without job and seeking work, housewife, student;
(3) Education, housing and household facilities, rents, personal income, expenditures on goods and services;
(4) Number of employees of firms, their value and volume of sales, inventories and new orders, capital equipment purchased;
(5) Ton miles of freight carried;
(6) Number of acres in various crops and number of livestock on farms;
(7) Company profits, assets, and liabilities;
(8) Prices.

Secondary sources of information are primarily administrative records of information obtained by governments, not primarily for statistical purposes but rather to administer particular programs, for example:

(1) Registration of births, deaths, and marriages;
(2) Recordings of hospital admittances and discharges;
(3) Import and export Customs documents;
(4) Corporate tax returns;
(5) Government records of income and expenditure;
(6) Information arising from the operations of such organizations as the Wheat Board, the Department of Transport, the Courts, canals, etc.

The confidentiality of returns is a matter of law, prescribed in the Statistics Act, which guarantees the confidentiality of any individual unit of information provided to the Dominion Bureau of Statistics, which may not be published or released in any way to either private or public persons. This secrecy provision is strictly interpreted by the bureau and the only information which it publishes is that which can be derived from the individual units of observation without revealing the characteristics of any particular firm or person. While this permits the publication of a great deal of detail, it imposes important limits which users, particularly government users charged with program responsibility, find frustrating. However, a recent thorough, but as yet uncompleted, examination of the secrecy clause of the Statistics Act has indicated that it should be amended in only marginal ways. Some restrictions can possibly be modified without doing damage to the statistical system itself, but strong confidentiality laws and practices are essential to protect the quality of information provided by the respondents, who must feel confident that the information will not be used later in some other context and for some other purpose to their possible disadvantage.

In broad terms, tabulation programs are determined as a result of continuing dialogue between users and producers of statistics with the objective of providing the maximum legal amount of information which will be useful to the user. The constraints operating on the system are the financial, physical, and human resources available to produce tabulations. In this field, cost benefit ratios are exceedingly difficult to determine. Typically, tabulations published will be those which experience has shown to be of widespread interest sufficient to justify publication. There is wide variation in the number of users in receipt of various publications. For example, in the case of publications of statistics of revenue and expenditure of governments, the number of users is small, whereas in the case of statistics of employment in manufacturing, the number of subscribers is several thousand. Behind the published tabulations will be large existing and possible tabulations available to meet the requirements of specific users provided that provision of them does not contravene the confidential clauses of the Statistics Act. Requests for unpublished data are typically met with the customer being charged the marginal cost of their production. The scope and form of tabulations are determined by the available technology, the state-of-the-art of data processing at any point in time, and the interests of researchers in such fields as demography, economics, and sociology. As researchers become more sophisticated, so do their information requirements.

The DBS product is released in several hundred publications ranging from weekly to quinquennial periodicity and from one-page reports to the *Canada Year Book* containing over 1 000 pages. These publications are described in considerable detail in various catalogues and are available at nominal cost from both the Queen's Printer and the Dominion Bureau of Statistics. Copies are available in depository, university and community libraries. Current copies are maintained in the eight regional offices of the Bureau at St. John's, Halifax, Montréal, Ottawa, Toronto, Winnipeg, Edmonton, and Vancouver.

DBS has an Information Division which disseminates bureau publications and is developing a comprehensive user-oriented service, not dissimilar from the Technical Information Service of NRC and the Extension Service of the Department of Agriculture. A survey has been made of the various categories and fields of interest of DBS users. Booklets such as *How to Profit From Facts* and other educational material are being prepared to describe how DBS data may be used and the advantages of using it. DBS is also involved in the "publication" of data in machine-readable form. Large quantities of machine-readable data obtained from the processing of the 1961 Census have been sold, and a very great increase in the dissemination of machine-readable data is anticipated.

The detection and evaluation of demand are accomplished through formal and informal channels and personal contacts designed to reach government, business, and academic users and the public. Formal arrangements include conferences, committees, and panels. At the federal level, interdepartmental committees, usually sponsored by DBS, exist in almost every subject area. The 10 provinces have exclusive jurisdiction over "property and civil rights" and other local and private matters. Formal and informal relationships have evolved between DBS and provincial officials, and committees representing both exist in a variety of fields, e.g. education, economic statistics, vital statistics, mining, agriculture, crime, and public finance. Federal-Provincial conferences in these and other fields take place at regular intervals. A regional statistical staff has been created to strengthen channels of communication with the provinces, to keep DBS management informed of provincial and local statistical developments, to help increase awareness of DBS services on the part of provincial agencies, and to co-ordinate and, where necessary, carry out programs designed to increase availability of provincial and interprovincial statistics.

Both the physical and human resources available to prepare special tabulations are inadequate to meet the demand for statistical services. Probably the greatest inadequacy relates to the provision of special tabulations and the speed with which they can be provided, but in some areas requests must be turned down in their entirety because of inadequate facilities. More adequate facilities might be available if the cost of providing them could be recovered. At the present time, such revenues are not available as part of the DBS budget. DBS plans to automate its data processing substantially beyond the present. A submission for the installation of a large third-generation computer has been made to Treasury Board, and extensive plans are under way related to the utilization of such equipment for the tabulation, storage, retrieval, and dissemination of statistics. As an example of plans for the development of fully automated information systems there is the Canadian Socio-Economic Information Management System, which is expected to be a successor to a much smaller but currently operational time series data bank. Personnel from DBS, the Bank of Canada, National Energy Board, and the Economic Council of Canada have been deeply involved in the development of this system.

Department of Energy, Mines and Resources

Scientific and technical information services of the Department of Energy, Mines and Resources reflect its role as the main Canadian instrument for the study and development of earth, water and energy sciences, and related fields. The services are distributed throughout 9 of the department's 10 component divisions and maintained not only at headquarters in Ottawa but also at various branch locations throughout the country. They employ a total of about 150 persons, including librarians, information officers, programmers, and support staff, and account for an annual budget of almost $2 million. They are not centralized as a distinct element of the department but operate as functional parts of the divisions in which they were originally established, some of which antedate Confederation. The Editorial and Information Division furnishes editorial services to all groups on request and provides liaison with the Queen's Printer.

Library Services

There are six major libraries operated independently by the branches they serve. Close liaison is maintained among them and with the National Science Library. They have attempted to develop comprehensive holdings in their specialized fields and to extend their usefulness to specialists in industry and scientific organizations throughout Canada by interlibrary or direct loans. They prepare accession lists periodically and a few staff scientists are provided with selected accession lists of items of specific interest to their research. Translations of papers in foreign journals are provided on requisition by the Translations Branch in the Department of the Secretary of State. The six libraries and the specialized fields they serve are:

(1) Dominion Observatory Library: Astronomy, Astrophysics, Seismology, Earth Magnetism, Gravity, Earthquakes.
(2) Geographic Branch Library, including the Geographic Map Library.
(3) Geological Survey Library: Geology, Geophysics, Geochemistry, Palaeontology, Mineralogy, Mineral Deposits.
(4) Mines Branch Library: Mining, Mineral Processing, Industrial Minerals, Metallurgy, Ceramics, Fuels.
(5) Water Section Library: Oceanography, Limnology, Hydraulics, Hydrology, Hydrogeology, Glaceology, Geophysics and Water Quality.
(6) Surveys and Mapping Branch Library: Surveying, Geodesy, Cartography, Photogrammetry.

In addition, a collection of publications devoted to mineral resources and mineral economics, taxation and legislation is operated by the Mineral Resources Division.

Publications

Reports from the Department are usually put out in series and associated by name with branches e.g. *Mines Branch Research Reports, Geological Survey Bulletins.* These publications are prepared and technically edited in the branches, given final editing by the branch or by the Information and Editorial Division, and published by the Queen's Printer. In several branches, special reports are prepared for distribution within the department and for limited distribution to other interested organizations. These reports may contain results of special technical investigations, information obtained on visits to foreign organizations, summaries of recent scientific or economic activities or other topical or confidential information. A large volume of information is also released by publication of papers in scientific and technical journals. An estimated 225 papers in professional journals were written by scientists of the department in 1966. In addition, about 150 papers are presented yearly by departmental staff.

The Editorial and Information Division operates a general information service which prepares articles, booklets, brochures, and news releases for the dissemination of technical information to the public.

Publications are issued to depository libraries in Canada and to as many as 500 depository libraries around the world, usually by exchange arrangements. New publications are announced through the Queen's Printer's daily checklist, but most branches supplement this general service by branch lists mailed to major users. Most branches maintain special distribution staffs in Ottawa which combine the functions of information officers with the distribution of publications. In the case of topographic maps and hydrographic charts, about 66 per cent of the distribution is effected through a network of over 400 commercial outlets.

Data Services

Data services in the department are many and varied. There is as yet no general policy on release of these data to the public but factors concerned in such release are: industrial security, provision of time for the originator to publish his conclusions before release, and provisions to ensure equality of access to the data.

Some data files now in standard form are expected to be converted to computer operation in the near future. Data services include machine-processable and other files on many aspects of oceanography, limnology, geophysics, rock magnetism, seismology, aeromagnetism, seismic activity, gravity measurements, geomagnetism, star positions, well measurements, aero survey, and geographical information.

The largest data file in the department is probably that of the Canadian Oceanographic Data Centre (CODC), which has a staff of 17. The centre processes oceanographic data for the benefit of the Canadian oceanographic and limnological community while acting as the country's official agency for the exchange of oceanographic data, both in Canada and internationally. Since oceanography constitutes a multi-disciplinary science, CODC is concerned with data originating from all scientific disciplines applied to research in the oceans and lakes. The centre's main output is data records, including punched cards, magnetic tapes, microfilm, and microfiche, and is disseminated to the scientific community.

The Yellowknife Array is a large seismological research facility set up to investigate the possibility of teleseismic detection and identification of underground nuclear tests from a small number of stations. The output of 19 evenly spaced seismometers is recorded on tape, and digital computing facilities are being acquired to allow search of the tapes at twice present real-time speeds.

A data file is also maintained by the Dominion Observatory for regional and local gravity measurements. Field observations are reduced to appropriate data for both geodetic and geophysical investigations.

The Geological Survey Analytical Data Storage and Retrieval System (GEØDAT) will eventually be a tape-oriented system for the handling of all analytical results generated by the laboratories of the survey. The codes are mainly numerical and the system is somewhat analogous to a conventional file, having eight to twelve cross-references for retrieval purposes. The system will include catalogues, several data files, and the location file, all punched on IBM cards. The data files will include oxide and element analyses, isotope measurements, physical properties and sediment size analysis, and location files will give latitude and longitude and the equivalent UTM co-ordinates. The system is still in the process of development.

In addition to the above files, there are others which may be open to staff only or to staff and the public:

(1) The Mineral Occurrence Index in the Mineral Resources Division—open to the public;
(2) Central Technical Files of the Geological Survey—open to the staff;
(3) Geographic Branch Toponymy Information File—open to the public.

A wide range of reference collections is held in various parts of the department. These contain unique reference material, including holotypes, whose existence is essential to scientific study:

(1) The reference series of the National Mineral Collection;
(2) The Stellar Spectrogram Collection;
(3) Oil Well Core and Cuttings Collection.

These collections are open to accredited scientists and facilities are provided for examination. In many respects, use of these collections is analogous to use of a library, and specimens are provided on loan to accredited institutions.

Consultant and Field Services

Direct consultant services by scientists constitute a major part of the department's technical information services. In the branches that have over 90 per cent of staff classed as "research scientists", estimates of time per scientist devoted to these services ranged from 7 per cent to 20 per cent, and for the 40 scientific officers in the Mineral Resources Division the figure is 25 per cent. A weighted average for 1 200 research scientists, scientific officers, engineers, geographers, survey officers, etc., in the department might be 5 per cent. Considering that most consultations are provided by research scientists, engineers, and scientific officers, more commonly at senior than junior levels, the cost of this work in terms of salary alone approaches $1 million annually. Questions of a general nature may be answered by staff of the Information and Editorial Division, by library staffs in some branches and, if related to branch publications, by the distribution staff.

Field services to industry and the armed services in such areas as ore beneficiation and physical metallurgy require frequent and often lengthy visits by Mines Branch scientists to mining installations, foundries, metal-fabricating plants, electronic plants, and other industries. These scientists develop, in the laboratories, metallurgical, welding, smelting, and other processes, new alloys and materials for solid-state physics, and take them to individual plants for testing and production engineering. Conversely, problems encountered in industry are studied in the laboratories and suggested modifications are taken back to the plants. Other branches also provide field services to industry on such matters as water supplies, geographic location, and hydrographic data.

Special Services

Several special services provided by the department have information components, and a few examples are given. The time service of the Dominion Observatory provides time and frequency by direct wire to:

(1) Communication channels of the Canadian Broadcasting Corporation, the Department of Transport, the Department of National Defence, Bell Telephone;
(2) Scientific laboratories of the National Research Council;
(3) Observatories to control telescope drives and time seismic events.

It operates transmitters CHU on three wavelengths, broadcasting time and frequency to eastern North America 24 hours a day.

There are two special services provided by the Surveys and Mapping Branch. The Air Photo Library contains more than 3 million vertical, oblique, and tri-metrogen air photos indexed on 6 000 topographic map sheets and on 40 000 cards. It has a staff of 11, spends $500 000 per annum on new photography, and processes 10 000 enquiries annually, of which 90 per cent originate in Canada. It also provides information on air photographs taken for and held by the provinces of New Brunswick, Québec, Ontario, Alberta, and British Columbia. Photographs taken for the other provinces are held in the Air Photo Library.

Map and chart distribution offices distribute all maps, charts, and allied publications for Canadian users. The Map Distribution Office stocks 10 000 Canadian and 12 500 foreign maps and 300 gazetteers for direct distribution and through private dealers: 20 million items are stocked. A staff of 33 uses modern unit record equipment and a computer to maintain catalogues and produce notification lists. The Chart Distribution Office distributes hydrographic and special charts, sailing directions and allied publications, and will shortly distribute tide tables so that mariners' requirements are all available at a single source. The Chart Distribution Office stocks 950 navigational and 350 special charts plus sailing directions and allied publications. A staff of 12 is employed at a total salary of $55 000.

Ministry of Fisheries

Dissemination of scientific information in the Ministry of Fisheries is carried on by both the Fisheries Research Board and the Department of Fisheries.

Fisheries Research Board

The Fisheries Research Board (FRB) is concerned primarily with fundamental research on aquatic organisms and their environment. The head office is in Ottawa and research stations are maintained in Nanaimo, Vancouver, Winnipeg, Montréal, St. Andrew's, Halifax, Dartmouth, and St. John's. There is no centralized scientific and technical information service. Each station carries out a distinct research program and the research officers keep in touch with the general and scientific public as part of their duties. The board maintains libraries in each of the eight research stations. There is no library in the head office in Ottawa. Total staff in these libraries amounts to nine and the budget, although not obtainable as a separate item, is about $158 000. The board also employs three scientific consultants at Ottawa in biology, technology, and oceanography, and a scientist at Halifax to answer questions and disseminate scientific information.

The board relies heavily on its main scientific publication, the *Journal of the Fisheries Research Board of Canada,* for the dissemination of information to all scientists. The Journal is the largest biological science journal published in Canada and probably the largest aquatic journal in the world and, consequently, serves as an effective medium for the dissemination of Fisheries Research Board scientific material. The board has prepared subject and author indexes covering papers from 1901 to 1967 published by (*a*) FRB staff in FRB publications, (*b*) FRB staff in non-FRB publications, (*c*) non-FRB scientists in FRB publications. The office of the editor is responsible for the editing, production, indexing, and exchange of all FRB publications. In addition, the board maintains a publication exchange with all aquatic research organizations in Canada, the United States, and 100 foreign countries. It distributes translations of foreign scientific papers which have been prepared for FRB scientists. Information is also disseminated through meetings organized with industry for which FRB provides information on the current state of scientific knowledge, and the specialized services of the department supply economic and technical advice. Both the FRB and the Department of Fisheries take part in federal-provincial meetings and international conferences. Canada participates in seven international fisheries commissions and has four federal-provincial fisheries committees.

Department of Fisheries

The Resource Development Service of the department employs 96 scientists and engineers and provides technical information to fishermen and the industry on the maintenance of fish stocks, improved techniques for the development of fish resources, and advice on scientific management. The laboratories are distributed across Canada but library facilities are limited, the largest being in Vancouver. Information on fish processing and related matters is provided to the industry by Inspection Services.

The Information and Consumer Service Division, which reports to the Deputy Minister, has a staff of 26 and distributes general and some scientific information to the Canadian fisheries industry. It produces two scientific periodicals, the *Canadian Fish-Culturist* and *Canadian Fish Reports.* The chief libraries of the department, at Ottawa and Vancouver, are relatively small but, taken together with those of the Fisheries Research Board, contain a comprehensive collection of information on various aspects of the fishing industry.

Department of Forestry and Rural Development

Scientific and technical information is disseminated by three main sections of the Department of Forestry and Rural Development: the Departmental Library Services; and the Scientific Editing Services, in the Forestry Branch; and the Information and Technical Services Division, which reports directly to the Deputy Minister's office. These services employ 102 personnel and operate on a budget of about $1 400 000. The bulk of the information is transferred by the publication of papers in scientific and trade journals and the further distribution of reprints of these as departmental reports.

Library Services

The departmental library service consists of a central library in Ottawa, with responsibility for the provision of information to the whole department and branch libraries in the department's 16 research stations across the country. There are 5 professional librarians and 10 clerical staff in the central library and 6 librarians in the research stations. There are 90 000 volumes and other items in the central library and over 2 000 periodicals are regularly received. The library subscribes to

19 abstracting services, to the *Current Library Catalogue* of the U.S. Department of Agriculture, and to the Centralized Title Service, which is a card bibliographic service of current world forestry literature put out by the Oxford University School and a microfilm set of the Oxford University School of Forestry Library. Monthly library accession lists are published which go to librarians all over the world, while both periodicals and Xerox copies of "Tables of Contents" are circulated regularly to departmental field stations. Subjects covered, in addition to all aspects of forestry and related fields, e.g. meteorology, ecology, entomology and pathology, include biometrics, economics, trade in forest products, statistics, insecticides, air and water pollution, sociology and rural development, land use, and engineering. Although not so designated, the library has operated as though it had full national and archival responsibilities.

Editorial Services

Scientific Editing Services (Forestry Branch) is responsible to the Directorate of Program Co-ordination and is mainly concerned with editing and processing scientific forestry research manuscripts for publication in scientific and technical journals or as departmental publications. It originates the publication *Bi-Monthly Research Notes* on current projects and research results. A second editorial service is provided by the Central Editorial Service of the Information and Technical Services Division. This group provides technical and administrative service for all forestry publications produced by the Queen's Printer.

Information Services

The Forestry Information Service and the Rural Development Information Service are primarily information services to the lay public. These two services are also responsible for the dissemination of scientific and technical information through publications, films, and displays including lists of scientific papers. In addition, the Forestry Information Service produces popular articles for trade magazines, a catalogue of publications and the bi-monthly publication *Research News*. The Rural Development Information Service produces the *ARDA Report*, the *ARDA Catalogue*, and *ARDA News* to inform the public about the ARDA program. The Scientific Interpretive Writing Service assists both branches. Recent experience in the department has indicated the desirability of the production of information in French and English simultaneously rather than generation in one language and translation to the other. Staff are being recruited so that French and English versions will be developed simultaneously.

In addition to the above groups in Ottawa, there are seven regional information officers located across Canada fulfilling a public information function. Liaison groups also have been established in the seven regions of the Forestry Branch to disseminate technical information and the results of research.

In the Forest Pathology Division, the International Tree Disease Register (INTREDIS) provides a system for rapid retrieval of references by subject, country, host plant, organism causing disease, or by journal consulted. It is operated under the guidance of a committee representing five different countries.

A specialized system has also been developed for the rapid handling of geographic information by the Canada Land Inventory Group. This is a computer-based system for the acceptance and storage of location-specific information and consists of two parts. The "data bank" contains the data, and the "information system" is a set of procedures for moving data into the bank and carrying out manipulations, measurements, and comparisons of data in the bank. The system will accept data in the form of maps dealing with areas, lines, or points. It can compact the data and measure and compare any data obtained. Information can be retrieved and maps searched for a wide variety of data and information that can be related geographically.

Department of Indian Affairs and Northern Development

The Department of Indian Affairs and Northern Development has varied interests and many groups within the Department are concerned with information of a scientific and technical nature. The activities of those most involved with information dissemination will be discussed.

Library Services

The library, which has a total staff of 11 and maintains holdings of about 42 000 books and 1 000 periodicals and journals, supplies reference services to the department and to officials of other government agencies. It also gives assistance to students, to the general public, and some outside agencies. The fields of interest include anthropology, sociology, historical development, welfare, health, and international relations especially as related to problems of the North. There is considerable interlibrary consultation particularly with other libraries in related fields in Ottawa.

Northern Science Research Group

The Northern Science Research Group was set up to foster, through scientific investigation and technology, knowledge of the Canadian North and means of dealing with conditions relating to its development. The group has a total strength of about 20 and implements its responsibilities through a university grant program, the Univik Research Laboratory, and research undertaken in social science by its officers. Three research officers in this group are responsible for the collection of scientific information, particularly of a social and economic type regarding population, health education, welfare, and resources. The program is divided regionally with one officer responsible for Canada and Alaska, another for Scandinavia and Greenland, and another for the Soviet Union. The program involves primarily the collation of existing information which is made available to researchers on request. The group has an active publication program with the emphasis on the publication of results of current research projects in report form.

Canadian Wildlife Service

The Canadian Wildlife Service employs 84 biologists and is responsible for wildlife research in the National Parks and in the Yukon and Northwest Territories. The Service has a national responsibility for migratory birds, through the Migratory

Birds Treaty between Canada and the United States. Arising out of the National Wildlife Policy and Program tabled in the House of Commons in 1966, the service co-operates with the provinces on wildlife problems that flow outside the provincial boundaries. The service provides scientific publications, public service television spots, movies, interpretive articles for the popular press, and contributes papers to scientific journals. It has three main series of publication: *Progress Notes*, which can be issued quickly and deals with the results of surveys and interesting developments in research programs; the *Canadian Wildlife Service Report Series* which handles reports on research studies, and the *Canadian Wildlife Service Monograph Series* which deals with the biology of individual wildlife species. Information is published in both French and English. The need is felt for an automated information system which might be used jointly by the U.S. Bureau of Wildlife Service, the Canadian Wildlife Service, and State and Provincial Game Agencies. It is suggested that this might be funded on a co-operative basis by the two federal governments.

Indian Affairs Branch

The Indian Affairs Branch provides an information service to Indian people on an *ad hoc* basis upon demand through various professional and technical staff and through other government agencies and consulting services. For this purpose the Resource Development Section is essentially a consumer of information and contributes little to the general fund of information. The Minerals Section administers the mineral resources in Indian lands under the terms of the Indian Oil and Gas Regulations and the Indian Mining Regulations. The Regulations require oil companies or mining companies exploring or developing the mineral resources to submit technical reports giving information on the results of geological, geophysical, and drilling operations. These technical reports are maintained in Calgary and Ottawa offices of the Indian Affairs Branch and remain in confidential status for a number of years in accordance with the policy of the province in which the reserve is located. These reports may be examined when released from confidential status or if the author of the report has given special permission for its release. No library facilities are provided for this information and the demand for interrogation of the files does not warrant the development of special handling facilities.

Resource and Economic Development Group

This group provides information dealing with water resources, mining activities, and oil and gas exploitation. The Mining Section publishes statistical reports concerning claims, accident statistics in operating mines, and an annual report, *Mining in the North,* giving details of calendar year activities in respect of mineral exploration, mining development, and producing mines in the Yukon and Northwest Territories. The Oil and Gas Section administers oil and gas rights in the two territories and compiles annual reports and the monthly *Oil and Gas Report.* It also holds technical reports available for inspection by the public.

Engineering Division of Northern Administration Branch

The division is responsible for all aspects of mapping, settlement planning, engineering and architectural design, construction of roads, municipal services, buildings and other installations and their operation and maintenance in the Yukon and Northwest Territories. The division also has some responsibility in Arctic Québec. Information is recorded on plans or texts and filed by settlements with certain information also gathered by subject. The information is gathered as follows:

(*a*) Aerial photography of all settlements obtained through the Interdepartmental Committee on Air Survey. Maps are prepared showing the present status of aerial photography, ground control, mapping, availability of site plans, low-cost housing programs, various activities, e.g. road, water and air transport, etc.

(*b*) Planning studies involving surveys and analyses of physical, social, economic, and cultural conditions in settlements as a basis for the establishment of site development plans. Included in these reports is information on local soils and geology, permafrost, wind, precipitation, snow drifting, freeze-up, break-up, sources of engineering materials, population economic base, resources, existing buildings and installations, etc.

(*c*) Investigations carried out to obtain the essential engineering data for construction programs and municipal services including the supply, storage, and distribution of potable water, the collection and disposal of sewage and garbage, supply of electrical energy, supply of oil and other fuels. There is close liaison with the National Research Council, and the Department of National Health and Welfare on sanitary engineering, various construction systems, and materials. Information is filed by settlement or subject and is readily available.

(*d*) The operation and maintenance of equipment, buildings, and services in the North. The division studies the northern adaptability of equipment and materials, and is responsible for the approval of new types of equipment or modifications to existing equipment intended for use in the North.

National and Historic Parks Section

The National Parks Service operates a system of 19 national parks across Canada and is responsible for natural history interpretation in these parks. The disciplines involved are related largely to geology, zoology, and geography. Interpretive research in the parks is as yet in its early stages. It is planned to have a collection in each park of all research and other information relating to the natural history of the park. The program is expected to develop in conjunction with the International Biological Program. The National Parks Service also provides information through individual reports and in response to individual requests. Abstracts of current Canadian recreation literature are supplied to the Bureau of Outdoor Recreation, U.S. Department of the Interior, on a co-operative basis. There is no formal information service within the Parks Service. It is planned to develop an information service on outdoor recreation in Canada which will require the computer storage of information. Such a system will then be capable of supplying information to other government departments, provincial governments, universities, and other groups.

The National Historic Sites Service is responsible for the provision of historical, archaeological, and anthropological research required for the selection, development, and interpretation of national historic parks and sites throughout Canada, and for the establishment and maintenance of a National Architectural Inventory. A new scientific publication series has just recently been established and it is anticipated that this will meet most of the requirements for the dissemination of information.

Department of Industry

The role of the Department of Industry is to promote and facilitate the efficient expansion of Canadian secondary industry. In more specific economic terms, the department is concerned with the twin objectives of raising the level of productivity and improving the competitive positions of Canadian industries.

To date, information services of the department are twofold: first, an Information Division which issues various publications prepared within the department concerning business opportunities in Canada and the advice, assistance, and information available to industrial companies from government departments; second, a library to serve the needs of departmental staff for information pertinent to the execution of their duties. The library is a new unit and is presently organizing its resources and developing its service. The information needs of the department are very broad and embrace statistical data, economic and financial matters, and scientific and technical information relevant to the whole gamut of secondary manufacturing activity in Canada.

Incentive programs designed to encourage industrial firms to expand research and development activities have been introduced by the department. Experience with these programs and studies of individual industrial sectors of the economy undertaken by the department have drawn attention to the general need for increased utilization on the part of industry of the wealth of information of all kinds that is available. The chief difficulty inhibiting the exploitation of published information appears to be the lack of any comprehensive organized attempt to provide for the specific information needs of individual companies in a simple and speedy manner. There are many sources of information and expertise that could be exploited but the industrial employee does not have the time nor the inclination, in most cases, to identify and locate those most appropriate for his immediate needs. Delays in obtaining information once a source has been located also often vitiate the effort that has been expended since industrial problems must be dealt with promptly.

In view of the benefits which it is anticipated would accrue from the widespread accessibility and utilization of scientific and technical information by industry, the department proposed the present Study and encouraged the Science Secretariat to assume responsibility for its execution. As part of the BEAM program, it has also made an in-depth study of the needs of the construction industry for improved information services, and is currently analyzing the results with a view to placing before the industry proposals for the gradual evolution of a comprehensive information system serving the needs of all concerned with construction activity.

Ministry of National Defence

Documentation and information services in the Ministry of National Defence include the departmental libraries and information services as well as the facilities of the Defence Research Board (DRB). The former is more concerned with engineering and development, while the latter is largely research-oriented.

Defence Research Board

The Defence Research Board's scientific information services are twofold. They include seven libraries in the various Defence Research Board establishments across the country, and the Defence Scientific Information Service (DSIS) located in Ottawa, serving DRB headquarters and one establishment directly.

The establishment libraries have a total staff of 6 librarians, 1 information scientist, and 20 supporting staff, while DSIS has 16 professionals, including 12 scientists and 1 librarian with about 50 supporting people. The budget for these services is not readily separable from the operating groups but can be estimated at approximately $688 000. Since each establishment has been set up for a particular function, there is little overlap of information requirements and each library does its own ordering and cataloguing. The establishment libraries collect published information in their own fields and act as the local agents for DSIS in disseminating unpublished or classified documents in these fields. About 2 500 books are added annually and 2 000 periodicals received regularly. DSIS maintains total holdings of about 340 000 documents, mainly classified or otherwise limited in availability, adding to them at the rate of about 20 000 titles a year. Up to 20 000 titles a year of unclassified material are obtained in microfiche form from the U.S. Clearinghouse for Federal Scientific and Technical Information and are reproduced for distribution when required.

Although about 50 per cent of the information handled is not classified or otherwise restricted in its distribution, the information activities of DRB are largely determined by security considerations. Some of the documents are classified by the country of origin and restricted in number of copies and circulation. Some of DRB's reports are also classified. Thus, DRB must have a centralized system for obtaining, disseminating, and controlling this type of information, and the service also provides for selective acquisition. Users serviced by DSIS include all branches of the Department of National Defence, the Canadian Armed Forces, the Department of Defence Production and its defence contractors, the Emergency Measures Organization, and other departments or agencies co-operating in defence research. The mandate of DSIS is limited to providing information for defence purposes.

The chief feature of DSIS is a group of 10 information scientists, each of whom covers a field defined partly by discipline and partly by military application. Each information scientist serves about 50 to 70 scientists or engineers, keeps up with the work they are doing, and supplies needed information. He secures releases of pertinent documents, decides who should see them, and sets priorities for seeing them. He also ensures that each document is catalogued, abstracted, and indexed for future retrieval. Catalogue cards are used for printing accessions for document control and are sent to certain users as part of a system for selective dissemination of information.

Responses to requests for information may be of several types, e.g. abstracts, documents, or prepared bibliographies. Qualified users, however, are encouraged to use the catalogue themselves. Plans are being developed for the automation of procedures for supplying information. Areas being considered are the acquisition and circulation of books and journals, the announcement and circulation of newly acquired documents, and the retrieval of information from the holdings and abstract journals. DSIS publishes all material prepared in or for DRB headquarters and supplies professional advice to the laboratories on the preparation and editing of their research reports. The distribution of all DRB reports is centralized in DSIS, which lists about 700 titles per annum. DSIS has a translations section which works on foreign scientific literature related to DRB's research interests. About 40 to 50 translations are made each year, many of which are distributed widely.

Internationally, DRB is represented on the Technical Information Panel of AGARD/Nato and on the Commonwealth Defence Science Organization. DRB also participates in The Technical Co-operation Program (TTCP) with the United States, the United Kingdom, and Australia. It maintains liaison offices in Washington, London, and Paris, through which documents are received.

Department of National Defence

In the Department of National Defence (DND) there is a main library and until recently there were five branch libraries set up to serve particular sections of the three services–one for the military, three for the navy, and one for the air force. During the last year these five libraries were combined into one available to land, sea, and air forces under the Chief, Technical Services Branch. Its holdings consist largely of engineering handbooks and classified reports. The main library is a co-ordinating centre for loans, purchases, etc. The staff of DND may borrow material from either library. Some use is also made of the facilities of DSIS. All purchases of books and periodicals are made by an agency in the Deputy Minister's office after being cleared through the main library. Funds for the operation of the military library are not available as a separate item and no professional library personnel are employed in it.

Department of National Health and Welfare

Communication responsibility is written into the basic legislation under which the department operates. Section 5(*h*) of The Department of National Health and Welfare states that:

> "Subject to the provisions of the Statistics Act, the duties, powers and functions of the Minister include the collection, publication and distribution of information relating to the public health, improved sanitation and social and industrial conditions affecting the health and lives of the people."

Provision has been made for the Minister of National Health and Welfare

> ". . . to co-operate with provincial authorities with a view to the co-ordination of efforts made or prepared for preserving and improving the public health and providing for the social security and welfare of the people of Canada."

Various units of the department are concerned with the physical, biological, social, and medical sciences and, in particular, public health, dentistry, pharmacy, and veterinary medicine. Besides its main library, the department operates a number of smaller libraries, film libraries, and an information retrieval centre concerned with drug specifications and reactions, and acts as a primary source of information in certain fields of health. Scientific and technical information services in the department as a whole employ a staff of about 200 and account for an annual budget of almost $2 000 000. While most of the material is strictly scientific in nature and designed for medical practitioners and scientists working in the health field, some is a mixture of scientific and statistical data, and still more consists of general publications designed for the public at large.

Information services are provided mainly by the Directorate of Information Services, the Departmental Library, the Directorate of Research and Statistics, the Food and Drug Directorate, the Health Services Branch, the Health Insurance and Resources Branch, the Medical Services Branch, and the Fitness and Amateur Sport Directorate of the Welfare Program. The services offered by the various information groups in the department reflect the activities of the divisions to which they are attached, only a part of which are scientific and technical.

Information Services Directorate

The Information Services Directorate is responsible for the preparation, production, and dissemination to the public of informational material related to the activities of the department. It has a staff of 51 and produces both general and science-based information in the various fields covered by the department. Individual divisions have their various items published through the Information Services Directorate, the cost of the items being charged to the division initiating the project. The resources of the directorate include a printing production staff, a press clipping service, a distribution section, four film libraries, and a biological and general photographic service including a film library and a theatre.

Library Services

The departmental library supports the work of the numerous divisions and consultants of the department with about 75 000 books, 2 500 journals, and a wide variety of pamphlets, monographs, and bibliographic subscription services, with particular emphasis on the medical and health sciences. At present it has an establishment of 25 persons and a budget of $159 000. It supplies material requested by departmental and outside users, in Canada or elsewhere. It has been officially designated to receive all published World Health Organization documents, and has undertaken several international commitments. A notable example was the organization of the Colombo Plan Medical Book Scheme, whereby medical books were made available to 76 libraries of medical schools from a classified list of 600 volumes selected by the library. The library prepares lists of selected accessions. Plans have been made for an extensive expansion of facilities and services within the next few years.

Other Services

The Research and Statistics Directorate is responsible for the collection, analysis, and evaluation of basic information on the socio-economic aspects of health, welfare, and social security. It employs a staff of 82 and provides information of a technical nature to government officials, international agencies, and members of the general public who request information. It conducts surveys and places technical information in bulletins, reports, and papers, and compiles inventories or research projects in hospital administration, medical care, and welfare research. In the Food and Drug Directorate, the Information Retrieval Centre maintains a staff of 12 professional persons and 8 supporting personnel. Using the Termatrex and Recordak Miracode systems, the centre acquires and indexes 2 500 documents a month concerning rulings and decisions on foods and drugs. It abstracts, classifies, codes, and films all human and veterinary preclinical drug submissions, as well as those on pesticides, food additives, cosmetics, and medical devices submissions. It classifies, codes, and films drug notification forms, provides retrieval of information from the above-mentioned input sources, compiles reports and surveys, and prepares literature reviews and bibliographies. The Consumer Division in this directorate, with a staff of 13, supplies directly to the general public and through consumer associations, pamphlets, consumer memos, slides, etc., on foods, drugs, cosmetics, and medical devices.

In the Health Services Branch, advice and consultation are provided by about 30 people on a part-time basis on all aspects of public health to provincial and municipal governments and health and welfare agencies. The divisions of Nutrition, Epidemiology, and Health Education act as sources of information in their respective areas. The Health Insurance and Resources Branch operates a small facility with one person supplying information in the field of health facilities and matters related to the operation of the Health Resources Fund, the Medical Care Act, and related programs. The Medical Services Branch furnishes information to field operations and to segments of the public concerned with immigration requirements, quarantine regulations, and northern health. It has been estimated that the total costs of information facilities of these groups amount to about $120 000 a year.

The Canadian Documentation Centre for Fitness and Amateur Sport, which is administered by the Welfare Branch of the department, is a depository for scientific and professional information in this field for use by the public. The annual cost of operation of the centre is about $25 000.

National Museums of Canada

The library of the National Museums of Canada had its beginnings with the Geological Survey of Canada in the 1840s, when field geologists reported on the natural history and native peoples in the areas of their surveys. In 1868 a geological museum was designated, and in 1877 museum functions were set out by Acts of Parliament. The anthropological and biological work was separated from the Geological Survey in 1920 and placed under a director of the Victoria Memorial Museum. When the survey moved into its own building in 1959, the Museum's library retained about 40 000 volumes concerned mainly with the life sciences. The present book stock is in excess of 60 000 volumes plus much uncounted material.

Areas of research in the Museum include botany, palaeontology, zoology, and mineralogy. In the Zoology Division, a recent addition is the Canadian Oceanographic Identification Centre, set up to satisfy the needs of Canadian biological oceanographers for a national sorting and identification service centre for zooplankton. The new Museum of Science and Technology, opened in 1967, is concerned mainly with the collection and display of scientific and technological history and advances, particularly in Canada. In the human sciences, the National Museum of Man studies the archaeology of Canada and physical anthropology, besides other subjects of a less technical nature. Conservators study and experiment with chemical formulae, plastics, and the various aspects of the preservation of artifacts and specimens.

To support these studies the library collects by purchase, gift and exchange books, journals, reprints and microforms, and catalogues and indexes them for Museum research staff. Visiting scholars, libraries or universities, learned societies, and research institutions also have access to the collection by personal visit and by interlibrary loan. The largest collection is in the natural sciences, and significant holdings are in early imprints of systematic research, long and complete runs of learned journals, and of bibliographic tools of the subject field of study.

A main library in the Victoria Museum building serves all branches by acquisition of material, cataloguing, interlibrary loan, and bibliographic research. Branch libraries and deposit collections have recently been established and others are planned. At the main library are held publications of learned societies which embrace multiple disciplines, and major reference tools such as directories, encyclopaedias, union lists, catalogues, indexes, and bibliographies. In addition, this library holds the publications of museums, rare books, most of the zoological collection, and publications on mammology, ornithology, and mineralogy.

The library has been the recipient of several collections by purchase and by gift. Among these are valuable collections in bryology, lichenology, and palaeontology.

The library makes use of multiple-form orders; it employs Library of Congress cards and makes generous use of photocopying equipment and microforms. Full co-operation is maintained with the National Library and the National Science Library as well as other Ottawa libraries. For 1968, it is proposed to use departmental data-processing equipment for handling subscriptions. The library is considered to be the potential national collection for natural history and anthropology, falling between the responsibilities of the National Library and the National Science Library.

National Research Council of Canada

The National Research Council of Canada (NRC), operating under the National Research Council Act, "has charge of all matters affecting scientific and industrial research in Canada that may be assigned to it by the Committee" (i.e. the Committee of the Privy Council on Scientific and Industrial Research). It may "undertake, assist, or promote scientific and industrial research". Furthermore, "The Minister may authorize the President to approve on his behalf the publication, sale, or other distribution by the Council of scientific and technical information". Within NRC, the agencies which carry the greatest responsibility for the dissemination of scientific and technical information are the National Science Library and the Technical Information Service, which are described separately. Each division of NRC, however, also provides extensive information services by means of publications reporting the work of the divisions and by providing answers to requests for information through correspondence, telephone conversations, and personal contacts. The Division of Building Research has probably one of the most highly developed information services and is described separately.

The basic policy of the National Research Council is to publish the results of research in established scientific journals. Approximately 700 such papers are published annually, including about 200 that are published in the eight Canadian Journals of Research. Information that is not suitable for such publications is printed as technical reports, particularly by the Divisions of Building Research, Radio and Electrical Engineering, and Mechanical Engineering, and the National Aeronautical Establishment.

National Science Library

The National Science Library is organized as a division of the National Research Council, and the chief librarian reports to the Vice-President (Administration). It was originally set up in 1925 to serve NRC scientists and engineers, but in recent years has been operating as a national science library. In 1966 authority was granted the National Research Council to "establish, operate and maintain a national science library", and the original NRC library has now formally adopted these dual responsibilities. It consists of the main library on Sussex Drive and five branch libraries at the Montreal Road site serving the Divisions of Building Research, Applied Chemistry, Applied Physics, and Radio and Electrical Engineering and, jointly, Mechanical Engineering and the National Aeronautical Establishment. A sixth branch at Uplands Airport serves sections of the National Aeronautical Establishment located at that site. The total budget of the whole operation amounts to almost $1 500 000. The main library, with a staff of 67, functions as the administrative centre for the entire system with major acquisition and cataloguing facilities. The branch libraries, with a total staff of 26, serve primarily as working collections with some duplication of the main library's holdings, and are designed to meet the special needs of the division in which each is located. Three branch libraries—the Aeronautical Library, the Building Research Library, and the Radio and Electrical Engineering Library—process and use large collections of technical reports, which are unique in the library's system. Close co-operation is maintained between the various library units for maximum accessibility of material to all borrowers. Development of applications of computers to library operations has been facilitated by the installation of a remote console station in the main library which is linked to the National Research Council's computation centre at the Montreal Road establishment. Before 1967 NRC scientists were the largest users of the library's resources, but now the total number of requests from outside the NRC for scientific and technical information, literature searches, and compilations of bibliographies exceeds those from NRC.

The main library consists of two major units, the Technical Services Section and the Science Information Services Section. The Technical Services Section is concerned with the acquisition and cataloguing of books, periodicals, and reports. The library's collection in all fields of science and technology consists of over 725 000 books, bound periodicals, pamphlets, and technical reports, and is increasing at the rate of 6 per cent a year. This represents the largest scientific collection in Canada. The library currently receives over 16 000 journals, including 500 in Russian obtained through an exchange agreement with the Academy of Sciences, U.S.S.R., and many in Chinese. Recently, the National Science Library was assigned the responsibility of serving as the national bibliographic centre for the medical and health sciences. In keeping with this enlarged responsibility, the library is rapidly expanding its existing collection of medical journals. At present, emphasis is being placed on the acquisition of foreign-language medical journals not available in Canada. The point has now been reached where most of the journals indexed regularly by *Index Medicus* are now being received. The library also acts as a depository for all publications issued by organizations such as the U.S. Atomic Energy Commission, the Rand Corporation, the National Aeronautics and Space Administration, and the U.S. Clearinghouse for Federal Scientific and Technical Information. More than 20 000 technical reports in microfiche form are received each year from the last-named organization. The library also receives more than 360 abstracting and indexing services.

The library publicizes its resources and services by means of a computer-compiled and printed list of titles and holdings of journals distributed to all libraries and interested organizations in Canada, and by means of bulletins, partial lists of new materials, and new editions of the *Union List of Scientific Serials in Canadian Libraries.* The last-named publication shows the titles, holdings, and locations of scientific, technical, and medical journals received by all the major libraries in Canada, and utilizes a computer for storage of the bibliographic records and for printouts.

The Science Information Services Section, staffed by librarian-scientists, answers requests for scientific information, carries out literature searches, compiles bibliographies, and provides a limited service for the selective dissemination of documents not only to scientists and engineers in NRC but to universities and other outside agencies. About 12 000 information enquiries are dealt with yearly, and an average of 300 requests for photocopies or loans are received each day from the scientific community. This service is facilitated by the use of Telex. In addition, many industries with specialized interests deal directly with the appropriate branch library.

The Translations Section, with a staff of seven, prepares English or French translations of foreign-language papers. Such translations, now numbering 1 300, are published in the library's *Translation Series.* The library also maintains the Canadian Index of Scientific Translations, giving the location of more than 200 000 translations of foreign scientific papers prepared in all parts of the world.

The National Science Library has a continuing program for the evaluation of equipment used in libraries and works closely with NRC scientists in assessing new procedures such as current awareness by selective dissemination of documents utilizing computer tapes. For six years it has operated an in-training program to assist science and engineering graduates to enter the fields of documentation and science information.

In all its activities the National Science Library seeks to complement and supplement local information resources and services rather than supplant or replace them. The purpose is to encourage libraries in all parts of Canada to develop resources which will meet the normal scientific and technical needs of the communites they serve.

Technical Information Service

The Technical Information Service (TIS) was formed in 1945 for the purpose of assisting in the technical development of medium and small industry in Canada. It forms a distinct technical information service separate from that provided by the National Science Library, and its head reports to the Vice-President (Scientific) of the National Research Council. The service, which is free, draws upon the wide industrial experience of its own staff, the National Science Library, scientists and engineers in NRC and other government departments and agencies, industrial sources and foreign technical information centres for the information it supplies. Its chief characteristic is the field service through which it maintains direct personal contact with companies. TIS, with a staff of 48 and a 1967-68 budget of $804 000, is organized into three main sections: Technical Inquiries, Industrial Engineering, and Technological Developments. The 22 professional staff in Ottawa are university engineering graduates with from 5 to 30 years production experience in industry in the mechanical, chemical, and electrical engineering fields.

The Technical Inquiries Section answers questions on a wide range of matters related to industrial processes and engineering sent in directly by companies or through the field offices. Such information is of particular value to those firms that may have limited or no engineering or technical staff. It is also of value to larger companies that may not always be able to cover fully their own specialized field, let alone associated fields that have a bearing on their work. All fields of industry are covered including mechanical, chemical, and electrical engineering, applied physics, the properties and processing of all metallic and nonmetallic industrial and construction materials, food technology, packaging, and standards and specifications.

The Industrial Engineering group provides information on managerial functions, office administration, and production operations to small companies which are not aware of industrial engineering techniques that can be applied in these areas to improve plant productivity, or cannot afford to employ expert consultants to assist them. Experienced industrial engineers visit individual companies on request to advise them how to collect relevant facts and data, how to analyze this material so as to recognize and identify problem areas, and help them decide what corrective action to take. They investigate processes, consult with staff, and may spend several days, spread over several weeks or months, in assisting the company to implement the suggested modifications. Fields covered include methods improvement, work measurement, plant layout, materials handling, organization, and quality and cost control.

This group also helps larger companies, as neutral advisers, to establish parameters of work before the employment of professional consultants, or to initiate or expand industrial engineering organizations within their company. Information on new, sophisticated, or specialized industrial engineering techniques is provided to industrial engineers in such large companies.

Considerable effort has been and is being made, in co-operation with educational authorities, to promote and assist in the establishment of work study schools, work study courses in technical high schools and institutes of technology, and industrial engineering courses in universities. The introduction of such trained personnel into industry thereby makes the work of TIS much more productive, and TIS not only encourages firms to send the staff for training but provides the schools with follow-up reports on their pupils' progress in industry and a continuous feedback as to industrial training requirements.

The Technological Developments Section operates directly from Ottawa to keep companies aware of new advances in technology and research applicable to

Canadian industry. This is done in several ways, including provision of reviews or reports covering the state of the art, and lists of up-to-date literature references in individual technical or industrial fields, a film loan service providing commercial films of new production processes and industrial engineering techniques and, of primary importance, the mailing of checklists of titles of technical articles to individual companies listed in particular fields of industry. These items include research results, engineering developments, improved processes and techniques, new products and worthwhile innovations selected by engineers with production experience as being of potential interest to the various sections of Canadian industry. A further refinement of this latter program now being developed will provide selective dissemination of information to specific companies. Their interest profiles, as listed by them, will be matched by computer against material available, and technical briefs, selected by the company from the list compiled by computer from them, will be supplied. Expansion of the film service to include short filmstrips to be shown with portable projectors and covering new techniques and processes not available on commercial film, is being investigated.

In addition to the staff at Ottawa, TIS maintains the equivalent of about 30 liaison officers in 11 field offices across Canada, accounting for about $450 000 of its budget. With the exception of five field officers in Manitoba, Québec, and Ontario, these officers are employed in the field services of the provincial Research Councils, which receive TIS grants to cover the technical information part of their activities. TIS field officers must be highly competent and have considerable industrial experience to obtain the confidence of industry. Their sources of information include their own knowledge and experience, that of associates in their own Council, in the provincial government, or industry, and the TIS staff in Ottawa. The field officers are key men in the TIS organization and without them its work would be not nearly as effective. The field officers of the provincial Research Councils, besides providing information, often provide technical assistance to firms in applying it.

TIS handles about 14 000 enquiries each year, more than half by letter. Most of the replies are filed for future use, since new enquiries very often duplicate old questions on essential points. It is estimated that about 75 per cent of the 34 000 companies in Canada do not make adequate use of technical information. With existing staff, TIS finds it impossible to cover industry adequately in Ontario and Québec, which contain about 73 per cent of Canadian industry. In other provinces, the coverage is relatively much better and TIS representatives are able to visit most companies upon occasion, although not as frequently as desirable. The time required to provide replies from Ottawa amounts, on the average, to about three weeks which normally is acceptable, although urgent enquiries may be handled by telephone. Longer delays are undesirable but do occur in some enquiries, because of work overloads or uncontrollable delay in obtaining information from outside sources. It is difficult to estimate the value of the enquiry service provided to industry. However, the fact that 50 per cent of enquiries originate from companies that have used TIS previously, many of them over long periods of years, indicates that the service is useful.

There is no problem in evaluating the results of the industrial engineering service in dollars and cents, and the demand for this service far exceeds the capacity of the staff owing to referrals from satisfied clients and requests for further assistance. Recruitment of qualified industrial engineers, scarce in Canada, poses a continual problem to TIS and industry.

Response of industry to the Technical Development Program through letters, questionnaires, and requests for information items has indicated a definite interest and need in both large and small industry, further borne out by the co-operation of some 3 000 companies in forwarding profiles of their individual interests to TIS. Lack of staff has prevented sufficient material being sent out to evaluate the experimental system now being used or to originate better methods. Studies in depth of user needs, faster and more efficient means of meeting these needs, and ways of ensuring effective usage of the information within the user organization are required.

Many technical enquiries from foreign countries are referred to TIS, which answers them as part of the informal international exchange of such enquiries. Interest is being displayed in some international organizations in setting up an international technical enquiry-and-answer network. If this should happen, TIS would be the logical Canadian organization to participate in its particular field. It already has informal arrangements with the Greek Productivity Centre and the Singapore Light Industries Services Unit to answer technical enquiries beyond the scope of their limited technical and scientific libraries. It has trained a Greek engineer, a Syrian technical information officer, and a Trinidadian engineer in the procedures and techniques used by TIS. These experimental efforts indicate that this is a form of external aid that meets an existing and universal requirement in industrially developing countries in a most practical way and at a very low cost, covering the salaries of the staff concerned and the small operating cost for office space, duplication, and mail services.

The main problems facing TIS are lack of an adequate personnel establishment, operating budget and trained personnel, particularly industrial engineers, to catch up on the existing technical information needs of Canadian industry, let alone providing for future industrial activity which is increasing in both physical size and sophistication. The possibility of extending TIS services to larger companies in appropriate ways should be considered, as well as its participation is some simple form of external aid on a formal basis.

Division of Building Research

The Division of Building Research (DBR) was established in 1947 to provide an information and research service to the construction industry. Information may be supplied from the division's library, from personnel within the division, or from other institutions in the construction field. If the information is not available, research may be done to obtain it. The division has two main groups: Building Science, which does work in the laboratory; and Building Practice, which receives requests and transmits information to industry. Thus, the work of this division is unique in that its entire program is oriented to supplying information to the building industry. The division also operates regional stations at Halifax, Saskatoon, and Vancouver to provide improved service in those areas, and is making arrangements for branch offices in Montréal and Toronto to handle local enquiries. Total staff of the division is 230 and its budget is \$2 700 000. The general policy of DBR is guided by the Advisory Committee on Building Research.

DBR has its own library which operates as a branch of the National Science Library. Its budget is about \$50 000 but purchases are made through the main library. The library not only serves the division but acts as a national library for the construction industry of Canada and is so recognized. It is linked through personal connections and through *le Conseil international du bâtiment pour la recherche, l'étude et la documentation* (CIB) with other similar libraries throughout the world. The library issues monthly accession lists and yearly lists of book holdings to approximately 400 other libraries and contruction firms. It acts as the depository for DBR films and for films dealing with construction on loan from other countries.

The division issues several types of publication through its publications section, which is responsible for the editing, processing, and distributing of all publications. Printing is carried out through contract printers. The section maintains 21 separate mailing lists and every month sends out 9 000 advices regarding additions to the publications list. In 1966, it distributed 689 000 copies of its publications, mainly throughout Canada. Publications include monthly *Canadian Building Digests,* the quarterly *Building Research News,* the *Annual Report of the Division of Building Research, Housing Notes, Fire Research Notes, Building Research Notes, Bibliographies, Better Building Bulletins, D.B.R. Bulletins, Technical Translations* and research and technical papers. The division also records computer programs developed for its own work, and publishes several internal reports. Both French and English are used as far as possible.

In addition, the staff of DBR visit every university in Canada each year to keep in touch with new graduates. They hold two seminars each year for the construction industry, one in Ottawa and one in the West. The staff of DBR also render technical assistance to several NRC associate committees including those on the National Building Code, National Fire Code, and on Geotechnical Research. These codes are used by municipalities in preparing and revising their by-laws.

Future plans include the publication of a series of books—the Canadian Building Series—by the University of Toronto Press, and the making of more special films. Films are considered one of the more effective means of disseminating information.

Other Divisions

The Division of Radio and Electrical Engineering issues a Quarterly Bulletin and two series of reports. In several fields the scientists send out data to other organizations, e.g. the International Geophysical Year and the International Year of the Quiet Sun, and data are processed for the International World Data Centre System. Also, they answer many requests for information from Canadian industry.

The National Aeronautical Establishment issues a quarterly bulletin and publication lists, and publishes about 140 papers of various types in scientific and technical journals each year. Its budget for information handling is about \$82 000 with a staff of nine. The establishment responds to hundreds of letters a year and, in addition, disseminates information through personal contacts and the issuance of *Laboratory Memoranda.*

The National Research Council sponsors the publication of eight journals in the Canadian Journal Series, in the fields of biochemistry, botany, chemistry, earth sciences, microbiology, physics, physiology and pharmacology, and zoology. In 1966 the eight journals published 1 572 articles and had a circulation of 18 000, largely in Canada, the United States, and Britain. Almost half of the articles originated from Canadian universities, with lesser numbers from government departments and NRC divisions. The budget for 1967-68 was $1 036 000. It is estimated that the journals double in size every six to eight years. Consideration is being given to the possibility of undertaking publications in applied science and engineering, and placing more emphasis on the proceedings of conferences.

Associate Committee on Scientific Information

The Associate Committee was established by NRC in 1957 to consider all matters relating to the acquisition, organization, and dissemination of scientific and technical information in Canada. It usually meets once a year, but may set up subcommittees which meet as required.

Specifically, the committee deals with such matters as:

–The functions of a national science library;
–The availability of foreign scientific literature;
–The operation of scientific liaison offices;
–The operation of a technical information service for industry;
–The availability of unclassified reports sponsored by military or other government agencies;
–Canadian participation in international meetings on scientific information;
–Abstracting and related services;
–Research in the field of scientific information.

The present membership of the committee includes the chief librarian of the National Science Library, as secretary, the National Librarian, and 20 other members of whom 7 are drawn from universities, 3 from NRC and 6 from other government departments and agencies.

Some of the main accomplishments and activities of the committee are:

(1) Establishment of the National Science Film Library;
(2) Establishment of a postgraduate scholarship program to encourage science and engineering graduates to enter the field of science librarianship and documentation;
(3) Sponsorship of the Bonn survey of Science-Technology Literature Resources in Canada, and proposals for implementing the recommendations of the Bonn Report;
(4) Serving as the Canadian National Committee for the International Federation for Documentation (FID);
(5) Obtaining the formal establishment of the NRC Library as the National Science Library of Canada.

National Science Film Library

The National Science Film Library (NSFL) was established in 1962 by the National Research Council in collaboration with the Canadian Film Institute as a service to the Canadian scientific, technical, and educational communities. The National Science Film Library is funded through the National Science Library, and the general policy of the library is determined by NRC's Associate Committee on Scientific Information. The Canadian Film Institute, which is a non-profit, non-government, service organization established in 1935, carries executive responsibility for the NSFL under the terms of a contract with the National Research Council. The annual budget is about $25 000 and the present establishment is one professional and one supporting person.

The National Science Film Library maintains Canada's national circulating and reference library of more than 2 000 scientific and technical films on all subjects, and includes films directly recording research experiments, films for use in higher education, and films intended to convey scientific information to the general public. In addition to its film library, the NSFL is also the national centre for information on science films and provides a number of other services. The library publishes evaluations and appraisals of science films prepared by qualified scientists and educators. These are distributed to scientists, industrial groups, and universities. Film makes it possible to record and reproduce transient phenomena, and enables these phenomena to be studied by repeated viewing of the films. Scientific films have as their primary purpose the recording of new knowledge or the production of a record which can be used for analysis. They can be used also to transmit visual information from one scientist to another, or from a scientist to an industrial organization, in much the same way as the printed scientific or technical report. Thus, the film record can be used to supplement the printed work and, in some cases, take its place.

The library has a card index of science films available in this country and abroad. Detailed information on more than 10 000 films (in addition to the 2 000 films in the library itself) is currently available and the index is being continuously expanded. The library maintains catalogue listings from many countries, information on films shown at festivals and scientific conferences, and a variety of other material. All information is catalogued according to the Universal Decimal Classification system. Films are indexed on about 12 000 "Main Title Entry Cards" which give information on producer, country and year of production, length, language versions, content, and references to additional information. The cards are filed alphabetically by original language title of the film and are also cross-indexed. English is the main language used but cross-indexes provide access to the information for French-language titles, and information can be provided in French, if necessary. The system provides answers on questions relating to specific film titles and specific subject areas but does not allow for an analysis of the film content.

The NSFL now has available more than 2 000 scientific and technical films. Its service is passive in that it waits to receive enquiries. The primary users of the film collection are universities and industrial organizations. Information on films in the library is made available through subject catalogues, information sheets, and evaluations.

A survey currently being carried out by NSFL into the use of cinematography as a tool for scientific research in Canada has already revealed that there are at least 190 scientists in Canada who have used or are using cinematography as a tool in their research. The results of the current survey will determine the future plans of the

National Science Film Library with regard to the extension of its information facilities on research films. Among plans now being considered are the publication of an index of research film footage currently in existence in Canada, and the establishment of a collection of important research films. It may be noted that the Canadian Science Film Association was founded in Montreal in September, 1967, during the congress of the International Scientific Film Association.

Future plans of NSFL include the development of systems which will increase accessibility to visual information on film or videotape, and the more active dissemination of information about these materials. It is considered important that a centralized collection of Canadian research documents on film be established so that other scientists will have access to this material. Funds will have to be made available for the acquisition of copies. An information centre for Canadian and non-Canadian research material would also have to be developed and would require expansion of the present staff resources of the National Science Film Library. The index of films should be transferred from a manual to an electronic system and catalogues of available material produced. The information service should adopt a more active role by the development of an "interest-profile" system. Obviously, any changes or expansion in the activities and services of NSFL would necessarily have to be developed in conjunction with the NRC.

It should be noted that some government departments also maintain film libraries on specific areas and operate in conjunction with NSFL; for example, the Department of National Health and Welfare has four film libraries—a national health film library, a national welfare film library, a national biological and medical film library, and a fitness and amateur sport film library.

Patent and Copyright Office

The Patent and Copyright Office in the Department of the Registrar General of Canada is under the direction of the Commissioner of Patents, and administers the Patent Act, the Copyright Act, the Industrial Design and Union Label Act, and the Timber Marketing Act. Its main function is the examining of applications for patents and, where appropriate, granting them. The philosophy of the various acts is to encourage and promote the progress and development of technology for the benefit of society as a whole as well as that of the inventor. The legislation provides an incentive for the inventor to disclose his invention by giving him sole right to exploit the invention for a certain number of years.

Patent applications on the average contain about 19 pages, of which 13 pages are disclosure, 2 are drawings, and 4 are claims. About 30 000 patent applications are received annually and cover all types of technology in the proportion of about 47 per cent mechanical, 36 per cent chemical, and 17 per cent electrical. In the last hundred years, over a million applications have been received, 27 per cent of them in the last 10 years. The average time required to process an application is 2½ years, during which time the application is considered confidential. In some cases the invention will have become public knowledge before the Canadian patent is printed, but forthcoming changes in the Canadian Patent Act will have the effect of reducing the lapse of time to about 1½ years.

The examination of patent applications is undertaken by patent examiners, who are graduate engineers and scientists usually with some experience in industry. It involves a thorough search of the prior art for any prior disclosure of the invention. The principal search is made among Canadian patents that have been issued. If the examiner's search does not reveal any prior patents in Canada pertinent to the application, his search may be extended to the patents of other countries, textbooks, abstracts, and technical journals. The Canadian examiner, however, is permitted by the Patent Rules to require an applicant to provide the Patent Office with the results of the searches made by other patent offices in connection with his corresponding foreign application and, where necessary, even to provide copies of the prior patents cited against the foreign applications. The examiners make considerable use of this rule, and in this way are able to achieve a much wider search than of the Canadian patents alone.

Each examiner is responsible for examining all patent applications in a class, or a portion of a class, depending on its size. The files used by the examiners for search purposes are kept in their individual offices. They consist of abstracts of the patents, comprising all the drawings submitted with the application, the two claims selected for publication in the *Canadian Patent Office Record,* and other details such as the title of the invention, name of the inventor, and date of issue of the patent. Besides the file of 750 000 Canadian patents, the Patent Office stores those of a number of foreign countries. For United States patents two separate files are maintained, one in which the patents are kept in serial number order, the other in which the patents are filed according to the classes and subclasses in which they were classified by the U.S. Patent Office at the time of issue. The patents of other countries, numbering about eight million, are kept in serial number order only. The Patent Office feels that the cost of maintaining a large file of all foreign patents in a classified state so that they could be searched is so expensive in relation to the amount of pertinent prior art likely to be found that it could not be justified economically. The non-patent literature kept in the Patent Office for use by the examiners as reference material consists of about 1 000 scientific and technical textbooks, including technical dictionaries and glossaries, and approximately 200 weekly and monthly technical and scientific periodicals. In addition, the examiners make use of the technical and scientific books available from the National Science Library.

Canadian patents have been classified and grouped into 313 classes, which in turn have been finely subdivided into a total of 24 769 subclasses. In general, the classification is intended to be an arrangement of subject matter which will best facilitate a search of scientific and technical inventions and disclosures that have been claimed. It is not directed to subject matter which may have been disclosed but not claimed in the patent.

Of the total personnel of 191 in the Patent Office, 29 scientists and engineers of the Classification Division work full time on information retrieval, while those in the examining divisions spend approximately 20 per cent of their time on this function. On this basis, the total annual manpower involved in information retrieval is estimated to be equivalent to 66 man-years.

Copies of Canadian printed patents are sold at $1.00 a copy. About 50 per cent go to the United States, 40 per cent remain in Canada, and 10 per cent go to other countries. Six companies, two of which are Canadian, have standing orders for patents in particular classes or subclasses. The Patent Office publishes weekly the *Canadian Patent Office Record* to comply with Section 27 of the Patent Act. It gives a record of the patents issued by serial number, title, and inventor, and is also used to inform the public about patent procedures and other details. Over 800 copies are distributed. The office also maintains and makes available to patent agents and the public an alphabetically arranged listing of scientific and technical subject matters, called *The Subject Matter Index,* which gives for each subject matter the classes and subclasses in which patented inventions in the subject matter will be found.

Officers of the Patent Office participate in the activities of the Committee for International Co-operation in Information Retrieval Among Examining Patent Offices (ICIREPAT), which fosters international co-operative research in patent information retrieval. Because of the priority of other commitments, the office has not been able to allot resources to the development of mechanical systems and its role has been largely that of an interested observer. Limited experiments in the use of foreign mechanized search systems have shown no advantage over the manual searches presently used. With the exception of West Germany, there is no co-operative effort between industry and patent offices in information storage and retrieval. In this instance, the Documentation Society has developed a system of information retrieval in the field of cables and conductors. The Canadian Patent Office suggests that an appraisal be made of the need for patent information by industry in Canada.

Department of Public Printing and Stationery

The Queen's Printer, in his present role of government publisher, provides guidance and technical assistance to Parliament, government departments, and federal agencies in the planning, designing, editing, printing, cataloguing, marketing, and distribution of their publications. The purpose of the service is to achieve the best form of publication and the best means of distribution. The department is presently responsible for the publication of all printed matter required by government despartments and agencies, excluding stationery and forms, and except as otherwise prescribed by Statute of Order in Council. This includes the publication of *The Statutes of Canada, Canada Gazette,* parliamentary proceedings and reports and other parliamentary and official documents, and the preparation and publication, by direction of the Minister, of works of public interest not emanating directly from Parliament or any department or agency. The Queen's Printer advises and assists departments and agencies in planning their publications programs to achieve consistently high standards of production, calls for tenders, and awards contracts for printing and related work.

The Queen's Printer also operates bookstores in Canada and abroad for the sale of government publications and of other authorized publications of international organizations. It maintains a bibliography and indexes of all government and parliamentary publications, and operates warehousing and mailing services for the distribution of parliamentary and government publications. The program is carried out through the activities and operations of the following divisions: Research and Development, Administrative and Personnel, Financial Management, Editorial Services, Print Procurement, Publishing Production, Purchasing, Sales Promotion, and Central Distribution Services. A total staff of 277 operates on a budget of about $4 800 000.

The department publishes each year, on behalf of Parliament, government departments and federal agencies, over 6 000 publications and periodicals worth over $8 million, reflecting the wide and diversified interests of Parliament and Government. The following publications are provided periodically to inform the public of publications available. The bilingual *Daily Checklist*, published mainly for administrative convenience, is issued Monday through Friday except public holidays. It is produced in loose-leaf form and records all government publications. All those who are entitled by law or regulation to a free copy of government publications receive the *Daily Checklist* automatically and without charge. The bilingual *Annual Catalogue of Canadian Government Publications* is a consolidated list of the publications issued during the year. It cumulates the issues of the *Monthly Catalogue of Canadian Government Publications*, from January to November, together with the publications noted in the *Daily Checklist* during the month of December. The sectional catalogue series will provide, when completed, a comprehensive record of all publications available for purchase, arranged according to government departments, and including a selection of important related publications issued by Parliament and by the various departments and agencies of the Government of Canada.

The Queen's Printer (Publisher) is required by regulations to furnish, free of charge, one copy of any government publication of a non-confidential nature to designated classes of libraries in Canada, for preservation and educational purposes so that the public may have access to all government publications. Full-depository libraries are entitled to receive one copy of every publication of the Parliament or Government of Canada that is made available to the Queen's Printer (Publisher) for distribution. Selective-depository libraries are entitled to select any series of government publications they are able to place adequately at the disposal of the public. Canadian government publications are sold to the public through a mail-order bookstore and six government bookshops across Canada, located at Halifax, Montréal, Ottawa, Toronto, Winnipeg, and Vancouver. Sales will be in the vicinity of $3 million for the fiscal year 1967-68.

The Queen's Printer (Publisher) recognizes that its delays in printing are intolerably long, and is actively investigating new techniques. In its role as publisher it has the responsibility of identifying, studying, and applying the concepts on which computerized publishing is based. Under the impact of new technology, the division between editing and typesetting is disappearing. Use of computers to compose type has led to their employment in editing–an integral part of the publishing process. The concept of the data bank, a product of information storage and retrieval technology, will play an important role in the mechanized or computerized editorial process. The Queen's Printer (Publisher) is concerned with the development of computer applications to the publication and distribution of scientific and technical information. The electronic photocomposer, along with other new devices, will permit the development of a completely integrated system designed to take any manuscript and package it in any way desired, as a book, an abstract, a stored mass of information to be retrieved by other methods, or as part of a bibliographical memory bank.

As publisher of the Statutes of Canada, the Queen's Printer is actually concerned with the development of computer applications to the publication of legislative information, and in the automated retrieval of legal information. There is the possibility that computer systems will, in the future, facilitate the transition, from a publishing standpoint, of draft legislation to introduced legislative bills, to enacted law, to revised statutes.

In 1958 the Queen's Printer, at the request of the Department of External Affairs, assumed the role of national sales agent in Canada for the following international organizations: United Nations; United Nations Educational, Scientific and Cultural Organization; International Labour Organization; World Health Organization; Food and Agriculture Organization; Organisation for Economic Co-operation and Development; Organization of American States (Pan American Union); General Agreement on Tariffs and Trade; International Atomic Energy Agency; International Civil Aviation Organization; Council of Europe; Commonwealth Economic Committee; World Meteorological Organization; International Telecommunication Union; New Zealand Government; Ghanaian Government.

Royal Canadian Mounted Police

The Royal Canadian Mounted Police, under the control of the Solicitor General of Canada, is responsible for the enforcement of all federal statutes as well as provincial statutes and municipal by-laws where agreements have been made under contract. Their general duties have been set forth in the RCMP Act. There are four units which are concerned with some aspect of scientific and technical information: the Telecommunications Branch, the Central Registry, the Identification Branch, and the Crime Detection Laboratories.

The Telecommunications Branch operates the extensive communications system required by the nation-wide activities of the Royal Canadian Mounted Police. Besides its radio and teletype facilities, a wirephoto service has recently been introduced in a number of points across the country. The communication facilities of the RCMP are operational systems which are used to direct investigations, despatch patrols, co-ordinate movements of investigating personnel, and transmit information for advice and direction. Thus, it is not possible to share the present facilities with other departments or agencies except in cases of extreme emergency.

The Central Registry is responsible for the operation and uniformity of filing systems throughout the Force, the registration, distribution, and custody of official correspondence and records, the compilation of police statistics, and the custody of exhibits and seizures at Headquarters in Ottawa, pending official disposition.

Approval in principle has been received for the establishment of a Canadian Police Information Centre with computer facilities. This nation-wide information system will act as a police data bank containing the names, physical descriptions, and other pertinent information relating to about one million persons with criminal backgrounds. In addition, a national stolen motor vehicle file is maintained containing the descriptions of all vehicles stolen and those wanted in connection with crimes throughout Canada. This information will be stored on random-access devices, allowing all accredited police departments in Canada to use the service through terminals on their premises. The system will permit rapid checking of facts on a stranger before he is out of sight and on the status of a vehicle before it is stopped.

Other identification files to be placed in the Information Centre's computer and made available to police forces include the National Firearms Registration File, the Identifiable Stolen Property File, and the Criminal Characteristics and Outstanding Physical Peculiarities File. These data will be provided to accredited police forces under long-standing policies established for the dissemination of information by the National Police Service. The data-processing capability will also be available to the Crime Detection Laboratories. They will be equipped with remote terminals and, through time-sharing, access will be available for their special programs for solving scientific problems using the interactive or conversational mode. It will also permit the laboratories to interrogate special information files such as spectrographic, X-ray diffraction, and other data.

The Identification Branch is a national repository for criminal records, and other criminal information derived from fingerprints which are submitted by all police forces in Canada for classification, search, and filing in the branch. As a national police service, the facilities of the branch are available to police departments, federal government departments, courts of law, and other agencies which, in accordance with the Identification of Criminals Act, are "engaged in the administration or execution of the law".

The Crime Detection Laboratories exist as part of the National Police Service to provide scientific and technical assistance to Canadian police forces and agencies at the federal, provincial, and municipal levels in relation to criminal investigation and security matters. The diversified nature of exhibit materials submitted to the five laboratories across Canada, and the wide variety of examinations and analyses carried out, require access to information in many natural science fields. Each laboratory maintains its own library facilities at a yearly cost of $4 000 to $5 000. The necessity of maintaining libraries at five laboratories results in considerable duplication of books and periodicals. The Central Library facilities are limited and the collection is not primarily scientific or technical in nature.

Standard reference spectra such as X-ray diffraction data cards, infra-red and ultra-violet spectra, and gas chromatography data are purchased from commercial sources and placed on microfilm. This is stored in the Scientific Data Centre of the Ottawa Laboratory Chemistry Section. Requests for comparative searches are received from the other four laboratories by teletype. The results of these searches and example spectra or data are returned by teletype or wirephoto.

For several years the laboratory operational statistics, such as the numbers of case-reports, examinations, types of examinations, geographical origin, originating department, length of time required to complete examinations, numbers of days attending court, number of miles travelled, etc., have been carded on to keysort punch cards. The Crime Detection Laboratories are now looking forward to the employment of IBM cards and a computer to handle the expanding volume of data. A position for an Officer i/c Scientific Services has been recently created. One of the functions of this office is to "co-ordinate the reference literature, scientific journals, and indexes of the Crime Detection Laboratories to be of maximum use of laboratory personnel". As this function becomes operative, a greater exchange of information among the several laboratories will take place.

Department of Transport

In the Department of Transport the Meteorological Branch, in particular, is concerned with scientific and technical information. By the Department of Transport Act, 1936, the management and direction of meteorological services in Canada are vested in the Minister of Transport. Although the scope of these services is not defined in this or in any other Act, parliamentary approval of annual estimates constitutes specific authority for the nature and extent of meteorological services provided.

The Meteorological Branch has broad responsibilities in certain allied scientific fields. In broad terms, it (*a*) provides information on past, current, and predicted values of meteorological parameters; (*b*) engages in, encourages, assists, and promotes research in the science of meteorology; (*c*) participates in international meteorological affairs; (*d*) conducts programs for the observing, reporting, and forecasting of sea ice conditions in Canadian waters, and (*e*) provides limited support to hydrological, oceanographical, limnological, and seismological programs in other scientific fields allied to meteorology. The branch has a total staff of approximately 2 500 people with an annual operating budget of $28 million. The facilities, operated in part by Meteorological Branch Headquarters situated in Toronto and by the field components under the jurisdiction of the six Air Services Regions, cover all of Canada.

The Meteorological Branch Library serves all Canadian Meteorological Service personnel, in Toronto, in liaison posts, and at all Canadian weather offices in Canada and Europe. The Central Library in Toronto holds the main collection, while small collections of basic texts and periodicals are supplied to the weather offices across the country. It has a staff of five, two of whom are professional librarians, and the remainder clerical and stenographic. There are approximately 50 000 items in the Central Library, including books, pamphlets, research reports, bound volumes of periodicals, published observational data from most countries of the world, and maps. About 3 500 items are added annually. Over 300 periodicals and serials are received. A separate library of meteorological films is maintained by the Training Section, with loans being made to field offices to assist with lectures and public displays. The Central Library has the responsibility for all ordering, processing, and cataloguing. Periodicals are centrally ordered, but are sent directly from publisher to individual field offices.

The Central Library houses the main national collection in meteorology and climatology, including some observational records dating back to 1840. The library is the official depository for the publications of the World Meteorological Organization, and it also receives automatically a large percentage of the publications of the British Meteorological Office and the U.S. Environmental Science Services Administration. Contacts are maintained all over the world for the acquisition of material on exchange or as gifts. The library subscribes to six abstracting services, and holds a microfilm copy of the British Meteorological Office Library's *Bibliography of Meteorological Literature* held by the library for the years 1935-1949, 1949-1952, and prior to 1935. In addition to serving Meteorological Branch personnel as outlined above, the Central Library answers requests for loans and information from other government departments, universities, research workers, graduate students, local firms, writers, and the general public. Information is given in writing, over the telephone, and directly to the user.

The Climatology Division at Meteorological Branch Headquarters is responsible for the provision of climatological information and data in Canada. This requires the collection, processing, analysis, publication, and dissemination of climatological data from all official weather observing stations in the country, and provision of an information advisory service regarding the climatology of Canada, in particular, and the world in general. To do this the Climatology Division has a staff of 150, of whom about 100 are engaged in the activities mentioned above. In addition, field offices of the Meteorological Branch disseminate climatological information and data, usually of a local nature.

The Climatology Division prepares and publishes a number of climatic data periodicals on monthly, seasonal, and annual bases with local climatological data summaries being issued from a number of regional and local offices. The Meteorological Branch also provides an information and advisory service to other government departments, industry and commerce, and the general public. Local and regional enquiries are usually handled in regional weather offices, while the more complex and extensive requests are usually handled at Meteorological Branch Headquarters. Climatological data are handled on a monthly basis and although unverified data are usually available from most parts of the country within a few days after the close of each month, it is six months before these data can be properly processed and made available in printed form. Numerous monthly report forms prepared at the various types of meteorological and climatological observing stations in Canada form the most important source of information.

Although a considerable amount of technical and clerical work is still required in processing climatological data, most of this work is now done using modern data-processing methods which were introduced in 1966. Except for a nominal charge for publications, photostats, reprints, etc., and nominal fees for computer, technical, and clerical work, when specific information is obtained for private users, climatological services are provided as a free government service. If business, industry, and the public were willing to pay for up-to-date accurate climatic data, these could be provided much faster than is now the case.

The Forecast Division is a source of scientific and technical information in the form of current and predicted data, and consultation services associated with its supply, for the support of scientific and technical activities, e.g. rocket soundings and auroral observations. This information is normally supplied through existing service outlets in response to requests to weather offices, regional or branch headquarters. When justified, special arrangements may be made for support to a project. As a user of scientific and technical information, the Forecast Division is interested in ready availability of scientific and technical information in the fields of applied meteorology, especially weather prediction, ice forecasting, communications, in sciences and technologies supporting these activities, and in user activities generating needs for meteorological information.

In 1957 the Meteorological Branch was assigned responsibility for carrying out ice observations in Canadian ice-congested waters. A manual entitled MANICE, *Manual of Standard Procedures and Practices for Ice Reconnaissance,* third provisional edition, January 1, 1965, and subsequent amendments, has been produced to provide a uniform procedure for ice observation and ice thickness measurements. On completion of an ice reconnaissance, the observations are transmitted by radio message or by facsimile to the Ice Forecast Central for use in the preparation of the ice forecasts. Ice charts are transmitted by facsimile for reception by those ships capable of receiving facsimile. Commencing in 1964, the *Ice Observations* and *Ice Summary* and *Analyses* were published in a series of four publications for the Canadian Arctic, Hudson Bay and Approaches, Canadian Inland Waters, and Eastern Seaboard. Since 1957, data on ice observations have been published in various circulars issued by the Meteorological Branch. Commencing in 1958, a series of Meteorological Branch circulars entitled *Ice Thickness Data for Selected Canadian Stations* has been published.

The research outputs of the units concerned with basic and applied research are normally in the form of published papers submitted to a range of standard scientific periodicals, both national and international. There are also scientific reports published by the Meteorological Branch which receive fairly wide distribution. Other normal channels of scientific communication are used such as attendance at scientific meetings and personal communications.

The Research and Training Division consists of several sections. The Atmospheric Research Section is concerned with micrometeorological research, physical research, and synoptic and dynamic research. The Climatology Division, consisting of the Hydrometeorology Section and the Climatological Research Section, is responsible for the preparation of climatological atlases, and publishes research results in publications such as *Meteorological Memoirs, Climatological Studies*, and the *Technical Circular Series,* and in national and international publications.

Figure 1.—Organization Chart of Information Facilities in the Department of Agriculture

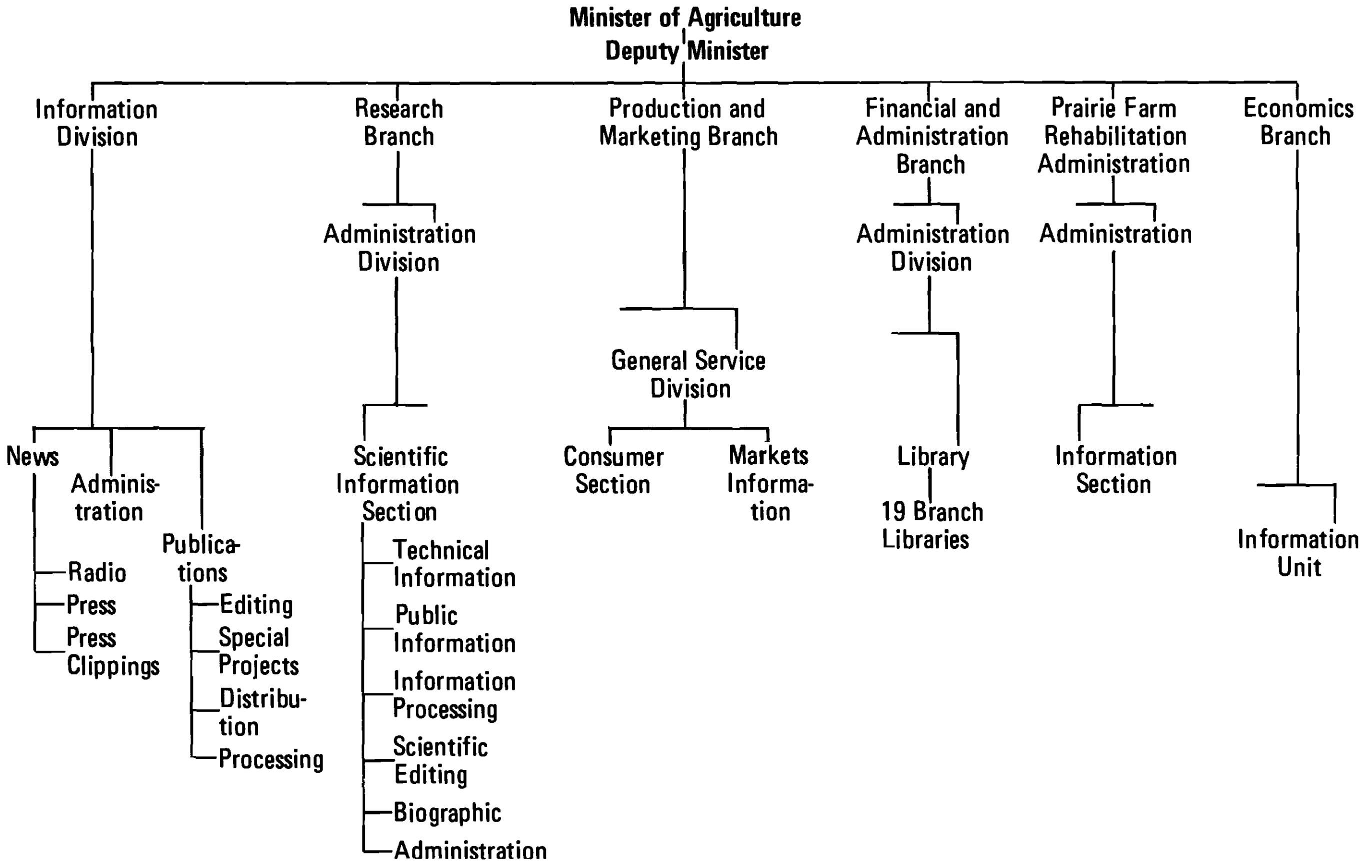
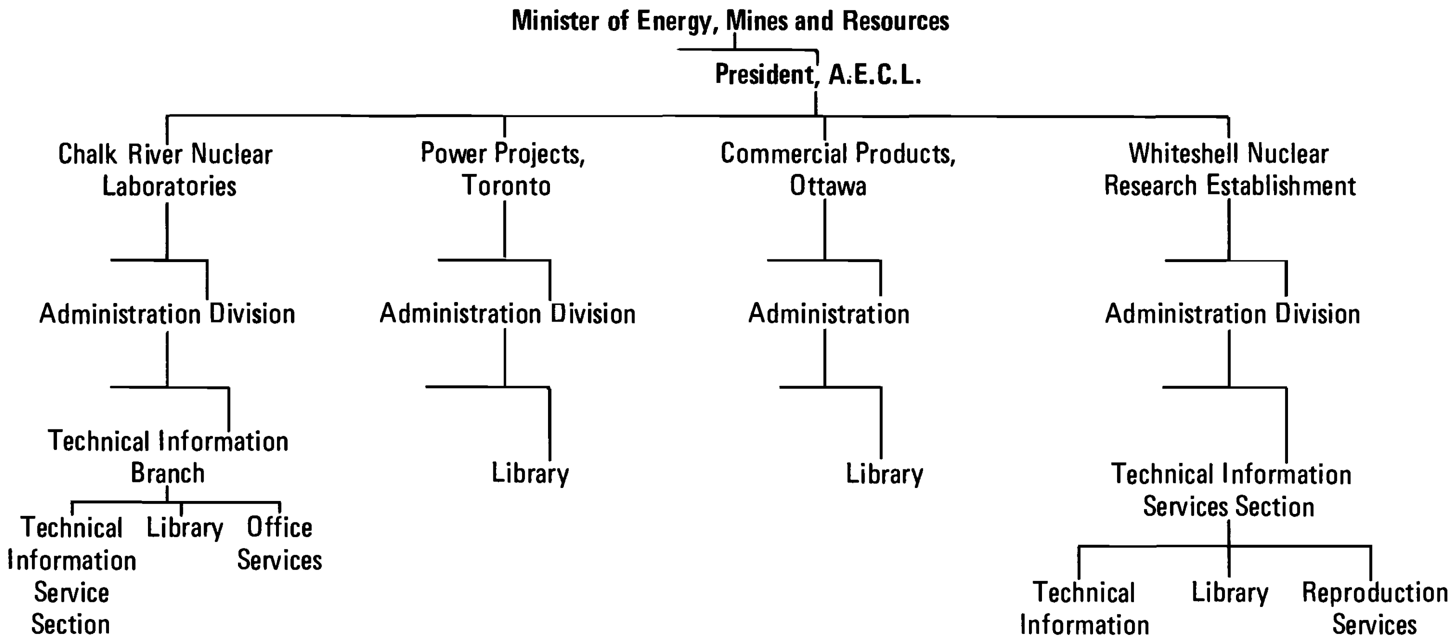


Figure 2.—Organization Chart of Information Facilities in Atomic Energy of Canada Limited



Note: The Public Relations organization is not included in this chart.

Figure 3.—Organization Chart of Information Facilities in the Department of Energy, Mines and Resources

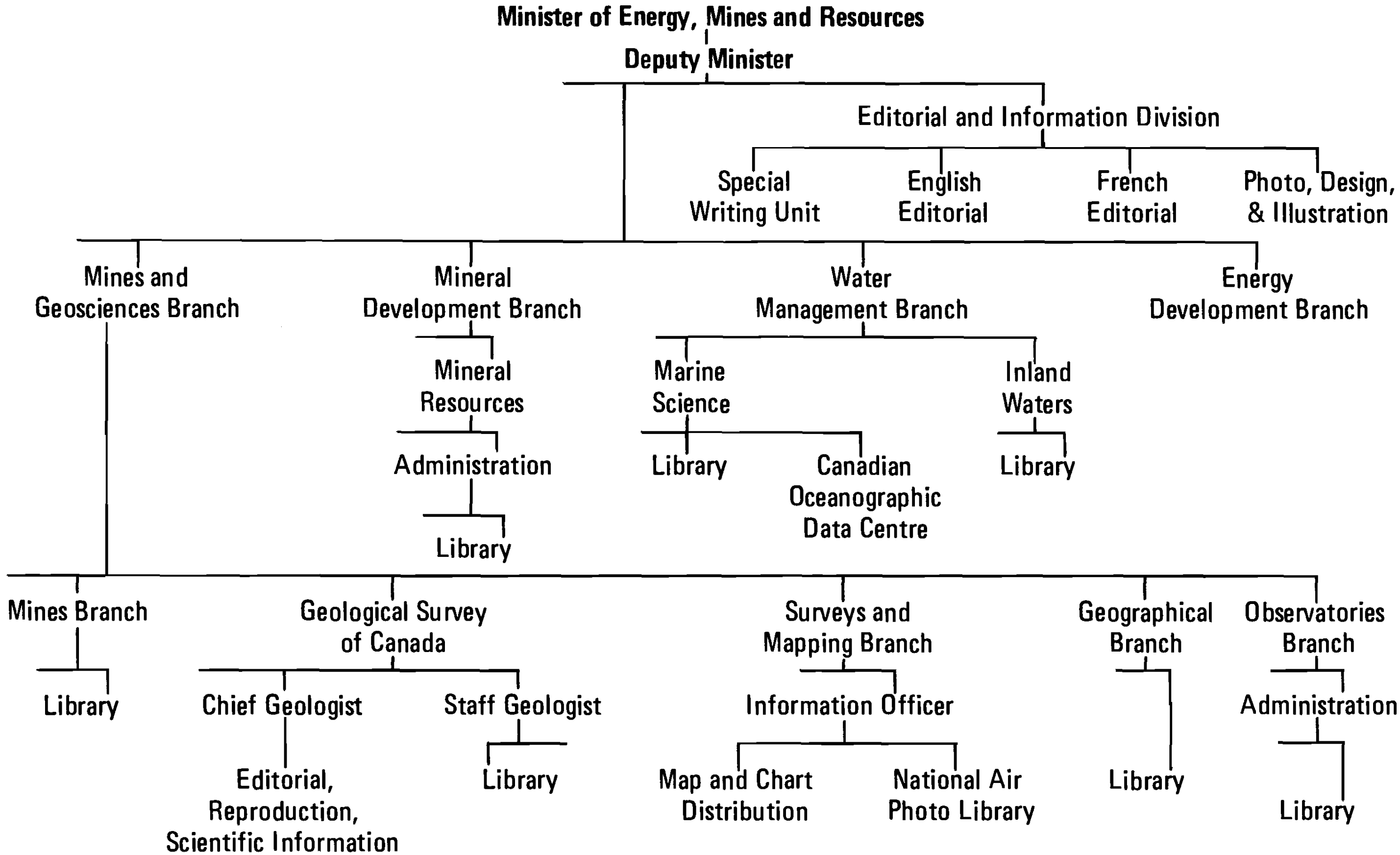


Figure 4.—Organization Chart of Information Facilities in the Ministry of Fisheries

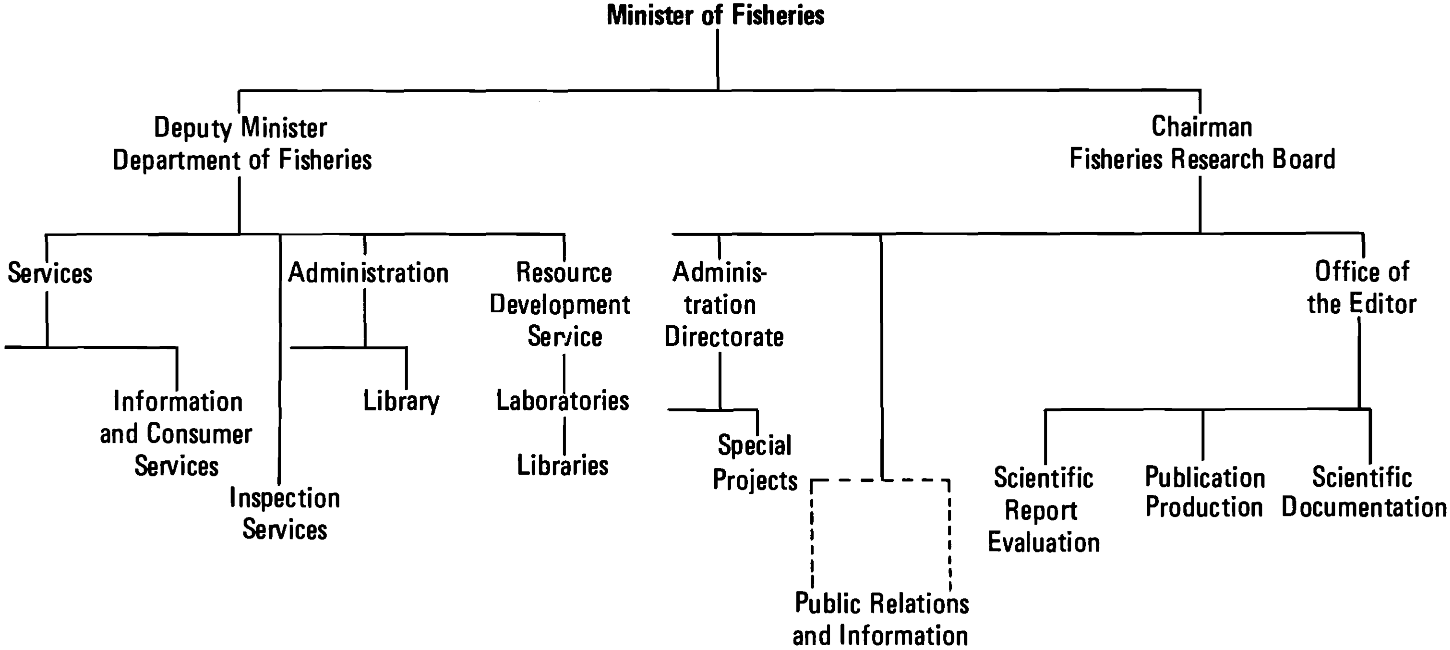


Figure 5.—Organization Chart of Information Facilities in the Department of Forestry and Rural Development

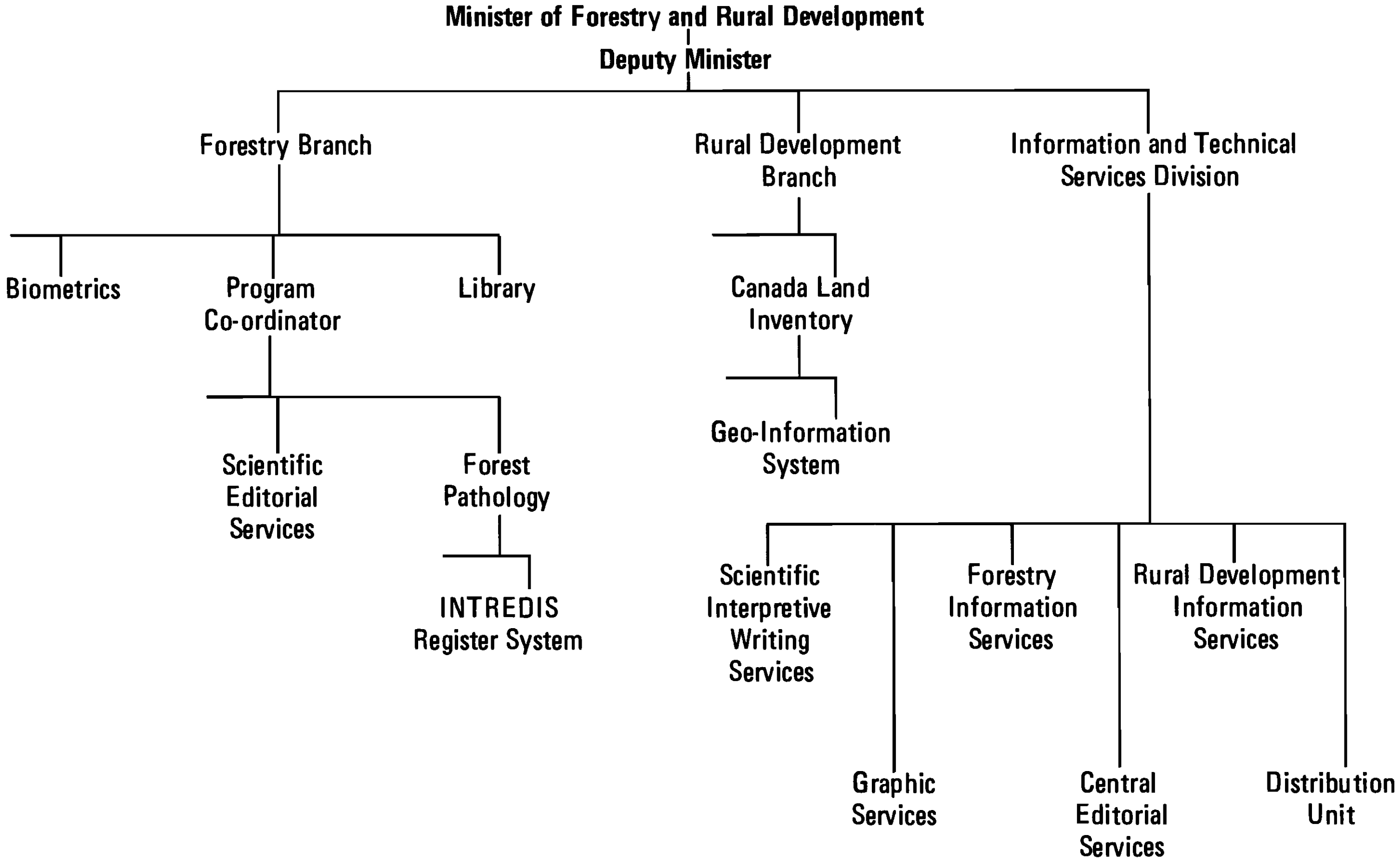


Figure 6.—Organization Chart of Information Facilities in the Ministry of National Defence

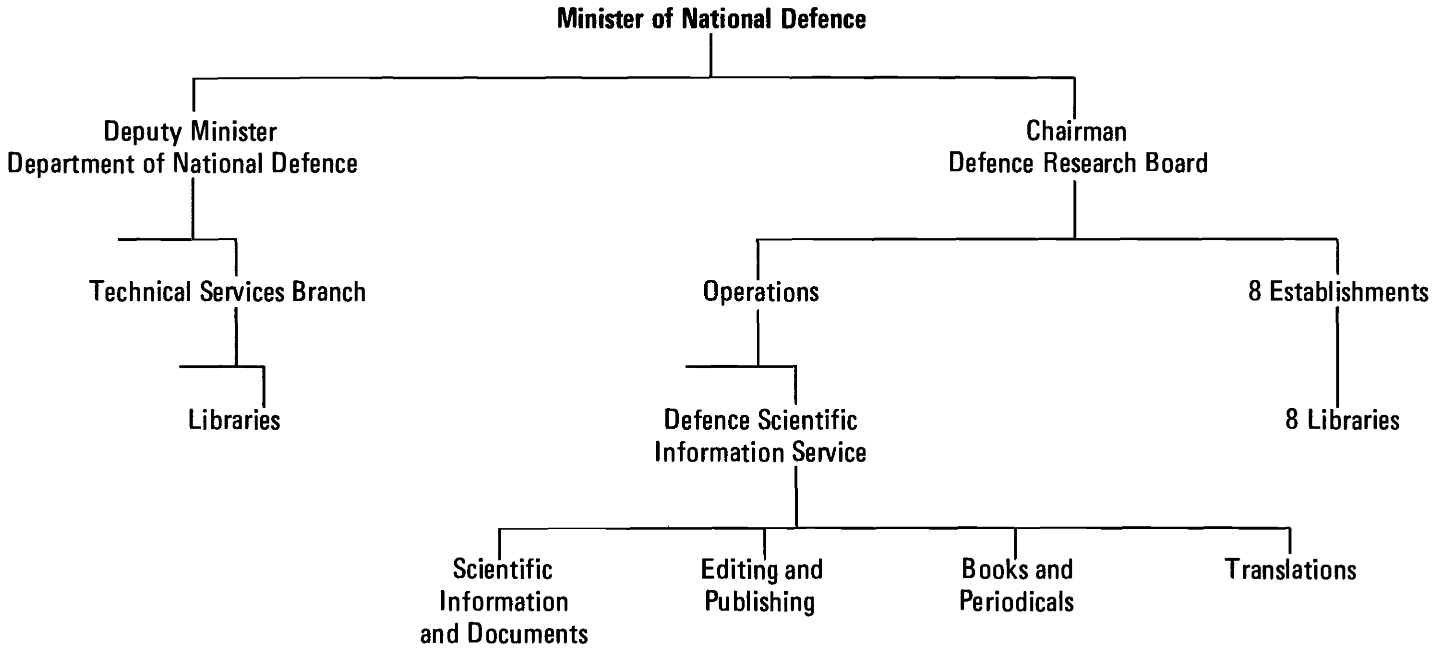


Figure 7.—Organization Chart of Information Facilities in the Department of National Health and Welfare

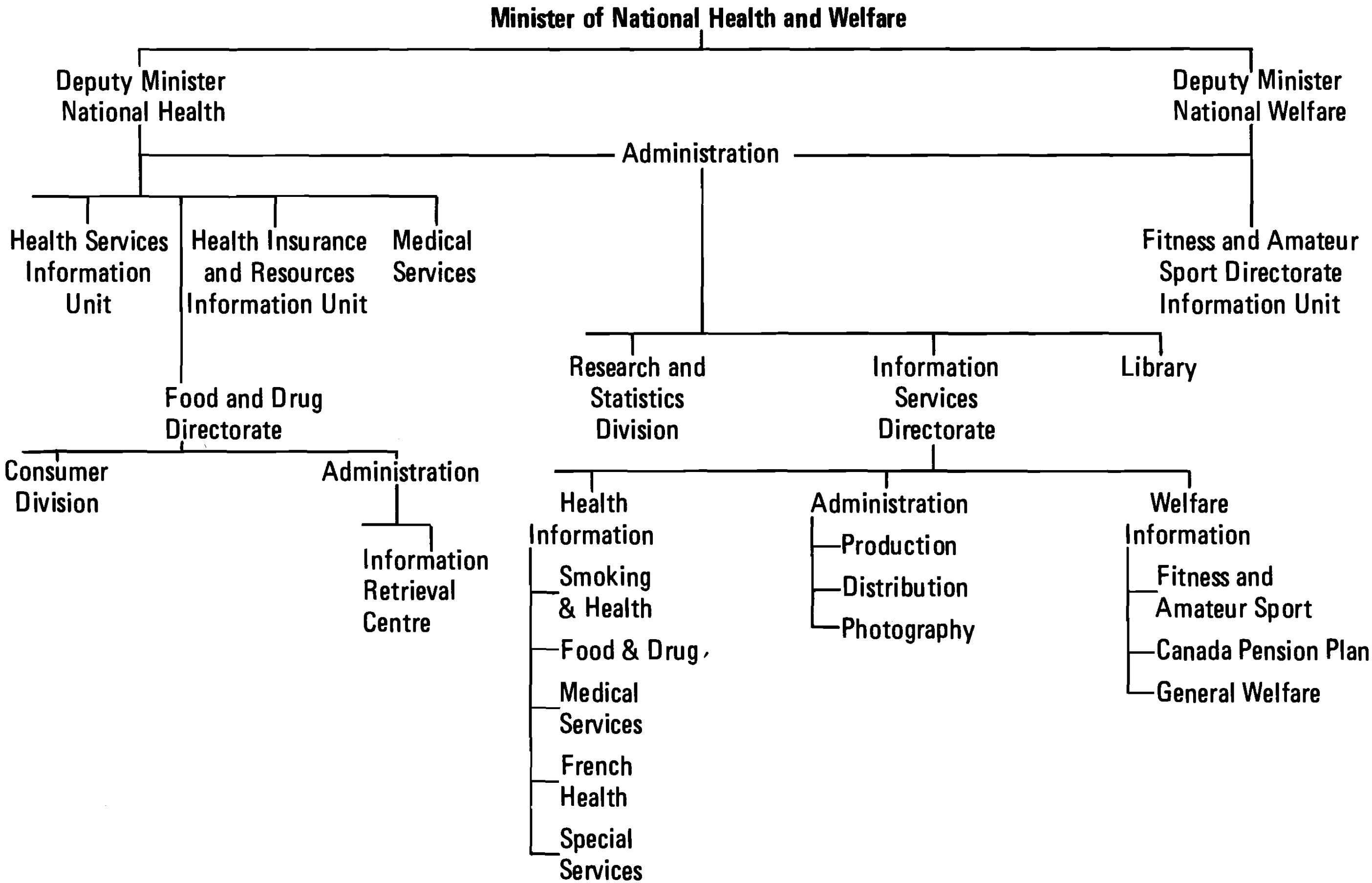


Figure 8.—Organization Chart of Information Facilities in the National Research Council

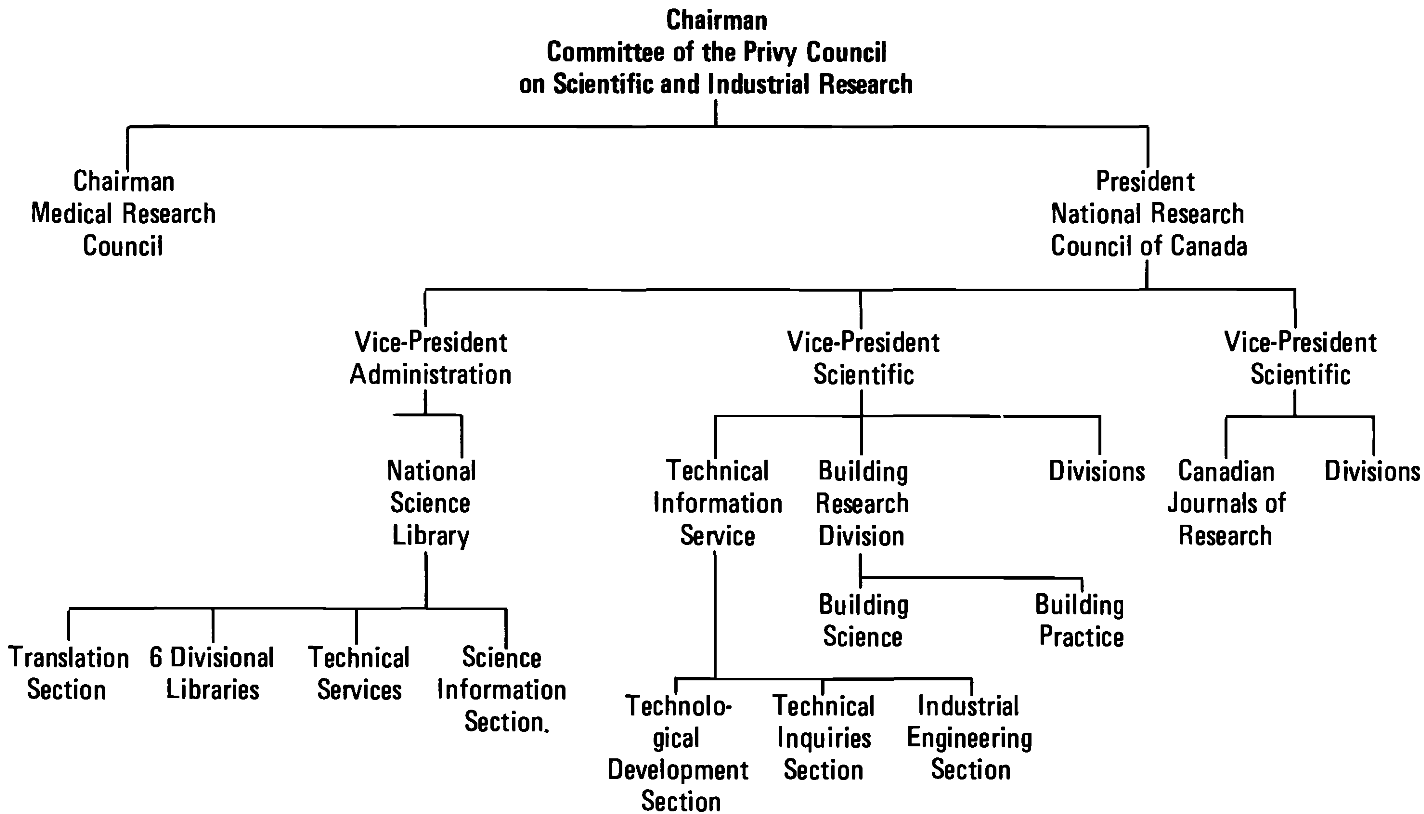


Figure 9.—Organization Chart of Information Facilities in the Office of the Commissioner of Patents

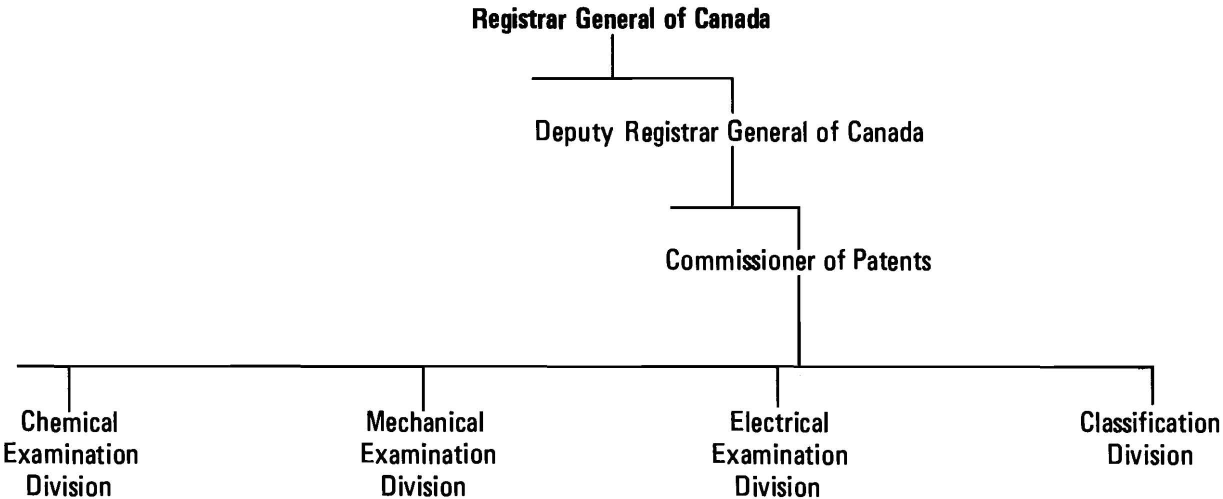


Figure 10.—Organization Chart of Information Facilities in the R.C.M.P.

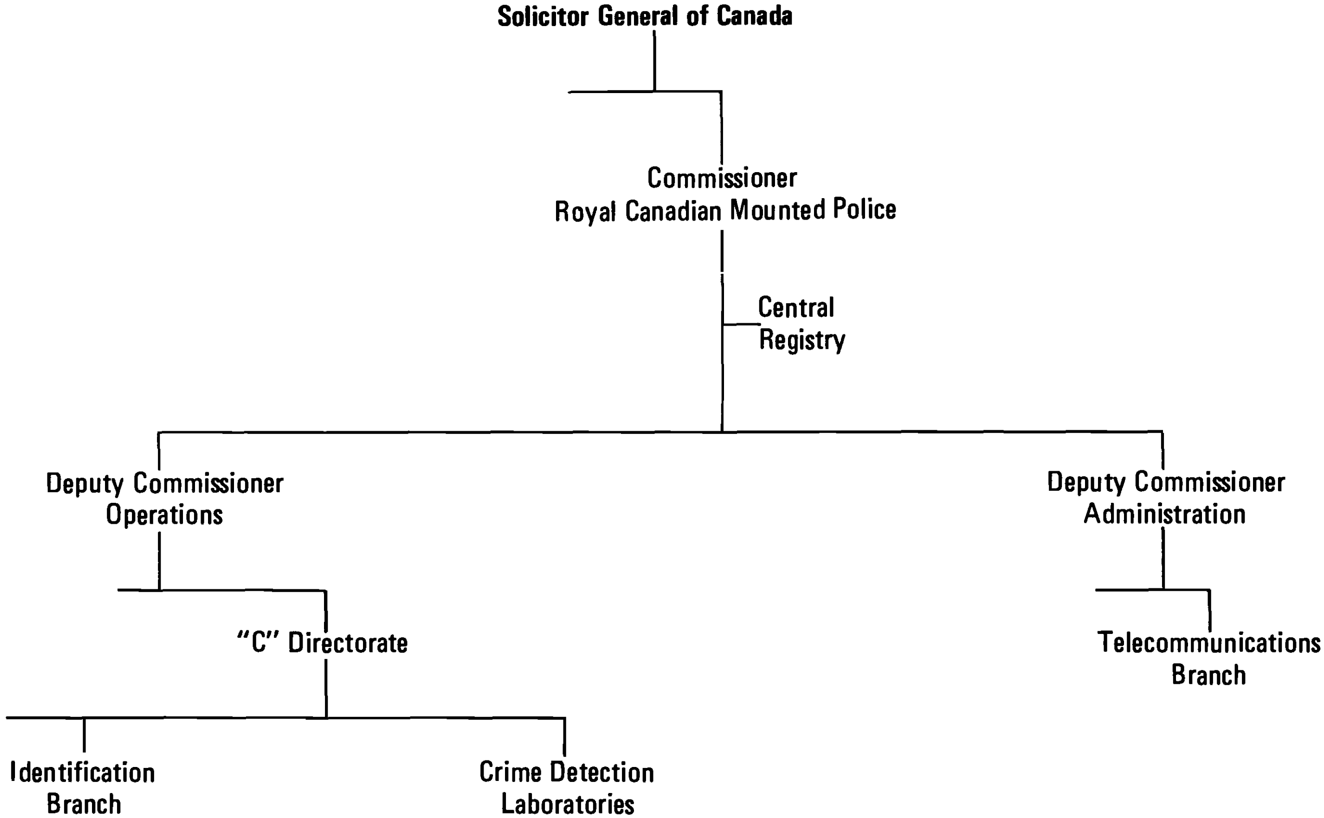


Figure 11.—Organization Chart of Information Facilities in the Department of Public Printing and Stationery

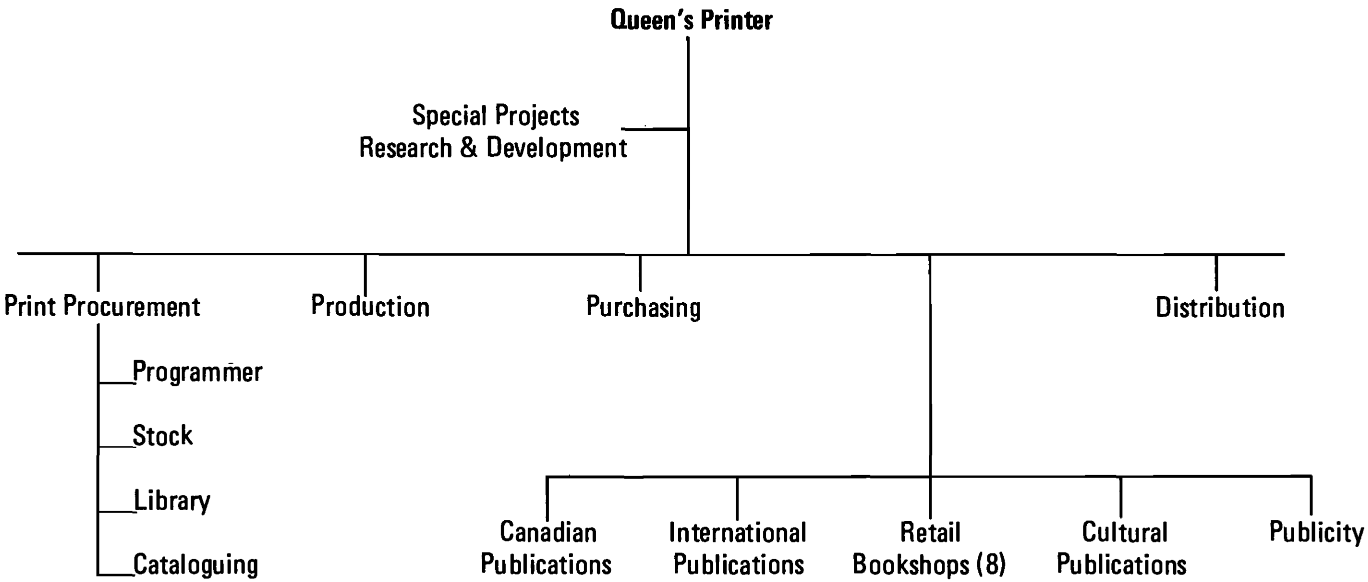
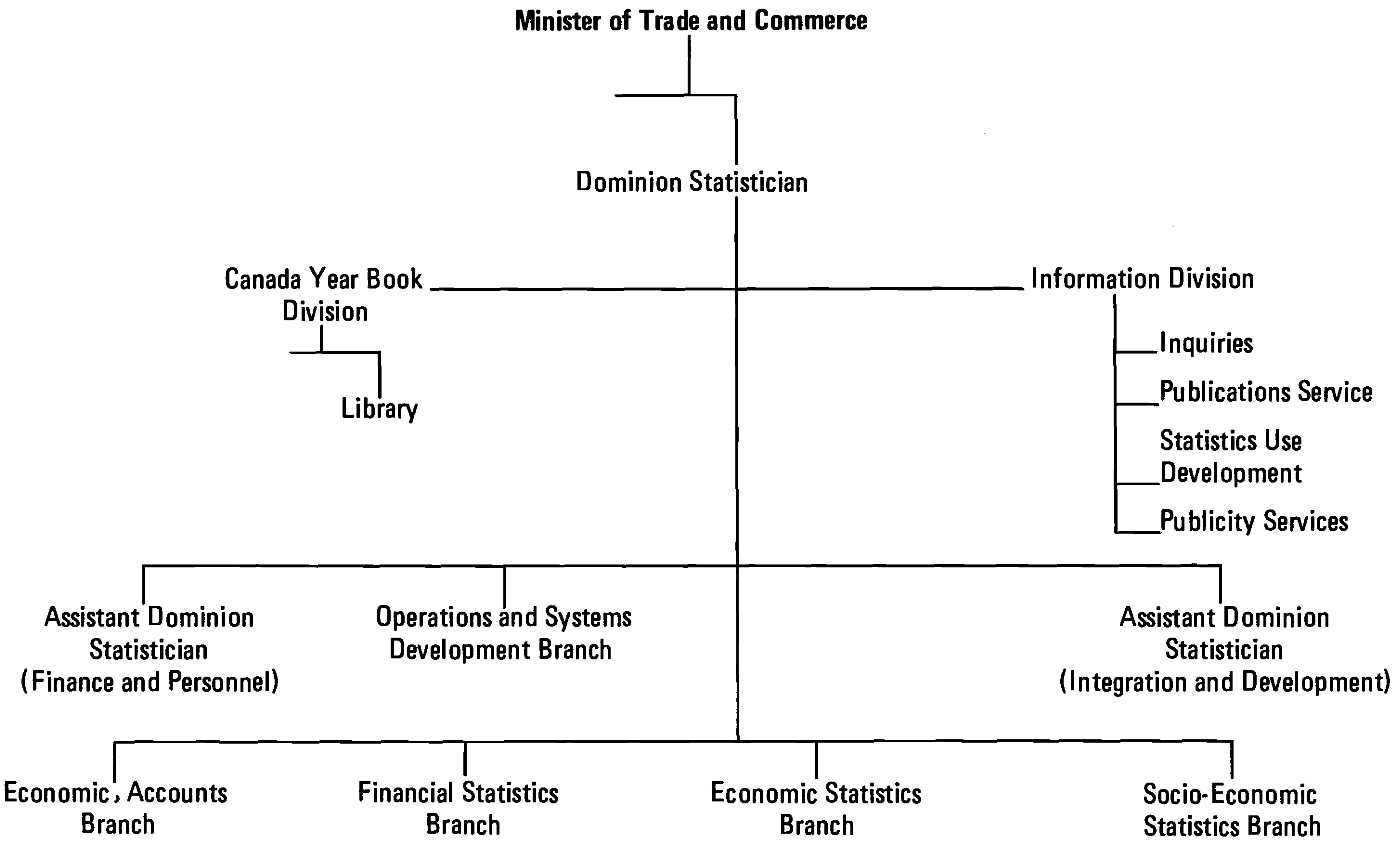


Figure 12.—Organization Chart of Information Facilities in the Dominion Bureau of Statistics



Appendix C

Table 1. – Personnel by Number and Training for 1967-68

	Professional							
	Scientist or Engineer	Library Science	Scientist, Engineer, Library Science	Other	TOTAL	Technical	Support	TOTAL
Agriculture								
Library	–	35	–	–	35	13	54	102
Information Division	–	–	–	25	25	15	35	75
Scientific Information Section	17	–	–	–	17	25	22	64
Market Information Section	–	–	–	–	–	4	15	19
Consumer Service	–	–	–	11	11	4	6	21
Prairie Farm		–						
Rehabilitation Administration	–	–	2	–	2	5	4	11
TOTAL	17	35	2	36	90	66	136	292
Atomic Energy of Canada Limited								
Tech. Inform. & Libraries	6	5	1	–	12	4	33	49
Defence Ministry								
Department	–	–	–	–	–	1	12	13
Defence Research Board	13	9	–	2	24	4	76	104
TOTAL	13	9	–	2	24	5	88	117
Energy, Mines and Resources								
Geological Survey Library	–	3	1	–	4	1	4	9
Mines Branch Library	–	3	–	–	3	–	5	8
Geography Branch Library	–	3	–	–	3	2	7	12
Marine Sciences Branch	–	2	–	–	2	13	6	21
Geological Survey Branch	2	–	–	–	2	–	2	4
Inland Waters Branch	2	–	–	–	2	2	8	12
Surveys & Mapping Branch	1	1	–	–	2	12	30	44
Public Rel'ns & Inform. Serv.	–	–	–	21	21	2	10	33

Cdn. Oceanographic Data Centre	3	–	–	1	4	4	9	17
Mineral Resources Branch	4	–	–	2	6	–	3	9
TOTAL	12	12	1	24	49	36	84	169
Fisheries Ministry								
Library (FRB)	–	3	1	–	4	1	4	9
Scientific Public'ns Directorate	4	–	–	–	4	4	5	13
Information & Consumers Service	–	–	–	7	7	–	6	13
Headquarters Library, Department	–	3	–	8	11	–	–	11
TOTAL	4	6	1	15	26	5	15	46
Forestry								
Library	–	5	–	–	5	1	8	14
Information & Technical Service	–	–	–	28	28	32	37	97
Scientific Publications	–	–	–	–	–	6	3	9
TOTAL	–	5	–	28	33	39	48	120
National Health & Welfare								
Library	–	10	–	–	10	–	13	23
Information Service	–	–	–	17	17	15	19	51
Information Retrieval (FDD)	–	–	–	10	10	–	10	20
Consumer Section (FDD)	–	–	–	8	8	–	5	13
Research & Statistics Directorate	–	–	–	42	42	18	22	82
Fitness & Amateur Sports	–	–	–	4	4	–	–	4
Other Health Services	–	–	–	5	5	–	2	7
TOTAL	–	10	–	86	96	33	71	200
National Research Council								
National Science Library	6	16	8	7	37	2	63	102
Technical Information Service	30	–	–	–	30	1	17	48
Division of Building Research	89	2	–	–	91	84	71	246
TOTAL	125	18	8	7	158	87	151	396
Patents & Copyright Office	66	–	–	–	66	2	25	93
ALL AGENCIES	**243**	**100**	**13**	**198**	**554**	**277**	**651**	**1 482**

Table 2. – Personnel by Number and Training Projected for 1972-73

	Professional					Technical	Support	TOTAL
	Scientist or Engineer	Library Science	Scientist, Engineer, Library Science	Other	TOTAL			
Agriculture								
Library	–	47	–	–	47	15	76	138
Information Division	–	–	–	33	33	18	40	91
Scientific Information Section	17	–	–	–	17	25	22	64
Market Information Section	–	–	–	–	–	4	15	19
Consumer Service	–	–	–	11	11	4	6	21
Prairie Farm Rehabilitation Administration	–	–	3	–	3	7	5	15
TOTAL	17	47	3	44	111	73	164	348
Atomic Energy of Canada Limited								
Tech. Inform. & Libraries	18	8	4	–	30	12	55	97
Defence Ministry								
Department	–	–	–	–	–	1	12	13
Defence Research Board **	13	9	–	2	24	4	76	104
TOTAL	13	9	–	2	24	5	88	117
Energy, Mines & Resources								
Geological Survey Library	–	6	1	–	7	2	9	18
Mines Branch Library	–	5	–	–	5	–	8	13
Geography Branch Library	–	4	–	–	4	3	7	14
Marine Sciences Branch	–	2	–	–	2	18	6	26
Geological Survey Branch	4	–	–	–	4	–	3	7
Inland Waters Branch	3	–	–	–	3	6	9	18
Surveys & Mapping Branch	1	2	–	–	3	15	37	55
Public Rel'ns & Inform. Serv.	–	–	–	42	42	9	28	79
Cdn. Oceanographic Data Centre	5	–	–	3	8	7	15	30
Mineral Resources Branch	6	1	–	2	9	–	3	12
TOTAL	19	20	1	47	87	60	125	272

Fisheries Ministry								
Library (FRB)	–	3	7	–	10	–	15	25
Scientific Publications (FRB)	6	–	–	2	8	10	8	26
Information & Comsumer Service	–	–	–	9	9	–	8	17
Headquarters Library, Department	–	6	–	9	15	–	–	15
TOTAL	6	9	7	20	42	10	31	83
Forestry								
Library	–	5	–	–	5	4	9	18
Scientific Publications	–	–	–	–	–	8	4	12
Information & Technical Service	–	–	–	39	39	47	50	136
TOTAL	–	5	–	39	44	59	63	166
National Health & Welfare								
Library	–	12	–	–	12	–	26	38
Information Service	–	–	–	26	26	18	29	73
Information Retrieval (FDD)	–	–	–	27	27	12	15	54
Consumer Section (FDD)	–	–	–	12	12	–	13	25
Research & Statistics Directorate	–	–	–	81	81	32	40	153
Fitness & Amateur Sports	–	–	–	4	4	–	–	4
Other Health Services	–	–	–	5	5	–	2	7
TOTAL	–	12	–	155	167	62	125	354
National Research Council								
National Science Library	10	25	17	8	60	6	91	157
Technical Information Service	47	–	–	–	47	2	24	73
Division of Building Research	114	3	–	–	117	111	122	350
TOTAL	171	28	17	8	224	119	237	580
Patents & Copyright Office	78	–	–	–	78	2	32	112
ALL AGENCIES	**322**	**138**	**32**	**315**	**807**	**402**	**920**	**2 129**

**No projection given – 1967-68 figures used.

Table 3. – Budgets for Agencies for 1967-68
(Thousands of Dollars)

	Salary	Equip't & Rental	Literature Purchased	Public'ns, Films etc. generated	Other Expenses	Supplied Services	TOTAL
Agriculture							
Library	528	57	80	2	25	–	692
Information Division	529	6	–	405	120	–	1 060
Scientific Information Section	407	–	–	150	76	–	633
Consumer Service	117	–	–	21	8	–	146
Market Information Section	99	–	–	7	–	–	106
Prairie Farm Rehabilitation Administration	65	–	–	20	3	–	88
TOTAL	1 745	63	80	605	232	–	2 725
Atomic Energy of Canada Limited							
Tech. Inform. & Libraries	289	55	235	204	46	200	1 029
Defence Ministry							
Department**	–	–	–	–	–	–	–
Defence Research Board	516	8	118	–	46	–	688
TOTAL	516	8	118	–	46	–	688
Energy, Mines and Resources							
Geological Survey Library	70	1	34	–	7	–	112
Mines Branch Library	75	–	35	–	2	–	112
Geography Branch Library	44	–	9	–	3	–	56
Marine Sciences Branch	125	12	–	–	33	–	170
Geological Survey Branch	53	–	–	–	70	–	123
Inland Waters Branch	73	1	3	88	2	–	167
Surveys & Mapping Branch	220	5	8	500	–	10	743
Information Serv. & Public Rel'ns	249	–	–	159	30	–	438
Cdn. Oceanographic Data Centre	100	18	–	15	15	23	171
Mineral Resources Branch	54	–	4	–	16	–	74
TOTAL	1 063	37	93	762	178	33	2 166

Fisheries Ministry							
Library (FRB)	65	2	77	6	8	–	158
Scientific Publications (FRB)	100	20	1	175	34	25	355
Information & Consumer Service	255	2	–	200	–	–	457
Headquarters Library, Department	45	7	10	–	–	–	62
TOTAL	465	31	88	381	42	25	1 032
Forestry							
Library	120	3	35	–	–	–	158
Scientific Publications	70	–	–	200	–	–	270
Information & Technical Service	149	21	–	744	101	–	1 015
TOTAL	339	24	35	944	101	–	1 443
National Health & Welfare							
Library	90	3	63	–	–	–	156
Information Service	410	12	–	107	29	–	558
Information Retrieval (FDD)	123	10	–	3	12	–	148
Consumer Section (FDD)	70	1	–	40	14	–	125
Research & Statistics Directorate	621	21	1	6	17	–	666
Fitness & Amateur Sport	40	–	–	220	–	–	260
Other Health Services	62	–	–	35	28	–	125
TOTAL	1 416	47	64	411	100	–	2 038
National Research Council							
National Science Library	610	30	320	13	422	–	1 395
Technical Information Service	410	–	–	–	323	21	754
Division of Building Research	2 035	–	–	–	849	–	2 884
TOTAL	3 055	30	320	13	1 594	21	5 033
Patents & Copyright Office	938	1	3	632	–	153	1 727
ALL AGENCIES	**9 826**	**296**	**1 036**	**3 952**	**2 339**	**432**	**17 881**

** No estimates possible.

Table 4. – **Budgets for Agencies Projected for 1972-73**
(Thousands of Dollars)

	Salary	Equipment & Rental	Literature Purchased	Public'ns, Films etc. generated	Other Expenses	Supplied Services	TOTAL
Agriculture							
Library	828	55	121	2	26	–	1 032
Information Division	816	10	–	534	121	–	1 481
Consumer Service	144	–	–	46	10	–	200
Scientific Information Section	407	–	–	150	76	–	633
Market Information	102	–	–	7	–	–	110
Prairie Farm Rehabilitation Administration	95	–	–	35	5	–	135
TOTAL	2 393	65	121	774	238	–	3 591
Atomic Energy of Canada Limited							
Tech. Inform. & Libraries	700	150	350	350	100	300	1 950
Defence Ministry							
Department**	–	–	–	–	–	–	–
Defence Research Board***	516	8	118	–	46	–	688
TOTAL	516	8	118	–	46	–	688
Energy, Mines & Resources							
Geological Survey Library	88	2	45	–	10	0	145
Mines Branch Library	106	–	40	–	5	–	151
Geography Branch Library	90	–	13	–	5	–	108
Marine Sciences Branch	156	9	–	–	55	–	220
Geological Survey Branch	71	8	–	–	80	–	159
Inland Waters Branch	95	2	6	120	5	–	228
Surveys & Mapping Branch	275	10	12	500	–	12	809
Information Serv. & Public Rel'ns	688	–	–	330	117	–	1 135
Cdn. Oceanographic Data Centre	230	30	–	30	25	50	365
Mineral Resources Branch	77	–	5	–	24	–	106
TOTAL	1 876	61	121	980	326	62	3 426

Fisheries Ministry							
Library (FRB)	200	25	200	25	25	–	475
Scientific Publications (FRB)	200	40	2	300	68	50	660
Information & Consumer Service	425	3	–	400	–	–	828
Headquarters Library, Department	60	16	25	–	–	–	101
TOTAL	885	84	227	725	93	50	2 064
Forestry							
Library	150	5	55	–	–	–	210
Scientific Publications	100	–	–	400	–	–	500
Information & Technical Service	310	28	–	964	132	–	1 434
TOTAL	560	33	55	1 364	132	–	2 144
National Health & Welfare							
Library	186	–	85	–	–	–	271
Information Service	763	19	–	193	52	–	1 027
Information Retrieval (FDD)	393	50	10	5	30	–	488
Research & Statistics Directorate	1 660	41	2	10	23	–	1 736
Consumer Section (FDD)	150	4	–	102	30	–	286
Fitness & Amateur Sports	40	–	–	220	–	–	260
Other Health Services	62	–	–	35	28	–	125
TOTAL	3 254	114	97	565	163	–	4 193
National Research Council							
National Science Library	1 060	50	370	37	471	–	1 988
Technical Information Service	970	–	–	–	460	41	1 471
Division of Building Research	3 680	–	–	–	1 380	–	5 060
TOTAL	5 710	50	370	37	2 311	41	8 519
Patents & Copyright Office	1 139	2	4	834	–	187	2 166
ALL AGENCIES	**17 033**	**567**	**1 463**	**5 629**	**3 409**	**640**	**28 741**

** No estimates possible.
*** No projection given – 1967-68 figures used.

Appendix D

LIST OF FEDERAL GOVERNMENT LIBRARIES

Air Transport Board Library

Atomic Energy of Canada Limited
- Chalk River Nuclear Laboratories Library, Chalk River, Ont.
- Commercial Products Library, Ottawa
- Power Projects Library, Sheridan Park, Ont.
- Whiteshell Nuclear Research Establishment Library, Pinawa, Man.

Bank of Canada Library

Canada Council Library

Canadian Broadcasting Corporation
- Research Library

Central Mortgage and Housing Corporation Library

Department of Agriculture
- Main Library, Ottawa
- Chemistry Library, Ottawa
- Entomology Research Institute Library, Ottawa
- Plant Research Institute Library, Ottawa
- Ottawa Research Station Library, Ottawa
- St. John's Research Station Library, St. John's, Nfld.
- Fredericton Research Station Library, Fredericton, N.B.
- Kentville Research Station Library, Kentville, N.S.
- La Pocatière Research Station Library, La Pocatière, Qué.
- Québec City Research Station Library, Québec, Qué.
- Animal Diseases Research Institute Library, Hull, Qué.
- Belleville Research Station Library, Belleville, Ont.
- Harrow Research Station Library, Harrow, Ont.
- London Research Station Library, London, Ont.
- Vineland Research Station Library, Vineland, Ont.
- Winnipeg Research Station Library, Winnipeg, Man.
- Saskatoon Research Station Library, Saskatoon, Sask.
- Regina Research Station Library, Regina, Sask.
- Swift Current Research Station Library, Swift Current, Sask.
- Lethbridge Research Station Library, Lethbridge, Alta.
- Saanichton Research Station Library, Saanichton, B.C.

Summerland Research Station Library, Summerland, B.C.
Vancouver Research Station Library, Vancouver, B.C.

Department of Defence Production Library

Department of Energy, Mines and Resources
Astrophysical Observatory Library, Victoria, B.C.
Bedford Institute Library, Halifax, N.S.
Dominion Observatory Library, Ottawa
Dominion Radio Astrophysical Library, Penticton, B.C.
Geological Survey of Canada Library, Ottawa
Geological Survey of Canada Library, Calgary, Alta.
Mineral Resources Division Library, Ottawa
Mines Branch Library, Ottawa
Mining Research Laboratories Library, Elliott Lake, Ont.
National Air Photo Library, Ottawa
Physical Metallurgy Division Library, Ottawa
Policy and Planning Branch Library, Ottawa
S ıveys and Mapping Branch Library, Ottawa

D artment of External Affairs Library

Department of Finance Library

Department of Fisheries
Headquarters Library, Ottawa
Field Library, St. John's, Nfld.
Field Library, Halifax, N.S.
Field Library, Québec, Qué.
Field Library, Sault Ste Marie, Ont.
Field Library, Winnipeg, Man.
Field Library, Vancouver, B.C.

Fisheries Research Board
Biological Station Library, St. John's, Nfld.
Technological Station Library, Halifax, N.S.
Biological Station Library, St. Andrews, N.B.
Arctic Biological Station Library, Ste. Anne de Bellevue, Qué.
Freshwater Institute Library, Winnipeg, Man.
Technological Station Library, Vancouver, B.C.
Biological Station Library, Nanaimo, B.C.

Department of Forestry and Rural Development
Main Library, Ottawa
Station Library, St. John's, Nfld.
Station Library, Amherst, N.S.
Station Library, Fredericton, N.B.
Station Library, Sillery, Qué.
Station Library, Forest Products Laboratory, Ottawa

Station Library, Petawawa Forest Experiment Station
Station Library, Sault Ste. Marie, Ont.
Station Library, Winnipeg, Man.
Station Library, Calgary, Alta.
Station Library, Forest Products Laboratory, Vancouver, B.C.
Station Library, Victoria, B.C.

Department of Indian Affairs and Northern Development
Department Library
Northern Administration Branch: Education Division Library

Department of Industry Library

Department of Justice
Justice Library
Combines Investigation Commission Branch Library

Department of Manpower and Immigration Library

Department of National Defence
Headquarters Library, Ottawa
History Directorate Library, Ottawa
Technical Services Library, Ottawa
Material Command Library, Rockcliffe, Ont.
Collège Militaire St-Jean Bibliothèque, St-Jean, Qué.
Royal Military College Library, Kingston, Ont.
National Defence College Library, Kingston, Ont.
Canadian Forces College Library, Toronto, Ont.
Institute of Aviation Medicine Library, Toronto, Ont.
Royal Roads College Library, Royal Roads, B.C.

Defence Research Board
Directorate of Scientific Information Services
Documents Section, Ottawa
Books and Periodicals Section, Ottawa
Defence Chemical, Biological and Radiation Establishment Library, Ottawa
Defence Research Telecommunications Establishment Library, Ottawa
Defence Research Establishment Atlantic Library, Dartmouth, N.S.
Canadian Armament Research and Development Establishment Library, Valcartier, Qué.
Defence Research Establishment Toronto Library, Downsview, Ont.
Defence Research Establishment Suffield Library, Ralston, Alta.
Defence Research Establishment Pacific Library, Esquimalt, B.C.

Department of National Health and Welfare Library

Department of National Revenue
Customs and Excise Division Library
Taxation Division Library

Department of Public Works Library
    Testing Laboratories Branch Library, Ottawa

Department of Secretary of State Library

Department of Trade and Commerce Library

Department of Transport Library

Department of Veterans Affairs Library

Dominion Bureau of Statistics Library

Economic Council of Canada Library

Library of Parliament

National Energy Board Library

National Film Board, Still Photo Library

National Gallery of Canada Library

National Library of Canada

National Museum of Canada Library

National Science Library—National Research Council of Canada Library
    Main Library, Ottawa
    Applied Chemistry Branch Library, Ottawa
    Applied Physics Branch Library, Ottawa
    Building Research Branch Library, Ottawa
    National Aeronautical Establishment—Mechanical Engineering Branch Library, Ottawa
    Radio and Electrical Engineering Branch Library, Ottawa
    Uplands Branch Library, Ottawa
    Atlantic Regional Laboratory Library, Halifax, N.S.
    Churchill Research Range Library, Fort Churchill, Man.
    Prairie Regional Laboratory Library, Saskatoon, Sask.

Patent and Copyright Office Library

Post Office Department
    Reference Library

Public Archives Library

Public Service Commission of Canada Library

Supreme Court of Canada Library

Unemployment Insurance Commission Library

Appendix E

SELECTED LIST OF FEDERAL GOVERNMENT INFORMATION SOURCES

Atomic Energy of Canada Limited
275 Slater Street
Ottawa.

Canadian Broadcasting Corporation
1500 Bronson Avenue
Ottawa.

Department of Agriculture
Information Division
Carling Avenue
Ottawa.

Department of Defence Production
123 Slater Street
Ottawa.

Department of Energy, Mines and Resources
Public Relations and Information Services
588 Booth Street
Ottawa.

Department of Finance
Information Service
Confederation Building
Ottawa.

Department of Fisheries
Information and Consumer Service
Sir Charles Tupper Building
Ottawa.

Department of Forestry and Rural Development
Information and Technical Services Division
161 Laurier Avenue West
Ottawa.

Department of Indian Affairs and Northern Development
Information Services Division
400 Laurier Avenue West
Ottawa.

Department of Industry (now Industry, Trade and Commerce)
Information Division
112 Kent Street
Ottawa.

Department of Manpower and Immigration
Information Service
312 Rideau Street
Ottawa.

Department of National Defence
Information Services
125 Elgin Street
Ottawa.

Defence Research Board
125 Elgin Street
Ottawa.

Department of National Health and Welfare
Information Services Division
Brooke Claxton Building
Ottawa.

Department of Public Works
Information Services
Sir Charles Tupper Building
Ottawa.

Department of Trade and Commerce (now Industry, Trade and Commerce)
112 Kent Street
Ottawa.

Department of Transport
Information Division
Hunter Building
Ottawa.

Dominion Bureau of Statistics
Information Division
Tunney's Pasture
Ottawa.

National Film Board
150 Kent Street
Ottawa.

National Library and Public Archives
395 Wellington Street
Ottawa.

National Research Council of Canada
Montreal Road
Ottawa.

National Science Library
100 Sussex Drive
Ottawa.

Queen's Printer
Department of Public Printing and Stationery
Boulevard Sacré-Coeur
Hull, Qué.

Attention is drawn to the Canada Year Book 1967, pages 1204-1235, for a detailed "Directory of Sources of Official Information". This provides a broad subject approach to both Federal and Provincial information sources.

Appendix F

SELECTED LIST OF DATA SERVICES AND SPECIAL I.R. SERVICES IN THE FEDERAL GOVERNMENT

Department of Agriculture

Scientific Information Section, Research Branch

Insecticide, Herbicide and Fungicide Information System

A data file on toxicity and effectiveness of insecticides, fungicides, and herbicides, employing co-ordinate indexing and optical coincidence cards.

Department of Energy, Mines and Resources

Geological Survey Branch

The National System of Geological Data Files

GEØDAT—An acronym for a computerized multiple file, geo-science data bank for the mainly numerical results produced by the Geological Survey Branch laboratories. The data include chemical analyses reported as oxide per cent and as elements in parts per million. The system is analogous to a co-ordinate indexing scheme having 8 and 12 cross-references such as: geographic location, originating agency, serial number, specimen type, material name, stratigraphical age, elevation in feet, analytical procedure, analytical result.

Canadian Isotopic Age Data File

The file summarizes all available Canadian isotopic data from G.S.C. laboratories and other Canadian institutions. It is a co-ordinate file on magnetic tape with a flexible retrieval system permitting selection and printout of any or all parameters. Examples of cross-references here are: field numbers, lab. numbers, latitude and longitude, geological formation, publication reference.

"M" File (Mineral Deposit Record File)

The unit of entry is a package of measurements and descriptive terms (including literature references and a descriptive note) that will permit comparison of one deposit with another. Cross-references include: name of deposit, stage of development, location, form and size, geological setting.

National Index to Geological Data

A national computer-based system is being developed for the recording, storage, and retrieval of geological data in government and non-government files, existing in the form of published or unpublished documents or in computer-processable files. A computer-assisted national index to the contents and location of such data files in Canada will be produced.

Aeromagnetism File

x and y co-ordinates and readings stored on magnetic tape.

Rock Magnetism File

A magnetic tape store of information on the magnetic properties of rocks.

Marine Sciences Branch

Canadian Oceanographic Data Centre

This centre operates a very large file of oceanographic data and limnological data on magnetic tape, and a large file of bathythermographs on aperture cards. Additional programs to permit greater manipulation of the store are being developed.

Observatories Branch

The names of the following data files in this branch are, for the most part, self-explanatory. They consist of data on magnetic tape with various program packages available for their manipulation:

Crustal Studies File (seismic records)
Gravity Data File
Geomagnetism File (intensity of earth's field data)
First Arrival Time File (seismic records)
Star Position File
Yellowknife Array File (for identification of underground nuclear tests).

Surveys and Mapping Branch

Aero Survey File and Horizontal Measurements File. These files contain computational data on distances and angles.

Water Research Branch

The following data files are located in this branch:

Daily Mean Discharge File
Tides and Water Levels File
Hydrogeological Well Data
Groundwater Level Data
Water Quality Data.

Initially on cards, these will all be eventually on magnetic tape.

Department of Forestry and Rural Development

Forest Pathology Division, Forestry Branch

International Tree Disease Register (INTREDIS)

Citations from standards services such as *Forestry Abstracts, Biological Abstracts, Review of Applied Mycology,* are stored on magnetic tape, permitting the rapid retrieval of literature references on such features as subject, country, host, and parasite in various combinations.

Canada Land Inventory

The Canada Land Inventory was established to assemble information on land capability for agriculture, forestry, recreation, and wildlife management. The system accepts, stores, and measures location-specific information, i.e. any information that can be related to the area or place from which it was derived. Output of the system can be either alphanumeric or graphic. In addition to the normal computer printer facility that provides tabular data, there is a graphic plotter that provides a map showing the location of desired areas, lines, points, etc.

Department of Manpower and Immigration

Program Development Service

Operates a computer-based national register containing information on approximately 70 000 personnel in the biological, physical, and social sciences.

Department of National Health and Welfare

Food and Drug Directorate

Food and Drug Information Retrieval Centre

This centre utilizes the Recordak Miracode system, which consists of a recording unit and a search unit. The recording unit uses a 16 mm. planetary camera capable of reduction ranges from 12:1 to 28:1. The file medium used is 100-foot reel of 16 mm. film stored in magazines. An input control keyboard located on the micro-filmer table permits an operator to insert rapidly either the accession number or a description in the form of a binary code under the film immediately preceding each document, and in one operation at the time the document is filmed.

The search operation utilizes an electronic selector and microfilm viewer. The codes relating to the desired search terms are keyed into automated retrieval keyboards, and a high-speed transistorized logic unit searches the file at the rate of 10 feet per second, i.e. 300 pages per second. The first page of the document which answers the search request is located and is automatically enlarged and displayed in the viewer. At the enquirer's request, a full-size hard copy may be prepared in 7 seconds. The logic unit is capable of searching simultaneously for 15 terms. Documents in the system include decisions, rulings and information on various types of foods, drugs, cosmetics, and devices.

Dominion Bureau of Statistics

Canadian Socio-Economic Information Management System

An automated data processing project developed jointly by DBS, the Bank of Canada, National Energy Board, and the Economic Council of Canada for the tabulation, storage, retrieval, and dissemination of statistics.

National Research Council of Canada

National Science Library

Union List of Scientific Serials in Canadian Libraries

This is a computerized store of journal titles and holdings which was developed to serve as a national reference tool for efficient interlibrary loan service. The record is updated weekly and permits frequent publication in upper and lower case of new editions as well as listing by individual library or region.

Files of numerical data are located in the various divisions of the National Research Council. Examples are: JANAF Thermochemical Tables, Selected Infrared Spectral Data, Selected Nuclear Magnetic Resonance Spectral Data.

National Aeronautical Establishment

Information Centre for Agricultural and Forestry Aviation

A card index for the location of references to the literature in this field of aviation for the use of aerial operators and research workers.

National Museums of Canada

Zoology Division

A national sorting and identification service centre for zooplankton.

Royal Canadian Mounted Police

Plans are being developed for the establishment of a nation-wide, computer-based Canadian police information system that will contain names, physical description, and other pertinent information relating to about one million persons with criminal backgrounds. It will also contain a national stolen motor vehicle file, the National Firearms Registration File, the Identifiable Stolen Property File, and the Outstanding Physical Peculiarities File.

Defence Research Board

Project SOCRATES

SOCRATES is an acronym for "System for Organizing Current Reports to Aid Technology and Science", and designates a project aimed at improving accessibility of STI to users in the Canadian defence community. Complete bibliographic data for all reports received by the Defence Scientific Information Service of DRB are stored on magnetic tape. Indexed accession lists, catalogue cards, and other printed outputs are generated by computer operations. The present system is based on batched mode of operation. On-line entry of data will be implemented in 1969, followed by introduction of a central master file, with all input-output functions available at remote locations. Access to machine-readable data generated outside DSIS is obtained by use of a universal translation program that converts externally generated data to the SOCRATES format, thus averting duplication of cataloguing effort. The file structures and management are generalized so that the system is not limited to document processing but may be used for storage and retrieval of all kinds of data, and conversion to formats required for entry to other systems. A library of report-generating programs is being developed to ensure that printed, display, and other outputs are in the form most acceptable to the user. Access to the functions of the system will be through natural language, and the user will not need to have programming experience.

Appendix G

LEGISLATIVE AUTHORITY FOR INFORMATION ACTIVITIES

Department of Agriculture

Our legal adviser had considered the problem, and it appears to him that other than the various Appropriation Acts there is no statutory authority giving the Department of Agriculture the right to publish material. There are statutes, however, such as the Experimental Farm Stations Act and the Department of Agriculture Act that make it mandatory to submit certain reports to Parliament. These Acts, however, do not give a general authority to publish. It is the opinion of our legal adviser that as long as the funds are authorized by Parliament for the purpose of publication, and such publications are specified, no specific statutory prohibition is involved, and the Department may publish.

Letter from G.M. Carman, April 2, 1968

Atomic Energy of Canada Limited

AECL was incorporated under Part 1 of the Company's Act (now the Canada Corporations Act) pursuant to the Atomic Energy Control Act. The Company hence possesses all the "incidental and ancilliary powers" conferred by Section 14 of the first-mentioned act on companies incorporated under that Part. While there is no specific reference to the handling and dissemination of scientific and technical information such as is reflected in Section 14 of the National Research Council Act there can be no doubt regarding AECL's authority in this regard as an incident in the exercise of its powers under its Letters Patent of incorporation as supplemented by Section 14 of the Canada Corporations Act. In the exercise of its right to handle and disseminate scientific and technical information, AECL must, of course, as in the case of any other person observe the requirements of the Atomic Energy Control regulations.

Letter from A.H.M. Laidlaw, March 25, 1968

Defence Research Board, Defence Scientific Information Service

Under Section 91 of the British North America Act, the Parliament of Canada has exclusive legislative jurisdiction in matters relating to defence. The Defence Research Board's function relates to *defence* scientific and technical information.

Under the National Defence Act the Minister has interpreted the needs of the Canadian Forces and the Defence Research Board to include the provision of libraries.

The Minister in Defence Council (8th meeting, 7 March 1947) directed that existing scientific and technical libraries be amalgamated under the Director General of Defence Research.

By an amendment to the National Defence Act, the Defence Research Board came into being on 1 April 1947. The Chairman, Defence Research Board, assumed the responsibilities previously carried by the Director General of Defence Research, including the operation of amalgamated scientific and technical libraries.

Under Part III of the National Defence Act, the Board has continued to operate and develop such scientific and technical libraries and information facilities based on them as the Board deemed necessary for the performance of its functions.

With the integration of the Armed Forces and the re-organisation of supporting services which preceded and accompanied it, the functions of DSIS were re-defined. This re-definition is given in Defence Staff Secretariat Directive No.1/66, dated 9 March 1966 (Restricted).

Letter From A.C. Jones, May 1, 1968

Dominion Bureau of Statistics

Statistics Act

R.S. 1952, c. 257, s. 3

3. There shall be a Bureau under the Minister, to be called the Dominion Bureau of Statistics, the duties of which are

(*a*) to collect, compile, analyse, abstract and publish statistical information relative to the commercial, industrial, financial, social, economic and general activities and condition of the people;

(*b*) to collaborate with all other departments of the government in the collection, compilation and publication of statistical records of administration according to any regulations;

4. (1) The Governor in Council may appoint an officer called the Dominion Statistician to hold office during pleasure, whose duties are, under the direction of the Minister,

(*a*) to advise on all matters pertaining to statistical policy and to confer with the several departments of government to that end;

(*b*) to organize and maintain a scheme of co-operation in the collection, classification and publication of statistics as between the several departments of government;

15. (1) No individual return and no part of an individual return made, and no answer to any question put for the purposes of this Act, shall, without the previous consent in writing of the person or of the owner for the time being of the undertaking in relation to which the return or answer was made or given, be published, nor, except for the purposes of a prosecution under this Act, shall any

person other than a person employed by the Bureau or working under arrangement with the Bureau and sworn under section 6, be permitted to see any such individual return, part or answer.

(2) No report, summary of statistics or other publication under this Act shall contain any of the particulars comprised in any individual return so arranged as to enable any person to identify any particulars so published as being particulars relating to any individual person or business.

Department of Energy, Mines and Resources

Resources and Technical Surveys Act
R.S. 1952, C.73, ss. 6, 7, 8

6. The Minister shall
   (*a*) collect and publish full statistics of the mineral production and of the mining and metallurgical industries of Canada, and such data regarding the economic minerals of Canada as relate to the processes and activities connected with their utilization, and collect and preserve all available records of mines and mining works in Canada;
   (*g*) prepare and publish such maps, plans, sections, diagrams and drawings as are necessary to illustrate and elucidate any reports of investigations and surveys made pursuant to this Act. 1949 (2nd Sess.), c. 17, s. 6.

7. The Minister may, for the purpose of obtaining a basis for the representation of the mineral and mining resources and of the geographical and geological features of any part of Canada, cause such measurements, observations, investigations and physiographic, exploratory and reconnaissance surveys to be made as are necessary for or in connection with the preparation of maps, sketches, plans, sections or diagrams. 1949 (end Sess.), c. 17, s. 7.

8. The Minister may cause distribution to be made of duplicate specimens to scientific, literary and educational institutions in Canada and other countries, and also authorize the distribution or sale of the publications, maps and other documents issued by the Department. 1949 (2nd Sess.), c. 17, s. 8.

Ministry of Fisheries, Fisheries Research Board of Canada

Fisheries Research Board Act
R.S. 1952, c. 121, s. 8

8. The Board may make by-laws for the conduct of its business, but no by-law shall be in force until it is approved by the Governor in Council. 1947, c. 61, s. 1.

Bylaws of the Fisheries Research Board of Canada, Section 15:

> Subject to the policy and procedures of the Government Service, the Board may, with the approval of the Minister, publish such scientific and technical information as the Board deems advisable.

Ministry of Fisheries, Department of Fisheries

According to the Legal Service of the Department of Fisheries, the Department does not appear to have statutory authority for the handling and dissemination of scientific and technical information. The Department feels obliged to make technical information available to the fishing industry and to fishermen, and their publications are issued "under the authority of the Minister".

Letter from J.C. Stevenson, March 14, 1968

Department of Forestry and Rural Development

Forestry Development and Research Act
8-9 Elizabeth II, 1960, c. 41, s. 6
as amended 14-15 Elizabeth II, 1966, c. 25, s. 26.

6. (1) Subject to section 24 of the Government Organization Act, 1966, respecting the duties, powers and functions of the Minister in relation to the forest resources of Canada over which the Parliament of Canada has jurisdiction, the Minister

(*b*) may undertake, promote or recommend measures for the encouragement of public co-operation in the protection and wise use of the forest resources of Canada;

(*c*) with the approval of the Governor in Council, may enter into agreement with the government of any province or with any person for forest protection and management or forest utilization, for the conduct of research related thereto, or for forestry publicity or education.

(2) In carrying out his duties and functions under this Act, the Minister may consult with and inaugurate conferences of provincial or municipal authorities, universities, representatives of industry or other interested persons.

Library of Parliament

Library of Parliament Act
R.S. 1952, c. 166

2. All books, paintings, maps and other effects in the joint possession of the Senate and House of Commons of Canada, or which are hereafter added to the existing collection, shall be vested in Her Majesty, for the use of both Houses of Parliament, and shall be kept in a suitable portion of the Parliament buildings appropriated for that purpose. R.S., c. 15, s. 1.

Department of National Health and Welfare

Department of National Health and Welfare Act
R.S. 1952, c. 74, s. 5

5. The duties, powers and functions of the Minister extend to and include all matters relating to the promotion or preservation of the health, social security and social welfare of the people of Canada over which the Parliament of Canada has jurisdiction, and, without restricting the generality of the foregoing, particularly the following matters:

(*h*) subject to the provisions of the Statistics Act, the collection, publication and distribution of information relating to the public health, improved sanitation and social and industrial conditions affecting the health and lives of the people;

(*i*) co-operation with provincial authorities with a view to the co-ordination of efforts made or proposed for preserving and improving the public health and providing for the social security and welfare of the people of Canada. 1944-45. c. 22, s. 5.

National Library

National Library Act
R.S. 1952, c. 330, s. 10

10. Subject to the direction of the Minister, the National Librarian may

(*a*) undertake the collection, by purchase or otherwise, of books for the Library,

(*b*) compile and maintain a national union catalogue in which the contents of the principal library collections throughout Canada may be listed,

(*c*) compile and publish a national bibliography in which books produced in Canada, written or prepared by Canadians or of special interest or significance to Canada may be noted and described,

(*d*) lend, sell or otherwise dispose of books forming part of the Library, and enter into exchange agreements with libraries and other institutions both in Canada and elsewhere, and

(*e*) generally supervise and direct the work of the National Library in such a manner that the facilities of the Library may be made available to the Government and people of Canada to the greatest possible extent consistent with the sound administration of the Library.

National Research Council of Canada

National Research Council Act
R.S. 1952, c. 239 as amended by 1953-54,
cc. 40, 42; 1966, c. 26, s. 13

13. Without thereby limiting the general powers of the Council conferred upon or vested in it by this Act, it is hereby declared that the Council may exercise the following powers, namely:

(*c*) to undertake, assist or promote scientific and industrial research, including, without restricting the generality of the foregoing,

(*fb*) to establish, operate and maintain a national science library;

(*g*) subject to the approval of the Minister, to publish and sell or otherwise distribute such scientific and technical information as the Council deems necessary;

Patent and Copyright Office

Patent Act
R.S. 1952, c. 203, ss. 10, 20, 27

10. All specifications, drawings, models, disclaimers, judgments, returns, and other papers, except caveats, and except those filed in connection with applications for patents that are still pending or have been abandoned shall be open to the inspection of the public at the Patent Office, under such regulations as are adopted in that behalf. 1935, c. 32, s. 10.

20. (5) Where any agreement for such assignment has been made the Minister of National Defence may submit an application for patent for the invention to the Commissioner, with the request that it be examined for patentability, and if such application is found allowable may, before the grant of any patent thereon, certify to the Commissioner that, in the public interest, the particulars of the invention and of the manner in which it is to be worked are to be kept secret.

(11) No copy of any specification or other document or drawing, by this section required to be placed in a sealed packet, shall in any manner whatever be published or open to the inspection of the public, but, save as in this section otherwise directed, the provisions of this Act shall apply in respect of any such invention and patent as aforesaid.

(16) The Governor in Council may make rules under this section for the purpose of ensuring secrecy with respect to applications and patents to which this section applies and generally to give effect to the purpose and intent thereof. 1947, c. 23, s. 4.

27. The Commissioner shall, in each year, cause to be prepared and laid before Parliament a report of the proceedings under this Act, and shall, from time to time and at least once in each year, publish a list of all patents granted, and may, with the approval of the Governor in Council, cause such specifications and drawings as are deemed of interest or essential parts thereof, to be printed, from time to time for distribution or sale. 1935, c. 32, s. 25.

Department of Public Printing and Stationery

Public Printing and Stationery Act
R.S. 1952, c. 162, ss. 4, 7, 14, 17, 18

4. (1) The Department is charged exclusively with the following duties in relation to services required for the Senate and House of Commons and the several departments of the Government, namely:

(*a*) the execution and audit of all printing, stereotyping, electrotyping, lithography, binding work, or work of the like nature, and the procuring of the material therefor:

(*b*) the purchase and distribution of all paper, books and other articles of stationery of whatsoever kind, except books that are required for the Library of Parliament, and printed books required for the use of the chaplains, libraries or schools in the penitentiaries which may be procured in the manner authorized by law;

(*c*) the sale of all books or publications issued by order of either or both Houses of Parliament or by any department of the Government; and

(*d*) the audit of all accounts for advertising.

(2) The aforesaid services shall be executed by or under the superintendence of the proper officers respectively of the Department. R.S., c. 162, s. 5.

7. The Queen's Printer and Controller of Stationery, under the Minister, has the management and control of the several services to which this Act relates, and has such powers and shall perform such duties as are conferred upon and assigned to him by this Act, or by any other Act of the Parliament of Canada, or by any order in council made thereunder: but all such powers shall be exercised and all such duties shall be performed subject to the control of the Minister, and as he directs. R.S., c. 162, s. 8.

14. A Government establishment shall be organized at Ottawa, and shall be under the management of the Director and Superintendent of Printing in which establishment all printing, electrotyping, stereotyping, lithographing and binding and other work of like nature required for the service of the Parliament and the several departments of the Government shall be executed. R.S., c. 162, s. 15.

17. An Office shall be established as a branch of the Department, which shall be called the Stationery Office, and shall be under the management of the Superintendent of Stationery. R.S., c. 162, s. 18.

18. (1) The Superintendent of Stationery, under the general supervision of the Queen's Printer, has charge of the custody and supply of all articles of stationery, required for the use of members and employees of the two Houses of Parliament and of the several departments of the Government of Canada, except printing materials, printing papers and printing supplies.

(2) The Superintendent of Stationery also has charge of the sale of all the official publications of the Parliament and Government of Canada that are issued for sale, as well as of the distribution of all public documents and papers to the officials and other persons who are entitled to receive the same without payment. R.S., c. 162, s. 19.

Department of State

Department of State Act
R.S. 1952, c. 77, s. 4 (2)

4. (2) The Secretary of State of Canada has the control, management and administration of the National Museum of Canada, and shall acquire, collect,

classify, conserve, display, store, and be generally responsible for the safe custody of such objects as are necessary to acquire and disseminate a knowledge of human history, natural history, science, technology, and such other subjects as may be designated by the Governor in Council from time to time, with special but not exclusive reference to Canada, and shall conduct and promote research and other activities designed to further these objectives.

Science Council of Canada

Science Council of Canada Act
14-15 Elizabeth II, 1966. C. 19, ss. 11, 12, 13

11. It shall be the duty of the Council to assess in a comprehensive manner Canada's scientific and technological resources, requirements and potentialities and to make recommendations thereon to the Minister; and in particular it shall be the duty of the Council to give consideration to, and make reports and recommendations to the Minister on,

(*a*) the adequacy of the scientific and technological research and development being carried on in Canada;
(*b*) the priorities that should be assigned in Canada to specific areas of scientific and technological research;
(*c*) the effective development and utilization of scientific and technological manpower in Canada;
(*d*) long term planning for scientific and technological research and development in Canada;
(*e*) the factors involved in Canada's participation in international scientific or technological affairs;
(*f*) the responsibilities of departments and agencies of the Government of Canada, in relation to those of universities, private companies and other organizations, in furthering science and technology in Canada;
(*g*) the statistical and other information on scientific and technological research and development that should be obtained in order to provide a proper basis for the formulation of government policy in relation to science and technology in Canada; and
(*h*) the best means of developing and maintaining co-operation and the exchange of information between the Council and other public or private organizations concerned with the scientific, technological, economic or social aspects of life in Canada.

12. (1) The Minister may refer to the Council for its consideration and advice in such matters relating to science and technology in Canada or otherwise relating to the operation of this Act as he thinks fit.

(2) The Council shall investigate and report to the Minister on all matters referred to it pursuant to subsection (1) and shall make such recommendations to the Minister in respect thereof as it deems appropriate.

13. The Council shall on its own initiative, or if directed to do so by the Minister, conduct such studies, inquiries and other undertakings as may be necessary with respect to any matter coming within sections 11 and 12 or with respect to any other matter relating to the carrying out of its duties under those sections, and shall report to, advise or make recommendations to the Minister with respect thereto as the circumstances require.

Appendix H

SCIENTIFIC AND TECHNICAL PERIODICALS PUBLISHED BY THE CANADIAN GOVERNMENT

Atomic Energy of Canada Limited

- AECL Review
- Reports. AECL Series

Central Mortgage and Housing Corporation

- Habitat

Department of Agriculture

- Canadian Insect Pest Review
- Canadian Plant Disease
- Current Review of Agricultural Conditions in Canada
- Economic Annalist
- Research for Farmers

Department of Energy, Mines and Resources

- Geographical Branch
  - Bibliographical Bulletin
  - Geographical Bulletin
  - Geographical Papers
  - Memoir
- Mines Branch
  - Canadian Metallurgical Quarterly
  - Information Circular
  - Mineral Information Bulletin
  - Mineral Reports
  - Mineral Survey
  - Monographs
  - Research Reports
  - Technical Bulletins
- Observatories Branch
  - Seismological Bulletin
- Dominion Astronomical Observatory
  - Contributions
  - Publications

Dominion Astrophysical Observatory
- Contributions
- Publications

Water Resources Branch
- Water Resources Paper

Geological Survey of Canada
- Bulletin
- Economic Geology Series
- Memoirs
- Papers

Department of Fisheries
- Canadian Fish Culturist
- Canadian Fisheries Reports
- Fisheries of Canada

Fisheries Research Board
- Bulletin
- Journal

Department of Forestry and Rural Development

Forestry Branch
- Forest Fire Control Abstracts
- Forest Products Research News

Department of Indian Affairs and Northern Development

Canadian Wildlife Services
- Occasional Papers
- Translations of Russian Game Reports
- Wildlife Management Bulletin

Department of National Defence
- DSIS KWOC Index
- Canadian Forces Sentinel
- Flight Comment

Department of National Health and Welfare
- Canada's Health and Welfare
- Canada's Mental Health
- Canadian Bulletin on Nutrition
- Canadian Nutrition Notes
- Occupational Health Bulletin
- Occupational Health Review

Department of the Registrar General
- Canadian Patent Office Record and Register of Copyrights
- Trade Marks Journal

Department of the Secretary of State

National Museum of Canada

Bulletin

Natural History Papers

Department of Transport

Air Navigation Radio Aids

Canadian Ionospheric Data

Canadian Meteorological Memoirs

Canadian Weather Review

Meteorological Translation

Monthly Bulletin on Canadian Radiosonde Data

Monthly Radiation Summary

Monthly Record of Meteorological Observations

Radio Aids to Marine Navigation: Atlantic and Great Lakes

Radio Aids to Marine Navigation: Pacific Region

National Research Council of Canada

Canadian Geophysical Bulletin

Canadian Geotechnical Journal

Canadian Journal of Biochemistry

Canadian Journal of Botany

Canadian Journal of Chemistry

Canadian Journal of Earth Sciences

Canadian Journal of Microbiology

Canadian Journal of Physics

Canadian Journal of Physiology and Pharmacology

Canadian Journal of Zoology

NRC Research News

NRC Review

Problems of the North. Translation of Problemy Severa Akademiia Nauk, U.S.S.R.

Technical Translation

Division of Building Research

Better Building Bulletin

Building Research News

Building Research Note

Bulletin

Canadian Building Abstracts

Canadian Building Digest

NBC News

Division of Mechanical Engineering and National Aeronautical Establishment

Quarterly Bulletin

Division of Radio and Electrical Engineering
- Quarterly Bulletin
- Reports. ERA Series
- Reports. ERB Series

Further information on these titles may be found in the Directory of Canadian Scientific and Technical Periodicals, published by the National Science Library.

Appendix I

DESCRIPTION OF INFORMATION RESOURCES OF PROVINCIAL DEPARTMENTS AND AGENCIES

Information resources supported by provincial funds consist essentially of those within provincial departments and their agencies and those supplied through provincial Research Councils in conjunction with the Technical Information Service of the National Research Council. The deputy head or his representative in most of the Departments of Agriculture, Health, Industry, Education, Economics, and Natural Resources was interviewed. Briefs were obtained from a few of the larger provincial departments and from all Research Councils, and the most recent annual reports of these departments were reviewed. It was not possible to comment on all departments, and the examples given are considered representative of recent developments.

Provincial Government Departments

Provincial government departments operate three general types of services, i.e. library services, information or extension services, and data banks. Most provincial departments maintain libraries for the use of their own staff. The resources vary in size from that of the Department of Health of Ontario, which employs a staff of 14 in six separate units, to small organizations that have no professional assistance. Some libraries have a system for the selective dissemination of documents or data. In most cases federal libraries, either locally or in Ottawa, are used occasionally as sources of additional reference material and data. With the exception of larger departments, the staff employed usually amounts to no more than one person per department in the library and one or two for other information services. No information could be obtained in regard to cost of these services as the departments generally did not fund them separately. All provincial governments have computer facilities which are employed to varying degrees in the administration of the provincial business. Such facilities are also available for the use of departments for their particular purpose but as yet practically no use has been made of them by library staff. Most government departments are interested in the increased use of computers for handling data of various types, particularly in the fields of trade, resources, economics, health and production. Use is not made generally of telephone or Telex in data transmission. Normally, because of cost, regular mail is employed and results in considerable delay in availability of material requested.

Almost all provincial departments showed considerable interest in the need for making more efficient and better use of the information they supply. In this regard, plans have been formulated in Ontario for an improved centralized service for all departments. On November 2, 1967, Hon. C.S. MacNaughton, Provincial Treasurer, issued the following statement:

> "The Department of the Provincial Secretary and Citizenship will provide a central service for the establishment and maintenance of quality standards for government publications and for the publication, cataloguing and distribution of these publications. An experienced publications executive will be appointed as Queen's Publisher to head up this operation and to provide advice and assistance with a view to achieving a uniformly high standard of design and editorial content of all government publications.
>
> "It is planned to establish a central publications store on the street level, where the public can purchase or secure any of the many departmental pamphlets, books or other government publications. This central operation will also provide for the cataloguing of all publications, efficient distribution, and compact storage."

Such a service might also promote the dissemination of information produced by federal agencies, since there could be direct links between the provincial Queen's Publisher and the federal Queen's Printer (Publisher).

Health Departments

The organization of the information services in Departments of Health in different provinces varies considerably. The main purpose of these services is general health education. In Manitoba, for example, the Health Education Branch assists the public health team in the community in developing public health programs, and provides health education and consulting services to all disciplines within the department and to allied agencies in the public health field. The branch provides educational resource material, visual aids, and equipment to public health field workers, non-government agencies, and the general public. It also publishes information concerning departmental facilities in all publicity media. Specific aspects of the program include the following: the organization and co-ordination of annual summer school public health workshops, educational material and guidance in "family life education" courses and programs on proper food handling techniques for commerce and the community, the revision of the school health curriculum, the development of annual health displays for exhibitions and, in conjunction with other agencies, the development of a water safety program. Television is widely used to discuss many aspects of health, including alcohol problems and nutrition education. The service produces publications and news releases, and offers a film service.

The Ontario Department of Health is one of the largest health departments and the largest service department of the Ontario Government, employing over one third of all public service personnel in that province. Its total staff of over 16 000 is distributed among various centres located throughout the province and bears the basic responsibility for all health matters affecting the people of the province. It embraces the whole field of medical and health sciences and includes such organizations as the Ontario Hospital Services Commission, the Ontario Cancer Institute, and foundations reporting to Parliament through the Minister of Health.

The information services include six principal libraries plus a number of smaller collections located in the branches they serve. General material is located centrally within the department and more specialized libraries are located in branches concerned with drug addiction, mental retardation, hospital services, and public and environmental health. Of the total library staff of 14 there are 6 graduate librarians. Budgets are usually formulated and administered in the branch to which the library is connected. The largest single library budget was $40 000 in 1967.

The libraries provide services primarily to the staff of the branches they serve. About half of all interlibrary exchanges occur within the department, the remainder being with the University of Toronto and the Toronto Academy of Medicine. Material is also lent to industry, other government departments, university students, hospital libraries, hospital councils, and planning associations. A recent survey of user opinion by the department indicated that 40 per cent are dissatisfied in some way with the way in which information is provided, the greatest complaint being in regard to delays in circulation or in providing information from outside sources. About half of the users complained of the lack of timeliness, usefulness, and availability of federal publications. There was some dissatisfaction with the communication between provinces and in not knowing what other provinces were producing because of lack of adequate indexing of the material.

Several libraries in the department have current awareness programs, and three libraries with qualified librarians carried out indexing of material in depth. There appears to be a need for the extension of these services. Although users rated the system as excellent or good, the faults that existed appeared related to deficiencies in the collection in certain areas or the lack of sophisticated library equipment.

The Information Branch of the department is independent of the library system. It generates and publishes about 20 pamphlets or booklets and several technical manuals each year.

Plans for future developments in information handling include better equipment for microfilming and microfilm storage in the Alcoholism and Drug Addiction Research Centre, increasing the number of library staff in the department, and the compilation of lists of journals received. A centralized information point is being developed with adequate communication using Telex to branches. Another development is the formation of a Health Data Centre of the Health Registration Board, which is developing a computer-based health statistics system for the province.

In Québec there is also considerable interest in the development of library systems and data-processing resources. The Division of Psychiatric Services of the provincial Department of Health is planning a province-wide system of library services for all psychiatric hospitals coming under its general supervision. It is also planning a central documentation centre that would serve all child-psychiatric organizations in the province. A pilot project to study the feasibility of a completely automated data-processing system is being planned for a hospital in the Montréal area. These plans are being developed in conjunction with federal objectives for a national system of health and welfare communications organized on a regional basis to provide scientific and technical information to qualified users across Canada.

With the exception of Ontario and Québec, which have greater resources, the Departments of Health of the remaining provinces normally operate small libraries for the use of their own staff. They do not rely to any significant extent on information supplied through the federal department but depend to a varying and limited extent on local university libraries. In British Columbia, the B.C. Library Service of the College of Physicians and Surgeons furnishes a service to physicians of the area who pay a fee of $10 per annum. It also purchases texts and monographs for 43 hospital medical libraries. It is unable at present to serve workers in the para-medical sciences but expansion to include all health sciences is planned. None of the departments attempts to supply the practising physician with much information, and specialist physicians usually depend directly on the nearest university library.

All departments are interested in the application of computers to hospital information, especially in relation to the handling of medical records, and are investigating or using various systems. Some hospitals are using systems such as the Professional Activity Study (PAS) from Michigan, with varying success. Others have found that these are not satisfactory for their purposes and are trying to develop new approaches. Particular interest in the handling of hospital records was evident in British Columbia and in Manitoba, where detailed studies are being made and plans laid for the application of computers to the various problems.

The provincial departments indicated several ways in which the federal department could assist their information services. It was pointed out in several provinces that there was a need for guidance in the collection of data. The federal department should define the type of data to be collected and offer more leadership in the fields of epidemiology, cancer, poison control, social hygiene, industrial health, and alcoholism. It should also be a source of information in these fields. In areas such as environmental health, there was no substitute for Canadian data which were urgently needed. There was need for the federal department to supply lists of publications available and in preparation. DBS data and other statistics from the department were reasonably satisfactory but there was too long a delay in the availability of the former.

Agriculture Departments

In agriculture, information is disseminated largely through extension services and information services which vary greatly in organization, size, and complexity between the larger and smaller provinces. To furnish background information they maintain libraries for the use of their staff.

Extension services are carried out to a large extent through agricultural representatives. The role of the Agricultural Representative Branch has been described in Saskatchewan as follows:

(1) To ensure that the most modern farming techniques and research findings are available to farmers;
(2) To provide leadership and general guidance in agricultural adjustment programs needed to bring about necessary social and economic progress;
(3) To co-ordinate and administer field programs and policies sponsored by other branches of the department for the purpose of encouraging desirable adjustments in agricultural practice and to cope with emergency situations.

In carrying out these functions the extension services endeavour to maintain close co-operation with, and co-ordinate the efforts of, other branches of the department as well as the university and the federal Department of Agriculture.

In other provinces the organization differs but the subjects covered are usually the same and include farm management, home economics, agricultural engineering, and fruit and vegetable growing. Information services use all types of media for the dissemination of information. In Ontario in 1965-66, 92 publications were processed at the rate of 17 773 copies per order. There were 511 news releases issued, 57 000 press clippings processed, 20 000 mail requests answered, 1 001 printing jobs completed, 149 radio and television programs released, and the film library showed 7 147 films. The photographic service produced over 11 000 photographs for extension work and over 12 000 for research and education at the University of Guelph. The information thus distributed is based on research carried out at the research stations and at the University of Guelph which is normally reported in various scientific journals.

Material that is not available locally is obtained through the local federal library or directly from Ottawa, but the delay may amount to several weeks. Many departments consider this arrangement adequate but some feel a need for more rapid service and for some system for selective dissemination of documents to assist staff in keeping up with the literature. Many libraries do not have facilities for storing and handling documents from FAO, etc. nor are such facilities available elsewhere within the department. In some provinces, e.g. Manitoba, library facilities are used by students, housewives, farmers, and teachers.

Although co-ordination with the federal department is on an *ad hoc* personal basis, provincial departments appear to receive sufficient information and data from Ottawa. Some departments feel that their program would be more effective if there were closer collaboration at the planning stage in the preparation of reports for the farmer. For example, it may happen that federal and provincial authorities see the need at the same time for a publication on particular subject matters primarily of interest to the province, and proceed to prepare it independently.

The smaller provinces depended to a greater extent than Ontario and Québec for publications of the federal department. As would be expected, the emphasis varied considerably depending on the type of agriculture. For example, in New Brunswick interest in food processing has developed to the extent that the New Brunswick Research and Productivity Council now publishes *Food Abstracts*. In this connection it should be noted that at a recent federal-provincial conference plans were laid for closer collaboration and co-operation in the preparation of material and its dissemination.

It was noted that on the whole there is close collaboration between federal and provincial authorities through the various subcommittees of the Canadian Agricultural Services Co-ordination Committee on subjects such as pesticide use in agricultural research, agricultural engineering, and animal and poultry diseases.

Several provinces are reorganizing or have reorganized their extension and information services. In Alberta the province has been subdivided into seven regions each with a regional centre, to aid in the decentralization of services. There has also been an increase in the number and effectiveness of agricultural advisory committees at the county level. Co-ordinating meetings have been held with all extension and research station personnel to improve communications with research workers and the extension service to farmers.

In British Columbia, the B.C. Agricultural Services Co-ordinating Committee was recently set up to promote co-ordination of extension services, teaching and research in the province. To carry out its objectives the committee has six subcommittees consisting of representatives of government, universities, and other agencies in disciplines such as social science, food science, animal science. It was pointed out that if committees such as this become effective in their work they will greatly increase the need for and use of scientific and technical information.

Mining Resources

Mining information reaches the public generally through a public relations or information branch of the department. These groups keep the public and the mining industry informed of the activities of the department and the ways in which the province assists industry in the development of mineral resources. The information is supplied through publications, speeches, exhibitions, and films.

Most provincial departments felt that they were kept well informed by data and other information from Ottawa but that there was a need for more consultation with other provinces on matters of mutual interest, e.g. where mines existed near the boundaries of provinces. There was also need for more consultation with industry. Most departments were interested in the application of electronic data-processing procedures to their problems of storing and retrieving data. For example, in Saskatchewan the Mineral Statistics and Research Branch uses EDP systems to provide:

(1) Audit control of production from oil and gas wells as related to provincial revenues derived from royalties and assessments on production;
(2) Statistical information required for regulatory control of mineral production;
(3) Statistical information required for land evaluation, unit royalty rate determinations, and for engineering studies related to the maximization of mineral recoveries and revenues from mineral production;
(4) Statistical information to industry and the public as may be requested and allowed by regulation.

A Statistical Input System (SIS) of the branch which has been designed and tested recently will permit the conversion of reports to punched cards, the processing, auditing, and checking of the cards and compilation of the data. The importance of standardization on report forms for provincial authorities and industry has been demonstrated. The Department of Mineral Resources also points out that considerable progress has been made to establish reporting techniques acceptable to the provincial authorities responsible for oil and gas production in Western Canada, and to the oil and gas industry. Long-range plans are to receive information on magnetic tape or punched cards from industry and eventually dispense with printed reports. About 25 per cent of the computer time provided output of information for the department, other government agencies, and industry. The success achieved in this operation is attributed to the close co-operation between the provincial centre and the departmental staff.

In Ontario, where the mining industry is well developed, a Select Committee on Mining appointed by the Legislative Assembly in 1964 investigated the status of their services to the industry and reported in May 1966.[29] The Committee pointed out that since most of Ontario's mineral production comes from the Precambrian rocks, the province should have one of the outstanding centres of knowledge in this field. It recommended that an effective storage and retrieval system be developed and operated for the processing of all geological data including that on hand in the department and that now recommended for transfer to the department.

Regarding library facilities, the Select Committee recommended:

(1) That the library be expanded to provide complete library service to the mineral and related industries of the province;
(2) That the libraries in geology and related fields, now scattered throughout the government, be centralized and that a centralized catalogue be created;
(3) That copies of the catalogues of the geological libraries of the Federal Governments in Ottawa and Washington be secured;
(4) That facilities should be established for modern library services such as interlibrary loans, the securing of microfilms, photostats, etc. Adequate reading and study space should also be available.
(5) That the policy of the library should be to acquire current books, periodicals, reports, maps, etc. in all fields related to the mineral industry of Ontario. Old material and back numbers of periodicals and reports should be acquired as occasion presents or as expediency dictates.

It was pointed out further that the prime purpose of district offices was to provide, through resident staff, essential services to the mining industry. The importance of close and rapid communication was stressed and it was recommended that all offices be connected by Telex.

As a result of the study by the Select Committee, an Information and Education Section was set up in 1966 to maintain a data centre and to promote education in the mining field. The section will also be responsible for library facilities which will be modernized and integrated with the data centre. The Publications Production Section is responsible for the production of geological maps and reports and for a variety of miscellaneous scientific and technical publications prepared by the staff of the department.

The recommendations made for the mining industry in Ontario might well serve as a guide for other provinces.

In Québec, the Information Division of the Department of Natural Resources took on a rather novel responsibility in 1965-66. In conjunction with professional organizations it sponsored a large informational and educational campaign to secondary school students, aimed at overcoming the scarcity of geologists, mining engineers, and hydrographers.

Oil and Gas Resources

The Oil and Gas Conservation Board in Alberta has authority to grant well-drilling licences and thus collects and distributes information on oil and gas wells in the province. It maintains close liaison with DBS and supplies provincial data to them. DBS is aware of difficulties and slowness of availability of data and has tried to overcome this. The Board is establishing basic well data files, which are not as yet operational, for the purpose of supplying data to interested industrial concerns.

The Sedimentary Geology Laboratory of the Department of Energy, Mines and Resources at Calgary holds large files on well data from Eastern Canada as well as the West. Consideration is being given to the use of a new system developed in co-operation with industry. This system, which appears to be one of the best available, would cost about $160 000 initially and $25 000 a year.

Other provinces are also interested in geological information, not only within their own boundaries but also in other provinces, and are collecting much information. They recognize a need for closer collaboration with other provinces, with industry, and with the Federal Government. In this connection, it is important to note the contribution of the Department of Energy, Mines and Resources in sponsoring a national system for the storage and retrieval of geological data in Canada.

Wildlife Resources

Most departments distribute some federal information supplied by the Wildlife Service. On the whole, there appears to be a good flow of information from the federal group. One of the chief deficiencies seems to be a need for information on immediate practical problems. Without such information it was felt that the public was not receiving the service they deserved. In Manitoba it was pointed out that one of the needs was for data-processing facilities which could handle the large amount of detailed information involved. In Ontario it was suspected that a considerable number of internal reports are not retrievable, and it was suggested that in the future a central registry might accumulate domestic and foreign material and distribute lists to interested organizations in the department. Such a registry would have close links with the NRC, federal departments, and universities.

Forestry Resources

Provincial departments or branches of Forestry vary considerably in the information used and disseminated. In British Columbia the Public Information and Education Division of the Forestry Service has noted a trend in the use of various publicity media. While the press used to be the chief outlet for information, there is more and more interest now in other media, particularly in the use of exhibits in the field of forestry education. During 1966 the service, among other items, printed 500 000 copies of a special centennial booklet, distributed for planting 2 000 seedlings, put out news releases on a wide range of subjects, provided services to 31 radio stations and 6 television stations, made 14 299 photographs and used 6 000 feet of colour movie film. There was a marked increase in the school lecture program and in the use of the film library. The Forest Service Library received increased demands for services from industry and the public through the interlibrary plan.

Some provinces depend to a considerable extent on the federal department for publications. Close collaboration is generally maintained with the federal department in research and in the production of publications for the industry. In some provinces it was felt, however, that there was need for more information and advice on practical problems which the province was facing. Statistics from DBS on the forest industry were not always broken down for best use by the provinces. In most cases greater detail would be helpful to provincial departments, and in others the statistics did not apply to particular conditions.

Fisheries Resources

Provincial branches of Fisheries made available to fishermen their fishing regulations and other information related to their particular resources. The provincial scientists made considerable use of federal publications. In Manitoba the provincial group has close association with the Fisheries Research Board in program discussions and thus obtains information at an early stage. It was pointed out, however, that there is no national register of work under way and for some data they find that, to obtain necessary information, they must rely on sources such as the Fisheries Data Bank at the University of Maine, the Sport Fishing Institute in the United States, or the Ontario Fisheries Research Laboratory.

Education Departments

On the whole, education departments disseminated information largely through the use of standard texts. There was increasing interest in the establishment of libraries to furnish related material, but no great demand for material from universities or other outside centres. Plans are being made in some provinces for increased use of TV in instruction, and in some areas difficulty has been experienced in obtaining the necessary channels. The possible implications of books being put on microfilm for copying as required has not been investigated.

In Ontario the Department of Education, in conjunction with the Ontario Institute for Studies in Education, is studying the needs for training professional and technical personnel in specific areas, and is using DBS data which is found to be late and insufficiently detailed. It is interesting to note in the Provincial Library Service of the department that the Toronto Metropolitan Library Board was taken over in 1967 by the Central Library in Toronto. This is the largest public library in Ontario. Expenditures for public library boards in Ontario amounted to $21 million in 1966, of which $4 756 000 was from provincial grants.

In some discussions with representatives of Departments of Education it was suggested that there was a need for a service which would provide information concerning school curricula and textbooks being used in the different provinces.

Museums and Archives

Most provincial governments have museums and archives which vary considerably in organization and scope. In Alberta the Provincial Museum and Archives, which was built as a centennial project by the province with the assistance of the Federal Government, is maintained under the Department of the Provincial Secretary. It has a total staff of 70, exclusive of guides and maintenance staff, which covers a broad group of subjects. Although the theme and collections are restricted to Alberta, the use and dissemination of information is of much wider scope. Types of information currently used include books, scientific journals, reports, bibliographic aids, and information about collections. There is considerable interest in the possible application of computer techniques to museum information.

Public Works

In the Ministry of Public Works in Québec there is a rapidly growing awareness that preliminary searches for information are not tapping the major sources of interest, and that perhaps only at the national level is it possible to have a coherent and all-inclusive information centre or system. Such a system is envisaged as an advanced state-of-the-art electronic data-processing system that will include all the associated input-output data lines across the country. It would permit the searcher anywhere in Canada to make a selection of the pertinent documents from a group of documents held centrally or elsewhere. The Ministry emphasizes that, in view of the increasing amount of material being published, there is a great urgency to the problem.

Industrial Resources

Most provinces publish information on industrial opportunities which are available in their area. In some provinces, such as Ontario and Québec, some of this information is detailed and will permit a very good estimate of the industrial potential of an area. For example, data are supplied on product marketing, manufacturing arrangements, plant location, municipal information, exhibitions, and research. Several provinces have trade offices or provincial sales missions which promote a two-way flow of information. Ontario has 22 sales missions and has trade offices in Chicago, New York, London, Dusseldorf, and Milan. Statistics are supplied on a wide range of subject matter, and in some provinces information is supplied in a form that may be matched with manufacturers' needs so that suitable areas for the location of particular industries can be readily determined. The Ontario Economic Council publishes the *Research Index, Ontario,* which has as its stated purposes to assist those responsible for decisions regarding research policy and funding and to facilitate communication between those engaged in research and those who can put their findings into practical economic form. The index lists research carried out by various agencies in almost all disciplines in Ontario and is updated periodically.

In Alberta the Industrial Development Branch of the Department of Industry and Tourism attracts attention to industrial opportunities in the province through the *Alberta Commercial Report*, advertising in business publications and direct contact through its offices in Edmonton, Calgary, Los Angeles, and Montréal. The branch assists industry by providing economic surveys and publishing data on industrial location factors, economic conditions, and living conditions. Data on industrial locations, including factors such as sites, markets, raw materials, energy costs, water, labour, and transportation, are provided free of charge to interested industrialists. The Publicity Bureau of the department is responsible for the promotion and printing of all government departments, for news releases and all government advertising. The Bureau of Statistics publishes a number of bulletins and pamphlets on subjects such as resources, business conditions, and market data.

Departments of Industry and Development make use of statistics from DBS. On the whole, there is very good co-operation between the federal and provincial authorities, but almost all departments pointed to the delay in the time required to publish statistics in the form produced by DBS. In many cases the data have lost their usefulness by the time they appear in print. There is also a problem in obtaining statistics on developing industries, as DBS is not able to collect statistics until there has been fairly broad development. One department also suggested that there are problems in interpretation, since the terms used may change in meaning over a period of time, and that DBS should have more representatives in centres across Canada to aid in the interpretation of their statistics. Such representatives would also be reasonably close for industrial people to consult as required. It was also pointed out by several departments that the statistics are not set up in sufficient detail for users at the provincial level and are, therefore, not of as much value as would be desired.

It was pointed out that there appear to be several problems regarding the issuing of patents in Canada. Slowness in processing patents, difficulty in granting patents for small companies or individuals, availability of patent information are among the more important. Amendments to the Patent Act will have the effect of reducing the delay in granting patents from about 2 ½ years to 1 ½ years, and may overcome some of the problems. The possible need for regional offices to supply information and service users was also brought to the Study Group's attention.

Provincial Research Councils and Technical Information Services

Because these two groups are usually closely associated in the provinces they serve, they will be discussed together. They vary in size, scope and field of interest but are organized along the same general lines. Additional information is given in the report of the Industry Subgroup.

The following table shows the distribution of manpower and funds in the two services across Canada.

The joint service of the Research Councils and TIS has as its objective to provide a type and level of service which will make the maximum possible contribution toward national productivity improvement, taking into account the cost of the service.

As described by the B.C. Research Council, the service aims at supplying technical information through the following steps:

(1) Creating a state of awareness of technical developments in the mind of the potential user of information;
(2) Recognition of a need for information in a particular situation;
(3) Gaining an understanding of the problem;

(4) Deciding where to go for information and searching for the answer;
(5) Interpreting the material located and preparing a reply to the engineer;
(6) Ensuring proper use of the information supplied.

The field contacts made by experienced field officers not only create an awareness of technical development but also keep TIS staff aware of industry's needs. Local sources of information are used as far as possible.

Provincial Manpower and Budget Allocations for Technical Information

The average budget per man-year is $13 235, including part of the associated expenses and services (travel, secretarial, library, space)

Province	Field Service Agency	Location	Equivalent Man-Years
British Columbia	Division of Technical Services, B.C. Research Council	Vancouver	5.0
Alberta	Industrial & Engineering Services, Research Council of Alberta	Edmonton	5.0
Saskatchewan	Information Services Division, Saskatchewan Research Council	Saskatoon	2.5
Manitoba Northwest Territories Yukon	Technical Information Service, National Research Council	Winnipeg	1.0
Ontario *	Department of Field Services, Ontario Research Foundation Technical Information Service, NRC	Sheridan Park Toronto Ottawa	4.0 2.0 2.0
Québec	Technical Information Service, NRC	Montréal Québec	4.0 1.0
New Brunswick Prince Edward Island	Industrial Services Group, New Brunswick Research and Productivity Council	Fredericton	4.0
Nova Scotia Newfoundland	Technical Services Division, Nova Scotia Research Foundation	Halifax	3.5
			34.0

* Exclusive of the central TIS office in Ottawa which has 22 professionals.

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Part II

Chapter 2

Industry

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This chapter of the report

SCIENTIFIC AND TECHNICAL INFORMATION IN CANADA

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FOREWORD

This Report on the Study conducted by Mr. J.P.I. Tyas and his colleagues is published as one of the series of Special Studies commenced by the Science Secretariat and now being continued by the Science Council of Canada.

The origin and status of this report are somewhat different from others in this series. The study was originally proposed by the Department of Industry in 1967, was by agreement taken over by the Science Secretariat and is now being considered by the Science Council of Canada's Committee on Scientific and Technical Information Services as an important background study.

As in all other special studies, the report represents the opinions of the authors only and does not necessarily represent the opinion of the Science Council of Canada, or the Science Secretariat.

This publication contains Chapter 2 (Industry) of Part II. Part I of this Special Study has already been published. The other chapters of Part II are

Chapter 1 – Government Departments and Agencies
Chapter 3 – Universities
Chapter 4 – International Organizations and Foreign Countries
Chapter 5 – Techniques and Sources
Chapter 6 – Libraries
Chapter 7 – Economics

and will be published separately. Each of these seven separate sections contains the report of a major subgroup, thus providing background data and considerations to complement the recommendations in Part I.

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

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Section I

SUMMARY

The rapid growth of scientific and technical information (STI) in its many forms and from a multiplicity of sources, both national and international, is placing unprecedented demands on industry to cope with the ever-increasing volume. Nevertheless, if Canadian industry is to maintain a leading position in domestic and foreign markets, information that is pertinent must be obtained quickly and utilized effectively for the development and application of new technology.

Canada provides less than 3 per cent of the STI generated in the world and therefore relies heavily on imported technology. It is now recognized that the technological gap between the United States and most other industrialized countries is not solely related to the level of scientific research but has a more direct relationship to the utilization and exploitation of scientific and technical knowledge. Canada has access to a large portion of foreign STI; therefore, the effective dissemination of this information and its exploitation can contribute greatly to the economic growth of the country.

A great deal of information is at present stored in government departments and agencies, in universities, and within industry itself, but it is unknown or inaccessible to most potential users. Canada, of all industrialized countries, can least afford to have valuable information restricted to a few users or have it lie dormant and unused.

A freer flow of information could reduce duplication and unnecessary research and will expedite innovation. Industry today cannot afford to ignore improved technology that can promote greater efficiency and stimulate economic growth. Much of the STI held by government, universities, and industry could be co-ordinated and exploited through regional and national communication networks to make it more readily available to all potential users. Modern methods of storage, retrieval, and dissemination could be utilized to provide information that is timely, appropriate, and effective.

Industry has made large expenditures and devoted considerable effort to the mechanization of industrial processes through the use of computers and special mechanical handling of materials to improve efficiency and expedite production. Similar attention devoted to computer storage, searching and dissemination of STI could improve the efficiency and output of managers, scientists, engineers, and technicians, who presently rely almost entirely on reference to a few technical journals, their own memories, personal contacts and, probably lastly, on the conventional library.

Co-operation in applied research between government, universities, and industry in Canada lags far behind most other industrialized countries. This is partially due to the low level of research and development contracted to industry by government, both in the defence and commercial fields. It can also be attributed to the lack of centres of excellence in universities to attract the support of industry. These circumstances have limited the transfer of STI, and therefore Canada is in an outstanding position to benefit greatly by the development of a national network that would stimulate co-operation and support between these sectors of our society. The cost of a comprehensive STI service, although high, is within Canada's capabilities and, if efficient and effective, the service will be financially supported by industry on an equitable basis with all other users.

It is therefore recommended that:

1. The Federal Government establish a co-ordinating agency responsible for the orderly development of national and regional systems to provide scientific and technical information services in Canada, using as far as possible existing facilities in both the public and private sectors.

2. The co-ordinating agency establish a national referral centre that would become the principal point for directing users to the best available information sources.

3. The co-ordinating agency promote the creation of regional information systems with the primary objective of serving industry.

4. The Technical Information Service of the National Research Council become more specialized and be partially paid for by industry. The provincial governments be encouraged to assume the administration and promotion of technical information field services.

5. The co-ordinating agency explore the feasibility of developing specialized technology-oriented information centres to meet the needs of particular industries or groups of industries to supplement the more general field services.

6. The co-ordinating agency encourage or direct responsible agents to develop, where appropriate, other special services such as information analysis, abstracting, indexing, and translating.

7. The Federal Government establish a high priority for research and development in the fields of communication and information sciences to encourage government laboratories, universities, and industry to devote more effort in this field with, if necessary, a reduction in other disciplines having a lower impact on the growth of the economy.

8. Industrial management accept the responsibility to provide adequate internal information facilities and to ensure that technical staff at all levels is trained to appreciate their value and encouraged to use them.

Section II

THE PROBLEM OF INFORMATION FOR INDUSTRY

Industrially advanced nations recognize that their economic future depends to a large extent on their ability to transform scientific knowledge into exploitable technology, which in turn provides marketable products and improved services. This transformation cannot be measured only by the amount of research carried out by industry, universities, provincial or federal governments on a local or national basis, since it also depends on the exploitation of the world's total pool of scientific and technical information (STI). In this connection, one of the outstanding examples today is Japan, which became the third-ranking industrial nation in 1967. Although there are many factors responsible for Japan's remarkable postwar growth, there is no question that this country's aggressive policy of acquiring and utilizing advanced technical information in parallel with the carrying out of original research on a moderate scale has contributed substantially to her present leading position, particularly in the highly technical fields of optics and electronics.

The Organisation for Economic Co-operation and Development (OECD) reports[1] that in 1964 Japan's cost of technology import agreements was 55.9 billion yen ($145.2 million), which is approximately 15 per cent of their total expenditures on research. In addition to purchasing technology, Japan is a large user of published technical information from world-wide sources. To support the use and transfer of technical information, Japan established in 1957 the Japan Information Centre of Science and Technology, the cost of which is shared by government and industry. In 1966 the annual budget of this centre was $2.6 million. It employs a permanent staff of 300 plus an additional 1 500 outside abstractors and 500 outside translators employed on a part-time basis.

Russia plans to set up an industrial information network under the All-Union Institute of Scientific and Technical Information (VINITI) to co-ordinate special information centres to improve technology transfer and to avoid duplication of research. In the United Kingdom, the Ministry of Technology, through its industrial liaison centres and the research associations, has launched a major effort to meet the information needs of industry. France has recently proposed the establishment of a National Agency for Research Evaluation (ANVAR), aimed at fostering technology transfer. In the United States, there has been much concern with the problem of information transfer. As a result, in 1965 Congress passed the State Technical Services Act "with the objective of promoting commerce and encouraging economic growth by supporting state and interstate programs to place the findings of science usefully in the hands of American enterprise."

Technical information is now as important as land, labour, capital and management in productivity, according to R. S. Rosenbloom,[2] and any acceleration of information transfer will inevitably increase the economic growth rate provided management is aware of, and receptive to, new developments in technology. Unless he applies new materials, processes, and techniques, today's businessman may be out of business in 10 years, when it is estimated that 75 per cent of the products produced in the United States at that time will be new relative to today's standards. Technical information, therefore, "... serves progress, saves expenditure and labour, and contributes considerably toward keeping a firm at a high level of efficiency."[3]

In the United States a three-year study[4] was recently completed by the National Planning Association and the National Science Foundation to provide quantitative data on how STI is converted into industrial technology. This study showed that more than two thirds of the outside information that a firm used was already widely diffused and generally known to knowledgeable people in the field. The problem, therefore, is not so much in locating information as it is in the firm recognizing its usefulness.

Fry[5] points out that it is becoming accepted that information transfer is an integral part of the research process and that an important part of the current information problem is to determine better means of speeding the transfer of technology so that this valuable commodity can be exploited more effectively. Thus, publication is only the first step in the information transfer process. It must be supplemented by considerable personal involvement and person-to-person communication. Pioneers in this field include the Netherlands, the United Kingdom, and Canada. In 1945 Canada inaugurated a Technical Information Service for industry in the Department of Reconstruction and Supply. This service was transferred to the National Research Council in 1946 where it has since expanded into its present form.

The principal challenge, says Fry, is to develop more effectively the techniques for transferring information between the systems and the scientists and engineers, who are the principal producers and users of the information. In addition, there is a need to develop more precise and objective measures of the value of information in order to relate the rapidly increasing expenditures on research and development to the potential benefits of improved information transfer to society. The subgroup feels that there is a further challenge to obtain better understanding of user needs and of behavioural science with respect to the transfer of information.

Since new technology often develops from relatively old research findings, alert firms realize that research in the library is often as productive and frequently much cheaper than research in the laboratory. For example, although the Swiss chemist, Zeidler, made DDT for the first time in 1874 and published his results, it was not until 1940 that another Swiss chemist, Müller, used this information to discover DDT's valuable insecticidal properties. On the other hand, a mechanical engineering firm, after spending much effort and money (but without undertaking a prior search of the literature) developed a new casting process only to find that the process had already been invented and patented.[6] A recent report[7] illustrates the time-lag in the communication of information on such a down-to-earth subject as garbage disposal. A group of San Francisco businessmen who were concerned with the growing twin problems of garbage disposal and air pollution visited Germany in 1967 and found that in several large cities garbage is being burned under carefully controlled conditions that do not result in air pollution. In addition, useful heat is being produced for the generation of power. Although some of these German garbage disposal installations have been operating successfully for almost a decade, their applicability to the solution of similar problems in North America had not been recognized previously.

The scientist or engineer engaged in industrial research, development or production engineering must spend a considerable part of his time reviewing existing sources of technical information which include both internally generated as well as published information in all its forms. An up-to-date knowledge of the present art will eliminate unnecessary duplication of effort and enhance the effectiveness of the research performance. Even in non-research-oriented manufacturing organizations a knowledge of currently available technology is invaluable in increasing productivity and serviceability. Although in-house research and development frequently provide the most directly useful information for a company, such activity is based upon valuable information gained from government research and development reports, professional and trade journals, and the patent literature, as well as from personal contacts. For example,[8] a semi-conductor manufacturer allocated $150 000 for the development of special equipment but found in time, through a United States Government research report, that the identical equipment had already been developed and was available commercially for $20 000.

Progressive Canadian companies do recognize the importance of information and the role of government in this field. Thus, in the annual report for 1967 of the International Nickel Company of Canada,[9] the president emphasized the need for co-operation between industry and government in information dissemination:

> "There are important roles for Government in the research field. In this age of information explosion, a vast flow of technical data is generated by all branches of science. In certain cases the gathering and dissemination of this data can, with much effectiveness, be handled by a government agency to make it more readily accessible to industry—to assure that it is not lost—to increase the prospects of its use."

The currently developing national system for the storage and retrieval of geological data in Canada provides a good example of voluntary co-operation by governments, industries, and universities in order to satisfy best their mutual information needs. The individual data files created by these groups remain under their own control rather than being centralized. However, a secretariat has the responsibility for preparing and disseminating a computer-produced national index of these files so that potential users may be aware of the existence of the data and can, if necessary, negotiate with the owners. The secretariat also initiates pilot studies on common standards for storing the data as well as studies on the assistance users require to obtain the desired information from the computer files. In addition, the secretariat is responsible for liaison between all users of the files.

The index already includes geological, geophysical, and geochemical data from over 130 major files, and is generating increasing interest in Canada.

In this connection, the subgroup believes that a similar national index for mining exploration data could be of great benefit to the Canadian mining industry. Such an index could make widely available the very large amount of potentially useful information that exists in the form of diamond drill cores now held by exploration companies and mining companies. The benefits that could result from the existence of such an index are obvious. The generator of the data could recover some of his original costs through negotiation with other interested users of the data, while the latter could obtain the information needed without incurring the high cost of drilling the same area a second time. The index would also help ensure that information already obtained was not completely lost. The success of a number of private companies in Western Canada in marketing pooled exploration data to other companies searching for new oil and gas occurrences clearly illustrates not only the advantages of sharing information in an industry but also the fact that industry is prepared to pay significant amounts for information that is relevant to its current needs.

About two thirds of the total expenditures on research and development in Canada are financed by federal funds. The knowledge and technology resulting from this expenditure are a national resource and should be available readily to industry. The Federal Government is also custodian of a vast amount of information received by agreements with foreign governments. It is the Government's responsibility to ensure that this information is available to those who need it, but it is the responsibility of industry and other users to utilize it effectively. The desired growth rate of our economy will depend on the effectiveness of the methods employed to make this information available, and on the ability, receptivity, and willingness of industrial management and individual scientists and engineers to utilize this information.

The Economic Council has pointed out that Canada can achieve a satisfactory economic growth rate only by improving the efficiency and expanding the output of its industries, particularly secondary manufacturing industries. The rapid adoption of new technology will accelerate this rate significantly. However, new information generated or stored by universities, government laboratories, other public organizations, and by private industry cannot in itself improve the industrial output. These sources of new information, to be effective as a stimulus to improved efficiency and industrial growth, must be made known to and be utilized by industry. As Sorrows[10] has pointed out, modern management has as much need for industrial technical intelligence as for financial statements. Therefore, much of the future success of managers will be measured by their cost effectiveness in converting technology into products and services beneficial to society.

Industrial information requirements cover an extremely broad spectrum extending from the multi-million-dollar company with many thousands of different products, at one extreme, to the small manufacturer with a few employees and a single product, at the other. The subgroup has, therefore, considered separately the requirements of companies that actively invest in developing new technology from those that passively accept or even ignore it. The former group includes not only companies actively engaged in research but many more that have a high technical competence within limited fields of interest; these are companies of all sizes which have qualified staffs to utilize STI within their specific disciplines. The latter group, which includes most medium and small manufacturing companies in Canada, needs special encouragement to utilize technical information in order to improve efficiency and productivity.

The Dominion Bureau of Statistics (DBS) reports that in 1965 Canadian manufacturing companies engaged in research and development employed 5 914 scientists and engineers in their laboratory operations: 13 per cent are at the doctorate level, 11 per cent at the master level, and the rest have bachelor degrees.[11] These professionals, supported by many more in process and production engineering, are well qualified to utilize technical information at a level equivalent to that required by leading research scientists in universities or government. Their chief problem is that of locating the sources of necessary information and of obtaining copy quickly before it has lost its value.

The company lacking adequate professional support, with very few exceptions, cannot use technology in its original published form. It usually has to be interpreted and repackaged in a form that can be understood by the user. For the very small business even this is not sufficient. In many cases the only practical solution is personal contact by a specialist knowledgeable in the business to determine what information is required and, subsequently, to train or show the user how it may be applied.

Section III

STUDY PROCEDURE

III.1 Review of Canadian Industry

The subgroup was charged with determining industry's current sources of technical information, the adequacy of such information, and industry's suggested methods for improving scientific and technical information (STI) transfer. In view of the large number of manufacturing establishments involved, it was not practical to survey each individual company.

There are approximately 34 000 manufacturing establishments in Canada. DBS reports that 620 companies[12] carry out organized research. Within the time limit available for the Study, it might have been possible to obtain the individual views of all these research-oriented companies but this would have included the requirements of this sector only, whereas the Study was intended to determine the information needs of Canadian industry as a whole.

The Dominion Bureau of Statistics[13] shows that 14 per cent of all manufacturing establishments produce 85 per cent of the goods and services in Canada. This group of establishments includes all those with value of shipments of goods of their own manufacture in excess of $1 million a year. Even a survey of this sector would not give the subgroup a realistic indication of the total industrial requirement for scientific and technical information. It would have ignored 86 per cent of the manufacturing establishments. Although this latter group produces only 15 per cent of the manufacturing output, it probably requires relatively greater technical support from outside sources than the large producers.

The subgroup, therefore, sought to obtain the views and suggestions of a good cross-section of business organizations and individuals interested and knowledgeable in industrial requirements for scientific and technical information. The program established to achieve this objective and a summary of the response are given in Appendix A.

III.2 Review of Foreign Developments

Concurrently with the above review of Canadian industry, the subgroup also assessed the many new proposals and developments in information for industry occurring in other advanced industrial nations. This assessment was carried out by reviewing the current literature on information transfer, especially as it applies to industry, and by personal discussions with a number of leaders in the information field, particularly from the United States and the United Kingdom. The subgroup also obtained a great deal of information from other members of the Study and many official government representatives to international organizations studying the problems of technical information transfer, such as the Organisation for Economic Co-operation and Development (OECD), the International Council of Scientific Unions (ICSU), and the *Fédération internationale de documentation* (FID). The results of these studies and their possible application to Canadian industry have been considered by the subgroup.

Section IV

INFORMATION SERVICES AVAILABLE TO INDUSTRY

The major sources of information on new technology are professional and trade journals, technical papers, patent reports, and books originating in the more industrialized countries. This public form of information is an international resource available to all nations, which ought to be made more readily available to all potential Canadian users. Much of this information is presently held and is continually being accumulated by government departments, crown companies, universities, public libraries, and industry.

The vast volume of this information and the diverse nature of its technical content have resulted in a large number of unco-ordinated storage centres, many of which are unknown, or not available, to industry. The net result is that in many cases Canadian businessmen, engineers, production staff, etc., do not know where information is available. Even more important, they are frequently unaware of the new technology that would be useful to them, although much of the information concerning this technology has been gathered or generated and records have been stored in Canada.

Research findings and new technology originate from many sources. Some new technology is generated by individual companies or obtained through private agreements with associated or parent companies that are often located outside of Canada; such information is not publicly available unless published or released by the company concerned.

This section presents a discussion of some of the sources of information that are publicly available to industry.

IV. 1 Technical Publications

Foreign publications provide a very high proportion of the information used by Canadian industry. In a survey of 162 companies carried out in the Toronto area by the Toronto Public Library, it was found that 61 periodicals were received by seven or more firms. Of these 61 periodicals, 21 were Canadian, 35 were from the United States, and 5 were from other foreign sources. While the figures cannot be extrapolated beyond the Toronto area, they show the potential impact of U.S. publications on the Canadian scene. One of the latest estimates of the number of technical and scientific periodicals published in the world gives an approximate figure of 26 000 different titles.[14] Consequently, the 550 scientific and technical periodicals currently published in Canada[15] represent only 2 to 2.5 per cent of the world's periodicals. If this is allied with the fact that the National Science Library purchased 16 000 journals in 1966,[16] it is apparent that Canada imports a very high percentage of her technical information.

Although well aware of this fact, the subgroup felt that the role of publications as an information source might usefully be examined in the context of Canadian technical publications. As technical publications have been for a long time, and are still currently, a most important means of both storing and disseminating information, special emphasis will be given to them in this section.

Two main types of technical publications will be considered separately: scientific journals (including abstract journals), and trade publications. The division between scientific and trade journals is a rather arbitrary one, but for present purposes it may be sufficient to define the former as a journal of high scientific or engineering content, usually published by a professional association whose prime motive is not profit, although it may include some advertising. On the other hand, the trade journal is primarily commercial and relies heavily on advertising. It presents new technological advances for a wide audience of diversified interests.

IV. 1.1 Scientific Journals

Scientific journals are normally published by professional societies as a service to their membership and to science generally. In Canada, very few professional organizations are large enough to be able to afford the high cost of publishing a regular journal. The situation is partly affected by the proximity of the United States, which has many societies with objectives similar to, if not identical with, those of Canadian societies. There is also a natural tendency for Canadian scientists to publish in a journal with a high circulation that reaches not only those Canadians in the same profession but also a much larger number of United States scientists as well. In spite of this, a number of reputable scientific journals are published in Canada, and the National Research Council provides a notable contribution to science with the publication of the Canadian Journals of Research.

The Canadian Journals of Research provide a means for both national and international distribution of the work of Canadian scientists from industry, government, and the universities. In this role they also play an important part in achieving an interchange with the publications of foreign countries. The National Research Council bears the administrative, editorial, and publication costs of the journals, recovering part of the costs through sales. This approach has acquired international recognition for Canadian science and should be encouraged.

The Agricultural Institute of Canada is also a major publisher of scientific journals in Canada. The institute, a private organization with 3 000 members, subsidizes the Canadian Journals of Plant Science, Soil Science, and Animal Science, as well as the Review, an in-house publication designed to carry semi-technical articles of general interest.

The increasing volume of published scientific or technical material has long passed the level at which the individual scientist or engineer can keep abreast of his field by reading a few professional journals. Attempts to keep up with the situation have produced scientific journals designed for the needs of specialists. The efforts have in part been successful, but the volume of published material in many cases continues to be overwhelming. As a consequence of the prestige associated with publication, there is a natural tendency for some authors to publish unnecessarily or to publish separate articles on slightly varying aspects of a single idea. This further compounds the problem as far as volume is concerned. Probably more important than volume, however, is the growing recognition that information can no longer be segregated into separate compartments. Developments or techniques used in one field may be applicable in many others. For example, it was suggested to the subgroup that an information system serving the meat industry would need to draw on information services in food science, chemistry, microbiology, statistics, engineering, agriculture, chemical industries, and refining. Consequently, it is becoming more and more apparent that the primary journal, with its full text reporting, is unable to convey recent scientific developments to all potential audiences. It is felt that abstract journals and critical reviews will play an increasingly important role in fulfilling this function.

Some suggest that the present system of publishing scientific and technical papers is ineffective and uneconomical, and that the publication of primary journals will probably be discontinued within the next 10 years. While a growing number of scientists are approaching this viewpoint, very few have recommendations that could be implemented in the near future and thereby completely replace the primary journal, although it is generally felt that a change will be inevitable in the long term. Not all published scientific information is found in recognized scientific journals. Trade journals are another major source of such information and hence many of the comments made above apply equally well to this other type of publication.

IV. 1.2 Trade Publications

Of the 550 scientific and technical periodicals published in Canada, 500 are technical, trade, or business periodicals whose main source of income is from advertising. The average circulation of these periodicals is slightly over 9 000. More than 50 per cent have circulations in the 5 000 to 15 000 range, while 40 per cent have circulations of less than 5 000.[17] They range from small publications with a circulation of 1 000 or less, serving a special audience or local community, to *The Financial Post* with a circulation of about 130 000.

Several of the trade journals have recognized weaknesses in their current reader services and have given considerable thought to improvement. *Canadian Forest Industries,* for example, is discussing with interested groups one way of overcoming the time lag between compiling information and its transmission to the people who can use it. They are considering publishing summaries of unpublished scientific and technical papers as soon as they have been prepared. Readers could then write to the appropriate group for photocopies of the manuscript. The journal would thus function as an information clearinghouse. Several other journals have stated problems without having progressed as yet to workable solutions. For example, the editors of *Design and Value Engineering* believe that there is scope for centralized, readily available, deeply cross-indexed information sources which would, in some manner, disseminate information pertinent to the field desired and at the level desired.

The magazine *Canadian Metal Working–Machine Production* suggests that a central information pool collect information from societies, research and development organizations, federal and provincial government departments, universities, and industry. Persons requesting the information would pay for the service in terms of dollars or in terms of information provided to the pool.

The subgroup recognizes that the experience of the business press representatives who have been actively involved in the problems of information dissemination is significant and requires appropriate emphasis in future planning. The Canadian business press is obviously serving a large audience with technical information presented on a selective basis, which is largely paid for by the advertisers. The quality and scope of the information disseminated in trade publications might be improved considerably by selected listings of current titles of interest to the particular trade, provision of abstracts of the more important papers, and critical reviews of new and significant developments.

The farm press is in most respects similar to the business press in its policies, purposes, and outlook. Several farm magazines have been published for more than 100 years, and two of the 75 currently published in Canada have circulations in excess of 400 000. Studies in Canada and the United States have demonstrated the importance of farm magazines as a source of information to the farm population. One study in Eastern Canada showed that individual farms receive an average of five farm magazines and that some families regularly subscribe to ten or more. Of the farms surveyed, 97 per cent subscribe to at least one magazine. Agricultural research and extension personnel have recognized the importance of this means of communication and have used it extensively in promoting new techniques.

IV. 2 Industrial Suppliers

According to the National Planning Association–National Science Foundation study already referred to,[4] the supplier's sales engineer is an important transfer agent of outside information, and accounts for 15 per cent of all information used in developing the customer firm's innovations. This study also showed that, although innovation results largely from market forces, new STI will often reveal needs previously unrecognized and undefined. A further study by Herner[18] concluded that technical representatives and sales engineers provided the oldest, most dynamic, and most successful technical information services for industry. The growth of such services illustrates the power of the profit motive, and also the importance of information supplied by direct personal contact.

In general, firms will seek from the supplier information on his equipment and processes as well as expertise when unforeseen difficulties arise during installation or operation. The supplier is also expected to provide information on new developments. Here, however, the source is not only likely to display some bias, but it is also probable that the information it supplies will frequently not be comprehensive enough for many user firms. Hence, the customer firm requires additional sources if it is to keep fully informed and thus make optimum decisions. Here again, the subgroup found that such additional information must be timely if it is to be useful.

Some examples from a study of users' requirements reported by the OECD[19] may best illustrate the types of technical enquiries that suppliers may be requested to answer by medium- and small-sized firms:

(1) Could aluminum be used for canning fish products?
(2) How can surface defects on steel billets be removed?
(3) Is it possible to manufacture tubes of an alloy containing 60 per cent copper, 2 per cent lead, and the remainder zinc?
(4) How can a caulking compound be modified to meet government specifications?

Herner[20] points out that large firms derive the greatest benefit from suppliers and other external information sources because usually they have larger technical staffs, operate laboratories of their own, and maintain formal internal information systems. On the other hand, small- and medium-sized firms, who most need outside information, frequently benefit less because they cannot absorb and utilize it as readily.

Many small manufacturers, particularly in Eastern and Western Canada, do not feel that the present level of suppliers' services meets their needs. They must at times depend entirely on vendors' catalogues, which may not contain the information required for a specific application. Standards and specifications for materials were frequently mentioned as items of information that the small firm often needs quickly but is unable to obtain from the supplier.

It is apparent to the subgroup that, whereas all sectors of Canadian industry make use of suppliers' information, it is the less technically oriented companies that rely most heavily on it as a major source of current technical information. The research-oriented companies, because of their well-qualified technical personnel, can often apply the suppliers' information more readily, but depend on it less.

IV. 3 Library Services

Progressive businessmen and industrialists are recognizing that, to compete effectively in the future, they will have to rely to an increasing extent on the rapid application of new technology. For this to occur at a satisfactory rate, scientific and technical information must be available, up to date, accurate, and relevant, in a form that can be readily understood and assimilated by industry. Moreover, industry must know of its availability and have rapid access to it.

In most large- and medium-sized industrial companies considerable amounts of information continually flow into the organization in the form of scientific and technical periodicals, trade literature, books, preprints of meeting papers, correspondence, reports, etc. Without co-ordination, much of the information is held within personal files or discarded so that other users experience difficulty in locating the information they want. Whenever management concludes that some co-ordination of information acquisition and storage is required, the mechanism most readily available and understood is the library which, however, is changing rapidly in form and operation.

IV. 3.1 Special Libraries

Industrial information users, particularly those associated with research-oriented companies, are to a large extent served by a class of library generally known as the special library. Special libraries are characterized by being part of a larger organization and for use by the people within the organization; hence the limitations in the subject scope of their holdings. These libraries seldom have an educational function as a major goal and have a staff of a few persons whose goal is "providing information for immediate and utilitarian purposes".[21] In many cases an industrial special library may do no more than the routine tasks of collecting publications scattered within the parent organization, purchasing or borrowing publications requested, and routing periodicals to users. On the other hand, it may develop special collections, index reports, prepare abstracts, perform comprehensive literature searches, and selectively distribute current information in anticipation of the organization's needs.

Special libraries must often borrow a substantial portion of literature in subject areas outside their speciality. This literature is generally required very quickly and may only be of short-term interest. An ability to locate and acquire literature rapidly is required to meet this need. A document may be required within 24 hours and, if not received, action must be taken without the desired information.

In brief, it can be said that the industrial special library is the agency through which a company or organization taps existing information resources. To do this it requires support to maintain adequate collections in its own specific subject area, but cannot reasonably justify expanding its holdings further and must, therefore, be in a position to draw quickly and efficiently on other collections covering many disciplinary areas. It should be prepared to pay for these outside services. In turn, the industrial special library should be prepared to make its own holdings available on similar terms to others.

IV. 3.2 Interlibrary Loans

The current system of voluntary library co-operation is through interlibrary loan. While the interlibrary loan greatly extends the material available through a library, it is not adequate for current industrial needs. The two major difficulties with the present interlibrary loan system are (*a*) the lack of accessible comprehensive union catalogues or lists to determine where material is located, (*b*) the delay in obtaining an item once it is located. The time required for interlibrary loan transactions is too long for optimum literature use by industry. Obviously the great distances involved in Canada are a contributing factor, particularly as most large documents are transmitted by second-class mail. Telephone and teletype communications as currently used provide only moderate time savings as they affect only the time involved in making a request. A number of briefs referred to the interlibrary loan and photocopying service provided by the National Science Library and, in many cases, indicated that the service was helpful and of considerable value to industry. On the other hand, some considered that the library was too busy and too far away in a communications sense to service many potential users rapidly and in depth.

Since the briefs and discussions during the Study indicated a considerable interest in the United Kingdom's National Lending Library for Science and Technology, a brief description is included here. The library was established in

1962 to supplement the existing interlibrary loan system and, hence, its services are normally available to other libraries rather than to individuals. The library only lends to organizations on an approved list of borrowers; these include universities, colleges, research organizations, government departments, and industrial firms as well as a number of public libraries. Only in exceptional circumstances are loans made to organizations outside the United Kingdom. Approved borrowers are provided with loan request forms which are charged for at a level that covers the average cost of postage. In addition, the library provides a photocopying service which is available to any organization or individual in the United Kingdom or abroad. Prepaid charges are made to cover postage and photocopying costs. The operation of the library is subsidized by the Ministry of Education and Science. Provision of books on loan or of photocopies is its main reason for existence, and therefore the library's acquisition and dissemination services have been organized in a streamlined manner in order, as far as possible, to deal with requests on the day they are received. Instead of aiming at complete literature coverage, the National Lending Library for Science and Technology concentrates on the more frequently used titles of books and serials. Because the library has made interlibrary loans its prime objective, and because it has been willing to examine new approaches to handling material, there has been a very significant improvement in interlibrary loan services, while at the same time other libraries have been relieved of much of the burden they had previously been bearing. Understandably, therefore, many Canadian users are interested in the possibility of establishing a similar service in Canada.

IV. 3.3 Abstracting and Indexing Services

To obtain a specific piece of information generally requires the user first to identify and locate the pertinent documents and then evaluate their content. The major indexing and abstracting services, such as *Chemical Abstracts* and *Engineering Index,* are currently the most powerful tools to search the open literature. In 1963 the National Federation of Science Abstracting and Indexing Services published a list of over 1 800 commercially available indexing services in the areas of science and technology. A considerable number of indexing and abstracting services are now available, or soon will be, in machine-readable form for computer searching. The cost of a major indexing and abstracting service such as *Chemical Abstracts* is high, and most industrial libraries cannot afford to maintain as many of these services as required for an adequate coverage of the literature. The mechanized indexing services are very powerful searching tools, but an individual special library has extreme difficulty in justifying the cost for private use and must turn more and more to co-operative use.

IV. 3.4 Other Library Services

Users who do not have access to a special library must rely upon public, academic, or government libraries for library services. While these libraries do provide valuable services, the size and diversity of their clientele means that they are not geared to handle technical information from the pragmatic, specialized viewpoint of the industrial user. Potential users of these large libraries frequently are not aware of the scope of the services available. Many of the small- and medium-sized companies which normally do not have special library facilities would be in a position to use the services of these libraries if more facilities were made accessible to them or if existing services were more fully publicized.

University libraries, considered collectively, could be one of the greatest potential sources of technical information for industry in Canada. This is due to the fact that they are serving a diverse and sophisticated sector of leading scientists and are located in most major industrial centres across Canada. The primary purpose of a university library is to serve its own staff and the graduate and undergraduate student body. Use of these library facilities by industry is, therefore, not usually encouraged, but a select few in industry do obtain access through a mutual interest in industrial research programs or as students on part-time extension courses.

Access by industrial personnel to university libraries was only referred to in a few isolated cases in the written briefs submitted to the Study, but owing to the potential value of these libraries to industry, the problem was considered at most meetings held with university personnel. The suggestion had a mixed reception. Most felt that the universities had a definite function to perform in the field of education and their efforts should not be diluted by adding to their responsibilities a service to industry. A few were in favour of the suggestion but they were concerned about the additional load that would be placed on their library facilities. In no case could an extension of services be considered without additional outside financial support. This support would have to come from the Federal Government, industry, or in the form of service charges.

Although this suggestion did not receive enthusiastic support from the universities, the subgroup is of the opinion that it warrants further investigation. In the United Kingdom, the Ministry of Technology's Industrial Liaison scheme is based on the utilization of facilities at advanced colleges of technology and universities, while in the United States a university is normally the headquarters for regional and industrial information assistance under the State Technical Services Act. For example, Southern Methodist University in Texas has recently inaugurated an industrial information service[22] designed to provide library services to industry. Membership fees of $100 to $10 000 a year are charged, based on the services required, or alternatively there is a charge for each individual service provided. Another new service, the Regional Information and Communication Exchange, has been established at Rice University, Houston, Texas.[23] The Exchange will link 18 college and university libraries by teletype and will offer services to business and industrial firms. Payment by the user will again be either by membership fee or service charge.

Several metropolitan public libraries in Canada have special sections providing business, economic, and technical information to Canadian industry. If more funds and trained staff were available, the services could be much more effective, particularly to medium and small industries. Payment by the user, either by a service charge or membership fee, appears advisable with perhaps some government assistance in building library holdings. Some public libraries in the United Kingdom have been particularly active in developing excellent services on a fee basis for their local industries and in acting as vital links in the communication chain. A subscription scheme set up by the Liverpool and District Scientific, Industrial and Research Library Advisory Council (LADSIRLAC) provides industries in the Liverpool area with what amounts to pooled library resources, of which the Technical and Commercial Libraries of the City of Liverpool provide the main core. There are somewhere in the order of 300 members in the scheme. Services provided under the scheme include documentation surveys and assistance in procuring documents, accession lists to the City of Liverpool libraries, exhibitions that bring together the information resources available in a particular subject area, industrial and commercial lectures, a translation advisory service to help industry obtain suitable translators locally, and information services in response to production enquiries. In 1966, production enquiries numbered approximately 17 000, of which 591 required in-depth follow-up. The remarkable extent to which firms in the Liverpool area have been ready to pool their industrial expertise and research material was revealed by the fact that half of the 591 enquiries were answered with the assistance of local industrial sources.

Government libraries, in particular the National Science Library of NRC, are an important source of scientific and technical information that is available to industry. There are criticisms of the degree of co-ordination that exists among these libraries and a belief that they are not adequately geared to serve outsiders, but this does not excuse industry for the apparently low level of use they make of these sources. In the year April 1967 to March 1968, the National Science Library, along with its five specialized branch libraries, supplied to outsiders other than NRC staff a total of 35 088 loans or photocopies.[24] A large part of these were supplied to universities and other government departments. An examination of the statistics of the National Science Library shows that over the five-month period from May to September 1967 less than 400 industrial firms used the loan or photocopying services of the various NRC libraries. When these figures are compared with the figures given earlier in this chapter—namely, 34 000 manufacturing establishments in Canada which includes 620 companies who carry out organized research—it is clear that industry should be making more use of the resources already available.

In summary, the subgroup considers that library services could be greatly improved by more co-operation, particularly among university, government, and industry groups. Thus, government libraries, particularly the National Science Library, can provide more leadership in information network development; universities can contribute by making their holdings more readily accessible and by sponsoring regional information services; and industry should be prepared to participate more fully by bearing an increased share of the costs of information services. For example, industry can support regional centres, can strengthen their own special libraries, and can contribute to the general pool of information by providing lists of their holdings and making these available where possible.

IV. 4 Federal and Provincial Government Information Services

Although many Canadian Government departments generate and collect a great deal of information potentially valuable to industry, their information services have frequently evolved on an *ad hoc* basis so that they are not organized in a manner that would be most useful to industry. Thus, the industrial briefs and discussions emphasized that Canadian industries are generally unaware of many of the services now available to them. Where they are aware of a service, they have often found it unsuited to their needs. For example, an industrialist in Vancouver or Halifax may require specific technical data within 24 or 48 hours but find that, although the information is available in Ottawa, he may not receive it for several days or even a week, at which time it may be useless. In fairness, many government agencies have not been charged with providing industrial information as one of their prime objectives and, hence, they are not organized nor funded to give such requests a high priority.

Although most of the important government sources are referred to in Part II, Chapter 1, of this report, the following is a summary of the principal services available to Canadian industry.

IV.4.1 Department of Agriculture

In co-operation with provincial extension services, the department provides information to farmers on the technological aspects of food and fibre production; provides marketing data and economic forecasts of farm and consumer prices; provides inspection and grading services for fruits and vegetables, livestock, poultry, and dairy products; conducts research on insects, weeds, plant and animal diseases and develops control methods; conducts research on processing, storage, and packaging of foods.

IV.4.2 Department of Energy, Mines and Resources

The department provides data files (oceanographic, limnological, geochemical, aeromagnetic, gravity, seismic, land measurement, stream flow, ground water, and mineral statistics); specialized libraries (astronomy and earth physics, economic and physical geography, land and hydrographic surveying, geology, geochemistry, geophysics, mining, mineral processing, metallurgy, oceanography and limnology); publications, including maps; scientific and technical enquiry services; field services (including visits to industrial plants and research establishments, and also advice on storage of explosives and the use of electrical apparatus in explosive atmospheres); and special services such as the National Air Photo Library and map distribution offices.

IV.4.3 Department of Fisheries

The department provides technological assistance by demonstrating equipment and techniques for catching and processing fish and for designing vessels and land-based facilities; quality control standards for inspection of fish and fish products; statistical and other current information services; economic studies in primary fisheries, processing, and distribution; publications on fish research; and information for consumers.

IV. 4.4 Department of Forestry and Rural Development

The department provides technical information on the properties and uses of wood products; regional industrial liaison officer services, research results on the more efficient utilization of wood, new uses for wood products, and improved manufacturing techniques; data on the mechanical, physical, chemical and anatomical properties of Canadian woods; information on timber harvesting, lumber manufacture, wood seasoning and preservation, veneers and plywood, fibre and particleboard, and containers and packaging; data on specifications and standards; and a technical enquiry service.

IV. 4.5 Department of Industry

The department provides assistance in adapting to technological change (aerospace, chemicals, apparel and textiles, electrical and electronics, food products, machinery, materials, mechanical transport, marine and rail, and wood products); information on area development incentives, the Automotive Adjustment Assistance Program (loans and tariff remissions), the Program for the Advancement of Industrial Technology; assistance under the Industrial Research and Development Incentives Act, the Defence Development Assistance Program, and assistance to the Canadian shipbuilding industry; co-operative promotion of improved product design including a register of Canadian designers, a design library, and design centres in Toronto and Montreal; and the Building Equipment and Materials (BEAM) Program for increasing productivity in the manufacture and use of building equipment and materials.

IV. 4.6 Department of National Health and Welfare

The department provides consultative and advisory services to business in connection with food and drugs (standards of safety and purity in manufacture and use, packaging, advertising, methods of analysis and testing, measures of clinical effectiveness of drugs), occupational health (services in co-operation with the provinces to prevent accidents and occupational diseases, surveys of hazardous environments, analytical services), radiation protection (in connection with industrial and research uses of radioactive materials, X-ray equipment, and nuclear reactors, national controls in co-operation with the provinces, monitoring, and inspection services and training courses), air pollution and water pollution (surveys and standards). Publications of interest to industry cover such topics as alcoholism in industry, hazards of grain dust, industrial dermatitis, respiratory protection, solvents, and static electricity.

IV. 4.7 Department of Public Printing and Stationery

The Queen's Printer issues all official publications of the Government of Canada and announces them through the *Daily Checklist of Government Publications,* the *Monthly Catalogue of Canadian Government Publications,* and the *Annual Catalogue.* In addition, sectional catalogues are issued at intervals arranged according to government departments and including each department's cumulative list of important publications. The Queen's Printer is the national sales agent for the publications of many international organizations such as the United Nations, the Organisation for Economic Co-operation and Development (OECD), and the General Agreement on Tariffs and Trade.

IV. 4.8 Department of Trade and Commerce

The Trade Policy Service provides Canadian exporters with information, advice, and assistance on foreign tariffs, import and exchange controls, documentation requirements, and other trade regulations of foreign governments. The Trade Commissioner Service operates 67 offices in 48 foreign countries to promote Canadian export trade and provides detailed market and credit information. The Commodities and Industries Service operates branches dealing with agriculture and fisheries, industrial materials, transportation and trade services, and manufacturing and engineering. Information is available on export potential and performance and on materials, products, and services available for export. The department also provides information on trade fairs and tourism, and issues a variety of publications for businessmen, including a handbook for Canadian exporters entitled *Trade and Commerce at Your Service.*

IV. 4.9 Atomic Energy of Canada Limited (AECL)

Staff information services are available to contractors and consultants concerned with nuclear power development and radioactive isotopes. Services include a library accessions list, abstracts of reports and publications by AECL staff and contractors, a monthly KWIC index of technical memoranda, a rapid service for producing hard copies of documents from microfiche, and a Canadian clearinghouse service for world nuclear energy literature. The Commercial Products Division provides expert advice on the use of radioisotopes in such areas as cobalt therapy and irradiation of vegetables.

IV. 4.10 Defence Research Board (DRB)

The Defence Scientific Information Service provides scientific and technical document information services to defence contractors as required, using a selective dissemination procedure. DRB does not provide a general service directly to the public.

IV. 4.11 Dominion Bureau of Statistics (DBS)

DBS issues a wide range of statistical reports dealing with commercial, industrial, financial, social, and general conditions in Canada. These reports are listed in the Queen's Printer *Catalogue of Canadian Government Publications,* and include the *Canada Year Book,* the *DBS Daily Bulletin* and *DBS Weekly Bulletin,* the *Canadian Statistical Review,* and a large number of reports dealing with specific aspects of Canada's manufacturing industries. In addition, the Information Division operates an enquiry service for more specific or more current information than is contained in its publications.

IV. 4.12 National Research Council of Canada (NRC)

The National Science Library provides information on its comprehensive collection of scientific and technical literature through accession lists and a computer-compiled List of Serial Publications in the Library. Reference and research services include answering requests for scientific information, literature searches and the compilation of bibliographies, and the identification and location of obscure publications. The library is a depository for national and international documents. It also issues the *Union List of Scientific Serials in Canadian Libraries.* Information is provided through loans, photocopies, and microfiche.

The Technical Information Service (TIS) provides information, especially to small- and medium-sized firms, by an enquiry service and by field officers visiting manufacturing plants. Free advice is given on all aspects of materials and processing, equipment, plant design and packaging, and such topics as wage incentives and inventory control. More detailed information and a discussion on the services provided by the TIS are given in Section V.4 of this chapter.

The Division of Building Research (DBR) supplies information to the construction industry through its research staff and publications (library accession lists, *Canadian Building Abstracts, Canadian Building Digests,* DBR Research and Technical Papers, etc.). An enquiry service is operated by Ottawa and by three regional offices. Two-day seminars are held at intervals dealing with one specific topic.

Information of interest to business is also available through publications or consultations with NRC's laboratory divisions, e.g. Applied Chemistry and Applied Physics, and with its engineering divisions, e.g. Mechanical Engineering, National Aeronautical Establishment, and Radio and Electrical Engineering.

IV. 4.13 Patent and Copyright Office

The Patent and Copyright Office at the present time receives about 30 000 patent applications annually covering all types of technology in the proportion of about 47 per cent mechanical, 36 per cent chemical, and 17 per cent electrical. Canadian patents have been classified and grouped into 313 classes which, in turn, have been subdivided into a total of 24 769 subclasses. In general, the classifications are intended to be an arrangement of subject matter which will best facilitate a search for scientific and technical inventions and disclosures that have been claimed. Copies of Canadian printed patents are sold at $1 a copy. About 50 per cent go to the United States, 40 per cent remain in Canada, and 10 per cent go to other countries. The office publishes weekly the *Canadian Patent Office Record.* It gives a record of patents issued by serial number, title, and inventor, and is also used to inform the public about patent procedures and other details. Over 800 copies are distributed. The office also maintains and makes available to patent agents and the public an alphabetically arranged listing of scientific and technical subject matters, called *The Subject Matter Index,* which gives the classes and subclasses in which patent inventions on any specific subject matter may be found.

IV. 4.14 Provincial Government and Other Services

Much useful technical information is also available from provincial government departments and agencies, including the Research Councils. Many of these services are listed in the *Canada Year Book* under "Directory of Sources of Official Information". Canadian industry should also be aware of the very large amount of useful scientific and technical information available at a low cost from many foreign government agencies. In particular, the Clearinghouse for Federal Scientific and Technical Information in the United States Department of Commerce, and the

Monthly Catalog of Publications from the Government Printing Office, Washington, D.C., are important information sources for Canadian industry.

IV. 5 Other Information Services

Information is valuable to the user only if it is relevant, accurate, and accessible. Providing accessibility as rapidly as possible is the function of a documentation centre or a library. Ensuring that information is accurate and relevant requires analysis and interpretation. To provide these services, additional resources are required in the form of funds and trained specialist staff, and so far only a few libraries have been able to secure these necessary resources.

To satisfy this demand, however, information centres have been developed to meet the needs in specific areas of science and technology. The degree of analysis or interpretation provided varies considerably from one information centre to another. Good examples of highly developed analytical services to meet needs in very specific subject areas are those provided by the Pulp and Paper Research Institute of Canada and the Battelle Memorial Institute, Columbus, Ohio. Many other information centres in the United States are listed in the publication of the National Science Foundation (NSF), *Non-Conventional Scientific and Technical Information Systems in Current Use.* This publication is periodically updated by the NSF with outside contractual assistance from a private company in the information systems field. It would be useful if a similar listing of information centres across Canada could be compiled. Through this list, areas requiring coverage might then become apparent.

Canada has undertaken specific responsibilities with regard to two major international information services, the Arctic Institute of North America, and the Commonwealth Agricultural Bureaux.

The Arctic Institute of North America maintains a library and operates an information and abstracting service that is internationally recognized. Their *Arctic Bibliography,* an abstracting service for the world literature on Arctic and Antarctic studies, reported in 1967 a total of 85 000 abstracts in 13 volumes. They also publish the journal *Arctic,* which reports on studies relating to cold-weather regions. In addition, the Institute supports research which, in 1966, resulted in a total of 858 publications. The Institute's information services and library are located in Montreal, and financial support comes from Canada, the United States, and other foreign countries.

In its plans for the future, the Institute considers it important to become more consumer-oriented, thereby concentrating on meeting the needs of researchers rather than being oriented toward accumulating knowledge. To support this, it is moving toward a co-operative approach with other libraries and information services, as it realizes that it will not be able to maintain self-sufficiency in all the disciplinary areas that might impinge on cold-weather studies. It will, however, require additional resources if it is to expand the present services. With the Canadian North opening up, and the consequent need for products to meet the special conditions involved, the subgroup believes that industry could profitably make more effective use of, and do more to support, this agency.

The Commonwealth Agricultural Bureaux (CAB), with headquarters in the United Kingdom, publish 18 abstract journals covering the world literature on agriculture and biology, including forestry, agricultural economics, and rural sociology. In 1967, 82 000 abstracts and citations were published. Canada's contribution of $400 000 a year represents 20 per cent of the total income of the Bureaux. While the Bureaux were originally designed to assist the less fortunate members of the Commonwealth, they have become internationally recognized as the foremost abstracting services for the agricultural and forestry fields. A statement in the 38th Annual Report, published by Her Majesty's Stationery Office, London, provides a resumé of its current functions:

> "The institutes and bureaux act as effective clearinghouses of information for scientists and research workers in agriculture, animal health, and forestry throughout the Commonwealth and, increasingly, throughout the world. To do this, they collect information by scanning and indexing as far as possible all journals in their subjects in all languages; by scanning other abstracts; and by keeping in touch with research in progress. They distribute this information by the periodical issue of 18 abstract journals; by the frequent issue of monographs reviewing some particular subject within their field; and by various other publications".

Section V

INDUSTRIAL INFORMATION REQUIREMENTS IN CANADA

An analysis of the many briefs submitted to the Study shows that the rapid growth of technology during recent years, and the forecast of an accelerated rate of growth in the future, are placing unprecedented demands on industry to obtain and utilize information quickly and effectively. Because of the complex nature of many manufactured products, industry can no longer rely upon a single source of information related to its primary area of business, but frequently needs to draw on interdisciplinary information. In this connection, however, it is important to recognize that no group of information consumers needs every bit of information generated by science and technology. As Herner stated:[25]

> "The fact is that for most individuals and most organizations working in specialized fields, a large proportion of the required information is attainable from routine or conventional sources, and it is a relatively small proportion of the information that gives trouble and creates the need for special treatment and systems."

This section deals with the current and future information needs of Canadian industry. It refers in further detail to the two distinct quality levels of technical information service required by different sectors of industry, and then specifically analyzes the requirements for research-oriented companies and those for medium and small companies or, more generally speaking, the non-research-oriented industries. The farming industry has been considered separately. This industry has special requirements, although some analogies can be drawn with the requirements for smaller industrial companies. It was also considered desirable to review the functions and needs of the professional and technical societies. These are primarily directed to the professional but in many cases provide a valuable service to the non-professional member. After this, the need for specialized information centres, the use of scientific and technical information, and economic and technical support by industry are discussed. The section is concluded by a summary of the information requirements.

V.1 Types of Industrial Users

The information requirements for industry are extremely broad and differ in many respects from those of universities and government. The industrial spectrum extends from the multi-million-dollar company with many thousands of different products to the small manufacturer with a few employees and a single product. The information needs at the two ends of the spectrum are quite different, and size alone cannot be used as a measure of a company's needs for information. Many small companies producing a highly specialized product require considerable technical support from outside sources. The scope of their individual requirements is, however, considerably narrower than that of the large company.

There are 620 manufacturing companies[12] in Canada that have established research organizations with professional personnel well qualified to utilize sophisticated scientific information, at a level equivalent to that used by the leading research scientists in universities or government. These 620 companies produce 55 per cent[26] of the manufactured goods in Canada and employ 47 per cent of the work force in manufacturing industries. In addition, many large companies not operating their own Canadian research laboratories have direct access to the research facilities of parent companies outside Canada. They have professional and technical staff to apply the technology obtained from foreign sources and, consequently, are capable of utilizing scientific and technical information at a level equivalent to that required by companies with their own research establishments. The methods and procedures of information transfer in this sector of industry must be oriented to meet the requirements of management and the professionals and supporting technicians in the companies concerned.

The medium and small manufacturing establishments with value of shipments of $1 million or less include about 86 per cent[13] of all manufacturers in Canada. They are primarily non-research-oriented, although there are some outstanding exceptions. The information requirements of this sector of industry must be transferred through different media and in a form that can be utilized effectively by this level of user. For the purposes of the Study it has, therefore, been recognized that the requirements for the medium and small companies must be considered as distinct from those of the large companies, which are generally research- or science-oriented.

V.2 Research-oriented Companies

Information for this section of the Study was obtained from a survey carried out by the Canadian Research Management Association (CRMA), briefs received from trade associations, research institutes, manufacturing companies not directly associated with CRMA, and individuals associated with industry. The information in the briefs was supplemented in many cases by discussions with representatives of these organizations during visits to the various industrial centres across Canada. The results of the CRMA survey and briefs from the research institutes, without question, specifically refer to the requirements of research-oriented companies. The opinions and recommendations expressed by the trade associations, other manufacturing companies and individuals cannot, however, be so clearly defined. The trade associations, in particular, represent both large and small companies, but the findings expressed in this section of the report apply only to the principal users of STI who, in the opinion of the subgroup, are the research-oriented companies. Comments put forward by the trade associations and others referring to requirements of non-research-oriented companies are included in Section V.4.

V.2.1 Survey Conducted by the Canadian Research Management Association

A survey was carried out by the Canadian Research Management Association which includes among its members 69 of the largest industrial research establishments in Canada. This association was extremely co-operative. They provided the Study with a report co-ordinating and consolidating the results of the survey, but they pointed out that the opinions and recommendations presented or implied cannot be regarded as being endorsed by the association as a whole. Approximately 25 per cent of their membership is from universities and federal and provincial governments, which did not participate in the survey. In addition, only 60 per cent of the industrial members replied to the questionnaire. The subgroup has recognized this lack of total endorsement, and therefore the opinions and recommendations in this section of the Study represent only the views of the respondents.

Returns from the CRMA questionnaire were received from 43 organizations, two of which had to be rejected as not providing sufficient information to be included in the statistical analysis. The remaining 41 companies represent a 60 per cent response and, together, account for annual sales of manufactured products or services amounting to $6.5 billion. These companies collectively show an annual research and development expenditure of $85.5 million (1966), which represents 36 per cent[27] of the Canadian manufacturing industry's expenditure in this area. This is, therefore, considered to be a representative sample of large research-oriented companies in Canada.

The members were asked to rank in order of importance the channels through which their companies' present technical information needs were met. The results of this survey rated the sources of information in the following order, with the most important on top:

(1) Company-generated;
(2) Parent or associate company outside Canada;
(3) Commercial publishers of technical books and periodicals;
(4) Technical, professional, or trade associations outside Canada;
(5) Suppliers and unaffiliated companies;
(6) Technical, professional, or trade associations in Canada;
(7) Government agencies in Canada;
(8) Universities and unaffiliated research organizations in Canada;
(9) Parent or associate company in Canada rated the same as government agencies outside Canada;
(10) Universities and unaffiliated research organizations outside Canada.

These ratings clearly establish that, apart from internally generated information, research-oriented companies at present rely most heavily on published technical literature for new technology. The survey gave added evidence of this in that the number of periodicals subscribed to by member companies ranged between 30 and 1 300 and averaged over 260 per company.

It is particularly significant that both government agencies and universities were given very low ratings as channels for obtaining information. This supports the contention that industry either does not have access to or is unaware of two important sources of scientific information in Canada. The subgroup further contends that the lack of appreciation of the value of government sources of information is partly due to insufficient publicity on the part of government and insufficient interest on the part of industry to explore these sources. Regardless of the reason, it illustrates the need for collaboration on the problems of information storage and retrieval among government, industry, and universities to ensure a better flow of information to industry. This parallels a recommendation of the Science Secretariat Special Study No. 2[28] in its assessment of physics requirements for Canada, which emphasizes the need for closer relations between government and industrial laboratories.

The high ranking given to foreign companies and to foreign technical, professional, and trade associations is an indication that sources outside this country provide the research-oriented companies with an important part of their required information. A good example of this is the Canadian aircraft industry, which relies heavily on research conducted in the United States and the United Kingdom. A leading aircraft company reports that its principal bibliographic sources of information are *Scientific and Technical Aerospace Reports* (*STAR*), issued by the National Aeronautics and Space Administration; *International Aerospace Abstracts* (*IAA*), issued by the American Institute of Aeronautics and Astronautics; and *Index Aeronauticus*, issued by the British Ministry of Technology. This underlines the need for Canada to establish and actively maintain good international arrangements for the exchange of scientific and technical information, and to ensure the existence of adequate means for making this information readily available to industry.

An interesting similarity is shown between the results of the CRMA survey and an industrial survey carried out recently for the National Aeronautics and Space Administration in the United States.[29] The latter showed that the external sources of information, for a variety of moderately sized industrial firms, were in the following decreasing order of importance:

(1) Professional and trade journals;
(2) Conferences;
(3) Suppliers;
(4) Vendor catalogues;
(5) Textbooks;
(6) Consultants;
(7) Government publications;
(8) Libraries;
(9) Abstracting and indexing services;
(10) Patents;
(11) Professional and industrial associations;
(12) Formal information dissemination centres.

The survey concluded that many firms do not consider government research results and information services as potentially useful. This indication of inadequate information transfer between government and industry, in a country that has been actively working at its information-handling problems for a number of years, shows that a concerted effort will have to be made in this direction in Canada if effective results are to be achieved.

Some attempted solutions to this problem in the United States include the establishment within the U.S. Department of Commerce of the Clearinghouse for

Federal Scientific and Technical Information (CFSTI) and the passing of the State Technical Services Act. The CFSTI is a distributing agency for unclassified report literature produced by federal departments and their contractors. It deals with the output of more than 30 U.S. federal agencies. The State Technical Services Act was passed by Congress in 1965 "... with the objective of promoting commerce and encouraging economic growth by supporting state and interstate programs to place the findings of science usefully in the hands of American enterprise."

As has been pointed out, research-oriented companies rely heavily on published literature for new technology. The growing difficulty of coping with the increasing volume of material points to three main requirements if the needs of individual scientists or engineers are to be met:

(1) A faster method of being kept informed of relevant new technical developments;
(2) A faster and more comprehensive method of obtaining relevant references as and when required;
(3) Faster means of supplying source material.

The individual company libraries or information centres have the responsibility of meeting these demands through a combination of their own internal resources and those available nationally and internationally.

The results of the CRMA survey show a growing awareness among industrial companies that conventional library procedures are not able to meet these requirements. Approximately 80 per cent of the companies were not satisfied with their own internal information services, and 18 out of the 41 respondents were actively exploiting new information-handling techniques with varying degrees of sophistication. Other companies were obviously willing to do so if they could be certain that their efforts would not be wasted because of rapid changes in information storage and retrieval techniques, and if they had a clearer picture of how far their own services should complement those provided nationally.

Some large firms have already developed or are in the process of developing their own computerized information storage and retrieval systems for company-generated reports and internal libraries. Three are described to illustrate that some Canadian companies are well advanced in these techniques and are making very deliberate efforts to provide their individual scientists and engineers with the means for faster and more efficient recall of information and current awareness reporting. These examples are typical but are not necessarily the most advanced systems in operation or under development.

(*a*) The Information Services Department of Imperial Oil Limited, Western Producing Region, located in Calgary, has a thesaurus-controlled, computer-based system which was designed in 1962-63 and for which successive stages have become operative since January 1963. The system provides an in-house service to a company staff of 400 technical and scientific personnel, both in research and operations, who are located in five principal centres. The system currently includes over 12 000 indexed items and is growing at the rate of over 3 000 items per annum.

Books, company-originated technical reports, published papers, technical memoranda, maps, etc. are all accepted for indexing into the system. The indexed input to the system has been carefully planned to give a high degree of output control so that, as new demands are made on the system, it has the flexibility to meet them. At present the system relies on computer-generated indexes but at the same time all the indexed information is stored on magnetic tape ready for machine search when volume or demand makes this step economically justifiable. The computer-produced indexes include a current awareness publication that is printed every 15 days and records, by discipline, the intake to the system since the last issue. Retrospective search is catered to by co-ordinate indexes of the dual-dictionary type, which can be produced for the total collection or for discrete parts of it. These indexes are an improvement over the conventional form of dual-dictionary in that a search will not only provide a relevant document number but also full details such as title, author, enough bibliographic reference to show what kind of document it is, and where it is stored in the library. The system also creates certain printed aids to help the librarians with their conventional activities. Imperial Oil personnel feel that their computer-printed indexes are proving a great asset and at the same time justifying the creation of an indexed information bank that will eventually warrant machine search.

(*b*) Canadian Industries Limited has developed a number of computer programs for preparing indexes that combine traditional author and subject indexes of documents with a co-ordinate dual-dictionary approach. The computer-produced dual-dictionaries carry approximately 20 indexing terms per document. The company has also applied the Keyword-In-Context (KWIC) method of automatic indexing by computer to a number of uses where the cost of indexing by trained personnel cannot be justified. This type of indexing has been used for manufacturers' bulletins, current literature titles, and X-ray diffraction data. Printed library catalogues for some 13 000 technical books are also prepared by computer. This computer program can produce printouts of either the whole catalogue or of indexes to the holdings in selected subject areas by title, author, subject, and Library of Congress class number.

A study has been carried out by the company on the problem of searching a large magnetic tape file containing 150 000 items with an average of 30 descriptors each. This has resulted in the development of a computer program that responds to a search by presenting answers in probable order of relevance to the particular enquiry. The program allows for "imperfect" indexing, which is virtually unavoidable in large files. A search question is formulated in terms of a number of concepts, each of which is expressed by a number of near synonyms which, in turn, are given "weights" according to their relative importance to the search. Answers are subsequently printed out in the order of score developed from the assigned weights and are, therefore, in probable order of relevance.

The company has also been doing work in the development and use of methods for defining chemical compounds by computer-generated "fragment" indexes. These are of great interest, as the increasing complexity of chemical knowledge is making systematic naming of new chemical compounds virtually impossible using the present traditional indexing methods.

(*c*) Polymer Corporation Limited is currently in the process of introducing two systems using an IBM System/360 model 30 computer. The first is an index to periodical and patent literature on polymer science and technology (*POST*) supplied on magnetic tape by Chemical Abstracts Service. It is hoped to have the system operative some time during 1968. Further development will provide a second system to give a current awareness service to the research staff of 400 and, eventually, the possibility of restrospective searches. These will be based on matching user profiles against the index of literature stored on the magnetic tape. The latter system would be handled on the computer in a manner similar to the *POST* index.

In addition to improving their own information services, most firms see a need for improvements on a national scale. The CRMA survey showed that 31 (75 per cent) of the respondents felt the need for some form of national information system, whereas 6 (15 per cent) felt no need for any changes, and 4 (10 per cent) of the respondents made no comment either way.

A wide variety of suggestions was made as to the national requirements, but certain main ideas emerge from these. There is a general consensus that a national system should be centralized to some degree. The degree of centralization that is suggested seems to depend on where the company is located and on whether the respondent is referring to immediate needs or looking further ahead to the day when fast, cheap, and convenient communication over long distances is generally available. Whatever the variations suggested, it is clear that most of the respondents foresee a federal government agency as the co-ordinator of any national information system that may be established, whether or not the system itself is centralized. Of the 15 respondents who have commented on the funding of a national system, 11 felt that it would, at least initially, have to be largely financed out of government funds. Most of these companies felt, however, that a large part of the costs could subsequently be recovered by subscription or service charges. The other four companies felt that a national system could be self-sustaining from the start on a subscription basis.

One of the needs most frequently expressed by the firms answering the CRMA questionnaire was for a central depository from which copies of published technical literature could be obtained quickly at a reasonable cost. This is not surprising, as the current delay that research-oriented companies have to accept in obtaining photocopying services or interlibrary loans is one of the more frustrating elements of their information services. Most companies feel that they can, to some degree at least, meet their retrospective searching and current awareness needs from within their own organizations, but it is completely impractical to try to meet the needs for published source material without going outside the company. A service that would provide requested material within a few days is considered highly desirable. Japanese experience bears out the need for a service of this nature in that one of the heaviest demands on the Japan Information Centre of Science and Technology is for photocopying service.[30] If such a depository is set up and operated by a federal agency, it would be the logical choice for acquiring and distributing non-classified publications of foreign governments.

A number of firms have indicated that locating the likely source of required information is often a major problem. A recent study[31] of the data and information needs of 600 scientists and engineers engaged in industrial research showed that 75 per cent reported difficulty in locating and obtaining data on the properties of materials. To help overcome this, two of the CRMA respondents have made the suggestion that a central co-ordinating body should be established to act as a referral centre. This body should be easily accessible to direct enquiry by teletype or telephone. It would relay any questions received to the appropriate information or data centre or would inform the enquirer as to the proper centre or individual to consult. It would be necessary for this agency to maintain a complete record of all information and data centres in this country and the main centres throughout the world in the fields of science and technology, and to organize this record in the most efficient manner for quick reference. Through its referral function, the agency should also be able to detect the areas where it is difficult to obtain adequate information. These findings could be the basis for establishing new information or data centres.

Various companies have suggested other conventional services that should be improved within the present framework or provided by a national system, including a literature translation service and an index of translations; a patent index covering at least United States, Canadian, and British patents with an associated searching and copying service; and a service providing abstracts and summaries of important foreign scientific meetings monitored by the National Research Council of Canada and other government departments. These comments by industry indicate either that they are unaware of existing services or that the existing indexes themselves do not satisfy requirements.

Many companies advocated a national computer-based system or systems as the only long-term solution to the needs of industry for retrospective searching, current awareness, and document handling. Here again, most see some form of federal agency as the heart of such a system but associated with a country-wide network of regional centres and centres with special interests that would not only act as outlets but also as sources, and thus contribute to the general store of information.

V.2.2 Trade Associations, Research Institutes, Manufacturing Companies, and Individuals

An analysis of the briefs from trade associations, research institutes, manufacturing companies other than those reporting through CRMA, as well as individuals, supports most of the findings, requirements, and recommendations emerging from the CRMA survey. The results show that industry's chief source of external technology is the scientific and technical journal. Some large companies have their own libraries with qualified librarians, and a few operate computerized storage and retrieval systems for specialized information of particular interest to their professional staffs.

Many companies with large holdings of technical journals provide a simple form of current awareness by circulating to their scientific staff copies of the index page of the most frequently used journals. Scientists and engineers can be expected to review no more than a limited number of journals in their own fields and they seldom consider publications in related fields. With a quick review of the index pages they may find articles of interest in publications that would not normally come to their attention. Copies of the articles are supplied by the library on request, thus reducing the circulation of journals and making them available at all times in the library. This is usually done only for current issues of the journals and does not eliminate the routing of back issues or extra copies to selected readers. Other current awareness programs are provided by some associations and by a number of industrial libraries. Some of these are purchased from foreign sources, but many are prepared and distributed by individual librarians in the selected fields of interest to their readers.

Most information users are currently paying outside agencies for specialized technical information service in very limited fields. They have expressed the need for a co-ordinated Canadian system. The cross-disciplinary nature of manufacturing makes it necessary to search for information in many different areas of technology so that even the best services today have only limited scope within a particular industry. Much broader coverage is needed. For example, the use of isotopes as radioactive tracers has found application in the area of fluid flow in such diverse fields as the oil industry and medical research. The results of research in any discipline must, therefore, be readily accessible to researchers in other disciplines.

The subgroup requested information from industry on future developments but made no reference to types of systems or methods of handling information. The following statistical information summarized from the briefs submitted by the organizations and individuals under study in this section of the report can, therefore, be considered as unbiased requirements of industry. These results do not include but supplement and further confirm the findings of the CRMA survey. Of the 81 briefs under study, 57 (70 per cent) respondents stated that presently available systems are unsatisfactory, and 42 of the 57 specifically suggested that a co-ordinated information complex is a future requirement of industry. Twenty-one respondents made no comment on future developments. The remaining three expressed the opinion that no centralized or co-ordinated system should be established in Canada.

Although 26 (30 per cent) of the respondents indicated their willingness to pay for STI, no industrial company provided any information on the probable value of such a service. It will depend on the savings industry can realize through its use. Several large companies report the cost of their present information services to be in the range of \$100 000 to \$250 000 a year, but any supplementary systems are unlikely to reduce this expense. The major saving, undoubtedly, will be in the time saved by scientists and engineers in searching for information or in avoiding unnecessary duplication of work that has already been done by others. Industry recognizes that the cost of developing an adequate information complex will be appreciable, and that the initial organization and operation will have to be largely supported by government funds. However, new, useful information services, when fully operative, are expected to become largely self-supporting according to many of the respondents.

V. 3 Farming Industry

The farm sector of the agricultural industry is, in effect, a very large number of small companies producing a wide variety of commodities. The general concept has been that one man provides capital, labour, and management. Research and the dissemination of information have traditionally been provided by government agencies in order to fulfill a national need not met by private enterprise.

Certain agricultural extension services predate Confederation, and it is considered appropriate to review the successes and failures of agricultural extension before considering information services for non-research-oriented manufacturing industries.

Gross Domestic Product per man in agriculture has increased at an annual rate of 4.3 per cent since 1935, compared to just over 2.2 per cent in the manufacturing industries.[32] The number of farms in Canada has decreased by almost one half in the same period. In 1967, gross farm income exceeded $4 billion.

Much of the change in agriculture has been due to technological innovation and to a great increase in farm capitalization. The new technology has come largely from the research efforts of the Canada Department of Agriculture, which employs approximately 1 000 research workers to study and increase the physical productivity of resources. The results of this research have had to be transmitted to the users, and provincial agencies have traditionally played the principal role in extension or information dissemination. There are currently about 400 extension workers in Canada, variously called Agricultural Representatives, District Agriculturists, or Agronomes. In co-operation with federal and university researchers, they make available the results of research and information on legislation and marketing by means of newspapers, farm press, radio, television, agricultural bulletins, motion pictures, exhibits, and personal contact.

Extension service, insofar as it is recognized as an educational function, is a field of provincial responsibility. Experience has shown that co-operation between federal and provincial workers in extension as well as in other fields of agriculture makes for greater efficiency, and it is on this basis of mutual understanding, rather than that of constitutional rights, that extension and other agricultural programs are carried out.

Despite the experience and manpower that have been made available over a long period of time, it is apparent that all farmers have not accepted the new technology. Those that drop out of farming—and they did so at a rate of 900 a month in 1967—have dropped out because of failure to make use of new techniques, or an inability to manage the financial resources necessary to use the new technology. As stated by Professor Gerald Fortin, of Université Laval:[33]

> "In our opinion, the still impressive number of non-commercial farmers and of so-called commercial farmers having a gross income lower than $5 000 seems to indicate that extension has not completely succeeded in persuading the Canadian farmer to convert to modern commercial farming. After two, three and even five decades of work with farmers, the agronomists have certainly succeeded in modernizing a number of farmers but not the majority of them. The result of extension work is certainly not a negative one, but the progress made is inferior to the one anticipated."

The search for the causes of this inferior performance has led to a substantial amount of research by sociologists in Canada and the United States into the techniques of communication. It is not our purpose here to review the entire body of knowledge on communications research that has accumulated in the past 20 years, but to point out some of the problem areas that may develop between users and a total information system.

On the basis of research reported in the journal *Agrisearch,*[34] farmers can be divided into five categories depending upon their willingness to accept new technology: innovators, early adopters, informal leaders, the majority, and the non-adopters. The innovator is generally well-educated, and frequently approaches the research worker directly in search of new ideas. The non-adopter, by contrast, usually has less education, reads fewer magazines, and takes a less active part in community affairs. The role of the informal leader is crucial. He is actually part of the majority and, while he is not recognized as a community leader, he sets the pattern for the majority. It is surprising to find that the innovator and the early adopter have little influence on the remainder of the farm population. Information apparently does not move from top to bottom: it moves laterally.

Farmers, in ranking sources of information, usually place farm newspapers as the most preferred source. Neighbours, relatives, and friends are frequently ranked second, and radio ranks third to sixth in most studies. Government bulletins are next in line but are far below farm newspapers. Salesmen and dealers rank low in nearly all studies. The above rankings refer to "helpful sources" as recognized by farmers. In ranking credibility of sources, the mass media again rank very high, whereas government bulletins receive a very low credibility rating.

In accepting a new idea, certain stages are recognizable: awareness, interest, evaluation, trial, and adoption. In the awareness and interest stages, farm magazines and radio are the significant information sources. In the evaluation and trial stages, neighbours and friends are the preferred sources. In the adoption phase reassurance is crucial, and the individual may turn to "official" sources for support as well as information.

A survey[35] conducted under the Agricultural Rehabilitation and Development Act observed that half the farmers in the study area (Eastern Canada) were submarginal in terms of income and resources available. Despite extension services and various agricultural programs, 50 per cent are unwilling or unable to accept the technology that is necessary to commercial farming.

The agricultural extension worker has in the past been trained as a generalist. The increasing complexity of agricultural practice has made it impossible for one individual to be knowledgeable in all fields. The current requirement is for commodity specialists and for total resource management, particularly in the field of financial management. Commodity specialists are now attached to research stations where they are in constant touch with the research workers and can provide immediate and specific advice to the highly specialized farm operator. Financial management will soon be available to most progressive farmers from government agencies, universities, and, occasionally, private industry who will provide computer facilities for the analysis and interpretation of farm records.

At a meeting of the Ontario Institute of Agrologists held in Ottawa in May 1968 it was suggested that by the mid-1970s the top third of farm operators would be buying technical information and management advice from private consultants. The bottom third will continue to be a sociological problem with a minor interest in technology. The middle third will continue to use government-subsidized services as long as these are available.

The history of agricultural extension services should influence planning for a national information service. Investigation into the processes whereby small industry accepts or rejects information could provide significant guidelines for the development of information storage and retrieval systems.

V. 4 Non-research-oriented Companies

This section deals primarily with the medium and small companies, which includes about 90 per cent of the total manufacturing community in Canada. Most companies falling in this classification are non-science-oriented, but there are a few exceptions. These exceptions are usually companies making a few highly technical products who therefore do not require the broad spectrum of information required by large manufacturers. In addition, because of their smaller size, even these specialized companies seldom have the financial resources to invest in adequate libraries and technical information services, either internal or purchased from an outside agency. The method of information transfer for most companies in the medium and small sector of industry is similar in many respects, although for the few exceptions the technical content can be at a higher level. The medium and small manufacturing company is a well-recognized entity in the industrial sector, both in Canada and in other highly industrialized nations. It is therefore appropriate to deal with the technical information requirements of this group on a collective basis.

Outside of the consideration given to the medium and small companies in the various briefs submitted by the trade associations, the subgroup received most of the input on user needs and requirements for this industrial sector from the officers of the Technical Information Service (TIS) of the National Research Council and by direct personal contact with representatives of companies. Very few briefs were submitted, probably because of the limitation of staffs and the lack of appreciation of the wealth of technical information that is available for innovation and for improving productivity and efficiency. TIS assisted the subgroup by arranging for a number of the industrial meetings and personal contacts with representatives from medium and small companies during visits to the industrial centres across Canada. Eight of the regional offices or agencies of TIS also provided the Study with separate briefs independent of the headquarters brief.

Medium and small manufacturing establishments are considered to be those with less than 200 employees and with value of shipments of their own manufacture of less than $1 million a year. The Dominion Bureau of Statistics[13] reports that there were 33 630 manufacturing establishments in Canada in 1964, and 96 per cent employed less than 200 people. This sector employed approximately 45 per cent of the manufacturing work force. The statistics also show that there were 86 per cent of manufacturing establishments with value of shipments of their own manufacture below $1 million. Although there is no direct correlation between these two sets of statistics, it appears that the group of manufacturers being considered represents about 90 per cent of the total number of manufacturing establishments in Canada that employ over 40 per cent of the manufacturing work force. This sector of manufacturing in Canada is an important factor in the economic growth of the country. Scientific and technical information (STI) services, if adequately administered, could be of considerable assistance to many of these companies. However, as in the case of the farming industry, it will be of little value to those who are unwilling to consider new technology.

Medium and small companies, with very few exceptions, have direct access to only a limited amount of technical information. They usually receive a few trade journals and technical publications, but their chief sources of information are direct personal contact with associates, suppliers, and the field services offered by federal and provincial agencies. A large holding of technical publications is seldom justified since the cost of the supporting library facilities and associated services for the retrieval of information is high. Hence, a comprehensive in-house service of this type is not feasible for most small companies nor for the vast majority of medium-sized companies.

Technical information transfer to medium and small companies depends to a considerable extent on personal contacts. Information from associates is generally limited to the readily available technicalities of common interest and is often restricted owing to the competitive nature of business. Support from suppliers is the most broadly used source of information and is dealt with in Section IV. 2 of this chapter. Supplier information, important as it is to industry in general, is more difficult to obtain and utilize by medium and small companies because of their limited buying power and lack of technical staff to study and apply this information.

A vast amount of technical information is available to industry through federal and provincial agencies. This is dealt with in considerable detail in Chapter 1 of this report and has been summarized in Section IV. 4 of this chapter. Technical information is, however, of little value to medium and small companies unless interpreted and supported by field staff who can discern needs and provide explanations through personal contact. The provincial Departments of Fisheries provide a service of this type for the fishing and canning industries. The Division of Building Research of NRC has a few field offices to support the construction industry. These are specialized services to limited industrial sectors. The Technical Information Service of the National Research Council of Canada has a prime responsibility to manufacturing companies throughout Canada in the field of scientific and technical information.

V. 4.1 Technical Information Service

The Technical Information Service (TIS) was started in 1945 to assist the conversion of medium and small industry to peace-time operations following World War II. It has been expanded during the intervening years to provide a current awareness service and assistance with manufacturing operations. The service provides direct support through engineers in the provincial offices who work with industrial firms to determine their needs and provide information and assistance in interpreting it. This service is available on a no-charge basis to all industry. Many medium and small firms who lack technical staff find the service particularly valuable.

TIS provides an effective and worthwhile service, but it is limited by the small number of officers and the broad area of industry that it attempts to cover. During visits of the Study Group to the principal industrial centres in Canada it was found that many companies were not aware of the service and, although there was no adverse criticism of the quality of the information provided by TIS, many of the users expressed dissatisfaction with the time delay involved in obtaining information or advice.

Technical information awareness and problem solutions are provided by the Technological Developments Section and the Technical Inquiry Section of TIS. The organization has a third section, known as the Industrial Engineering Section, which provides assistance in the identification of problems associated with general plant operations and production methods.

The Technological Developments Section prepares a group of publications to meet recurring needs for technical information not already published in suitable form. The reports and information notes prepared in past years are being evolved into reviews, guides, technical briefs, digests, and checklists to meet the technical information needs of manufacturers on a variety of subjects. These publications summarize current industrial practice and provide a bibliography of selected textbooks, periodicals, pamphlets, and associations. Manufacturers are encouraged to register their specific interests so that checklists of articles and publications can be sent to them on a continuing basis according to their interests.

The Technical Inquiry Section answers enquiries and gives solutions to problems from industry, many generated by the checklists and regular current awareness publications issued through the Technological Developments Section. These enquiries may be sent directly to TIS headquarters in Ottawa or to the information field officers located in 11 industrial centres serving all of the provinces. The direct personal contact of the field officers, although used by some large companies, is primarily directed to medium and small users who have little or no access to other comprehensive sources of technical information.

The Technical Inquiry Section at headquarters in Ottawa, with a staff of 22 scientists and engineers, handles more than 1 400 verbal enquiries annually and processes some 2 300 solutions to technical problems submitted by letter. The field officers, in all locations except Québec, Montréal, and Winnipeg, are provided under contract by the provincial research councils and foundations. Approximately 50 scientists and engineers provide this field service, but many of them are on a part-time basis provided by the foundations or councils for specialized service required in a particular area. It is estimated that the full-time equivalent would be a little more than half this number. The field staff handles some 14 000 written or verbal enquiries annually.

The service provided by these two sections of TIS in general terms can be considered to be equivalent to a current awareness service and an information analysis and answering service with supporting staff to ensure that the information is intelligible to the user. The primary function of TIS is to support medium and small industry technically, and therefore publications and answers to enquiries, as far as possible, are prepared in terms suitable for the technical capability of the recipient. This type of service is essential to the economy of Canada, and the functions presently carried out by TIS will be required as part of any national information system.

The Industrial Engineering Section is a part of the field service offered by TIS and provides, free of charge, a direct in-plant industrial engineering service to identify key operating problems. This section was established in 1962 and even today is a small group, employing only one or two industrial engineers at each of the field offices across Canada. The work of these officers is to train and improve the capability of local personnel to interpret and apply new technology in the areas of their processes, production methods, and general operations. The broad scope of their activities is illustrated by the fact that they are often asked to solve problems or provide advice and assistance on administrative and management techniques in the field of production planning, costing, pricing, distributing, and marketing. Analysis, evaluation, and demonstration may be necessary to show the effectiveness of anticipated results. They encourage management to train their own staffs in this work and give assistance on a do-it-yourself basis. The field industrial engineers also advise on the need for consultants or full-time employees.

The present service as provided by TIS is inadequate to meet the national requirements, for it serves only about 10 per cent of the manufacturing industry. Resources of manpower and time are used where there is the greatest receptivity. As would be expected, the service exceeds 10 per cent in the Maritime and Prairie Provinces, which are not heavily industrialized and can be more thoroughly covered by the staff available; but this is offset by a lower coverage in the large industrial provinces, such as Québec and Ontario, where information needs extend over a broad spectrum and are very diversified. At the present time, service is limited to a few mailings each year or a few enquiries each year from a limited number of companies.

The subgroup believes it is essential that these services be expanded to ensure adequate transfer of available technical information, but only in conjunction with a revised overall program which will meet most effectively the needs of medium and small industry. From a cost standpoint, it would be impractical to consider that a personalized free service, as now offered by TIS, could be expanded to serve industry completely.

In this age of specialization, field officers need back-up from functional specialists to give adequate service to a large number of diversified users. The provincial Departments of Agriculture, which have been providing a field service for nearly a hundred years, have found it expedient to employ specialists so that they can better serve the farming community. The agricultural service, with approximately 400 field officers, does not come under federal administration but is the responsibility of each province, although a great deal of the technical information is provided by the Federal Government. The type of service and responsibility for meeting the requirements of the user in the case of agriculture is, therefore, a provincial matter. The role of the Federal Government in the field of information service is to provide the results of research in a form that can be utilized by the provincial authorities. This engenders close co-operation between the various government bodies, as each has a specific and well-defined responsibility.

Under the U.S. State Technical Services Act, each state is being encouraged to accept responsibility for information transfer. The United States Federal Government does not initiate or carry out programs established to meet this objective but provides matching funds with the state to encourage such programs. The state funds are usually provided by industry or some other sponsoring agency. Expenditures by the Department of Commerce to administer the program for the Federal Government are limited to 5 per cent to ensure that the programs are developed locally and are truly oriented to the specific requirements of the individual states. A description of the State Technical Service Act with comments is included in Appendix B.

During the formative stages, the TIS field function was entirely supported by federal funds. Today the provincial research councils and foundations, in a few cases, provide equal or greater financial support. The total TIS program is, however, still administered as a federal service, and the supporting field services are recognized as a federal responsibility.

With the introduction of a national information system, TIS will have available and should utilize the system as a basic source of input for their operations. After analysis and repackaging to meet the requirements of their users, the national system will be used as a means for disseminating their output. Section V.9 of this chapter deals with economic support for STI by industry and the need for service charges to support an efficient and effective system. It therefore seems appropriate that TIS should put into effect some equitable system of charging for service, particularly in those areas that would be competitive with "paid for" services from a national system, commercial systems, or private consultants. Such service charges would provide a feedback mechanism for TIS to determine user satisfaction, so that parts of the service could be eliminated or expanded to increase the overall effectiveness and value. They would also provide for the necessary expansion of the service without drawing on public funds.

To provide a more effective service, it is recommended that the provincial governments, through appropriate agencies, be encouraged to take over complete responsibility for the promotion, development, expansion, and operation of TIS field services. Under provincial operation, with the co-operation and support of the Ottawa headquarters, the field service could be developed more effectively to meet local and regional requirements.

The services provided by both federal and provincial authorities should become more specialized to support sectors of industry that are predominantly composed of medium and small companies which do not have the resources to support research or to provide expertise for their own information services. Special services could include planning and active projects similar to those promoted under the U.S. State Technical Services Act, with cost-sharing support by the Federal Government. The project being carried out by the Saskatchewan Research Council for indexing of potash literature is a good example. This effort, however, can be greatly expanded.

A system of annual subscription fees or service charges should be instituted to recover at least a portion of the costs of the TIS operation. Public funds will still be required for promotion of the service and for the training of potential users, but as soon as possible other types of services should become self-supporting.

V.5 Professional and Technical Societies

Professional societies, both Canadian and foreign, are an extremely important factor in the transfer of technology in Canada. One of the main functions of most societies is the publication and dissemination of scientific and technical information. The increasing costs of publishing and abstracting make the task more difficult and result in subscription rates that often place the service outside the reach of many individuals and small organizations. Publications are discussed in general, as an industrial source of information, in Section IV.1 of this chapter, so this section has been restricted principally to the acquisition and use of information by individual scientists and engineers.

A total of 32 Canadian societies was contacted during the Study, and briefs were obtained from 14. In addition, the subgroup studied the report on Canadian research and development policy by The Engineering Institute of Canada[36] and also the special study of physics in Canada by the Canadian Association of Physicists.[28] The Joint Council of Professional Engineers of Canada did not provide the Study with written comments, but briefs were submitted by the provincial associations in Alberta and British Columbia.

The Canadian Aeronautics and Space Institute states that technology transfer is one of the principal functions of the institute, and that it is actively engaged in the traditional forms of publishing and distributing technical papers. The institute, however, has growing doubts that this system is effective and economical. It considers it likely that the publication of technical journals, as they have been known in the past, will be discontinued generally within the next 10 years. The institute further suggests that the cost effectiveness of the open literature might be enormously increased if technical journals were to confine themselves to the publication of abstracts or condensations. These could be readily adapted to the needs of computerized retrieval services.

The Canadian Medical and Biological Engineering Society represents professional workers in an interdisciplinary field embracing both life and physical sciences. The society points out that the field is relatively new, and several national and international associations have been established in the past 10 years. A number of publications are now available in the field, but these provide only a partial answer to the needs for information transfer. Many members of the society can use comprehensive university libraries, but access to current awareness and retrospective searching services appears to be limited. The common complaint of the members of the society is not too little information but too much, with no means of selecting and evaluating its content. The society reports that the greatest need of its members is faster access to the current literature. There is general agreement that, while the user is prepared to pay for a specific search or reproduction service, government at the federal and provincial levels should underwrite a major portion of the cost of setting up the service.

The Association of Professional Engineers of Alberta, and the Association of Professional Engineers of British Columbia, both emphasize the difficulty of obtaining information and the long delays in receiving documents after the location has been identified. The Alberta association feels the distance from the central facilities in Ottawa is a real barrier to communication. The British Columbia association states that its members have access to the University of British Columbia Library for a fee of $7.50 a year. The association also makes an annual contribution to the Vancouver Public Library to support services given to its members. According to the associations, people seriously interested in searching for information tend to go directly to United States sources and to ignore Canadian sources. In addition, the associations point out that other nations may not be willing to provide indefinitely information services that are paid for principally by the issuing nation. The development of adequate information services in Canada would have a strong and far-reaching impact on the development of Canadian secondary industry and would lessen the trend to rely on foreign sources.

The Canadian Operational Research Society indicates that there is a need for comprehensive bibliographies and state-of-the-art reviews. Current abstracts and reviews are at least one year late and the location of journal articles is extremely difficult. Members of the society primarily need easier access to a relatively large and therefore expensive collection of operational research literature. They foresee the need for a centralized store of scientific and technical literature that can be searched by computer from remote terminals across the country, but expressed some concern over the high costs involved. They also expressed the opinion that the major funding for improved retrieval and dissemination of operational research information should come from government sources with lesser contributions from industry.

The Agricultural Institute of Canada prepared a questionnaire on information needs and practices which was forwarded to 2 000 professional members in eight member societies. The 971 usable replies ranked information sources in the following decreasing order of importance:

(1) Scientific journals;
(2) Bulletins and semi-technical publications;
(3) Scientific and professional meetings;
(4) Individual personal contact;
(5) Reference books;
(6) Abstracts of journals;
(7) Review articles;
(8) Planning sessions by working groups;

(9) Microfilms, microfiche, and magnetic tape;
(10) Mass communication media.

Allowing for the obvious differences in the user requirements of this professional group and those participating in the CRMA survey and that carried out by the National Aeronautics and Space Administration in the United States, referred to in Section V.2 of this chapter, there are some interesting similarities. Scientific journals and trade publications rate high in all three studies. Conferences were not considered by CRMA but they rank second and third in the other two studies. Specialized services rate relatively low in all studies.

The average personal expenditure for information was reported to be $130 per annum. Personal costs (principally for attendance at conferences) paid by the employer were estimated at $290 per annum. It was also reported that the average professional agriculturalist spent 3.5 hours per week searching for information. Allowing a minimum of $6 an hour for a professional salary, the annual cost of this search exceeds $1 000. In summary, the total cost per person per year for information is at least $1 400. Any facilities provided by the employer, such as libraries, automatic circulation, etc., would represent additional costs.

Respondents reported that 86 per cent had access to libraries, and that 60 per cent had access to current awareness services. Other services, such as retrospective search and selective dissemination of information, are available to less than 18 per cent of the membership.

There does not appear to be any concerted demand for improved information services by Canadian agriculturalists. However, the recognition that some research scientists spend four to five hours a week searching for information suggests that improved methods of literature search would pay substantial dividends. Members of the extension departments, i.e. Agricultural Representatives, and sales representatives are often remote from libraries and it is these individuals who feel most keenly the lack of communication. Two major criticisms were voiced: first, the long period between the completion of research and the publication of results and, second, the lack of written material interpreting scientific results in a form that farmers and extension agents can use.

The Commonwealth Agricultural Bureaux (CAB) were mentioned on several occasions as providing adequate coverage of Canadian and world literature in the agricultural sciences. There would be no point in providing a purely Canadian service that would duplicate the work of the CAB. Only the agricultural economists and the extension people report inadequate abstracting services. The Commonwealth Agricultural Bureaux have recently taken over *World Agricultural and Rural Sociology Abstracts*, and the situation could improve. However, it was pointed out in a private brief that much of the agricultural economic material is published in separate papers rather than regular journals and that it is very difficult to locate.

The problem of providing suitable material to extension workers will not be solved by mechanized methods of storage and search. It will be the responsibility of research workers or special interpretive writers to provide the needed material.

Translation services are reportedly available to a majority of members of the Agricultural Institute of Canada. It is notable that the information service provided by the Canada Department of Agriculture provides over 75 per cent of its material in both the English and French languages. Translations from foreign languages are also available but the delay can be extensive and the cost high.

Agricultural research and extension services have been traditionally conducted by government agencies. While many of the associated industries – processing, distributing, and retailing – are now able to do some of their own research, it is apparent that the farm sector will rely on government agencies to supply these services for some years to come. It is not surprising, therefore, that the members of the institute recommended that governments should continue to pay the cost of information services both to the individual researcher and to the individual farmer.

The Canadian Association of Physicists did not submit a brief to the Study, but a review has been made of the Science Secretariat Special Study No. 2, *Physics in Canada, Survey and Outlook*.[28] The report pointed out the importance of fostering closer relations between government and industrial laboratories, and recommended that arrangements be made whereby government and university physicists be encouraged to spend one or two years in industrial research laboratories. The subgroup feels that this recommendation should be expanded to encourage industry to accept more responsibility and provide financial support to enable graduate students, with the approval of the university concerned, to carry out part of their thesis work in industrial laboratories. The Canadian Organization for Joint Research was recently established to act as a catalyst to promote this objective as well as greater use of university staff and facilities for industrial research. The industrial research institutes recently established in four Canadian universities with financial support from the Department of Industry are intended to encourage greater co-operation and enable industry to utilize the research capabilities of the universities. To be successful, both of these endeavours need the enthusiastic support of industry.

The Engineering Institute of Canada in its report[36] devotes one section to a "National Information Centre". It cites the estimate that in 1964 two million scientific articles were published throughout the world and that the total volume of publications is doubling every seven years. It also refers to the plans of the U.S. engineering community[37] to set up a huge technical information centre in New York City, costing $20 million to start with and about $10 million each year for operation. The Engineering Institute, therefore, recommends that:

> "A national computerized technical information centre be established ... with an annual budget of 3 per cent of the federal research and development budget to collect, store, and disseminate scientific information to Canadian researchers in the most effective manner possible."

The institute stresses the importance of its proposal as follows:

> "Such an investment would yield a considerably greater return to the total Canadian technological position than 3 per cent invested in any other scientific activity, because all technology would benefit, rather than just a narrow segment. It is very obvious that there will always be a competition for federal research funds, but in this competition, a very high priority must be given to information handling. Handled properly, the vast

world information output in basic science and in technical patents (as examples) becomes available to us for only the cost of information processing. No experimental research of comparable scope can possibly be as inexpensive, or as productive."

Another major function of professional societies is the holding of meetings and seminars to encourage the dissemination and transfer of technology between their members. A few societies made reference to this function but did not elaborate to any extent, except that the Canadian Aeronautical and Space Institute referred to the major systems studies carried out by the U.S. Department of Defense. These studies[38] have shown that direct personal contact is the most important means of communication and provides 65 to 70 per cent of the information required to initiate a project. The individual scientist or engineer considers attendance at meetings and seminars of professional societies as one of the most important means of keeping up-to-date with advancing technology. Such meetings are usually the first indication they have of the introduction of new techniques and concepts.

Eleven of the reporting societies and The Engineering Institute of Canada suggest that the present methods of disseminating scientific and technical information should be expanded and improved. Most respondents recommend a centralized information service that would be largely supported by government funds, but only a few were in a position to express the opinion that their members would be prepared to pay more than a nominal charge for services received.

V. 6 Specialized Information Centres

In this era of increasing volume of knowledge, specialization is necessary and has led to the development of technology-oriented services such as *Chemical Abstracts* and the *Engineering Index.* In Canada the pulp and paper industry and the mining industry have limited forms of special information services that have effectively demonstrated their value. In Section V.4 of this chapter it has been suggested that the TIS field service might provide specialized information to local groups of industries, but this falls far short of the requirements of major industry groups such as construction, food, electrical, electronics, oil and gas. The subgroup, therefore, feels that there is a need for the establishment of specialized technology-oriented information centres to serve various industries or groups of industries in Canada.

Each of these centres would have a strong documentary collection and would be conversant with all sources of information that might be useful to personnel within the industry to which they are catering. The centres would also have to be staffed by personnel knowledgeable in the particular technology and capable of interpreting literature of interest to the sector of industry concerned. To play a more effective role in meeting the needs of industry, the centres might also provide field services.

It is considered likely that, if a centre is to become truly viable as the main source of information for a particular branch of technology, it will also have to become more than a documentation centre. It will undoubtedly have to establish close association with agencies that are involved either in innovation or testing associated with the particular technology. With time, some of the centres may even find that it is profitable to become more directly involved in these activities.

Each centre should be developed to meet the specific requirements of an industrial group. Although it may be necessary for government to stimulate studies to establish the need for such services, trade associations, technical societies, and publishing houses should play an important role in determining the nature and scope of the service. One or more of these organizations, either individually or jointly, could be responsible for implementing and operating the service.

Although the establishment of specialized information centres will have to be encouraged through government financial support, after a period of time the centres should become either totally or largely supported by users. This should be in the form of annual contributions from the companies being served by the centre, supplemented by additional service charges that would account for differences in the use made of the centre by the various companies. In this way it would be possible to ensure that the centres are fulfilling their purpose, as support would be withdrawn if they were not. Each centre should logically be located where the density of users is greatest, but on account of the vast size of Canada it might be necessary to establish one or more satellite centres. The specialized information centres would fit into a nation-wide information network as the points to which all enquiries within their competence would be directed.

It is not implied that all industrial groups will be large enough to support this type of centre. This is where it is felt that the services of TIS might then concentrate their efforts. Through a program of special projects, along with a general service, they would fill the areas which it is not feasible for the specialized information centres to cover.

V. 7 Industrial Surveys on Special Information Services

In addition to reviewing the briefs from industrial firms, trade associations, professional and technical societies, etc., the subgroup examined edited accounts of surveys of the furniture industry and the construction industry undertaken by professional consultants at the request of the Department of Industry quite independently of the present Study.

The first of these studies, commissioned by the Wood Products Branch of the Department of Industry, examined the extent of research and development work carried out by the furniture industry, the influence of government in-house research activity on the furniture industry, and the desirability of promoting additional research and development work specific to the needs of this industry. There are over 2 000 firms in the Canadian furniture industry but only 383 employ more than 25 persons. Questionnaires were sent to 78 of the latter companies and replies were received from 39.

In addition to ascertaining the extent of research activities, the survey showed that the industry feels it is not particularly well-informed on technical developments. Manufacturers stated that their best sources of technical information are interplant visits, discussions with competitors, and advice from suppliers. Overwhelming approval was expressed by the respondents for the idea of a furniture technology information centre, since manufacturers find their present sources of information inadequate and somewhat biased.

The second survey was undertaken as part of the BEAM program of the Materials Branch of the Department of Industry. The objective of the BEAM program is to increase efficiency and productivity in the manufacture and assembly of building equipment, accessories, and materials. To achieve this objective, the decision-making processes in the various industry sectors must be improved in both speed and quality. The present organization, dissemination, storage, and retrieval of information required to make productive decisions are considered to be uncertain, inefficient, and often not far short of chaotic.

In undertaking the survey, the consultants mailed questionnaires to over 10 000 organizations and individuals in all sectors of the industry and undertook about 80 in-depth interviews to extend the fact-finding in greater detail. An industrial advisory committee assisted the department in organizing the study, analyzing the results, and formulating the final recommendations.

The results of the study have not yet been published, but from preliminary information provided to the Study Group by the Department of Industry it is quite evident that the Canadian construction industry has a large and costly information "system" of uncertain quality and efficiency, and that the industry is keenly interested in doing something about it. In reviewing all the data obtained in the survey, it was concluded that the direct cost of information retrieval cannot really be isolated from the economics of the work process, and that the real cost of information retrieval is more an implied cost. Specifically, it is mostly the cost of not being able to get information for decision-making or making do with less than is necessary. This can be costly but difficult to evaluate. Lack of information concerning materials can increase costs and cause possibly unsuitable products to be used, resulting in loss of efficiency. Changes in information system technology will undoubtedly affect changes in people's work habits, and if information were available almost instantaneously on demand, it could have a profound influence on the efficiency of creative professional staff.

The net result of the survey was to define the magnitude of the information requirements of the Canadian construction industry and to point out the need for a more efficient and effective information transfer system than now exists. Such a system must aim at providing a comprehensive service that is broad in scope yet sufficiently selective to provide answers in depth when required. It must be impartial and as complete as possible, and not favourable or prejudicial to any particular group of users or suppliers or geographic region. It will be necessary to demonstrate to the user the value of the system and its component services through an extensive demonstration and marketing program. Such a program must be a continuous process because users' requirements change, technological developments occur, and the performance of the system will have to be constantly re-evaluated. Finally, the user of the system must have easy access to the system from his office and have the opportunity to select from a scale of information services those relevant to his individual requirements and ability to pay for the service.

The scope of the information requirements considered in the construction industry survey is much broader than that included in the terms of reference of this Study. In addition to STI, it includes commercial requirements such as the generation and distribution of product information and sales literature, the availability and source of materials, and pricing. On this basis it is estimated that the production, dissemination, storage, and retrieval of this vast volume of information is costing the construction industry in excess of $300 million a year, which is 3 per cent of the total annual value of all construction work. The survey further shows that approximately 90 per cent of the bulk of this information deals with general product information and pricing. Therefore, something in the order of 10 per cent, or $30 million, would be directly applicable to scientific and technical information. This figure of $30 million can be related to the cost studies included in the various sections of this Study but it combines the figures for the cost of libraries and information services, and user costs. The Study has usually dealt with these separately.

Even with this bulk of information being considered for the construction industry, any STI system proposed by this Study Group can be readily expanded to include this type of information or any other requirements of a specific industry group. If such information is put into the system, it can be made available and disseminated to any authorized users.

The two surveys sponsored by the Department of Industry and any additional surveys they may carry out will be invaluable in determining the need for specialized information centres, the cost of the current unco-ordinated service, and the possible savings and improved efficiency that will result from improved service. An analysis of these results should also indicate the financial support that can be expected from various industrial groups for such specialized services.

V. 8 Use of Scientific and Technical Information

The Study has found that very few manufacturing companies appreciate the value of STI, and it is questionable whether industrial management is aggressively encouraging and stimulating their staffs to utilize such information. There has been little change in library methods since the beginning of the century. Present systems can be considered obsolete from the point of view of services required. They have not kept pace with current technological developments. From a service requirement standpoint, as far as industry is concerned, a library can be compared to a manufacturing warehouse filled with component parts ready for the assembly line. Modern management today utilizes computer control and mechanical handling to ensure that component parts are available at the time and place they are required. It cannot tolerate delays. Few libraries or information service facilities have been subjected to such a modernization program.

The Bonn Report[39] and many other studies that have been carried out in recent years have pointed out that there is a serious shortage of professional librarians. There are few training facilities in Canada for the information scientist who, as far as industry is concerned, is even more important than the librarian. In spite of the shortage, industry has done little to relieve these professionals of a vast amount of routine work which can be readily handled by machine or by trained technologists. For many years industry has been faced with a shortage of professional scientists and engineers, but has taken active steps to support this professional group with improved facilities and engineering technologists so that the professionals can be used more effectively. If industry appreciated the full value of scientific information, there is no doubt that similar support could be given to the librarian and the information scientist.

Industrial management also has the responsibility to ensure that technical staff at all levels is trained to appreciate the value of STI and is encouraged to use such information. The inadequacy of most information systems as they are today has in many cases discouraged their use. This has led to unnecessary duplication of research and long delays in the exploitation of new technology. This is one of the prime reasons for the so-called "technological gap".

Many industrialized countries are taking active steps to apply modern technology to improve and speed up the process of information transfer. Improved systems, in themselves, will not assist industry unless they have trained staff to operate the facilities and professional scientists and engineers who are prepared and willing to use them. Canadian industry must be capable of reaping the benefits of such systems, both domestic and foreign, if they are to remain competitive at home and abroad. Users of such information must be trained and ready to meet the challenge that lies ahead.

V. 9 Economic Support by Industry

The Guidelines for Briefs provided by the Study Group to all industrial organizations requested comments on "How should any new or more extensive system be funded? " In general, large industry recognized that the cost of a co-ordinated system would be high and the initial facilities and operation would have to be largely supported by government funds, but many companies are prepared to pay a service charge for information received. Thirty per cent of the manufacturing companies who submitted briefs or who replied to the Canadian Research Management Association questionnaire commented on funding, and all indicated their willingness to pay for services received. Most of the companies expressed the opinion that after the initial financing of a system or systems a large part of the cost could be recovered by subscription or service charges. Four of the research-oriented companies felt that a national system could be self-supporting from the start on a subscription basis. These comments undoubtedly reflect the opinions of large research-oriented companies and other companies who are technically capable of utilizing scientific and technical information.

In contrast to these findings, the briefs from the field offices of TIS give little support to the suggestion that information services should be paid for by industry. The major objections to a fee system included the cost of administration and the natural tendency on the part of field officers to direct their efforts to clients providing the largest source of income. This might lead to neglect of the companies that could least afford to pay but needed STI most. In addition, they emphasized the service is largely educational and should be available to all industries without exception.

The Economics Subgroup points out, in Chapter 7 of this report, that information is a commodity for which price and value are related. Such a price, which serves to offset—at least in part—the cost of the service, provides a feedback mechanism. "Free" service can never achieve such self-regulating characteristics; in the free service environment the extent of usage is not a measure of true user satisfaction. Furthermore, "free" services provided out of public funds have a detrimental effect on the development of commercially oriented services which may be much better adapted to user needs but cannot find sufficient initial support. Society, therefore, suffers rather than benefits from the existence of "free" service, especially in the field of STI where the link between information and economic productivity is more direct than it is in the arts, the humanities, and entertainment.

Supported by these economic considerations and the views expressed by the research-oriented companies, the subgroup believes that it is impractical to operate a national information system that is paid for by some users and free to others when both classes would have access, direct or indirect, to the same sources of information. It may be necessary to provide public funds to set up and promote the use of the national and regional network of systems, but all users should pay for services received on an equitable basis. The service should eventually become self-supporting.

Equitable service charges could be established by a combination of annual subscription fees and supplemental charges for special services. The annual subscription fee would depend upon the number of different information classifications required by the user and the extent of the information contained in each classification. The supplemental service charge would depend upon the cost of obtaining the information requested. The range of subscription fees could vary from less than \$100 for the small company requiring information in one specific classification to many thousands of dollars for large companies requiring information over a broad range in highly technical areas.

The cost of current information services, as reported in the CRMA survey and the user cost surveys carried out by the Study Group, have been used as a base to forecast the probable financial support that may be expected from industry if an efficient and effective information service could be provided by a national system. The 41 respondents to the CRMA survey reported that they were spending a total of \$1.5 million a year on library and information services. This is 1.8 per cent of the total expenditures of \$85.5 million by these companies on research and development. DBS reports[17] that intramural expenditures on R & D by manufacturing companies carrying out research amounted to \$241 million during the year 1966. Assuming all manufacturing companies engaged in research are spending on the average 1.8 per cent of their research dollars on library and information services, the total expenditure of this sector would be \$4.3 million. In addition to these, there are many other companies who do not operate their own research laboratories but, because of the technical nature of their products, are highly qualified and are large users of STI. Therefore, it would seem reasonable to estimate that there are at least twice as many companies in this latter group who spend an equivalent amount of money on library and information services. The total for the two groups would therefore be in the order of $15 million and includes about 2 000 manufacturing companies in Canada.

The rest of the manufacturing establishments, totalling some 30 000,* must on the average spend at least $1 000 a year, which would cover the cost of a minimum number of periodicals and attendance at a few technical and trade meetings a year. The total expenditures on information service for this group would therefore be $30 million. The annual cost of library and information services for the total manufacturing industry is therefore estimated to be in the order of $45 million.

User costs are another factor which must be considered in estimating the total expenditures by manufacturing companies on information services. Based on a user survey, the Economics Subgroup (Chapter 7, Appendix B) reports that the average cost per user per year (salary only) associated with time spent on procuring information is $1 717 for industry. This figure can be doubled to cover overhead and administration. DBS reports[11] that there are 11 157 scientists, engineers, and technicians employed by the manufacturing companies carrying out research. The total user cost for this sector of industry is therefore approximately $38 million. This figure can be raised to at least $100 million to include the major users of STI corresponding to the mark-up used for library and information costs, as outlined in the previous paragraphs. It is extremely difficult to estimate user cost for the balance of some 30 000 manufacturing establishments, but even if each establishment had one man on the average who spent three or four days a year on STI, the cost would be about $5 million.

In summary, it is estimated that the manufacturing industry is paying approximately $150 million for libraries, information services, and user costs. This does not include the cost of preparing technical information such as drawings, specifications, technical sales literature, etc., which undoubtedly runs into many hundreds of millions of dollars.

Industry is aware of the improved service and savings in manpower that can be achieved through the effective use of computers. There is much evidence to show that similar improvements can be attained in the field of information transfer through the application of this new technology. Industry has more than doubled its research and development expenditures in the past five years. If this continues for the next five years, with a corresponding growth in information service and users, it is logical to expect that much of this increase will be channelled into new technology for information transfer and use of a national information system, if such is available.

The Economics Subgroup refers to cost trends for university and college libraries as shown in the Downs Report, which indicates projected expenditures by 1975 at several times today's figures. It is unlikely that industry can tolerate an

* DBS reports research statistics on the basis of companies and total manufacturing statistics on the basis of establishments, so the balance of 30 000 establishments resulting from deducting 2 000 companies (estimated to represent 4 000 establishments) from 34 000 total manufacturing establishments as reported by DBS is only approximate.

increase of this magnitude. To maintain the increase within reasonable limits, it is evident that industry must exploit modern technology to improve the efficiency and effectiveness of STI services.

V.10 Technical Support by Industry

The implementation of a Canadian information system and supporting communication networks will require further research and exploratory development as well as systems engineering studies on the total complex and individual components making up the system. The United States reported to OECD in 1966 that government expenditures for research and development in the field of information-handling methods amounted to $60 million.

No comparable figures were reported by Canada but the Techniques and Sources Subgroup in Appendix A reviewed 35 selected Canadian non-conventional information and data systems, mainly in the field of science and technology, to illustrate some of the activities in Canada that use machine methods for information dissemination. It excludes systems that employ handsort cards, microfilm, and similar non-computer-based techniques. All the work on these systems can be considered as being in the development field, and many are truly research projects. Nine of the projects are supported by the Federal Government, five by provincial governments, nine by universities, and twelve by industry and commercial firms and municipal services.

The University Report, Chapter 3, describes a number of additional projects under development. It is also possible to identify seven research projects in the field of information retrieval being carried out at the graduate level in various universities in Canada. This figure of seven is undoubtedly on the low side because of the incomplete listing of all graduate study work in the universities, as published by NRC,[40] and the brief title description.

This brief summary of the number of research and development projects being carried out by government, universities, and industry, although not complete, illustrates the growing interest in the subject of mechanized information retrieval.

The Canadian computer companies and communication companies have shown considerable interest in the work of the Study Group and have provided sufficient technical data and other information to demonstrate their capability to provide equipment and services to meet the Canadian requirements for systems and networks when detailed design information is available.

Several management consultants and library consultants provided the Study Group with briefs indicating their interest and capability in the field of information storage and retrieval. The Canadian Association of Management Consultants in a recent report[41] stated that 14 per cent of the consulting services for the 11 association firms in 1967 was on computer applications. Although this effort was not entirely devoted to information services, one of the most advanced and imaginative applications was for a computer system to catalogue in standard form the millions of geological facts that are available from every source in Canada, including field geologists, mining and oil firms, government mining departments, and universities. The consultants can, therefore, contribute to the development of some of the services that will be required for a national information network.

Further research is required, but Canadian industry, with the support of universities and government, is capable of developing, providing, and operating types of information services that will be unique to Canadian requirements. Research in the field must be stimulated. Study contracts should be awarded to industry to determine system and subsystem capabilities and requirements. Development contracts should also be provided for pilot-scale operating systems and networks. This work should be authorized at the earliest possible date to further develop technical competence in Canada. The nucleus to develop this technical competence is available, but we are lagging behind other industrialized countries. If not supported and encouraged, the result is inevitable: industry from the United States and other foreign sources will take command.

V.11 Summary of Requirements

The principal information needs of industry identified by this Study and summarized as follows have been used as a basis for the recommendations in the last section of this chapter.

V.11.1 Location of Specialized Information Resources

The industrial user needs to know where to obtain quickly the best available information on such subjects as materials, standards, and specifications; where data banks exist, particularly for Canadian conditions; the names of consultants expert in specific fields; the location of specific documents in Canada; and more information on research and development programs in progress in Canadian universities and government laboratories. Industrial representatives stated that such requirements could best be met by setting up appropriate referral services on a national basis. These referral services would compile directories of non-conventional sources of information, including documents and special consultants, and would then be prepared to carry out the function of rapidly directing the user to the source or sources from which the desired information could be obtained.

V.11.2 Specialized Information Centres

Services such as indexing, abstracting, information analysis, and translation are carried out by a number of government agencies, libraries, and, in a few cases, commercial enterprises. The service by the various organizations, however, is seldom co-ordinated. Designated centres to expand these services and to catalogue existing information would be of great assistance to industry.

Technology-oriented information centres to meet the needs of particular industries or groups of industries are required. They would be highly industrially oriented and, where practical, developed and operated as commercial ventures.

V.11.3 Current Awareness and Retrospective Searching

Many users expressed a need for a current awareness service with in-depth coverage for various specialized fields to cope with the large volume of information being produced. Such information must be current and relevant and should be combined with a retrospective searching service. The service should include information on patents, foreign literature, and translations, and also a better announcement of the published results of research work conducted in Canada, particularly by government laboratories.

V.11.4 Document Handling and Supply

The subgroup found a very urgent need for improved services in interlibrary loan and photocopying services. In many cases large library collections are not available to industry or the services offered are restricted, usually because of lack of staff and funds. Even where services are available they are often of little practical use to industry because of the excessively long time required to meet the user's request. The need to receive wanted documents within a few days of the original demand has been stressed throughout the briefs received. A number of industrial users considered there is a need for a Canadian service similar to that provided by the National Lending Library for Science and Technology in the United Kingdom.

V.11.5 Scientific and Technical Publications

The subgroup found that industry looks upon scientific and technical publications as one of its prime sources of new technology. The increasing volume of publications is the cause, however, of a growing uneasiness about present publishing practices. It is becoming more and more difficult for any particular user audience to discern what is useful to them in the broad base of information that is created by the full-text primary periodicals. Consequently, those forms of publication that condense or analyze information will play an increasingly important role in the future. These forms include the abstract journals, digests, review articles, and the more exhaustive critical state-of-the-art reviews.

Critical state-of-the-art reviews by acknowledged experts are recognized by many users as being most useful, particularly when information required is in an area normally peripheral to an individual's or company's interests. There is a need to explore at the national level the best ways of identifying the areas that should be covered by this type of review and securing competent reviewers. It should also be noted that state-of-the-art reviews may, in addition to print, use seminars or mobile demonstration units.

V.11.6 Co-ordination and Planning

As the Study progressed it became clear that most users interviewed would like to see a much greater degree of co-operation among governments, industries, universities, and public libraries in all aspects of information generation, retrieval, and dissemination in Canada. In their view, the Federal Government, in particular, has a clear responsibility for seeing that there is better co-ordination of existing information services; there should be more joint planning by all concerned to determine existing gaps in the information structure and steps taken to rectify such shortcomings.

V.11.7 Specialized Service for Medium and Small Companies

Companies with limited scientific and technical capabilities have a definite need for educational and interpretive services of the type now provided by the

Technical Information Service. The service should not be restricted to the general information service as presently provided by TIS but should be expanded to include special projects where information transfer in a specialized field could assist the development of new skills or assist new or distressed industries to contribute effectively to the economic growth of the country. Provincial governments, through appropriate agencies, should be encouraged to assume responsibility for the development and operation of the technical information field services.

V.11.8 Training of Scientific and Technical Staff

Industrial management has a responsibility to provide adequate internal information services and to ensure that technical staff at all levels is trained to appreciate its value and is encouraged to use it.

V.11.9 Economic Support

Many large manufacturing companies, and particularly the research-oriented companies, have indicated their willingness to pay for services received if a national information system becomes available in Canada. Although this view is not shared by a number of companies, particularly those in the medium and small sector, it is not economically feasible to provide a totally free service of this magnitude. Free service lacks feedback to evaluate user acceptance. The subgroup, therefore, believes that, as far as possible, the service should be user-financed.

V.11.10 Long-term Needs

Although there was general agreement that a considerable improvement in information services is possible through a better co-ordination of existing traditional information channels, many of the more progressive research-oriented companies interviewed are convinced that future information requirements can only be met satisfactorily by the gradual development of a computerized national information system, closely linked to international systems, operating through a nation-wide communication network. Research-oriented companies and others capable of selecting, analyzing, and utilizing technical information should have direct access to the communication network. A special agency such as TIS would also have access to such services to obtain, analyze, and interpret information so that it could be provided to non-technically oriented manufacturing companies in a form and in a language that could be effectively utilized by such companies.

While some large companies are already using computers in their internal information systems, there appears to be general agreement that the Federal Government must be prepared to provide leadership and considerable funding before any really widespread use of computers for information can be implemented. A well-organized plan for the implementation of a national system would enable many industrial companies to proceed with the development of compatible internal systems, parallel in time with the introduction of the national system.

V.11.11 Research and Development

Research and development in the field of computerized information systems should be stimulated. The Federal Government should authorize at the earliest possible date study contracts and development contracts to provide the initial experimental systems that will be required to meet conditions that are unique to Canadian requirements. Joint programs with industry and universities participating would expedite results and contribute to the further development of technical competence in Canada.

Section VI

RECOMMENDATIONS

The recommendations contained in this section of the report result from a review of the scientific and technical information used and required by industry, a study of existing and proposed national and international systems, and from an analysis of industrial requirements for improved information service as summarized in the preceding section of this report. The recommendations provide for an orderly and effective means of developing a national system for storage and dissemination of STI through progressive stages to meet the long-term needs of industry.

It is therefore recommended that:

1. **The Federal Government establish a Co-ordinating Agency responsible for the orderly development of national and regional systems to provide scientific and technical information services in Canada, utilizing as far as possible existing facilities in both the public and private sectors.**

Such an agency, to be effective, will require the co-operation and support of all levels of government, including federal, provincial, and municipal, as well as universities, industry, publishing houses, and professional and trade associations. Advisory committees at national and regional levels, representative of all groups concerned with information, may be helpful in stimulating the necessary co-operation and support.

The Co-ordinating Agency should have authority and funds to carry out its mission. It should formulate plans on a national scale and initiate contracts for developing such plans to co-ordinate existing information services, to identify gap areas in the present services, and to provide for systems that in the future are considered essential to meet the requirements of continuing adequate information services in Canada.

As plans evolve for the establishment of national systems, the Co-ordinating Agency should place contracts with Canadian industry for the development of experimental systems that will be required to meet conditions that are special or peculiar to Canadian requirements and for proving the feasibility of such systems on a pilot scale.

2. **The Co-ordinating Agency establish a national referral centre that would become the principal point for directing users to the best available information sources.**

The national referral centre, which should preferably be located at a major facility such as the National Science Library, should collect, prepare, and maintain directories that cover, as fully as possible, all Canadian information sources, including libraries, information centres, data banks, document stores, and special consultants in the fields of research and engineering. It should inaugurate a rapid referral service using a team of knowledgeable experts and should publicize available directories and services widely and continuously through appropriate advertising with particular emphasis on industrial information users.

3. **The Co-ordinating Agency promote the creation of regional information systems with the primary objective of serving industry.**

These systems would include industrial libraries that are prepared to co-operate by including all or part of their collections for use by others, provincial research councils, foundations, and institutes, as well as universities and public libraries which are prepared to provide service to industry. Each of the systems would maintain a union catalogue of its holdings and all material so registered would be available for loan or photocopying services by any member library. All such regional systems would be linked by communications to each other and to the National Science Library for the purpose of locating material held outside each regional system. To encourage the establishment and maintenance of adequate collections, to discourage abuse of borrowing privileges, and to foster a better awareness on the part of librarians and industrial management of the true cost of information services, a charge system should be implemented for loans and the provision of photocopies.

4. **The Technical Information Service of the National Research Council become more specialized and be partially paid for by industry. The provincial governments be encouraged to assume the administration and promotion of technical information field services.**

The technical information services provided by both federal and provincial authorities should become more specialized to support sectors of industry that are predominantly composed of medium and small companies which do not have the resources to support research or to provide expertise for their own information services.

A system of annual subscription fees or service charges should be instituted to recover at least a portion of TIS operating costs and to evaluate user acceptance. Public funds will still be required for promotion of the service and for the training of potential users, but as soon as possible other types of services should become self-supporting.

Under provincial operation, with the co-operation and support of the Ottawa headquarters, the field service could be developed more effectively to meet local requirements and to assist medium and small companies that have potential opportunities for expansion and can contribute to the economic growth of any specific community.

5. **The Co-ordinating Agency explore the feasibility of developing specialized technology-oriented information centres to meet the**

needs of particular industries or groups of industries to supplement the more general services.

These centres should be highly industrially oriented and, where practical, developed and operated by industrial trade associations or other industrial groups. They should be industry-financed, including charges for services rendered and due credit for input to the system. The centres should have a strong documentary collection and be conversant with other sources of information that might be useful to personnel within the industry to which they are catering. The centres should be staffed with personnel knowledgeable in the particular technology and capable of interpreting literature of the industry concerned. To play a more effective role in meeting the needs of industry, the centres may also provide field services including, where applicable, mobile demonstration units.

6. **The Co-ordinating Agency encourage or direct responsible agents to develop, where appropriate, other special services such as information analysis, abstracting, indexing, and translating.**

These special services should only be developed as the need becomes evident. Wherever possible, existing agencies should be used to carry out the work. Highly competent, discipline-oriented personnel will be required to develop such services, and therefore it will require in most cases a number of different agencies to meet the total requirements of any specific centre. It may, therefore, be necessary to designate or establish a central agency to co-ordinate the work for each special information centre. Such central agencies could act as international agents to exchange information in the same field with foreign countries.

7. **The Federal Government establish a high priority for research and development in the fields of communication and information sciences to encourage government laboratories, universities, and industry to devote more effort in this field with, if necessary, a reduction in other disciplines having a lower impact on the growth of the economy.**

The implementation of this recommendation should not necessarily involve the establishment of any new granting agency or any new incentive programs for the promotion of industrial research. All R & D projects in this field, however, should be able to qualify for existing grant funds and to participate in present incentive programs. With a high priority assigned to research and development in the field of mechanized information sciences, it should provide an incentive to universities and industry to orient their future programs to give preference in this field.

8. **Industrial management accept the responsibility to provide adequate internal information facilities and to ensure that technical staff at all levels is trained to appreciate their value and encouraged to use them.**

Industry has made large expenditures and devoted considerable effort to the mechanization of industrial processes through the use of computers and special mechanical handling of materials to improve efficiency and expedite production. If industry is to obtain the maximum benefit of a national information service, more attention should be devoted to computer storage, searching, and dissemination of technical information to improve the efficiency and output of managers, scientists, engineers, and technicians who at present rely almost entirely on their own memory, personal contact, and, probably lastly, the traditional library. This not only involves the provision of facilities but the training of staff to utilize the service.

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Appendices

Appendix A

STUDY PROCEDURE

Newspaper Publicity

A notice was published in 26 leading newspapers across Canada inviting all interested parties to submit briefs to the Science Secretariat on the scientific and technical information (STI) services now in use and on proposals concerning the future development and co-ordination of these services.

Canadian Technical Journals

A press release was issued on the same subject to 113 Canadian technical journals that are primarily directed at the individual scientist or engineer. Eighty of these publications were in the English language and 33 in French.

Trade Associations, Technical Societies, and Research Institutes

Contact was initiated with 130 trade associations, technical societies, and research-oriented institutions either through personal interviews or correspondence. These organizations were provided with a brochure giving general information about the Study and guidelines for the preparation of briefs.

Survey by the Canadian Research Management Association

A special survey was organized through the Canadian Research Management Association (CRMA) to obtain from its member organizations a full account of their present scientific and technical information services and to determine their future requirements in this area.

Canadian Manufacturers' Association

The Canadian Manufacturers' Association (CMA) was extremely co-operative in supporting the work of the Industrial Subgroup, although they did not provide a brief. Their membership totals approximately 6 500 manufacturing firms and represents a broad spectrum. As an alternative to providing a brief, they recommended that the subgroup make a survey of a selected group of their members. To support this survey, the CMA provided the Study with the names of 220 of their members whom they considered would be best qualified to contribute to the work of the Study. These companies were contacted as recommended by CMA. The companies are located in major centres across Canada. The list was divided into seven groups by company size and further subdivided into regional areas as follows:

Company Size	Regional Areas and No. of Companies				
	Western Provinces	Ontario	Quebec	Eastern Provinces	Total
up to 25 employees	2	1	1	–	4
25 to 49 employees	4	3	3	–	10
50 to 99 employees	4	8	4	2	18
100 to 199 employees	1	5	7	–	13
200 to 499 employees	8	15	7	3	33
500 to 999 employees	8	11	15	4	38
over 1 000 employees	7	70	27	–	104
	34	113	64	9	220

Technical Information Service of the National Research Council

Both verbal and written reports were obtained from the Technical Information Service (TIS) of the National Research Council concerning the services provided and the future requirements of the users of these services across Canada. This organization, consisting of a headquarters in Ottawa and 11 regional offices or agencies from Halifax to Vancouver, is principally concerned with providing technical information to medium and small business concerns.

Public and Private Meetings across Canada

Members of the Study visited a number of the large industrial cities across Canada. During these visits, public meetings and private interviews were held with representatives of trade associations, technical societies, manufacturing companies, provincial agencies, and universities, as well as private individuals. As a result of these discussions, further information on industrial requirements was obtained as well as clarification of information previously submitted in briefs to the Study.

Survey by the Agricultural Institute of Canada

The Agricultural Institute of Canada prepared a questionnaire on information needs and practices which was forwarded to 2 000 professional members in eight member societies.

User Survey

As part of a survey for the total Study, the Industrial Subgroup forwarded to a selected group of approximately 50 manufacturers 25 questionnaires, each (total 1 250) designed to determine the amount of time spent by individual scientists and engineers in searching for and obtaining technical information. The companies were asked to have the questionnaire answered by a representative sample of individuals, including approximately 10 per cent management, 70 per cent professional scientists or engineers, and 20 per cent technicians.

Summary of Response

Outside of the unrecorded contacts through the press, the technical journals and the surveys of individuals, the subgroup contacted a total of 477 organizations.

This included 32 professional and technical societies, 90 trade associations, 8 research institutes, and 347 manufacturing companies. Approximately 3 250 questionnaires were sent to individuals.

The subgroup received a total of 97 briefs from organizations and individuals. The professional and technical societies provided 14 briefs, trade associations 17, research institutes 8, individual manufacturing establishments 35, and individuals 23. The individual user surveys to members of the Agricultural Institute of Canada and to industrial managers, professional scientists and engineers, and technicians provided the Study Group with 1 675 replies. Approximately 50 per cent response was received from both the agriculturalists and industrial personnel. It also received opinions and many constructive suggestions from the hundreds of individuals attending the public and private meetings all across the country. The opinions expressed in the formal briefs, in many cases, represented the views of a large number of companies or individuals, as the trade associations and technical societies collectively have a very large membership. The response from manufacturing companies, although relatively small, is not indicative of the total interest in the Study, as many companies contributed information either through trade associations or through the special study of industrial research organizations carried out by the Canadian Research Management Association. The subgroup specifically requested companies not to duplicate their replies unless they had additional comments not incorporated in any previous submission.

Appendix B

DESCRIPTION OF U.S. STATE TECHNICAL SERVICES ACT OF 1965, WITH COMMENTS

Introduction

Public Law 89-182 of the 89th Congress of the United States was enacted on September 14, 1965, with the objective of promoting commerce and encouraging economic growth by supporting state and interstate programs to place the findings of science usefully in the hands of American enterprise.

The Declaration of Purpose which introduces the Act states that Congress:

1) Finds that wider diffusion and more effective application of science and technology in business, commerce, and industry are essential to the growth of the economy, to higher levels of employment, and to the competitive position of United States products in world markets.
2) Finds that the benefits of federally financed research, as well as other research, must be placed more effectively in the hands of American business, commerce, and industrial establishments.
3) Declares that the purpose of this Act is to provide a national program of incentives and support for the several states individually and in co-operation with each other in their establishing and maintaining state and interstate *technical service* programs designed to achieve these ends.

For the purposes of this Act, *technical services* means activities or programs designed to enable businesses, commerce, and industrial establishments to acquire and use scientific and engineering information more effectively through such means as:

(1) preparing and disseminating technical reports, abstracts, computer tapes, microfilm, reviews, and similar scientific or engineering information, including the establishment of state or interstate technical information centres for this purpose;
(2) providing a reference service to identify sources of engineering and other scientific expertise;
(3) sponsoring industrial workshops, seminars, training programs, extension courses, demonstrations and field visits, designed to encourage the more effective application of scientific and engineering information.

Establishment of the Office of State Technical Services

The Office of State Technical Services (OSTS) was established November 19, 1965, under the Assistant Secretary of Commerce for Science and Technology. The organization consists of the Director's Office, including administrative staff and legal counsel, and three divisions: State Programs, Special Programs, and Reference Services. The legislation provides that not more than 5 per cent of the total amount appropriated for the program shall be available to the Secretary of Commerce for the direct expenses of administering the Act.

The main function of OSTS is to administer and co-ordinate the State Technical Services program at the national level. This includes advising and assisting the states in establishing programs that serve needs at state and local levels and assigning available grant money in the most effective and equitable way.

Participation of the Individual States

Programs under the State Technical Services Act depend upon effort by the states in terms of providing local planning, leadership, initiative, participation, and matching resources in support of the federal commitment. Thus, each state designs and manages its program on the basis of its own plan. Assistance is provided in terms of a federal grant in support of equal matching funds from within the state.

The Act specifies that the Governor of the state shall designate an institution, to be known as the Designated Agency, to administer and co-ordinate the program in the state. It is the function of the Designated Agency to invite the participation of all the qualified educational institutions in the state in the planning of activities. (A qualified institution is defined as an educational institution which grants a degree in engineering, science, or business administration. Other institutions may also be qualified to participate by meeting criteria published in the Rules and Regulations.)

Qualified institutions in the state are invited to submit proposals to the Designated Agency for inclusion as part of the overall technical services program for the state. The Designated Agency must certify that at least one half of the money for the program will be raised locally from non-federal sources, such as state funds, user fees, private industry support, or foundation grants.

The Act also specifies that each Designated Agency shall have an Advisory Council with broad representation from business, industry, labour, and education in the state to review the annual technical services program, evaluate its relevancy to the purposes of the Act, and report its findings with recommendations to the Designated Agency and the Governor.

Funds

Appropriations for the purposes of the Act were originally \$10 million, \$20 million, and \$30 million respectively for the fiscal years ending June 30, 1966, 1967, and 1968. However, these have now been reduced to \$3 500 000, \$5 500 000, and \$11 million. Actual federal matching funds in the form of grants to State Designated Agencies totalled \$3 025 000 in the fiscal year 1966 and \$4 981 939 in 1967.

State Plans

The Act states that an amount not to exceed \$25 000 per annum for each of the first three fiscal years may be granted to each Designated Agency to assist in the preparation of a five-year plan and the initial technical services programs. Every Designated Agency requested and qualified for the outright planning grant for fiscal year 1966.

Twenty-four states submitted five-year plans and annual technical services programs for matching fund grants before the end of fiscal year 1966. Forty-one states participated in 1967. The five-year plans outlined the technological and economic conditions of the state, identified the major regional and industrial problems and the general methods and approaches to be used in working towards the solution of these problems.

State Programs

Program grants, as distinct from planning grants, are for active projects. The former increased from 24 in 1966 to 41 in 1967 and federal grants more than doubled from $1.6 million to $3.8 million, while the planning grants dropped from 53 to 43 and federal expenditures were less than half at $647 000. This illustrates that many programs have evolved from the original state plans.

The individual projects dealt with the following types of activity: Information Dissemination Services, Referral Services, Field Services and Industrial Liaison, Directed News of STS Activities in States, Courses in Information Dissemination, Use of Educational TV, Courses in the Use of Computers in Business, Courses in Specialized Technology (Wood Technology, Metal Working, Mineral Industries, Electronics, Construction Industry, Food Processing, Numerical Control, Operations Research, Structural Mechanics), Use of Libraries in State Technical Service Programs.

Federal funds for program grants to the State Designated Agencies totalled $3.8 million for 1967. The application of these funds by category of technical service is of interest. Ten per cent of the resources were used to administer the program, one third of the resources was used for educational projects, 23 per cent for informational projects, 11 per cent for referral service projects, 21 per cent for field services, and 1.3 per cent for demonstrations.

Special Merit Programs

The Act also provides for matching grants to qualified institutions in support of technical service programs having special merit. Proposals for grants in this category may be submitted at any time directly to the Office of State Technical Services without regard to the annual requirements or nature of the technical service programs submitted by the states. Three of these grants were made in fiscal year 1966, totalling nearly $110 000. A grant of $75 089 was made to Graphical Arts Technical Foundation, Pittsburgh, Pennsylvania, for a program to expand the dissemination and use of science and technology in the graphic arts industry in the United States. A grant of $23 070 was made to the Civil Engineering Department of Cornell University, Ithaca, New York, for a program serving the construction industry on a regional basis. Finally, a grant of $11 420 was made to the Stevens Institute of Technology, Hoboken, New Jersey, for a course of lectures for industrial chemists on the interpretation and analysis of data derived from mass spectroscopy and nuclear magnetic resonance. In 1967, special merit grants increased to 16 and matching federal expenditures totalled $506 910.

Reference Services

The Act authorizes and directs the Secretary of Commerce to aid State Designated Agencies in carrying out their technical service programs by providing access to scientific, technical, and engineering information from sources outside the state. In response to this directive, OSTS engaged the Clearinghouse for Federal Scientific and Technical Information (CFSTI) to assist the designated agencies and participating institutions. A number of compendia and guidebooks were prepared under this arrangement and distributed to the states through OSTS on a complementary basis. The regular services of the CFSTI, as an existing resource, were also available to the states. The first *STS Newsletter* was distributed in April 1966. Now published monthly, it is the prime communication medium between OSTS and the State Designated Agencies.

Relationships between the Department of Commerce and other Government Agencies

A number of government agencies and offices have been charged with broad responsibility for promoting commerce and encouraging the economic growth of the country. However, only OSTS has as its primary function the administration and support of programs designed to place the findings of science usefully in the hands of American enterprise. This primary function has been the basis for determining what interfaces may exist between OSTS programs and those of other agencies with a view to preventing duplication or a conflict in objectives or functions. The major science-supporting agencies of the Government such as NASA, DOD, and AEC have programs aimed at disseminating the results of research and development from their mission-oriented programs to commerce, business, and industry. A prime example is the Office of Technology Utilization of NASA. Co-operation with the NASA effort has already been undertaken by OSTS and, in a joint bulletin, the two agencies have recommended to State Designated Agencies the possible use of the seven NASA Regional Dissemination Centres to augment their individual STS programs. Discussions have also been held with DOD and AEC aimed at bringing about similar co-operation arrangements.

The role of the Federal Council for Science and Technology, the Resources Program Staff of the Department of the Interior, the Rural Community Development Service of the Department of Agriculture, the Office of Education in the Department of Health, Education and Welfare, the Science Information Exchange of the Smithsonian Institution, the National Referral Centre of the Library of Congress, and the proposed national system for scientific and technical information are all being studied in relation to the evolving program of the Office of State Technical Services in order that effective working relationships can be established with these several agencies without overlap or omission.

Comments Pursuant to the Above Description of the State Technical Services Act and its Implementation

(1) It is significant that a highly industrialized and sophisticated country such as the United States has considered it necessary to institute such a program to sustain the vigour of the economy.
(2) During the third fiscal year of the program, the individual states and the Federal Government will spend approximately $20 million implementing the Act.
(3) Implementation of the programs is to be undertaken largely by universities and colleges, thus bringing the academic world into closer contact with the business and industrial community.
(4) Implementation of the Act is largely decentralized thus allowing for, and encouraging, local initiative to solve local problems.
(5) Provision has been made for the support of special projects leading to regional or national services for the dissemination of scientific and technical information.
(6) The immediate response from 24 states during the first year, expanding to 41 in the second year, with a corresponding increase in federal grants from approximately $3 million to $5 million which has been matched by the states, indicates an acceptance of the service by state agencies.
(7) The acceptance of the program is further indicated by the rapid change from planning grants to active program and special grants. The latter increased from approximately 55 per cent of the total federal grants in 1966 to 85 per cent in 1967.

Appendix C

CONTRIBUTORS TO THE INDUSTRIAL STUDY

Organizations Submitting Briefs

Trade Associations

Canadian Business Press
Canadian Electrical Manufacturers Association
Canadian Feed Manufacturers Association
Canadian Good Roads Association
Canadian Industrial Communications Assembly
Canadian Institute of Steel Construction
Canadian Printing Ink Manufacturers Association
Canadian Research Management Association
Canadian Restaurant Association
Canadian Standards Association
Canadian Toy Manufacturers Association
Canadian Truck Trailer Manufacturers Association
Meat Packers Council of Canada
The Mining Association of Canada
Sheridan Park Association
Steel Castings Institute of Canada
Tanners Association of Canada

Research Institutes

British Columbia Research Council
Manitoba Research Council
New Brunswick Research and Productivity Council
Nova Scotia Research Foundation
Ontario Research Foundation
Pulp and Paper Research Institute of Canada
Research Council of Alberta
Saskatchewan Research Council

Manufacturing Establishments, Including Those Participating in the CRMA Survey

Amerada Petroleum Corporation
Aurora Technical Industries, Ltd
Avon Rubber Company Ltd
Barringer Research Limited
Bell & Howell Company, Micro-Data Division
The Bell Telephone Company of Canada
The British American Oil Company Limited
Canada Packers Limited
Canadian Celanese Company
Canadian General Electric Company Limited
Canadian Industries Limited
Canadian International Paper Company
Canadian National Railways
Canadian Pacific Oil and Gas Limited
Canadian Refractories Limited
Canadian Vickers Shipyards Limited
Canadian Westinghouse Company Limited

Columbia Cellulose Company Limited
Combustion Engineering-Superheater Limited
Cominco Ltd
Computing Devices of Canada Limited
Consolidated-Bathurst Limited
The de Havilland Aircraft of Canada, Ltd
Dominion Bridge Company Limited
Dominion Magnesium Limited
Dorr-Oliver-Long Ltd
Dow Chemical of Canada, Limited
Dunlop Research Centre
Du Pont of Canada Limited
E.M.I.-Cossor Electronics Ltd
Eldorado Mining and Refining Ltd
Electric Reduction Co. of Canada Ltd
The Electrolyser Corporation Ltd
Falconbridge Nickel Mines Limited
Ferranti Packard Electric Ltd
Golden Eagle Oil and Gas Limited
W. R. Grace & Co. of Canada Ltd
The Griffith Laboratories, Limited
The Hydro-Electric Power Commission of Ontario
Imperial Oil Limited
Imperial Oil Enterprises Limited
International Business Machines Corporation
Johnson Matthey & Mallory Limited
Kennedy Smith Associates
Lever Brothers Limited
Litton Systems (Canada) Limited
MacMillan Bloedel Limited
Manitoba Telephone System
Maple Leaf Mills Limited
National Grain Company Limited
Noranda Research Centre
Northern Electric Company Limited
Norton Company
Pharma-Research (Canada) Limited
Polymer Corporation Limited
The Proctor & Gamble Co. of Canada Ltd
Pyle-National (Canada) Ltd
Rayonier Canada (B.C.) Limited
RCA Victor Company Ltd
I. P. Sharp Associates Limited
Shawinigan Chemicals Ltd
Sherritt-Gordon Mines Limited
T. S. Simms & Co. Limited
Smith, Kline & French Research Centre
Spence Taylor & Associates Ltd
The Steel Company of Canada, Limited
Sun Oil Company
Syncrude Canada Ltd
Twin-Skin Limited
Union Carbide Canada Ltd
Uniroyal Limited
Watts, Griffis and McOuat Limited
Weiser Lock Company of Canada Ltd

Professional and Technical Societies

The Agricultural Institute of Canada
The Association of Professional Engineers of Alberta

The Association of Professional Engineers of the Province of British Columbia
Canadian Aeronautics and Space Institute
Canadian Association for Research in Toxicology
Canadian Farmer Writers Federation
The Canadian Institute of Food Technology
Canadian Medical and Biological Engineering Society
Canadian Operational Research Society
Canadian Pulp and Paper Association (Woodlands Section)
The Computer Society of Canada
Institute of Sedimentary and Petroleum Geology
Patent and Trademark Institute of Canada
The Textile Technical Federation of Canada

Others

Alberta Department of Industry and Development
Alberta Experimental SDI Association
Arctic Institute of North America
Institute of Computer Science, University of Toronto
Saskatchewan Wheat Pool

Private briefs were submitted by 34 individuals, including 11 members of the Technical Information Service of the National Research Council.

Organizations Represented at Interviews but not Submitting Briefs

Bristol Aerospace Limited
CAE Industries Ltd
Canadair Limited
Canadian Bronze Powder Works Limited
Canadian Industries Limited
The Canadian Institute of Mining and Metallurgy
Canadian Iron Foundries, Limited
Canadian Johns-Manville Co. Limited
Canadian Manufacturers' Association
Canadian Marconi Company
Canadian National Telecommunications
Computech Consulting (Canada) Ltd
The Consumers' Gas Co.
Dominion Corset Co. Ltd
DOMTAR Limited
Electrohome Ltd
Electronic Industries Association of Canada
Garrett Manufacturing Limited
General Foods Limited
General Motors Diesel Limited
Industrial Enterprises Inc.
Information Systems Company
The Institute of Electrical and Electronics Engineers, Inc.
Johnson & Johnson Ltd
Kimberly-Clark of Canada Ltd
Lignosol Chemicals Limited
Lowe Petroleum Engineers of Canada Ltd
Maclean-Hunter Publishing Company Limited
Mallory Battery Company of Canada Limited
Marsland Engineering Limited
Pioneer Electric
Polytronics Co.
Raytheon Canada Limited
Raylo Chemicals Limited
Reid Crowther Consulting Engineers

Thomson Research Associates Ltd
United Aircraft of Canada Limited

Many individuals representing universities, public libraries, and federal and provincial government departments also provided the members of the Study Group with interesting and valuable comments on industrial requirements for scientific and technical information in Canada.

SPECIAL STUDY
No. 8

Scientific and Technical Information in Canada   Part II   Chapter 2   Industry

Chapter 3.

Scientific and Technical Information in Canada

Part II

Chapter 3

Universities

Prepared for
The Science Council of Canada

SCIENTIFIC AND TECHNICAL INFORMATION IN CANADA

PART II

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Special Study No. 8

Scientific and Technical Information in Canada

Part II

Chapter 3

Universities

Prepared for

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This chapter of the report

SCIENTIFIC AND TECHNICAL INFORMATION IN CANADA

consists of three parts:

Part A, **Knowledge and the University**, was prepared by Gerald Waring on the basis of special discussions with the following members of the academic community:

Dr. W.E. Beckel	Vice-President–Academic, University of Alberta
Dr. B.L. Funt	Dean of Science, Simon Fraser University
Dr. Philippe Garigue	Dean of Social Sciences, Université de Montréal
Professor Michael Gregory	Department of English, Glendon College, York University
Dr. D. McN. Healy	Vice-President for Academic Affairs, York University
Dr. J.E. MacDonald	Vice-Chairman, Committee of Presidents of Ontario Universities
Mr. A.K. Mackworth	Department of Industrial Engineering, University of Toronto
Dr. M.O. Morgan	Vice-President–Academic, Memorial University
Dr. Arthur Porter	Professor of Industrial Engineering, University of Toronto
M. Pierre-Paul Proulx	Executive Director, Committee of University Presidents of Quebec
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Professor Don Theall	Department of English, McGill University
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Part B, **Scientific and Technical Information in the Universities**, is submitted by the Universities Subgroup:

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Samuel Rothstein — University of British Columbia, Vancouver

FOREWORD

This Report on the Study conducted by Mr. J.P.I. Tyas and his colleagues is published as one of the series of Special Studies commenced by the Science Secretariat and now being continued by the Science Council of Canada.

The origin and status of this report are somewhat different from others in this series. The study was originally proposed by the Department of Industry in 1967, was by agreement taken over by the Science Secretariat and is now being considered by the Science Council of Canada's Committee on Scientific and Technical Information Services as an important background study.

As in all other special studies, the report represents the opinions of the authors only and does not necessarily represent the opinion of the Science Council of Canada, or the Science Secretariat.

This publication contains Chapter 3 (Universities) of Part II. Part I of this Special Study has already been published. The other chapters of Part II are

Chapter 1–Government Departments and Agencies
Chapter 2–Industry
Chapter 4–International Organizations and Foreign Countries
Chapter 5–Techniques and Sources
Chapter 6–Libraries
Chapter 7–Economics

and will be published separately. Each of these seven separate sections contains the report of a major subgroup, thus providing background data and considerations to complement the recommendations in Part I.

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SUMMARY

The primary function of the university is to teach. However, alarm is growing that the universities may be unable to discharge this function effectively in the future, for undergraduate enrolment is expected to double by 1975; graduate enrolment, to triple. This explosive growth is well beyond the capabilities of the universities to handle, even taking into account the maximum increases in plant and staff that financial resources will permit, unless the universities scrap teaching methods as old as Aristotle in favour of a new, automated, electronic, audio-visual teaching technology that is only now being conceived and developed.

Moreover, the universities will have to specialize. First, they must specialize on teaching, if necessary at the expense of in-house research that some academics already deplore as being too diversionary of time, effort, interest, and money from the teaching function. Second, they must specialize among themselves, co-operating to make optimum use of all the resources available to them—the talents of their teachers, the knowledge stored in their libraries, the physical plant on their campuses, and the share of public funds that may be apportioned to them.

In the long run, the knowledge emanating from universities that will be the most beneficial to society will not be in theses, books, and magnetic tape, but in the minds of graduates who go forth to work in society and eventually to direct the affairs and create the achievements of society. Consequently, urgent attention must be given to the development and introduction of new equipment and techniques to enable the universities to cope with their looming crises.

A strong instinct for intellectual and corporate autonomy partly accounts for the universities being ill-equipped to deal with the population explosion, and is evident as well in the university libraries. Every university wants a great library. Every university library wants to become a great library. This has led to wastefully expensive duplication of holdings which, in turn, contributes to pressures for expansion of library plant. Authoritative sources put the bill over the next decade at three quarters of a billion dollars, of which a third will be for more buildings. University administrators, who can see five ways to spend every dollar, are faced with determining whether this vast outlay is really necessary.

The universities' need for knowledge is expanding with the knowledge being created, but the need is for knowledge to be readily available, not necessarily for it to be permanently stored on each campus. The answer to the $750 million question is at hand. It is logical, economical, and philosophically in harmony with life in our interdependent world. It entails dedicating existing libraries to the service of all universities through interlibrary loans, extending interlibrary co-operation to embrace co-ordination of purchasing and cataloguing, establishing regional storage centres for little-used books and other material, and acceptance of a retirement policy for library holdings that would optimize conservation of useful knowledge, on the one hand, and use of storage facilities and human resources, on the other.

This new approach must also bring university libraries with their stores of scientific and technical information into much more relevant and meaningful relation with society, especially the science-based segment of society, the industries that create much of the wealth that goes first to the tax collectors and thence into university treasuries.

Universities also should be developing new information services such as documentation centres, data banks, and referral, abstracting, selective dissemination, and translation services. Such a program of marshalling and augmenting the information the university can supply would be designed to make that university a powerful unit in a national information network.

Hand in hand with this should go a great deal of rationalized and mission-oriented university research aimed at such targets as improved techniques of information classification and retrieval, selective dissemination of information, scanning and abstracting, automatic translation, more effective use of computer-assisted instruction, and better understanding of the human problems involved in information transfer. This will require money, and money should be provided.

The concept of a national network of scientific and technical information would not be feasible without the active participation of the universities. Not only do they have information indispensable to the economy, but they are a major source of manpower possessing the skills needed for creating a national information network and for training the variety of personnel required to operate the network. With the universities' co-operation, pilot projects in information handling should be established in a co-ordinated pattern that will facilitate their link-up at a second stage to create regional networks that would meld into the proposed national information network.

To assist in the formulation of policies to achieve this objective, the Universities Subgroup recommends that:

1. A task force be established by the Association of Universities and Colleges of Canada, or a similar body, to plan a university information network that would develop in phases from present facilities to a fully integrated nation-wide network.
2. A national agency be established with responsibility for stimulating, assisting, and co-ordinating the development of information systems in all sectors of the economy.
3. National and regional university groups be organized to work with the national agency in developing the university information network.
4. As automated information network operations become more widespread, the universities should assume a responsibility for providing scientific and technical information outside the academic sphere.
5. Goals and priorities be established for research on information science, and adequate funds be provided to support such research.
6. Universities develop curricula to train the variety of personnel needed to plan, develop, and operate a comprehensive information network and encourage the development of courses which instruct and involve the user in the exploitation of information resources.

As a result of its examination of the present situation in Canada regarding the need for trained personnel to manage and exploit the country's information resources, the Training Subgroup recommends that:

1. A Federal Government agency be set up as an essential instrument in assuring that Canada develops and maintains an adequate supply of people trained in the field of information management, and that her scientific and technical community is trained to find and use the information of its specialties. The Federal Government should establish such an Agency at the earliest possible moment to provide leadership, co-ordination, and support of plans for the development of adequate information personnel in Canada.
2. The Agency be mandated to gather and to publish the statistical data that will precisely identify the problems that bedevil those responsible for the training of information personnel.
3. Considerable expansion of the present scheme of federal scholarships (offered through the National Research Council of Canada) for science and engineering graduates to enroll in library schools and schools of information science be initiated, and that this scholarship funding be a responsibility of the Agency.
4. The Agency be funded and authorized to administer federal grants to library schools and schools of information science, paralleling those that the National Research Council of Canada, the Defence Research Board, *et al.* now make for equipment and staff in scientific and engineering departments of universities.
5. The Agency be funded to support and co-ordinate Canada's research efforts in the information field.
6. University science and engineering faculties and technical institutes consider making a good working knowledge of the scientific literature an essential requirement for graduation.

Part A

Knowledge and the Universities

Section I

INTRODUCTION

Canada in 1969 is a nation in metamorphosis, a nation progressing from an economy based on natural resources to an economy based on knowledge.

Canadian society is in metamorphosis too—politically, sociologically, and culturally in the throes of change, of evolution that is sweeping away old concepts, prejudices, values, and institutions and replacing them with much that is fresh, even radical and, it is hoped, more equitable and more effective for bringing the good life within reach of all.

There is conflict, too. Pessismists call it the distemper of our times and cry woe that governments confront governments, French-Canadians confront English-Canadians, students confront professors, Indians confront whites, women confront men, the underprivileged confront the privileged. Yet essentially it is all part of the same confrontation between the status quo and a nascent social state that will be different and, it is hoped, better.

Out of ferment will come order; it always has. But first, society must arrive at a thousand consensi on what it wants, for society is the grand arbiter of all conflict within it, and what society wants, society gets.

Most of all, society seems to want the good life, a new life that will not be based upon the sweat of thy brow, nor yet upon despoiling the good Canadian earth for the chief benefit of other societies, but rather upon the intelligence, ingenuity, knowledge, inventiveness, adaptability, and co-operative spirit of the 21 million persons who compose our national society. If this is indeed the consensus as to society's greatest desire, then society must marshal the capital and human resources necessary to achieve it. And the key to success is clearly the knowledge of almost infinite variety that society can bring to bear on the task of improving the quality—and not only the economic quality—of the life that Canadians will enjoy in a future that is limited only by our own myopic vision.

There are among us three broad classes of men: the thinkers who produce the knowledge, the doers who apply the knowledge, and the governors who guide and control the thinkers and doers—and this is not gainsaying the fact that all men think and do and govern in at least some small degree, which saves us from complete regimentation. Moreover, our society is never static, but progresses as new knowledge is developed and communicated to the doers who put it to use in ways that the governors deem not inimical to society's interests.

The system should work well. In fact, it is in something of a mess. The reason is partly a lack of rapport and understanding among the three groups, but perhaps more important, it is a result of the postwar knowledge explosion. The channels and techniques of knowledge transfer are unable to transmit the load. Knowledge that may be vital to achievement of society's goals is stored where it is inaccessible or not readily accessible to those who need it–in university libraries with inadequate indexing, scanning, and abstracting services or restrictive lending policies; in unpublished theses; in secretive industrial research organizations; and in the minds and notes of savants who are loath to communicate before they publish learned papers.

But if the universities, those greatest of all storehouses of knowledge, lack the transfer techniques and the sense of service dedication to meet society's exploding knowledge needs, society's doers and governors are not blameless. The former often lack comprehension of how new knowledge might aid them, or they may not know how and where to look for it. The latter, preoccupied with a multiplicity of problems, pressures, and demands, may fail to recognize this vital flaw in our socio-economic organization or do much about it if they do appreciate its significance.

That is the measure of the mess. The measure of the cure is new attitudes, new technology, and new techniques of communication, and a melding of purpose by those whose roles in society are to find, store, retrieve, transmit, and use information–which, in one way or another, includes just about all of us. And the obvious place to start is with the universities, wherein researchers find, libraries store, and teachers transmit knowledge, and wherein students absorb knowledge and develop attitudes to fit them for roles as thinkers, doers, and governors in the new society gleaming on the horizons of our time.

Section II

THE WINDS OF CHANGE

Universities have traditionally been a part of society but apart from its main stream; places for study and preparation on the part of students, for teaching, thinking, and research on the part of the faculty. Now, important segments of society outside the universities want to turn them on-stream for economic purposes foreign to the traditional ivy-walled apartness of these cathedrals of the intellectual community. How do the universities react? How will they respond?

If you were to discuss the university in relation to society with a cross-section of deans and professors, as we did, you might find that new knowledge needs of the industrial community would evoke less interest than new teaching needs in their universities. This is not simply parochialism; it goes deeper than that, to a difference in basic attitudes as between the university community and the community outside that reflects the fact that aims and goals are not necessarily identical, but often are parallel and may even be divergent.

Faced with increasingly insistent demands from both students and the community at large that universities involve themselves in the affairs of society as active participants rather than passive observers more ready to criticize than help rectify, university administrators and professors are being forced to reappraise the roles and responsibilities of the universities.

This reappraisal has produced a broad consensus among educators that the universities must change, become more responsive to society's special needs, but that special service to the community must not debilitate the universities' primary and primaeval function of searching for and teaching truths.

"The universities are the repositories of knowledge," one educator explained. "It is their duty to transmit this knowledge in the educative process, while also advancing knowledge and disseminating it in other ways, and perpetuating and gradually enlarging the cultural élite of the country. This is the traditional concept of the university, but in the past quarter century it has become increasingly clear that this concept is no longer valid. More and more we are adopting the view that the university is a consequence of forces in society. Thus, its role is more responsive to current pressures than it is self-directed."

"The university can no longer be simply a community of scholars," another added. "The liberal type of university is dying on its feet, while the organization world of the 20th century is spawning a new university, an integrated, mission-oriented university."

"There is no escape from this service role of involvement in the goals and tasks of the community," a third declared. "Very often the universities are the only agents in our society with the constellation of resources necessary for coping with new problems, especially problems of social organization. The universities are receiving greater and greater public financial support, and have an obligation to use these public funds as effectively as they can. Nevertheless, teaching and research remain the primary responsibilities of the university. Service is secondary, and should not be provided at the expense of teaching and research."

In our society, research is a magic word. It implies progress, especially material progress such as better commercial products, new and valuable processes, and better life-saving drugs. An institution or company that is "research-oriented" is accepted almost automatically as being holier, or at least more valuable, than one that is not. Universities are traditionally centres of research. This contributes significantly to the respect in which society holds them, and also to a materialistic society's expectations of them. The doers of our society need an unceasing flow of new scientific knowledge and technology to keep the wheels of industry humming and the national economy prosperous, so where better to turn than to the research-oriented universities?

In the universities, this aspect of society's rising expectations is received with some discomfiture. Indeed, the more idealistic academic researchers and the radical students are aghast. The former fear it will dictate the lines of research to be followed, while the latter reject the idea of orienting research toward supporting the industrial complex to which they attribute much that they consider wrong with society.

"The universities," said one influential university administrator, "see their task not only as the communication of knowledge but also the critical examination and the creation of knowledge."

The critical examination and creation of knowledge. Not necessarily knowledge with any appreciable market value—and this is a distinction that is important in differentiating between the universities' attitude toward research and the usual meaning of research to industry, government, and the public. This begets academic apprehension that society's need for new knowledge to apply to industrial and production problems, combined with the universities' need for ever greater amounts of public and private money, will increasingly force the universities to become the servants of society's doers and governors. Some academics suggest it is already time to call a halt; that, in the best interests of the university and of society as a whole, the research function of the universities should be de-emphasized, and that industry and government should undertake the principal research role, with assistance from the universities.

"My chief job is to teach and do research," one academic said. "If I get too involved in the application of knowledge, I cease to be able to do the former job."

Another deplored that some teachers are increasing their research and writing activities at the expense of their teaching function, and criticized them also for an alleged tendency to identify with their research field and colleagues therein rather than with their university.

The Massachusetts Institute of Technology's methods of merchandizing technological research to all corporate comers for a fee are cited as being inappropriate for public institutions. As one academic put it, "Public universities should serve the public, not corporate industry."

"It's almost obscene," he added, "to see some professors assign research work to graduate students working under them, and then sell the results to industry."

If these attitudes are valid in a society that must feed on new technology to maintain and improve its economic performance, then they are arguments for the proposal to reduce the role of the universities in applied research, and to expand the research role of industry and government.

"Nowadays," said one proponent of such transfer, "more new ideas are born outside the university than within it, and the university no longer has a priority claim to being the source of all innovation. It is now only one element in the task of finding and transmitting new knowledge. So research should become less and less the dominant factor, while the university concentrates more and more on teaching."

Rapidly increasing costs of research in the physical sciences are instanced as another reason for industry and government to take over the major part of the universities' function in this area. From an expenditure of about $345 million in 1969 to a projected $1 200 million in 1978, total research costs for the universities during the decade will probably exceed $6 billion.[1] Still another reason is efficiency. "Research is dominant in the nation," one academic said, "and the nation cannot afford to leave it in the hands of institutions so badly organized as the universities. No university is as well organized, from the standpoint of either input or output, as government or industry for the role of research."

These men, numbering among them some of the more avant-garde thinkers in the university community, are in effect proposing an important reallocation of responsibilities in society, comparable in its way to the immensely more wide-ranging and vital reallocation of responsibilities as between federal and provincial governments that is envisaged in the current dialogue on constitutional reform. And as in the latter, there are difficulties. Research is so important to the teaching function that it is hard to imagine abdication of the research function, least of all in the humanities and social sciences.

"It will still be necessary," the same academic said, "to maintain a research dimension for faculty members, or they will get out of tune with the world of knowledge outside the university, which would lessen the quality of their transmission of knowledge to students."

Moreover, there would still have to be provision, although not necessarily intramurally, for graduate students to pursue quests for new knowledge that traditionally differentiates them from undergraduates. The solution here, it is suggested, lies in mixed industry–government–university research groups operating extramurally and drawing upon the resources of all the collaborating parties.

It is not antipathy toward community responsibilities that prompts this "you research, we teach" attitude in response to the growing needs of society for new knowledge, but rather qualms about the type and quantity of future research demands and the total effect upon the university and upon the university's ability to discharge its teaching responsibility. Moreover, there are undoubtedly a good many university scientists who would meet the problem, not by passing the responsibility to industry and government, but by accepting the society-oriented research role with important caveats.

One is that government should define the fields of socially desirable research, and that the universities should then have freedom to decide which fields they care to develop and to subdivide research responsibilities among themselves. This school acknowledges that extramural financial aid would be available for specific research projects in ratio to the interest of government and industry in such projects, and that there would thus be a strong incentive to develop research in directions where extramural interest guaranteed adequate funds.

A social scientist suggested that if universities were influenced as to where research should be concentrated by the availability of extramural dollars, there would be "slim pickings" for social scientists despite the need for research in the social sciences to guide the development of our social organization.

A natural scientist replied, with perhaps more casuistry than conviction, that he would hope that the government research initiative would not be at the expense of areas in which individual scientists wanted to work.

An administrator experienced in dealing with government took a median position, suggesting that the universities' responsibility to society could be largely expressed through assistance to government, as by helping government redesign social programs and by providing government with an independent evaluation of industry's needs of government support for technological innovation. For instance, what does government know about the negative income tax concept, except that it seems to be an appealing and progressive idea? University research here, as by a trial-and-error pilot project, might help government avoid fallacies in coming to a decision on this kind of social legislation.

Would universities be denying a responsibility vital to society if they were to cut back on research activities and concentrate on teaching? Those who suggest this obviously think not, and their conclusion is saved from the charge of rationalization by two facts. One is that industry's need is for new knowledge that it can profitably apply to its problems, and not for research *per se.* Countries such as Italy, Japan, and Germany have achieved enviable rates of economic growth through the judicious use of results of research and development carried out all over the world. Knowledge is international. Universities collect knowledge on a global basis and store it in their libraries–in books, serials, documents, and magnetic tapes; in stacks and in computers. So if this knowledge is made available to those outside the university who can use it, and is so organized that it can be retrieved unerringly and transmitted quickly, the universities would be fulfilling a great part of society's knowledge needs. This could be effectively accomplished by assigning equal financial support to information services and research activities.

The second fact is that, however great the short-term importance of knowledge that universities transmit directly to extramural suppliants, it is still less important than the value in the long term of the knowledge that the universities transmit to society indirectly in the minds of students who, after graduation, will become the leading thinkers and doers and governors of society. This knowledge is society's major investment in its own future, in the direction that society will take, in the achievement and advances by which society will progress toward ever-expanding goals.

Section III

BIBLIOGRAPHIC BOTTLENECK

University libraries are criticized for their lack of adequate information resources, for inability to provide instant knowledge, for restrictivist policies in the face of knowledge demands from outside the university community, for duplication of collections that wastes money, and for a generally conservative approach incompatible with changing needs and the expanding technology of knowledge handling.

These criticisms are particularly pertinent to the problem of dissemination of scientific and technical information out of universities. The libraries are main channels of STI flow. If the channels are too narrow or too shallow, who will dredge them to adequate capacity? How will this be done?

Within the universities the future of existing libraries and the potential of new storage and retrieval systems are being actively debated because the knowledge-handling problem is critical. The knowledge explosion is overtaxing traditional methods of storage, and the pressure from the libraries for more money to buy books and more money to build buildings to hold them has become a major university cost factor at a time when the universities' financial resources are expected to increase less rapidly than in the decade just past.

The Joint Economic Committee of the U.S. Congress was apprised, in a 1966 report[2] by its economic progress subcommittee, of the magnitude of the knowledge explosion. "There have been estimates," the report said, "that as much technical knowledge will be developed in the next 30 years as has been accumulated in the entire past history of mankind."

This suggests that all the world's libraries must double their facilities for knowledge processing and storage by 1966 just to keep abreast of what is new, unless different techniques are adopted to increase efficiency.

In 1967, Canadian library requirements were analyzed in a report on *Resources of Canadian Academic and Research Libraries* prepared by R. B. Downs[3] for the Association of Universities and Colleges of Canada. Downs's findings were then costed by Robert Blackburn,[4] chief librarian at the University of Toronto, to determine the financial investment that would be required over 10 years to provide library collections of the quantity and quality needed to meet minimum requirements in 1978.

The Blackburn study indicated a need for an expenditure of $2.25 billion on university libraries over the decade, comprising normal operating costs, supplementary operating costs to raise standards and improve collections, and capital costs for new buildings.

Blackburn limited his study to the decade's needs, but what thereafter? The Congressional Committee's report invites speculation that Blackburn's $2.25 billion in the first decade would be but a prelude to even higher expenditures in the second decade as the rate of new knowledge production escalated, and so on, *ad infinitum*. That is, unless academics who establish the knowledge requirements of their libraries, and librarians who establish techniques for managing collections, and governments which provide the funds can all agree on procedures that will provide the required service at costs that governments can bear with greater equanimity than Blackburn's $225 million a year.

Academics argue the library problem from different viewpoints. There are those who propose various forms and degrees of experimentation and innovation, and there are those traditionalists who would feel a keen sense of loss if they were unable to browse through library stacks.

"In 10 years it will seem strange to go into a library to get information," commented a proponent of the new technology of tape-stored, computer-retrieved, and electronically transmitted knowledge. Another criticized the $43 million graduate library under construction at the University of Toronto: "A book library–yet book libraries are obsolescent."

"Any idea that we're going to load all our knowledge into computers is naïve. Not for another 100 years," counters another academic. "The role of the printed book and journal will become increasingly important, and the library will become more and more dominant. The new information-storing technology will never replace the book in view of the latter's convenience and low cost. Without books the traffic in information retrieval would be intolerably great."

Essentially, the disagreement is only over how far it is feasible and desirable to go in adapting new technology to the library's needs to store more, index better, and retrieve more quickly. From the viewpoint of the extramural consumers of knowledge, faced with increasing difficulty in finding the knowledge they need in the flood that is overwhelming libraries everywhere, knowledge that they need to create new wealth, anything that will improve the accessibility of knowledge is worth a great deal. This suggests the desirability of applying the techniques of operations research to the management of knowledge.

To the dedicated knowledge seeker it is almost axiomatic that available knowledge is inadequate. He goes from library to library, finding new bits in the process, but also finding enormous duplication of material. The conclusion is inevitable: that if each library concentrated on collections that would cover fewer disciplines but each discipline more thoroughly than any library can now afford, the total effect of such library specialization would represent an incalculable increase in library-stored knowledge that could be shared among all through systems of interlibrary book loans, xeroxed or telexed abstracts, or computer links. Moreover, it must be assumed that this would result in substantial savings of money now dissipated in buying, storing, and managing duplicate collections.

Such a system would be mainly for research use, mainly to meet the needs of graduate students and, incidentally, the needs of research people operating outside the university milieu. Libraries would still require their own collections covering the basic disciplines for undergraduate study.

However, a complex solution to a complex problem can hardly be achieved in isolation from other factors in the life of the university. Library specialization in building up massive reference resources in only a few fields as part of a co-operative arrangement with other university libraries is a logical response to a rational development of academic programs for which specialized library collections are needed. Some, and perhaps a good many, academics demur at the extremes of rationalization that are thereby indicated.

Advocates of library rationalization admit that while it would work well as far as scientific research is concerned, it would involve difficulties in humanities research, as when examination of original documents is required. But under existing conditions, researchers often have to go where the original documents are deposited, as to the Public Archives in Ottawa.

A more concrete difficulty perhaps is the question of copyright. An author's position, naturally enough, is that if you want to use his work you must buy his book. Thus a very sticky problem is created by reproducing parts of copyrighted books and despatching the copies to persons requiring them—in effect, republishing and thus infringing on the author's property rights. And the problem is made all the more awkward because many of those using the abstracts will eventually be writing and copyrighting books themselves. The solution may be the negotiation of some master agreement between publishing houses and, say, the Association of Universities and Colleges of Canada for the payment of an annual quit-claim to be apportioned among authors of reference books while such works are still in print, and thereafter no claim to be entertained. Or it may lie in reducing the protection given to authors under the Copyright Act and the international copyright convention.

There is dissatisfaction in the universities that the process of applying modern technology to the libraries is proceeding so slowly. Also there is criticism of library scientists as being too conservative, too enraptured by neo-gothic spires, subterranean stacks, and the look, feel, and smell of books. Some liken the traditionalists to sailors who looked askance at steam, and admirals who preferred battleships to aircraft carriers.

"With electronic hardware, all that will be needed is simple, utilitarian buildings to provide storage for tape," was one junk-the-battleship argument heard.

But even stout defenders of books as being irreplaceable by tapes advocate use of electronic storage techniques to extend rather than supplant the libraries' existing repository capacity. Among the needs are more sophisticated cataloguing systems, computer scanning for abstracting and rapid retrieval, and improved hard copy facilities. This would minimize the work, money, and time involved in borrowing books from distant libraries. In the extreme case, the books need never move from their stacks but the knowledge in them could flow almost instantaneously from the computer to any part of the country or world where it might be needed. But first, of course, somebody has to put the contents of books into computers, and that is as good a reason as any why books will be around for a very long time.

Western Canadian university libraries are examining the problem of such an interlibrary computer link. The Committee of Presidents of Ontario Universities is moving toward creation of one bibliographic centre linked electronically with all 14 Ontario universities. As these systems are established, first on a regional basis then nationally with international tie-ins, there is no reason why government and industry should not tap the flow in the miraculously deepened and broadened channels and, indeed, contribute to it from their own stores of knowledge. Certainly, no national interuniversity information network should conceive of itself as an exclusively in-house operation without extramural responsibilities—particularly when knowledge, like trade, is a two-way street and the input from such sources as the National Library and the National Science Library will be vital to the university exchange system.

But the universities, especially the men who manage their money, are not about to rush out to sign coaxial cable lease contracts and transform the transfer of knowledge overnight.

"We need to evaluate the new techniques. We need to know what we are doing," one said. "Where do we get our information now? Is the process effective? How much are we spending? Are we spending money in the very best way? What could we do, and what would it cost? There is very little information on how library resources are used. Until research provides such information there is no use talking about putting money into computers. We need pilot projects—we don't know enough to go spending a lot of money."

"The universities," said another, "would welcome Federal Government initiative in this field."

Some Federal Government initiative does, indeed, seem warranted—first, to help resolve fears that greater co-operation and participation in computer time-shared systems between universities will lessen individual university autonomy, and second, to ensure that the most effective use is made of the money to be spent on university libraries over the next decade, i.e. a projected $1 billion, which could rise as high as $2.25 billion if the improvements described by Downs are implemented.

Section IV

THE STUDENT EXPLOSION

It was quite appropriate when 'Varsity' established an overflow campus at Ajax after the war. Where munitions had been made to win the war, munitions of peace were to be turned out, young minds packed with knowledge to help reconstruct and restructure the nation and the world. Today the analogy of explosives would be even more apt. The whole student body is exploding, in numbers at a rate of 30 000 or more a year, and in anger and frustration that what the universities offer them does not seem to relate to the students' needs. And if we concede that the universities' primary function and responsibility are to educate young men and women to become in time the thinkers, doers, and governors of society, then this is an area of information transmission more important than whether a library uses a DC-9 or pony express to deliver a book.

The men and women at Ajax, and thousands more like them who left Quonset hut campuses all over the land to marry and raise children and make up for the lost years, are now sending their offspring to college. And those of us who did not lose those six years perhaps can acknowledge some responsibility to do what we can to ensure that they get a fair return on their investment in their children's education.

The Economic Council of Canada's Staff Study No. 20,[5] on enrolment in schools and universities, is a stark portrayal of the magnitude of the student population problem that the universities face in the next few years. Three years ago there were 206 000 full-time students, both undergraduate and graduate, in the universities. Next year, 1970, the ECC study forecasts 383 000 students, with the growth continuing at a rate of between 30 000 and 35 000 a year so that by 1975 the enrolment will be 540 000.

The ECC projection went no further than 1975-76, but longer range projections by Ontario provincial authorities suggest that the student population peak will not be reached until 1980. Assuming that the current rate of annual increase of at least 30 000 will be valid until then, the universities face the staggering prospect of opening their doors to nearly 700 000 students only 11 years hence.

The Ontario projections point to an easing of student population pressures after 1980, reflecting the sharp decline in the birthrate that followed the introduction of oral contraceptives in Canada in 1961. However, it seems a fair assumption that such a result could be negatived by increases in the proportion of 18- to 24-year-olds who opt for university as an increasingly technology-based country moves in the direction of universality of university education.

Almost astronomical though these figures are in relation to the universities' present capacity, they still do not include another wave of seekers of knowledge that already is flooding onto the nation's campuses. These are the part-time students, whose numbers are projected by the ECC study to rise from 74 000 to nearly 200 000 in the decade ending in 1975. Included among them are the retreads, coming back to update their knowledge, to absorb what is new in their career fields in a process of continuing education that will become increasingly important as our economy becomes increasingly knowledge-based.

Nor is that all. University teaching staffs now total about 16 000. Assuming no significant change in teaching methods, double that number will be needed by 1975.

How will the post-secondary educational system ever cope with this enormous influx? Where will it get the professors, the physical plant, the money? Even just housing the huge increment presents "an insoluble problem" one source said.

"By building more buildings, and using electronic and other pedagogic tools," another academic replied. But his solution overlooks the fact that money is tight, that some of the electronic hardware (e.g. videophones) envisioned by advanced thinkers is not yet available, that most of the hardware has not been sufficiently evaluated to warrant more than pilot-project applications, that the quantity of high-quality software yet available represents only a tiny fraction of the needs of a university attempting to use machines to overcome the potential shortage of instructors, and that the educators have not even been able to decide who should be responsible for software production, let alone launching a crash program to create the mountain of material that will be needed to feed the pedagogic devices.

One solution, supported more covertly than openly, is "élitism", the proposition that student intake be limited by the capacities of the universities to applicants best qualified. Many of those applying for admission would perforce be turned away, while the universities concentrated their resources on the education of an intellectual élite. On the other hand, many academics consider élitism as a kind of intellectual apartheid, morally repugnant in a democratic society where the universities are largely supported by public funds and open to all as of right–government policy being to provide university education for all who desire it and who can qualify on academic grounds.

But élitism by another name may be another matter. One man in the top echelon of educators said that he does not believe in limiting student admissions but, if this has to be done, then the policy should be applied only to students who for their own good might better be directed elsewhere, as to community or technical colleges.

The idea of telling the teachers to teach more students, doubling the size of classes if necessary, is a solution that appeals to neither professors nor students, yet there is apprehension that governments in financial extremities may attempt to force such a policy on the universities. A major cause of current student dissatisfaction is the depersonalization of the student–teacher relationship. Classes are so large that students feel alienated from the professor and the teaching process–no more involved, one student said than "so many cattle".

One professor who lectures regularly to a class of 424 students commented that the problem of establishing personal contact with more than a handful of them is insurmountable. Since there are not enough professors, and no prospects of hiring enough, to break such mass confrontations down into even 50-student classes wherein personal relationships could be established, professors look to a solution in fewer lectures and development of a tutorial system to provide the personal contacts that the students need and demand. It was suggested that graduates in business life, graduate students, and married women who are graduates might be enlisted as tutors.

A more intriguing attack on the big-class problem is being made at Memorial University where a professor is carrying a course with 350 students by using brighter students to tutor the more backward. At McGill University a somewhat similar experiment is planned. It will encompass a close student–teacher relationship in the first year of an honours course, but withdrawal of the professor to the more remote role of overseer during the second year, while second-year students assume a tutor-like role in relation to students just beginning the course.

The problem of more plant is not as difficult as it first appears, if one assumes that public opinion, or fear of public opinion, will eventually impel legislatures to find the funds required to cope with the population explosion. The most economical use of public money requires low-cost utilitarian construction. So does acceptance of the theory that new teaching methods adopted to cope with the population explosion will result in a decentralization of education, so that universities of the future will not require great agglomerations of costly buildings.

Another aspect of flexibility lies in the growth of community colleges and technological institutes that may siphon off part of the huge mass of high school and late elementary school pupils that now appears headed for the universities. A large part of building construction may take place here, rather than at the universities, especially if institutions like Ontario's new Colleges of Applied Arts and Technology develop academic programs relative to the needs of students who otherwise would go to the universities.

Undoubtedly, in time there will be more universities. One educator predicted that in 10 years satellite colleges like Toronto's Scarborough and Erindale will be independent universities, and in 15 years Ontario's present 14 universities may be doubled or tripled in number. Similarly in Québec, the development of the Université du Québec with its several campuses will provide facilities for expanded enrolment.

But what of the approaching revolution in teaching and learning methods, and of the sharp reduction in the birthrate that started in this decade? These factors will bear heavily on decisions relating to increases in university plant.

In industry, when demand or consumption or disappearance exceeds production, management's first thought is not to build a new factory or open a new mine. That's a last resort. The first resort is to increase production from existing plant and work force: overtime, an extra shift, start up another production line. Management will hire more workers without turning a hair, but a good many hairs would be turned in a decision to expand plant to meet what may prove only temporary demand.

Is this approach a sound one for the universities—and if not, why not?

At most universities the academic year commences in late September and runs well into May, with vacations at Christmas and Easter. The plant runs essentially on a one-shift basis, although on some campuses there is substantial evening use of facilities, especially by part-time students. But even granting that graduate students and professors engaged in research use part of the plant the year round, and that there is an influx of summer school students for classes in July and August, any competent industrial manager would be able to lay out a program for doubling production by hiring more workers, putting on a night shift, and utilizing plant fully during the summer season.

Two economies ago, when Canada's meagre wealth was based on the production of the family farm, sons went to university after the harvest was in and left in time to help with the seeding. Our universities still operate as though that were still life's pattern. But not quite all. Simon Fraser and Guelph are experimenting with a trimester system of three terms a year, which theoretically could boost production by 50 per cent.

The weight of academic opinion is against the trimester system. "Experience with it has not been good," said one university executive, pointing to its failure at the University of Pittsburgh. Another said that for it to function properly, students would have to attend in summer in the same numbers as in the fall and spring terms, and many of them want to work in the summer or want a holiday. A third view suggests that it is better for the student's orientation if he gets out and works in the summer—and that it is definitely better for the professor, giving him time to think, to take a three months' run at research important to his career, to write, to concentrate on graduate students, or even to take a vacation. Of course, students could attend three terms a year and professors teach only two, providing additional staff were hired to take on the extra work load.

Despite these objections, which must be assessed in the light of the critics' self-interest, the weight of logic and arithmetic supports the trimester system. But university tradition, personal habits, and consideration of a long summer break as a valuable fringe benefit peculiarly accruing to teachers, judges, and legislators, militate against its acceptance without a strong push by government and public opinion. On the other hand, two-shift, six-day use of plant during normal terms is as acceptable to professors as the trimester is not, providing additional staff are hired.

The industrial manager, used to dealing with reasonable, tractable, obliging union bosses, would be frustrated by traditionalist professorial attitudes. He would then opt for rationalization and automation—and in fact these are the only alternatives to the two-shift trimester system that appear even remotely capable of coping with the university population problems.

Section V

CO-OPERATION OR CHAOS

Voluntary rationalization and co-operative specialization, two sides of the same coin, are something that everybody agrees should be done, yet nobody is doing very much about or very quickly or perhaps even very willingly. In this context one learned doctor asserted that "the universities are like a group of duchies", each committed to policies of academic, physical, and financial self-aggrandizement. Parenthetically, the world roster of duchies is getting pathetically small.

The argument for rationalization and specialization from the academic point of view was stated succinctly by a professor at a university which is beginning to apply such policies. "It doesn't make much sense," he said, "to duplicate facilities and skills at many universities and, as a result, weaken the total effort to a state of mediocrity." The argument from the budgetary point of view is equally strong because there is no less a need to optimize use of limited financial resources than to optimize use of intellectual resources.

If universities accept these arguments, then it is incumbent upon them to agree among themselves which universities should develop what areas of excellence, taking into account existing strengths and areas of interest. Single centres-of-excellence could be built up in various regions, or two or more universities could agree to share responsibilities for teaching and research in fields of major importance. Obviously, there are some areas in which most, if not all, universities need to provide instruction, and other areas which only one university in a region should attempt to cover.

Going hand in hand with apportionment of specialty fields should be co-operation in exchanging teaching and research material, easier movement of professors among universities on a loan or exchange basis to provide staff and students with fresh viewpoints or to meet staff overload situations, and co-operation in applying new technology to teaching, in the development of software for that technology, and in establishment of interuniversity information networks.

Some beginnings have been made on a regional basis. Ontario and Québec universities are committed to the principle of rationalizing programs and resources. The University of British Columbia and Simon Fraser University have agreed not to duplicate some of each other's courses. Waterloo has not emphasized metallurgy, in deference to McMaster's strength in this field, while building up a specialty in civil engineering. In the Atlantic Provinces, the universities are studying ways in which graduate studies and research might be rationalized. The Prairie Provinces have established an Interprovincial Committee for University Rationalization.

All Québec universities co-operate to exchange information on research projects, through the *Conférence des recteurs et des principaux des universités du Québec,* with an "Index on Theses and Research Projects under way in Québec Universities" being an impressive fruit of this collaboration. This index lists more than 4 000 research projects and data pertinent thereto. It is a computerized, up-to-date record of who is doing what and where in Québec, to the ends of encouraging information exchanges among researchers, avoiding costly duplication of effort, and aiding the government in deciding how best to distribute research grants. Total production costs were only $6 100, two thirds of which was expected to be recovered by sale of the 100-copy printing at $40 a copy.

These moves are being made not without qualms. Some stem from interuniversity rivalry, from the feeling that everything at Bigtown U. must be the biggest and best, that if you agree to downgrade here and there and let others develop excellences, you surrender some of your academic sovereignty. Others relate to the wholeness of the individual university, to the quality of education in an institution which does not strive for excellence in all fields; such an institution would be unable to provide opportunity for sufficient interdisciplinary contacts by students, especially at the graduate school level.

"Part of what goes on at universities is interdisciplinary cross-fertilization," explained one graduate student. "We won't get enough of that if the universities specialize too much."

One authority involved in nurturing the co-operative spirit among Ontario universities pointed out that while joint decisions would require modification of some of a university's ambitions, the university's basic independence and autonomy need not be sacrificed. He suggested that in any machinery set up for arriving at decisions in the common interest, each university could retain the power to opt out. But, he predicted that they would not do so lightly, nor often. "It is possible," he said firmly, "to develop policy decisions on a common basis that will work."

There was general agreement among those interviewed that government incentive is required to make the universities move quickly enough so that rationalization, specialization, and co-operation will be major elements in the universities' response to the student population crisis–and agreement, too, that this response will be ineffective without these elements. Government incentive is seen as taking one of two forms: the carrot, as with financial incentives for the universities to pursue policies desired by government; or the stick, as directives from ministries of education that would raise welts on the universities' pride in their academic independence and autonomy. The carrot is much preferred, not only as being less painful but also because it leaves the university some freedom of choice to placate those who fear too much government direction to the detriment of their academic or research interests. Government encouragement appears to be particularly needed for co-operative agreements that cross provincial boundaries.

"There are all sorts of possibilities in shared programs and partnerships," one graduate school dean said, "and there is no excuse for not exploring them, especially if government provides financial incentives."

Section VI

THE NEW TECHNOLOGY

To delve into the new technology of pedagogy is to lift a corner of the curtain on the University of the Future.

The universities as they are now organized cannot cope with the looming student population explosion. Willy-nilly they are being hustled along toward a still distant kind of teaching institution that will satisfy vastly expanded knowledge demands by development and use of new teaching technology. This is evolution, and it is part and parcel of the metamorphic change that runs through our whole society.

We have already mentioned the use of computers in libraries, in the storage of the university's knowledge resources and in the instant retrieval of knowledge on demand. Using the same or similar electronic equipment, as well as equipment that has been around as long as lantern slides, the universities may be able to take the big step from simple transmission of information from point A to point B, to automation of the process of implanting knowledge in the minds of students. These techniques will take the universities into the era of automated education, the era of the push-button B.A.

But that is still a long way off. As one academic put it, in wry comment on the conservatism of many of his colleagues: "A generation of administrators has to disappear before the independent community on the hill will assume its new form."

What, then, are the short-term prospects for change in methods of instruction? In the first place, such change must be mission-oriented, and the mission is to process, or educate, many more students than at present. Second, it must be oriented to student attitudes, or the latter reoriented to it. And third—or maybe first—it must be quality-oriented, for any change will be self-defeating if it merely turns out more of an inferior product.

Television and the computer are the most sophisticated and possess the greatest potential of all the teaching aids available for the automation of the instructional side of the learning process. The thinking is that they will eventually replace the traditional course lectures, which are regarded as obsolete by the proponents of the new teaching technology. Indeed, some consider them worse than obsolete because of the feelings of student hostility that they are said to arouse. One man lecturing to one or two or three hundred is an example of the depersonalization of teaching that students protest, and a hostility target in the confrontation atmosphere of the lecture room.

That raises the question of how much personal rapport can be established between a lecturer on closed-circuit TV and a student. If the students see the televised lecture in a large group, none at all. It is simply the familiar "canned" film lecture electronically transmitted, and hence even more depersonalized than what it replaces. But this is not the method contemplated for use of educational television (ETV). Instead, TV lectures will be made available to students at different scheduled times, or even on demand, via receivers in residence common rooms, in their own rooms, and most likely in university information centres that will take the place of the traditional library.

Aside from the flexibility of such an approach, allowing students to take the lecture at their convenience, this approach has two other great advantages. One is that the number of students it can serve is limitless, with little capital expenditure aside from TV receivers and transmission lines. The other is that as a result of rationalization, specialization, and co-operation among universities, lectures by the best men in every field can be available to all by ETV.

There is general agreement that such automated instruction must be supplemented by seminars and tutorials, obviously for the purpose of discussion and detailed explanation of points in the automated instruction that may not be fully clear to the students, less obviously for the purpose of supplying the students' personal contact needs both with the professor or tutor and with one another. The expectation is that the seminar side of the instructional process would keep professors as fully occupied as they had been with formal lectures but more profitably, as far as the students are concerned. "A vastly improved kind of instruction," declared one academic.

Computer-assisted instruction (CAI) is a more sophisticated system than ETV. It entails programming a computer to instruct a student, face to face, by student-machine dialogue, so that the student proceeds step by step, with the machine repeating instruction where necessary until the student's responses signal the machine that the student has understood. The "personal" relationship between man and machine may not be humanly warm but it can be more personal to the student than his relationship with a lecturer from the back row in a class of 400. However, CAI should be used in concert with seminar discussions, for programmed learning alone may discourage student thinking and initiative.

Films, video tape, sound tape, and other forms of audio-visual information transfer have less dramatic yet important roles in the new approach to the problem of individually instructing great numbers of students. For example, film or video tape can show surgical techniques clearly to students who might miss much from the third row of the operating theatre gallery. And a TV camera using the "candid camera" technique can teach social science students much about human reaction in situations that otherwise would be available only in books.

"By these means," one academic commented, "I can see an improved type of education being offered and a solution to the student population explosion. I can also see a breakdown of university parochialism through enormously greater interuniversity communication, co-operation and interaction."

However, if every university in Canada had a computer and closed-circuit TV tomorrow, students would still be trudging up the hill to 9.00 a.m. lectures. The reason is that in the present state-of-the-art these machines are like coke machines with no coke in them. There is in existence not more than a tiny percentage of the programming and other software necessary before they can take over the classroom lecture function.

Starts have been made in automating instruction. At Simon Fraser University, instruction in biology laboratory work is on tape, enabling the students to do their lab assignments at times of their own choosing. Simon Fraser also has a CAI pilot project, a computer programmed to teach chemistry and mathematics, and York University has made beginnings in CAI. At Sir George Williams University, special telephone circuitry enables students to receive language lectures simply by dialing certain numbers.

Seemingly, the use of the new technology is being delayed by the shortage of software, but the real snag is elsewhere, notably in university administrations and departments of education. Until there are policy decisions to automate instruction no one is going to spend time and money either on buying and installing hardware or on producing software in the quantity and quality required. So the contribution of automation to solving the problems of the student population explosion can only be assessed with a question mark.

"The new technology will be introduced when it has proved really workable and worth while," said one educator. He speaks of a responsibility of government to provide money for evaluation, experimentation, and innovation of hardware, but not for continuing operating support.

Meanwhile, the question of who should produce the software exercises the academic community. Professors whose minds and voices are the software of the existing system lean toward the idea that the software their students will use in automated instruction should be of the same intellectual content, in essence involving the transfer of personally delivered lectures onto video tape and computer tape. It is illogical, however, to conceive of simply transferring their teaching material into teaching machines. This is wasteful of time—it takes 100 hours of a professor's time to put 1 hour of instructional programming into a computer. It is wasteful of money—it means endless duplication of effort at every university. It is wasteful of one of the great benefits of automated instruction, the ability of the new technology to give students the advantage of instruction by the ablest men in any given field regardless of physical distance between those men and the students.

The rationale of this tendency is probably a man's professional pride in the quality of his work, plus a feeling that only by personal involvement can he retain his place in the university hierarchy, plus a feeling that control of what is taught must remain in the hands of the university, which means in the hands of the professors thereof.

But production of software in great quantities is a problem of industrial production as well as one of academic content. Each university does not write and publish all the textbooks it uses, and no more should it expect to produce all the software it uses. There will be opportunity for professors to offer their talents to whoever is assigned the task of producing software, although obviously only the best men will be accepted. Beyond that there is a continuing and very important role for professors in augmenting the automated material in seminar discussions with students and in laboratory work.

There is considerable agreement, however, that the universities should control software production, as through establishment of a commonly owned production centre. One proponent of this procedure asserted that "production has got to be done by an interuniversity co-operative, with the universities all contributing both intellectually and financially. That way they would be 100 per cent behind the project."

The point he is making here, which others make too, is that without such co-operative arrangements software production will be inhibited by personal jealousies, interuniversity rivalries, and attitudes stemming from each university's jealous regard for its academic independence. "It's hard even now to arrange interfaculty exchanges," one educator noted.

Another asserted that software production is more properly a responsibility of government and industry, not a function the universities should perform except indirectly through the intellectual input of professors selected by the production authority. He emphasized that, once started, software production would be a never-ending process because of the constant need to incorporate new knowledge into earlier production. Also he suggested that the life of software for any university course might be no longer than one year because of the outdating factor.

Another educator made the point, reasonably enough, that "if you have the teachers on the campus, then you should use them to develop your own software." He instanced a program at Queen's University to produce software for teaching a first-year credit course in biology. It is being carried on co-operatively with other universities, ensuring agreement on what core of knowledge students should receive. At the same time, he saw "no reason why universities should not use software developed through the incentive and inventiveness of industry", providing professors supply the intellectual input to save the production from being "stereotyped and sterile".

One professor expressed an industry-go-home attitude. He is "very concerned" that industry may come to dominate software production in the way that the publishing industry dominates the textbook field. He sees a disquieting augury in the acquisition of textbook publishing houses by U.S. electronic companies, in effect, a marriage of software and hardware production capabilities. His solution: that the National Film Board, or some other kind of Crown corporate structure, might become the chosen agent for software production. Something close to this proposal, such as an interprovincial and interuniversity production facility that would be subsidized by both Federal and Provincial Governments, might be eminently practical.

In summation, another academic asserted: "The key to successful use of the new technology is good production and well-thought-out programming. If we have this, depersonalization doesn't need to be a factor because we can supplement the automated instruction by as much tutorial type seminar discussion as we can afford. The economies may be great enough so that we can afford many tutors. So one can visualize increased efficiency—which the students couldn't care less about, they want love—in the use of information from and in the attitudes of professors."

However, he added, "We cannot afford not to proceed on a national basis. And if we don't start to get down to something pretty soon I despair of success.

It's all money. If there were enough money we could start pilot projects right across the country. I feel we would have more success from these than from all the talking about it."

Student receptivity also is vital to successful use of the new technology. In frequently and vociferously stated undergraduate attitudes there is ample evidence that students will reject any greater depersonalization at the student-learning interface. But the overwhelming weight of professional opinion is that automated instruction would result in more student-professor contact, mainly in seminars. "It's amazing," one professor said, "how TV gives a professor more time to spend with his students."

Moreover, as noted earlier, the student-machine interface in CAI is not without its element of personal contact through the intricate programming that provides dialogue as the machine "thinks" along with the student. There is thus reason to expect that students would enjoy and be stimulated by the man-machine contact.

If, as one professor suggests, the development of knowledge machines is "something like the invention of printing", will there be literacy problems? Most of the opinions sampled suggest not. Young people of the electronic age, subjected since childhood to haphazard audio-visual learning through the family TV set, arrive at university much more knowledgeable than earlier generations of students, and with learning habits that logically should be more readily adaptable to the new teaching techniques.

The question may be more pertinent when applied to the "retreads" who return to the universities for continuing education usually years after they received their degrees. The universities accept their re-education as a major responsibility, at the same time recognizing, as one administrator put it, that "the task is going to be enormous, to give them what they need while taking them out of the labour force for as brief a period as possible."

Even after delineating the universities' responsibility to exclude many whose need, as for updated technical knowledge, can better be met by community colleges and technical institutes, the potential demand on the universities' facilities will be so huge as to be incapable of satisfaction without resort to automated instruction. One dean, who describes the need for more ongoing education as desperate, sees the problem not merely as what the university can do on its campus for the re-education of its and others' alumni, but how the university can sow its knowledge broadcast into the ground of the community, fertile or barren as that ground may be. He proposes that universities use educational television broadcasting to transmit knowledge out into the communities night after night in the form of lectures, demonstrations, and discussions for both credit and non-credit instruction. Students participating in such home study would be invited to come to the campus for scheduled personal contact sessions with professors, but otherwise would be on their own. If they wrote examinations they would be charged fees; otherwise, not. But exams passed and fees collected would not be the true measure, he suggests, of the broad cultural impact that such programming would make on the whole community. Perhaps in no better way can the universities repay the millions who will never see the inside of a university yet whose taxes contribute to the universities' support.

Another educator offered a pithy comment. "The idea of going back to school may be one of the hang-ups of adults," he said. If so, then ETV could sweep away an inhibition that is holding up the intellectual progress of the country.

Section VII

THE UNIVERSITY OF THE FUTURE

The consensus in the academic community that universities must evolve in response to society's changing, needs, and indeed are so evolving, suggests that by the turn of the century, or sooner, the universities will be much changed, broadened in scope of service, revolutionized in methods of supplying service, and closely paralleling the main stream of society.

Today's agglomerations of stone and concrete will still exist as increasingly archaic monuments of a bygone era when learning required the daily presence of students in classrooms for scheduled lecture periods, in libraries to look up reference works, and in dormitories to crack books and cram for exams. College won't be like that any more. What will it be like?

One senior academic thought for a few minutes, his gaze roving out of his office window across the Ontario flatlands that surround his new university's campus under construction. "Instead of spending seven months on the campus," he said, "the student will spend only two, but in those two months he'll have fairly close contact with members of the faculty. Much of the rest of the time he'll be involved in autodidactic procedures before progressing to seminars."

"Evolution," he explained, "will be dictated by exigencies. Now we have the large mass lecture spawning a large number of discussion groups, and we can't man that any more. We must get to a point where we don't have to assemble people because we can get at them individually. That will be possible, when the hardware and the software of the new technology are developed, when cities are "wired" so that much of the present on-campus instruction can be transmitted to receivers in students' homes. Then, it won't be necessary to deal with thousands of students thronging daily on to the campus."

Another professor predicted it would be 15 to 20 years before the new technology took over. He said that then the university will offer the "optimum learning environment". Students will study in carrels with the new machines of instruction, and then experience maximum contact with professors in seminars. Professors will not have private offices in this man's futuristic concept, but only desks in seminar rooms to facilitate student approach. His futuristic university would be built around a service-oriented knowledge centre that would store, retrieve, and disseminate information in the old forms of books, serials, and documents, and in the new audio-visual forms of film and tape for a variety of communication machines from a slide projector to a CAI installation. Instruction would be automated for the basic disciplines, supplemented by tutorial guidance, and more advanced studies would be mainly autodidactic supplemented by seminars. The university would be involved in software research and production, it would be plugged in to computer services for a variety of purposes, and its knowledge centre, the old library, would be a link in a national information network.

It would be commonplace for professors to take sabbatical leave to work in industry and government, and lecturers from industry and government also would form a part-time supplement to the full-time faculty. Under these conditions a close three-way research collaboration would grow, while students would be "inseminarated" in a process of intellectual cross-fertilization by exposure to the attitudes and outlooks of government and industry. Emphasis also would be placed on interdisciplinary communication for mutual support, and on continuing education.

A young engineering lecturer visualizes the university of the future as little more than a resource centre and coming-together place—not a lecture place or study place or even a working place for researchers except for knowledge retrieval. Indeed, much of the research function of today's universities would have been taken over by government and industry.

Students would do much of their learning at home, with multi-participant discussions over a videophone network after televised instruction. While they would no longer need to come together for instruction, they would still meet in groups simply to feel, to establish emotional rapport, to develop interpersonal sensitivity, and participate in non-verbal communication as part of the personality development of man as a social primate.

In this academic community the individual student would not necessarily be identified with any particular university but would plug in his videophone to knowledge wherever it might be stored: "Varsity", McMaster, Laval, London School of Economics, Massachusetts Institute of Technology, or wherever. This assumes, of course, international computerized information networks disseminating knowledge on schedule or on demand, and university education universally available.

The practice of granting degrees would be abandoned as lacking real meaning in tomorrow's society. With students long since having won their battle for a meaningful relation between studies and their intellectual needs as producers in society, the students could follow courses of study suggested by their potential employers. Each interest group in society might lay down its own study requirements and evaluate the knowledge and abilities of students after completion of their study programs. Moreover, education would be continuing, with periodic re-evaluations of the producer-worker as a lifelong learner.

And one professor foresees the day when the teaching function will be performed by "a satellite in the sky".

Per astra ad ardua, as it were.

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Part B

Scientific and Technical Information in the Universities

Section I

INTRODUCTION

This is an age of rapid and proliferating change; an age in which the genius of man is fostering remarkable scientific discoveries and technological advances resulting in an accretion of new knowledge that, decade by decade, may double the diameter of man's intellectual horizons. The impact on the social, political, and intellectual life of our time is incalculable. Our society is reacting, giving way, being restructured by the unprecedented situations and challenges being rapidly thrust upon it, often without a clear understanding of how or why it must transform. All areas of our society have felt the effects of these changes but none more dramatically perhaps than the university. In seeking to accommodate itself to the times, the university must examine the need for change within itself, particularly in management, curriculum content, teaching techniques, research opportunities, information handling, and interaction with the community at large.

Increased involvement with the community, especially at the professional level, should not be a one-way street. The greater the complexity of Canadian industry and government, and the more intellectually demanding the roles played by individuals in these environments, the more universities can expect to learn from these sectors of the economy. Such dialogue is a necessary condition for universities to remain as the principal forum for the exchange and examination of ideas, concepts, techniques, and knowledge.

Society has invested heavily in universities and is beginning to look for services from these institutions beyond degree programs for those who qualify in the 18 to 24 age group, and associated research activities. There are growing demands that research in universities should have some visible relevance to social needs; that carefully organized "continuing education" be provided for everyone who is interested; that special programs be developed to keep scientific and engineering graduates abreast of their fields, and that "information services" be provided in various configurations.

In the words of Dean James Ham, of the University of Toronto:[1]

> "We have come, socially, to the conviction that every person should have the opportunity to be educated to the limits of his talent throughout his lifetime . . . . I think we are coming to the time when, if you graduate from any institution, you may well have an apprenticeship relationship to that institution for the rest of your life. University degrees will become what they ought to have become long ago–simply tokens of having been somewhere for a short time. They will be subject to renewal and revalidation."

Universities in Canada play a major role in the production, use, and dissemination of scientific and technical information (STI). They use it during the formulation of research projects, determining what has already been done in the field, and continue to use it throughout the course of investigative studies. They produce it as the result of such research projects. They disseminate it in published papers and reports and in talks and discussions at various colloquia and conferences. They also make use of and disseminate it during the teaching process. They will continue to play a major role in these areas but, because of developments in modern technology and social aspirations, the utilization and dissemination of STI in the academic world needs a thorough re-examination. It has to be recognized that:

(1) The university is the most heterogeneous melting pot within the scientific community, requiring information services that will satisfy requests ranging from the simplest to the most sophisticated enquiry, in both applied and theoretical contexts;
(2) The university is usually the largest source in any community of information capable of satisfying the needs of most recognized areas of scientific and technical endeavour.

It is imperative that this facility, usually developed at high cost, be made available to the active scientific and technical community both within and without the academic sphere. This report suggests that STI in universities should be regarded as part of a single national resource, incorporating a new approach to the use and dissemination of STI throughout the country.

Section II

UNIVERSITY STI REQUIREMENTS

II.1 Information and the Scientist

A scientist's use of information, whether obtained from print or other sources, arises from three needs:[2]

(1) A current awareness need, i.e. a need to know what other scientists are doing or have done recently, both in his specific field of research and in a broader area. It has been estimated that on the average it takes between one and two years to get a paper published in many refereed journals. Yet almost without exception scientists want and need the most up-to-date information possible.
(2) An everyday need for some specific information directly connected with the research or problem at hand. The need may be for statistical data, a method, details of the construction of a piece of apparatus, an equation, or an explanation of an observed phenomenon. However, thousands of products, processes, and techniques have been discovered, invented, or marketed, and it is difficult to find and identify those that could facilitate a research program.
(3) A need to search the literature before starting a new investigation. Knowledge of who is currently doing research, what research is in progress, and how far it has gone is often difficult to determine.

A growing flood of documentation complicates the scientist's task of locating information. Even the scientific paper, the primary means of communication among scientists, is no longer adequate for its function, mainly because of:

(1) Volume. The number of papers generated is expected to exceed a million a year by 1970.[3]
(2) Language. Many of the publications are now in languages with which the scientist is not familiar, e.g. of the chemical publications written, 60 per cent are in English and 6 per cent are in French.
(3) Specialization is making it increasingly difficult to communicate between disciplines, yet such communication is needed for the development of interdisciplinary groups and for the identification of ideas that may be applicable to several disciplines.
(4) New media. Optical and electronic methods of transmitting information, such as films, tapes, microforms, and telephones, are supplementing published papers to an increasing extent.

To help alleviate some of these problems, there are hundreds of secondary sources, such as abstracts and current reviews, produced throughout the world. In addition, symposia, colloquia, and congresses flourish. A conservative estimate places the number of conferences at 5 000 a year. Many conferences publish some form of proceedings which often lack indexes, are poorly edited, and suffer from poor preparation and format. A major disadvantage is the frequent delay between a conference and the publication of its proceedings. An additional problem is illustrated by the fact that while only 50 per cent of all papers presented at U.S. conferences are published, some 32 per cent of these appear in periodicals other than the ones in which the summaries appear.[4] This complicates retrieval of research information.

There is another aspect to the problem. It is difficult to evaluate the quality or uniqueness of the papers published. This is particularly serious within the universities because publication of papers remains one of the principal means of achieving professional advancement.

The first contemporary studies analyzing the information needs of scientists appeared in the 1930s. These consisted of counting the journals and books most often referred to in scientific articles. These limited studies dramatized the fact that applied sciences, such as agriculture and engineering, depended upon the pure sciences for up to a third of their information.

In the late 1940s and the 1950s many studies of abstracting and indexing services were made. They clearly demonstrated that:

(1) A wide variety of bibliographic aids are available to the user of scientific literature, including abstracts, indexes, annual reviews, monographs, handbooks, bibliographies, and references in journals.
(2) About half of the useful articles are not abstracted.
(3) Many of the articles that are abstracted usually appear in more than one abstracting service.

There have been other studies of how scientists obtain information, but no attempts have been made to weigh the relative importance of all the different sources. Results of some of these studies are listed here in their order of significance as evaluated by the Universities Subgroup:

(1) The scientist obtains more than a third of his printed information without any bibliographical reference to sources. He finds it mainly by browsing through or reading the most important journals in his field.
(2) An additional 10 to 30 per cent is located as a result of recommendations of colleagues, through meetings or preprints.
(3) From 5 to 20 per cent comes from the scientist's own "built-in bibliography", i.e. his memory.
(4) Abstracts and indexes contribute between 4 and 7 per cent of references.

II.2 Information for Interdisciplinary Research

The growing complexity of research programs and new public interest in applying research to broad social problems is fostering the formation of interdisciplinary research efforts. Emphasis is on "problem-oriented" teams incorporating skills from many of the traditional branches of science and technology. Examples of interesting interdisciplinary activities in Canadian universities include forestry studies at The University of British Columbia, the problems of Northern Ontario at Laurentian University, transportation studies at the University of New Brunswick, studies on water resources and on single-enterprise communities at the University of Manitoba, urban and rural development at Université Laval, and the activities of the Centre for Culture and Technology at the University of Toronto.

There is also a growing desire to co-ordinate graduate studies within provincial boundaries and to develop research interests in matters that are particularly relevant to the community in which the university is situated. One result is that several universities, especially those whose graduate programs are relatively new or expanding, are selecting foci for development. For example, oceanography and extractive chemistry are being emphasized at Memorial University, in Newfoundland; research at Dalhousie University, in Nova Scotia, is being directed toward the Atlantic Ocean and its shorelines; and Laurentian University regards anything to do with Northern Ontario as appropriate for graduate study.

This type of research creates information problems during the development of the program and the dissemination of the results. Many scientific and technological disciplines will be involved, making it necessary to have effective communication with sources of information in all of them. The results must be communicated rapidly and in a form comprehensible to people with a wide variety of interests and educational backgrounds.

Such specialization, resulting in group activity and excellence, places a heavy responsibility on information resources and communication facilities of universities. Information resources and associated services must be built up to serve these specialist groups.

Section III

PRESENT STATUS OF UNIVERSITY STI SERVICES

III.1 Libraries

University and government libraries are the main repositories of Canadian scientific information resources. These have been called upon to deal with most aspects of science by the increased demands for information by university scientists. In the absence of any policy of co-ordination between the universities with respect to the acquisition, processing, and servicing of their library resources, there has been and still is much duplication of material and effort, a vast program of building new libraries and additions to existing libraries, and a serious shortage of qualified personnel. Relatively little effort has gone into utilizing modern technology to alleviate the problem.

At the present time university libraries assume they have to acquire large collections to be effective. This assumption has been based on a number of factors:

(1) Geographical size of the country and poor use of communications make on-site large collections desirable;
(2) The user is so capricious in his demands that one has to prepare for any eventuality;
(3) The conservationist urge of librarians to preserve every bit of recorded knowledge "somewhere", regardless of its value.

Of these, only the last still has validity, but it is now a matter of debate whether that "somewhere" should be every large and costly university library building. The collection that offers its clientele all possible choices does so at the cost of speed of service and, at times, of accessibility itself. The library that prides itself on its ability to answer any given question, given sufficient time, must realize that time is the one luxury scientists can no longer afford. Downs stated:[5]

> "Mere size does not guarantee a great library or even a good one. The quality and richness of the book collections are more significant . . . ."

University library buildings already constitute a substantial investment. Most of them have been erected, remodelled, or enlarged since 1960, and further expenditures approaching a quarter of a billion dollars are anticipated for new projects in the next 10 years. Planned developments by 12 universities in Ontario, Québec, and the Maritime Provinces already amount to $140 million. Such buildings, in addition to providing space for scientific and non-scientific documents, provide areas for readers and service staff. However, these buildings, erected or planned, are largely dedicated to the handling of traditional forms of information by conventional procedures.

The Association of Universities and Colleges of Canada has recently issued a report, prepared by Robert B. Downs, which presents a detailed account of the state of university libraries today. The following statistics are drawn from this source to indicate the size of these resources.

At the end of 1966, collections in Canadian university libraries totalled about nine million volumes[6], with over 50 per cent of these housed in only five libraries. In 1965-66, total library expenditures amounted to $25 million, 7.1 per cent of total university expenditures.[7] It was recommended in a report of the Canadian Association of College and University Libraries[8] that this should be raised to at least 10 per cent and that, for planning purposes, the operating cost of Canadian academic libraries over the next 10 years should be established at $50 million annually. Budgeted expenditures for 1967-68 amounted to $40 million, with book acquisition accounting for about $17 million.[9] If the division between operations and acquisitions continues at the percentage of the last several years, then new acquisitions would amount to $225 million over the next 10 years. On the same basis, some $275 million would be required for operating services during the next 10 years. This would be made up mainly of salaries, with the balance for supplies and equipment. On September 1, 1966, Canadian university libraries employed 900 professional librarians, 125 professional support staff, 330 sub-professional librarians, and 2 100 clerical staff.[10]

The extensive use of microforms, automated procedures, and communication facilities, in association with greater interlibrary co-operation, could most likely reduce these expenditures and certainly make the libraries much more effective and productive.

III.2 Computers

It is appropriate to comment on the roles of computers in universities, as many of the skilled people needed to develop automated STI services may be found in the universities' own computer departments, and because computers are becoming increasingly involved in information retrieval systems. The current trend in Canadian universities is to have one or more computers, plus a staff of operators, systems programmers, planners, administrators, and consultants in a computing centre.

Of the 40 universities in Canada, 12 have large computer installations (UNIVAC 1108 or equivalent), 20 have medium installations (IBM 360/50 or equivalent), and the rest have either little or no equipment. An effort to co-ordinate university computer services in Ontario has been made by the Committee of Presidents of Ontario Universities and the Department of University Affairs. The policy of establishing regional computer centres independent of individual universities has been accepted and will ensure that, regardless of size, each university will have access to adequate computer facilities. This is a principle which should be considered by university libraries.

The principal function of the computing centre is to operate as a service facility for computer users, from inside the university and sometimes outside. Psychologists, economists, and social scientists tend to use the machine to process large quantities of statistical data; physicists and some engineers tend to use the facility for analytical or dynamic studies of physical systems; philosophy, history, language, and art departments tend to process non-numeric information for purposes of logical analysis and characterization. However, many universities have developed academic activities whose goal is to expand the usefulness of computers in society, and to teach people how to exploit this usefulness. These activities involve both research and teaching, and may involve hardware (equipment), software (computer programs), or both. Hardware activities are likely to be found in the electrical engineering or physics departments, while software activities are likely to be in a Computer Science Department.

Another computer-related activity is university management and operation, embracing records kept by the accounting office and the Registrar's Office and often extending to personnel, physical plant, and the library. These applications are generally similar to those in corporate enterprises and have the effect of mechanizing tedious and repetitive tasks of record-keeping and filing.

To relate these activities to the purpose of this Study, the following points should be noted:

(1) Universities have expertise in computer systems and their use, which could be employed in creating and maintaining future information systems.
(2) Universities provide existing computer and library facilities in close geographical and organizational relationships. The increased co-operation and co-ordination of these facilities are both economical and consistent with institutional patterns and goals.
(3) Computer software is a form of scientific and technical information but is clearly different from the books and microfilms found in conventional libraries. The computing centre is a channel through which this type of information could be made available to the community.
(4) Large memories in computer installations have the capability for storing and rapidly retrieving scientific and technical information. It is becoming relatively cheap and feasible to store large quantities of economic, social, physical, bibliographic, and other data needed by scholars and decision makers in electronic computers and data banks. Obviously, computers should and will be so used.

University libraries are gradually becoming aware of the advantages of automation, and many libraries have already undertaken to automate some of their services. These are reviewed in the report published by the Canadian Association of College and University Libraries.[11] It is, however, "a matter of great concern that many of these projects are conducted individually, even hermetically, without the experience of similar programs in other institutions being taken into consideration".[12] Some statistics obtained from a report[13] to the Canadian Association of College and University Libraries committee on automation, presented at a seminar in Toronto, reveal that many programs are duplicated by university libraries, including at least seven circulation control programs, five serial processing programs, and three catalogue programs. Far greater co-operation is needed if costs are to be kept within reasonable bounds.

III.3 Communication Techniques

Universities make widespread use of a variety of communication facilities for the dissemination of information.

(*a*) Conventional Methods. Mail is still the most common method of transmitting information and material, but service is not reliable and the use of anything other than airmail is prohibitively slow. To overcome these problems, a number of universities are using motor vehicles for document transmission among themselves and to locations remote from a campus. For example, the interuniversity library transit system in Ontario makes library holdings a province-wide resource for faculty and graduate students, and interlibrary loans now take only 24 hours. Teletype is being used by many libraries to speed up the transmission of enquiries and requests, but it is of little use for exchanging large volumes of STI. Improved telephone service at lower rates is prompting scientists to use the telephone more frequently for information exchange despite the disadvantage of not always being able to view simultaneously material under discussion. The telephone could be used to greater advantage if universities combined to subscribe to wide area telephone service (WATS), particularly if circuits were used to carry both voice and computer data traffic. Some experiments have been conducted with long-distance "conference" telephone calls. In this arrangement, participants in different parts of the country can listen to presentations by telephone and take part in group discussion of the subject matter. Such conferences have the advantage of low-cost participation by large groups, but may suffer from a lack of visual contact that only the nascent videophone can remedy.

(*b*) Television. A number of universities have their own television production facilities and produce course material on a regular basis. Indications are that this will become more widespread. Some are also using closed-circuit television for transfer of lectures outside the campus area. Several universities work with CBC television and radio in the production of school broadcasts, usually on a provincial basis but often with network coverage. CTV also participates in this information exchange and includes coast-to-coast presentations, for example its University of the Air series.

(*c*) Language Laboratories. These are now becoming standard at many institutions. They involve the use of sophisticated audio aids and prerecorded language courses, to help students develop expertise in a foreign language.

(*d*) Computer-assisted Instruction. Although this method is still in its infancy, a number of courses have been developed which enable a student, sitting at a computer console, to be instructed in a subject by an interactive man–machine dialogue, using course material stored in the computer. The preparation of course material for such activity is an arduous and expensive process, and avoidance of duplication in this developmental area is highly desirable.

(*e*) Computer Data Links. A number of universities, e.g. Toronto, McGill, Manitoba, Waterloo, Alberta, have data links from their main computer to remote terminals, enabling remote users to have access to information stored centrally. Some, e.g. Laval, also have terminals on campus attached by telephone lines to data banks in the United States. Standard teletype or voice frequency circuits are generally used. The trend, however, is to high-speed transmission.

These techniques for instruction and information transfer have widespread application in Canadian universities. Greater co-operation through an organization such as the Interuniversity Communications Council would hasten advances and avoid duplication of effort in many areas to the general benefit of all concerned (see Section IV.4).

III.4 Information Retrieval Systems

In Canada, development of information retrieval systems is slowly getting under way. There are a number of projects in universities related to the establishment of data bases and the retrieval of information from these files. Some of the projects under development are as follows.

(*a*) University of Calgary. Jointly with the University of Saskatchewan, the Geological Survey of Canada, and Imperial Oil Limited, a sophisticated information retrieval system is under development, being an extension of one developed earlier by Imperial Oil Limited. The role of the University of Calgary is to develop a capability for document data entry using visual display units and typewriter entry devices. In addition to this, a search algorithm for retrieving information is being developed. Initial data for entry to the system is in the field of pattern recognition, with several other categories planned.

(*b*) University of Toronto. An experimental project using *Chemical Abstracts* tapes is being tried out. A program has been prepared to scan the tapes and select items of interest for a group of scientists within the university. The selection process is based on an "interest profile" supplied by the scientists which is matched against corresponding words contained on the abstract tapes.

(*c*) University of Manitoba. This project is to develop a capability for taking any text on disc or magnetic tape and from this text preparing a concordance and statistical word counts. Any paragraph or line can be updated by replacing old information with new. A retrieval capability enables a word, a phrase, or combination of words, conjoint or disjoint, to be entered via computer terminal, and the program will identify all lines or paragraphs in which they appear. It has been used to retrieve information from the Criminal Code of Canada, and was also used to prepare each phase of the 1968 Manitoba Condominium Act (including amendments) as the Bill passed through the Legislature. Related programs have been used in other fields such as French prose analysis. In another project a hospital information system is under development. From video display units or typewriters, doctors' orders, nurses' notes, and other hospital data will be entered through a "conversational" program. Once data are entered, they will be transferred to appropriate points in the hospital for action, e.g. a drug order on the ward will generate automatically a request for drugs at the pharmacy, and also will become part of the patient record. Information can be retrieved and displayed visually or in hard copy form. Modifications to the program have been used for a business credit operation and are to be used for a school division information system.

(*d*) Université Laval. A number of projects are being developed in the area of law. In one of these the Revised Statutes of Québec are being placed on magnetic tape and programs developed to enable any legal concept to be retrieved and printed. In a second project a survey of lawyers was conducted to determine needs in terms of jurisprudence in insurance, and a group of jurists is now extracting and analyzing, from judicial reports since 1867, items pertaining to insurance contracts. These are placed on film and retrieval is by video-mechanical device, scheduled as a service for the public in 1970. Other projects include a system for recording and updating collective agreements in force in Québec. This updating can be achieved on a clause-by-clause basis, and scanning and retrieval are available by video-mechanical means. Various indexes have also been developed, including one on all research projects and theses in progress in Québec universities, and another for the *Canadian Historical Review* for the years 1950 to 1964.

(*e*) Queen's University. Treaty texts between the United Kingdom and former colonies are being rendered in machine-processable form in a project financed by the Department of External Affairs. Retrieval of the material by various criteria will be possible, as will updating of the text. A service will be offered to the treaty countries.

(*f*) McGill University. In one project, data on several thousand companies have been collected, going back over 20 years, and placed in data files on-line to a large computer. Subscribers can draw on the data and execute various analyses from remotely located teletypewriter terminals. This system operates in a real-time environment. Another project has involved the development of retrieval programs that search through magnetic tape files containing abstracts of bibliographic information in the area of nutrition. Interested scientists can specify a "profile" of interest and have abstracts pertinent to this profile retrieved and printed.

(*g*) University of Guelph. A project has been developed for the organization and control of holdings of government publications and reports, using a special computer-based system. Access to the documents is through personal or corporate author, title, serial title, report number, contract number or catalogue number.

Projects such as the foregoing should be encouraged, while guarding against the danger of duplication with needless expense in computerizing information. There is need for co-ordination at the national level. Existing information system development covers only a small fraction of what is required by our decision makers, administrators, industrialists, and scientists. Only a comprehensive plan will permit the nation to gather, analyze, classify, and disseminate necessary and relevant information.

Section IV

FUTURE GROWTH OF UNIVERSITY INFORMATION RESOURCES

IV.1 Individual Library Development

The development of new methods of storing, retrieving, and transmitting information will enable university libraries to provide faster, more varied, and more specialized services. Therefore, the traditional concept of a library as a book storage and loan operation, with some reference service, must be abandoned. The library must become an information and data resources centre providing a variety of grades and formats of service, from computerized selective dissemination of information to archival storage, designed to suit the modes and scale of user activity:

(1) browsing,
(2) problem-solving,
(3) learning and study,
(4) integrative and critical analysis of contents.

IV.1.1 Referral Services

Almost every brief submitted to the subgroup from universities mentioned a need for some form of referral service, i.e. a "switching network" by which an enquirer either inside or outside the university could be put in touch with the most likely source of an answer. A faculty member who would like to know what is going on in his field at another university, an industrialist who wishes to obtain expert advice, a registrar who needs to know the content of courses in a given curriculum, or a symposium attendee who wishes to know where his conference is taking place, all would expect to obtain nation-wide, up-to-date information through their local university information centre. In large and small institutions it is almost as difficult for a faculty member or a student as it is for an outsider to know who is doing what, or to locate a staff or faculty member.

A referral service is a potentially valuable communication facility among the community, the universities, and governments. Since most of the required listings of projects and registers of people have to be maintained for local internal needs anyway, the cost burden, borne by a provincial or national referral centre, should be relatively small.

Current data which universities have said they would like to have available for referral include:

(1) A union list of all books, periodicals, and other holdings in Canadian libraries (universities, special, municipal, and National Science Library);
(2) A list of Canadian internal and external reports and publications;

(3) A directory of industrial research organizations and details on their information services and holdings;
(4) A directory of consultants, with location and special experience;
(5) Information about research projects in progress, giving status, scope, staff, and financing;
(6) An inventory of research facilities in Canada, including major equipment and computers, costs, and availability;
(7) A directory of conferences and symposia, including fees, location, and agenda.

IV.1.2 Documentation Centres

University documentation centres based on specific subjects should be created and co-ordinated on a national basis. Each such centre might be developed on the basis of an existing capability of the university in a specific subject field, and would have bibliographic responsibility for that subject. For example, a documentation centre would determine the extent of a specific area of interest, gather all the primary and secondary sources of information, designate the methods of input of such information into a computer or other storage device, and optimize retrieval methods. Computer input and output would have to be compatible with established national standards.

For each area of interest a committee could establish documentary needs and determine the value of input material. This committee would be composed of representatives of the community, of faculties, of the documentation centre, and of the computer centre. It would determine priorities for information entry and further documentation research. Academic responsibilities would remain with the faculties, while techniques and administration would be handled by the documentation centre. (A policy similar to this has been established at Université Laval since July 1967.) If all the universities in Canada that have the necessary resources had documentation centres, there would exist all the elements needed for an integrated nation-wide university information service.

IV.2 Interuniversity Library Co-operation

There is a need to consider Canadian university libraries as a nation-wide organization accessible by any user in the country. Given adequate communication services, every member of the university community would thus have access to a much larger effective library. Moreover, the cost of such an integrated library system would be considerably less than the total cost of a group of individual university libraries, each one attempting to cover too large an area by itself.

IV.2.1 Acquisition Policies

Most scientific research is dependent on ready access to up-to-date information. One of the principal vehicles used is the scientific paper, and its principal place of publication is the serial. Many libraries are buying and processing the same titles in a similar manner. Since the need for such material is universal and urgent, the acquisition and processing of serial publications should be standardized and automated as soon as possible on a national scale.

A reappraisal of the policy of university libraries with regard to the purchasing of materials should be instituted on a co-operative and co-ordinated national scale. A national purchasing program and the consideration of holdings as a national resource can aid materially in reducing some of the pressures mentioned by university librarians for extra space and funds for such items.

IV.2.2 Cataloguing Policies

Librarians commonly distinguish two types of cataloguing:

(1) Descriptive cataloguing, i.e. the physical description of information. This includes author, title, size, pagination, and publisher.
(2) Subject cataloguing, which essentially provides the user with access to the information by subject.

Most descriptive cataloguing is fully structured, and is one of the functions capable of being carried out by library technicians. Subject cataloguing is inadequate in the university environment and a completely new approach to subject access is required. Little is to be gained from automating present methods. Since subject cataloguing implies availability of the data for at least several years, and since scientific information requires continual updating, the technique used for subject access must be dynamic. In a large information network the system must also be capable of handling special needs of local users. A thorough examination must be made of the semantic structure of existing subject catalogue forms to determine those best suited to Canadian needs.

IV.2.3 Interlibrary Loan Policies

The interlibrary loan service needs considerable improvement, it being universally condemned (in practice rather than in principle) at the public hearings conducted by the subgroup. The low opinion in which it is currently held is best illustrated by statistics[14] which show that in 1965-66 the interlibrary loans by some 40 participating libraries totalled approximately 55 000, or an average of about 6 per university working day. The introduction of teletype has eliminated the delays experienced in sending requests by mail, but has done very little to improve the service; delays of four to six weeks were cited in some instances.

IV.2.4 Retirement Policies

To urge libraries to discard books may seem to contradict those who assert that one of Canada's problems is a lack of books. But a library must be two things: it must be a storage place for material, and it must be a channel for access to material. If the material becomes so unwieldy as to be inaccessible then it is not a library, it is a book museum or, perhaps more accurately, a book mausoleum.

It is becoming increasingly obvious that universities must develop and implement realistic retirement policies for items now in their collections. It should be noted that some well-known libraries have, in effect, already adopted modified discard policies. In the case of Harvard and Yale this entails off-site storage; in the case of midwestern U.S. institutions it involves transferring materials to another jurisdiction, the Midwest Interlibrary Center.

One quotation from Yale's experience should be made:[15]

> "It is also clear that, to be successful, selective book retirement must be a program executed over an extended period of time. It must become as routine as acquisition and other recognized library procedures."

It is logical to assume that pressures for extensions to existing university libraries and for new libraries could be alleviated by establishing regional centres for little-used material. Because regional storage areas will not be as readily accessible, the regional centre must be able to describe a given item in such a way that the researcher can accept or reject it on the basis of the description. Such descriptive information should be available in each local library. Response to requests from a regional storage area should be on a 24-hour basis, with photocopying of requested items being a routine procedure where economic.

IV.2.5 Abstract Services

University libraries subscribe to foreign abstracting services, but people outside the universities concerned often do not know these abstracts are available. An index to the abstract services available in Canadian universities would assist in the development of additional services. A designated national agency should be responsible for preparing such an index, collecting Canadian and foreign tapes of abstracts, publicizing the availability of the tapes, and disseminating copies to libraries. The agency should also abstract Canadian material of interest not reviewed by other agencies. The total collection of abstracts could be used to provide a selective-dissemination-of-information service whereby any scientist would regularly receive abstracts of the world's literature pertinent to his personal interest.

IV.2.6 Government Publications

Governments' responsibilities and activities are expanding in practically every sector of public life, and this is increasing the scope, number, variety, and diversity of government publications. In fact, there is hardly any topic that a government publication has not touched, often with the aid of expert contributors from outside of government. So great is the volume of publications in this category that it introduces two major problems:

(1) physical requirements for storage, and
(2) cataloguing and indexing for subsequent retrieval.

There are few resources so valuable to the research worker, the student, and the general public, and it is important that the publications be available and readily accessible. This is no easy task and imposes an enormous burden on many institutions that need to handle large numbers of them.

Most Canadian university libraries file these publications by the names of the issuing offices plus catalogue numbers provided by the publishers. This is moderately successful with publications of most national and international organizations, but not with provincial or municipal publications. Systematic distribution schemes do not seem to exist for the latter. As a result, some work, such as in regional planning and development, is hampered by an acute shortage of factual information.

Few university libraries can be expected to accumulate or file the more relevant government publications and documents, let alone all. The subgroup believes that the responsibility for collecting these publications should be allocated to a national organization, possibly associated with a university, and that:

(1) A national agency should index government publications by subject and provide indexes at cost to interested libraries;
(2) Provincial and municipal publications should be handled by a similar agency in each province;
(3) These agencies should provide an effective interlibrary service of loans, hard copies, or microfiche.

IV.3 Interuniversity Computer Co-operation

In recent months a number of proposals have been made for university-based computer utilities. A typical proposal is that submitted by the University of Waterloo to the Ontario Department of University Affairs. In this proposal a large central computer is suggested which would be shared by educational institutions, boards of education, government agencies, hospitals, and welfare agencies within the area. In addition, a growing number of commercial utilities, such as Computel Systems Ltd. and Computer Sciences Canada Ltd., are being established where, for a fee, customers can attach remote terminals over telephone lines for input of data and receipt of results, and use the very powerful central computer on a shared basis with other commercial users.

IV.3.1 Data Banks

An information service based on computers which requires co-ordinated development is the "data bank"–words and numbers, usually in a prearranged format, describing a series of objects or events. Most data banks are designed with computer-readable files, and a number of such data banks have been proposed for governmental, industrial, and commercial use. For example, the Dominion Bureau of Statistics has its price and trade indexes on magnetic tapes. Currently, the data are provided free to universities which develop programs for processing these data. Later, it should be possible to gain access to the data banks (maintained at one location) from any other location via telecommunications and remote terminal equipment. As another example, McGill University is operating a computerized file of financial and performance data of corporations. Rapid response on remotely located computer terminals is provided to users' requests for information about any company, and the data also make it possible to conduct statistical studies of the financial behaviour of corporations in the Canadian economy.

It is this combination of complementary benefits that interests universities in establishing data banks–financial support for and commercial use of a data file plus the opportunity of studying the business or physical world with the aid of a large, expensive record of interest area characteristics. However, university data bank development should not be limited to those applications with prospects of commercial gain; for example, data on nuclear physics may have a limited commercial market but are essential to activities in many scientific and applied fields.

IV.3.2 Computer-based Library Network

It is possible to centralize and automate library operations for a number of local libraries on a single, dedicated computer. For example, a computer-equipped bibliographic centre is planned in Toronto to assist all Ontario university libraries with acquisitioning, cataloguing, maintaining union lists, and other activities. There are also services beyond those traditionally offered by libraries that can be handled effectively by a computer on a batch or job basis; examples are retrospective search and current awareness in which the computer is programmed to scan files of bibliographic data to produce lists of items pertaining to a subject, or recently available material on a subject.

The subgroup believes economies and improved services would result if all university libraries were to co-operate in the development of a library computer network which could also serve industry and commerce. To achieve maximum effectiveness in communication there would have to be compatibility and convertibility among provincial, national, and international library computer systems. Such a network could be launched on the basis of existing university computer centres and computer utility operations. A problem is that demands for computer time are growing so rapidly that university computer centres usually cannot guarantee long and continued access to their equipment. Although this situation may change as regional computer centres are established, firm financial support for pilot operations is definitely required. In the long term, an independent computer-based information network should be developed; many briefs submitted to the subgroup stressed the need for it.

To initiate the project, it would be necessary to establish task groups in designated regions, each group consisting of one or more working participants from each university plus full-time members. Three task areas for each group would be:

(1) Systems Design and Implementation: compiling specifications for library systems, including interlibrary and library-computer interfaces, which meet the needs and capabilities of each participating university and are capable of being realized economically;
(2) Management: defining performance standards for libraries; setting program planning and budgeting systems standards for each participating library and for each regional or provincial group; assuming responsibility for integrating library-computer systems development with overall university objectives; carrying out long-term and short-term planning and forecasting; deciding on allocation of artifacts to remote or local storage; and apportioning interlibrary loan costs;
(3) Services: determining scale and characteristics of needs for library services, methods of user education, development and promotion of new services, and development costs.

These groups would be responsible not only for co-ordination within their own regions but also for national co-ordination in conjunction with task groups in other regions.

It must be emphasized that the design of systems is only part of the task these groups will face. Virtually all university administrative and decision-making areas will be involved in implementing these designs; the business offices will be required to modify their cost-accounting procedures, personnel policies may well be affected, and both the computer centres and the libraries will have to accept some compromises of their freedom and autonomy. In the end, though, only the provincial and federal governments can establish the policy that these decision makers will be encouraged to adopt for the common good.

In addition to the network development, a number of communication developments must be considered concurrently:

(1) Wide-area telephone service for universities on a country-wide basis would improve person-to-person dialogue and considerably facilitate information exchange by university-based scientists. Eventual use of video telephones would further improve the information exchange process.

(2) A high-speed data transmission network is an urgent requirement, on a tariff base that is not distance-dependent. This would speed up transfer of information from university centres once a university information network has been established. Canadian communications satellite planning should not neglect this requirement.

IV.4 Interuniversity Co-operation in General

One approach being followed by universities in the United States to assist in the adaptation of new communications technology to the requirements of the teaching and research processes is the creation of the Interuniversity Communications Council (EDUCOM). This Council was conceived as a focal point for the development and application of communications technology to education through the co-operative efforts of the universities. The program of EDUCOM is expected to result in:

(1) Better use of existing personnel, i.e. teachers, researchers, and administrators;

(2) Improved methods that would accompany the use of new technology;

(3) Identification of gaps (including gaps in evaluation) in educational and research systems;

(4) Co-ordination with similar programs that are being developed by government, business, and industry.

The Council has defined a classification scheme that suggests four areas of study:

(1) Technological aids to instructors. These range from the slide projector, through the motion picture, to television. They include maps, charts, and three-dimensional models.

(2) Technological aids to the learner. The hardware starts with the printing press and goes through the highly complex system of computerized programmed learning.
(3) Technological aids to research. The researcher is overwhelmed with the flood of results from other researchers in his field, and sorely needs help in coping with expanding knowledge.
(4) Application of technology to the administration and operation of our colleges, universities, hospitals, and clinics.

EDUCOM is also involved in developing a program for the co-operative handling and dissemination of information among member institutions. Canadian universities have much to gain by creating a similar organization with links into EDUCOM.

Section V

RESEARCH AND DEVELOPMENT IN THE UNIVERSITIES

V.1 The Division of Research Effort

In Canadian universities, research is conducted primarily as part of postgraduate education, one to two man-years resulting in a Master's thesis and three to four man-years producing a Doctoral thesis. In addition, a few reports and conference papers may be co-authored by the supervisor and his student. This research is the principal non-government source of new scientific and technical information in Canada.

Very few students in the sciences and engineering undertake graduate study without some form of financial support and many are, in effect, hired by their supervisors to carry out research tasks funded from various sources. About half of all such postgraduate students are supported by the National Research Council, either directly through scholarships and bursaries or indirectly through research grants to faculty. Such support has been provided in the expectation that Ph.D.s would be produced who would, in turn, produce information from which economically significant innovations would eventually flow. This strategy is now being questioned for a number of reasons, e.g. the cost of research has risen rapidly, these élite graduates are finding themselves too narrowly specialized to fit the positions available in industry, and the economic benefits of university research, which tends to be dominated by "purists", are not as certain as the strategy implies. One suggestion arising from the ongoing debate is that there should be a switch in emphasis to co-ordinated interdisciplinary activity and applied research directed at problems of the real world. This would call for each institution and the different government funding agencies to strike a new balance in the allocation of resources to work designed to alleviate existing social needs and to that required to further the evolution of the sociological and technological structure of society.

Until very recently, the NRC avoided even the appearance of attempting to co-ordinate research programs under its sponsorship in order to preserve the autonomy of universities and the individual faculty. Now, however, the NRC has embarked on a program of negotiated development grants; universities are invited to submit proposals for programs of co-ordinated research, and to sit down with NRC to discuss them. This may partially alleviate the problem, but the establishment of Canadian priorities for research programs is an urgent requirement.

In the past, universities have been reluctant to commit their resources to applied research. Not only is there a tendency to regard this type of research as not contributing to academic excellence, but there have been few grants available for graduate students working in such research. Universities and research-supporting agencies should modify their policies so that greater consideration can be given to applied research programs. Greater attention should also be given to the cost effectiveness of research programs and particularly to the generation and dissemination of scientific and technical information for the economic benefit of the country. To this end:

(1) Contributions by faculty to information services should be credited in performance evaluations;
(2) Costs associated with information retrieval for a research project and those associated with dissemination of research results should be identified both in the grants and in the projects to assist in determining cost effectiveness.

In the past few years, the U.S. space program, weapons development, nuclear power development, and similar programs have introduced a new view of the structure of scientific endeavour. This type of research is mission-oriented and is characterized by having specified goals which may be achieved from one to ten years in the future, whereas non-mission-oriented research is directed toward satisfying curiosity about nature and is usually unrelated to specific goals. Research in universities tends to favour non-mission-oriented tasks and work which is intellectually abstract, analytical, discipline-oriented, and novel. Mission-oriented tasks, which are expected to contribute to concrete, specific, synthetical, function-oriented (albeit novel) objectives, are not easily accommodated, and the subgroup suggests that this type of activity might best be developed by the National Research Council. Thus, while the NRC should continue to sponsor basic and applied research at Canadian universities, it should also attempt to co-ordinate this research. The Council's own research should be concentrated on mission-oriented activity, working with industry and with universities as required.

V.2 Research and Development in STI Services

Large amounts of money are being spent in other countries on developing information systems, and much of this knowledge and equipment could be imported by Canada. However, it was made clear to the subgroup that many faculty members and students could be attracted to work on improving techniques of information generation, diffusion, and utilization. But they would need leadership, adequate status, financial support, and confidence in an overall program.

The structure of an information research program should be adapted to the pattern of work in universities. It will involve many discipline-oriented groups (such as engineering and physics on hardware, psychology on learning and perception) as well as interdisciplinary groups (such as computer science, management science, environmental design, and communications). At present there is no research group in Canada with scope spanning the whole breadth of information. Some that are partly involved include the Ontario Institute for Studies in Education, and the Centre de documentation of Université Laval. Such groups should be encouraged to develop their capabilities, but there should also be a single group or organization for long-range planning, principally of an integrated network of scientific and technical information systems. Such development cannot be allowed to occur in piecemeal fashion; it must be co-ordinated.

Canada, like most countries, provides very little money for research on information systems. The Universities Subgroup concurs with the Techniques and Sources Subgroup's recommendations that more money should be provided, and that particular attention should be paid to the development of techniques and devices adapted to the dissemination of scientific and technical information, such as:

(1) Optical and audio input-output devices for quick and accurate entry and retrieval of descriptive material;
(2) Cheap, high-volume information storage devices with fast access;
(3) Printing and reproduction processes controlled by computers for cheap and rapid output;
(4) Communication devices capable of handling high-volume data transmission and facsimile.

Systems development will be a continuing requirement, particularly for library operations and interlibrary movement of material, both physically and electronically. The strategy suggested in one brief, that several small pilot projects be established before a massive information network is implemented, is appropriate for the immediate future. Such pilot projects should grow quickly to a scale that will determine the requirements for success, and they must be co-ordinated so that transition from a pilot project to a successful national system can be accomplished in the near future and at reasonable cost. Pertinent to such systems development are:

(1) Improved techniques of information classification and retrieval. If information is to be regarded as a national resource accessible to the population, then information must be identified in such a manner that users can recognize what is stored and be able to retrieve it. This involves classification of the information by useful descriptions. Such descriptions should be capable of modification as new areas of knowledge develop.
(2) Selective dissemination of information. A user should be able to put a description of his interests (a profile) into the system. In turn, as new information is received by the system, the user should be advised of those items that correspond to his profile. The user neither wants to receive too much irrelevant material nor to miss material of interest to him.
(3) Other research areas include automatic language translation, automatic extraction of information from documents, and development of workable techniques for computer-assisted instruction.

These studies should be concerned with human as well as technical factors, and must involve social scientists as well as engineers and computer scientists, in areas such as perception and human information processing in the brain.

In addition, an important area for study is the dynamics of information generation, dissemination, and utilization. What environment is best for creative research and development? What is the process by which a new idea is translated into an economically significant innovation, and how can the necessary conditions be established for this process to take place? How does the information communications complex actually work in Canada? What preparations should be made now to provide for the year 2000? Such questions are appropriate for university teams to ponder.

V.3 Development of Information Diffusion Services

Universities should take greater responsibility for making information available to the community at large. Examples of services that could be emulated in Canada are the Industrial Liaison Program at the Massachusetts Institute of Technology (MIT), and the Industrial Extension Program at Wayne State University.

MIT's Industrial Liaison Program gives each member privileged access to non-proprietary research projects at MIT. An Industrial Liaison Officer is assigned to each member and visits him to ascertain his information needs and program plans. The officer ensures that appropriate individuals in the member's organization receive copies of any MIT publication relevant to the member's interest. A book describing research projects under way is published annually. The liaison officers, each holding a Master's degree in science or engineering, in effect become information specialists with a good understanding of the state-of-the-art in the fields of their member's interests. The officers are appointed for three-year terms, at the end of which they must go into responsible research management jobs, well aware that "information is a tool of mission".

About 90 per cent of members' enquiries are handled in the Liaison Office by the officers and their secretaries. The remaining enquiries, which require direct contact between a member's representative and the research group, are screened to ensure that the enquiry is well founded and that the reply is likely to be comprehensible to the member. Consulting arrangements arising out of such interviews are outside the liaison programs. In addition to "members only" publications (such as the project book), occasional special "members only" conferences are arranged at which faculty members give current progress reports and state-of-the-art reviews of their research programs. Proprietary projects are not discussed.

Several additional factors should be noted. First, members tend to be active in the development of products and services based on new technology (especially in materials, electronics, and computers); they employ professionals (many with Ph.D. degrees) who are capable of utilizing the MIT information. Second, MIT's research program includes a large fraction of mission-oriented projects as well as "pure" projects, and the projects tend to be in the forefront of science and technology.

Annual dues are scaled in proportion to expected services rendered. For an average membership fee of about \$20 000 (in 1967), a liaison program member was able to enjoy this privileged, fast communication channel into research programs of approximately \$50 million per annum* supported by various

*Equal to about half of all research money spent by Canadian universities in that year.

government agencies and foundations. This leverage makes the fee appear quite modest.

Wayne State University, in Detroit, offers an information service that might be called a "technological extension service", closely parallel to more traditional agricultural extension services. Application engineers employed in the service acquire local industrial plants as clients. After helping to define a problem or enquiry, the application engineer searches for the answer in reference sources and through faculty in the university. If the answer exists, he interprets it to the client and assists in implementing the solution.

Section VI

TRAINING FOR SCIENTIFIC AND TECHNICAL INFORMATION SERVICES

VI.1 Personnel Requirements

If Canada is to develop and operate an effective national scientific and technical information service it must have properly trained personnel. There must be information scientists and systems planners to conduct research in information and to develop the systems, competent administrators to manage the systems efficiently and effectively, librarians and technicians trained in library functions adapted to automation and the new services, information specialists capable of working with scientific and industrial users to ensure that they gain maximum benefit from the services. In addition, there must be teachers working in all branches and at all levels of our educational system showing students and graduates how to use a comprehensive information system. Our present educational system pays but scant attention to this type of training and, except in library schools, the student is left largely to his own initiative.

The demand for information personnel is difficult to determine. Available data show that academic, school, and public libraries account for most of the demand. While distorted by the marked growth in schools and universities occurring in the late 1960s, the projected requirement of 500 information personnel a year[16] seems to be in reasonable balance with the graduating classes from the library schools, although a more recent survey by Cameron[17] showed the estimated demand to be somewhat higher.

The pressure on library schools to prepare students for immediately useful vocational training cannot be ignored, but to respond to this demand alone will lead to a state of intellectual bankruptcy within the profession. The two-year M.Sc. program that is now offered at four library schools (upgraded as necessary) could help to provide an adequate number of professional librarians with the type of training that can take maximum advantage of the new technology.

Cohan and Craven in a report to the U.S. Office of Education[18] in 1967 stated:

> "To see the information specialist as exclusively a librarian is to discourage other qualifed personnel from information work, limit the number of potential library school students, and encourage a stereotype in the minds of scientists."

It should be said, however, that library schools often lack the necessary funds for research, experimentation, development, and recruitment. The forward outlook required in a research program is vital to the development of systems in Canada that can keep up with the changing information sources on which we depend so heavily.

Since much of the professional staff required in science information work will come from sources other than the graduate library school program, the most immediate need appears to be for short courses and seminar-type training for those qualified in related fields. Refresher courses for library school graduates are also highly desirable. A flexible training program is needed that will gear itself for training personnel, according to ability and educational background, who can fit where they are needed. Information networks will provide a wide variety of opportunities.

An organized profession of science information specialists is emerging slowly. The services they can perform were outlined in the report to the U.S. Office of Education.[19] While guided by this comprehensive study, the following list takes into account the needs of Canada and more recent developments.

(*a*) Administration. Management of libraries, information networks, and information centres requires imagination and intelligence as well as administrative ability. A manager must be familiar with systems planning, information handling, and electronic data-processing. He must anticipate user requirements, plan and develop services to meet them, and administer the operating system.

(*b*) Systems Planners. Devising schemes for co-ordinating all the elements of information handling requires people with sufficient knowledge of the capabilities of communication equipment and computers to be able to reconcile them with the needs of users.

(*c*) Librarians. As systems develop, the need for reference and bibliographic service will increase. The need will also grow for the traditional library functions of cataloguing and subject analysis, and for maintenance, storage, and retrieval of documents. Changes can be anticipated in these functions owing to electronic data-processing. Reference work, which has sometimes been neglected because of the pressures of handling the increasing bulk and variety of materials, should take on increased importance in library work. Librarians will be the prime source for many of the personnel needed in the evolving information systems.

(*d*) Library Technicians. Studies by the American Library Association and the U.S. Office of Education[20] conclude that lack of adequately trained personnel is forcing the professional librarian to spend his time on tasks that neither demand nor exploit his professional education. A number of provincial institutes of technology and junior colleges across Canada have introduced training programs for library technicians, but acceptance of these technicians is by no means unanimous.[21] However, it is expected that they will prove as useful and acceptable as laboratory technicians are in the science laboratory. Library technicians could do much to improve information service in Canada.

(*e*) Information Scientists. Canadians are gradually realizing that research in information handling can lead to increased productivity in science. To gain maximum benefit, information scientists are needed who have been trained in several disciplines such as systems design, communications, linguistics, behavioural science, and statistical mathematics. Without an information science research program in Canada, much of the value and significance of developments in other countries will be delayed or missed entirely.

(*f*) Subject Specialists. Critical analysis is the key to exploiting scientific and technical information, and centres have been created in the United States to do this in important advanced technological areas such as defence and aerospace. Specialists with deep subject competence are needed to evaluate and elucidate the significance, pertinence, and relevance of specific information.

(*g*) Information Specialists. Information work in science and technology is often undertaken by persons trained in science but not in library work. This tendency has been accentuated by the development of mechanical and electronic data-processing aids. Although this type of work has been important for at least 20 years, library schools have not, until recently, provided training specifically for it. Knowledge of the subject, user requirements, and information-processing principles and methods should be the aim of training courses.

(*h*) Educators. One fact that stands out throughout the Study is the need for continuing training programs in information handling for scientific personnel at all levels. Library schools have constituted virtually the only academic program in this field. The need is for a broader appreciation of the different levels of information. Training is needed in the preparation of scientific information as well as in its use. This involves the whole of the educational system.

VI.2 Training Facilities

VI.2.1 Library Schools

The only facility in Canada for academic training in information handling is the library school. However, there is a lack of faculty for these schools, so that Alberta, Dalhousie, and Western Ontario have had to recruit the directors of their library schools from outside Canada. There are also no programs at present which lead to the award of Ph.D. degrees by Canadian library schools.

The demand for new skills emphasizes the need for broadening the training facilities, which could be done by expanding present library school programs or by following the trend in the United States toward formation of new graduate training programs in information science. If either or both of the above are done, on-the-job training, technical society meetings, seminars, and short courses will continue to play an important role.

Canada has six library schools that graduated classes in 1968, and two more are scheduled to start in 1968 or 1969. All schools require a bachelor's degree as a prerequisite to admission. One (The University of Western Ontario) requires the bachelor's degree with honours.

Library school administrators, with the exception of those at Alberta and Dalhousie, met in Toronto during May 1968, and agreed to convert all existing programs into four-semester postgraduate M.L.S. programs by 1973. This decision was made in an effort to improve the standards of library science education, and to introduce compatibility within the profession in Canada. All new programs will be based on similar entrance requirements. Moreover, increasing the length of time a student studies will allow for the broader and far more flexible training needed to prepare librarians for the demands of today's markets and users.

Library Schools in Canada

Institution	Course	Graduates in 1968
McGill University	2-year M.L.S.	48
University of Ottawa	1-year B.L.S.	67
University of British Columbia	1-year B.L.S.	84
University of Montreal	2-year B.L.S.	54
University of Toronto	1-year B.L.S.	191
	2-year M.L.S.	8
University of Western Ontario	3-semester M.L.S.	32
		484
Planned for 1969 graduation: University of Alberta	1-year B.L.S.	40
Planned for 1970 graduation: Dalhousie University	4-semester M.L.S.	30

Curricula are changing markedly, both in content and in emphasis, to include the application of new technology to library procedures. It is not yet clear whether this change in curricula will be adequate for the wider range of information personnel needed. As in other fields, more advanced training may have to be sought outside the country. Nevertheless, there is need for at least two advanced training programs in Canada, one in French and one in English.

The number of graduates from library schools is increasing rapidly, from 377 in 1967 to 484 in 1968, or 28 per cent in one year. As schools have been changing from a one-year B.L.S. program to a two-year M.L.S. program, the figures may be somewhat distorted for these years; however, data from the Dominion Bureau of Statistics for the years 1960-65[22] show a similar average growth rate.

The proportion of persons with science backgrounds attending library schools is low. The Dominion Bureau of Statistics reports about 6 per cent for 1967. One brief pointed out that advanced training in information had not received scholarship support comparable to that in the scientific and engineering disciplines (an average of $468 per student as against $2 500). The median salary for library school graduates is about $1 000 less than for engineers who have put in the same number of years of study. These facts reflect the low value placed by employers on the training received. It is doubtful if many of the required personnel will be attracted to the field through the present library school programs which, in the main, *have produced a product for which there is little demand in the field of scientific and technical information.*

Persons entering the scientific and technical information field normally have advanced subject training but many lack the basic training in librarianship that would be more helpful in their new endeavours. They are hesitant about entering a two-year M.L.S. program, and the one-year B.L.S. program is usually not suited to their needs. A one-year program designed for information personnel has been suggested[23] to meet the needs of this group. Alternatively, Canada might consider a course of the type offered by the Northampton College of Advanced Technology, in London, England. This school offers a "two-year postgraduate course in information science" to people who have specific science degrees and are employed in "information service". The courses are held two evenings a week and prepare students for the examinations of the Institute of Information Scientists. The alternative approach of summer courses and seminars, which has been successful in the business administration field, would also be helpful.

Fortunately, scientists, engineers, linguists, and administrators are entering the information field, all with new ideas. Many have had experience in data or information processing using computers and statistical approaches. Strides have been made in single areas, but often without regard for the entire information system. Overall planning of a system to take advantage of new technology remains to be done, and this is hampered by the lack of trained personnel.

A quotation from the U.S. Office of Education study[24] is pertinent:

> "There is no one best structure for the organization of the science information function in a government agency, industrial firm or research organization. One must weigh the variables of competition, company history, nature of the industry, legal statutes, business stability, relation of research to production, location and personnel. The only architect who can design appropriate, unique, overall answers to these information problems is the science information specialist intimately familiar with the situation."

VI.2.2 Technical Institutes

With the support of the Federal Government, the provinces have moved ahead strongly in the development of technical institutes. Thirteen of these have included library technician training in their curricula,[21] and it is expected that 20 to 25 institutes across Canada will be offering this type of training by 1971-72. At that time they could turn out some 500 technicians a year and continue to do so, provided library technicians prove acceptable in information work. If those responsible for the curriculum continue to seek and obtain the support and follow the guidance of librarians in this new development, acceptance can be made easier. One serious problem is that suitable instructors will be scarce because of rapid expansion of training institutes.

A training program should include basic sciences and humanities; general clerical and typing skills; data-processing principles; punch-card operations; computer terminal operation; photoreproduction processes; and library purchasing, circulation, cataloguing, and filing routines. Technicians could continue with on-the-job training and, in some cases, continue their education through part-time studies.

VI.3 User Training

Library and information services are of no benefit unless they are used. Designers of services must be aware of this and plan ways to encourage and guide the users. Attention should be paid to both graduates and undergraduates. For the former, seminars, workshops, and short courses on new services are needed. Good results have been achieved with training sessions instituted within an organization, as by some professional societies such as the American Management Association which carries on a most successful program.

The scientist as an author contributes to the flood of technical writing, and as a user is in danger of drowning in it. He must, therefore, be able to express himself clearly and succinctly, with consideration for the subsequent retrieval of what he writes. Good writing should be stressed as part of his education.

There is a growing realization of the desirability of having good public and secondary school libraries and of the necessity of having trained personnel in charge. It is interesting to note that the new library school at the University of Alberta has emphasized this. Training in the use of libraries is not usually part of a curriculum, nor are assignments that involve serious delving into books. Training in the use of information sources should start at this level.

In undergraduate study at universities, science and engineering courses seldom include instruction in the information sources available and their efficient use. Assignments that involve search for and correlation of data should be a required part of the instruction. If the science library were to set itself up as a model "information centre" offering selective dissemination, computerized search, selective catalogues, reactive computer terminals connected to data banks, and microfilm indexes with reader printers, instruction in information handling would take on new impetus and purpose.

Section VII

RECOMMENDATIONS

VII. 1 Planning

Nation-wide planning is required for the development of automated facilities and associated communication networks which will play an important role in improving the quality and broadening the scope of the scientific and technical information services provided by universities. This must ensure the optimum allocation of resources with some viable balance being established between the continuation of existing services on a manual or semi-automated basis and the development of comprehensive automated services.

It is suggested that pilot projects be established in several regions, each including a number of universities. From the experience gained with these projects, a nation-wide university information system which would include existing and planned facilities should be developed as an integrated university resource.

There is a need for a national agency to co-ordinate Canadian scientific and technical information developments on a nation-wide basis, and for the university information services to co-operate with the agency. The universities should set up national and regional groups to work with the national agency in implementing plans for an integrated information network.

Therefore, it is recommended that:

A task force be established by the Association of Universities and Colleges of Canada, or a similar body, to plan a university information network which would develop in phases from present resources to a fully integrated nation-wide network. This planning must encompass:

- Co-ordination of library acquisitions;
- Realistic discard programs for libraries;
- Regional stores for infrequently used items;
- Referral services with regional outlets;
- Special information services.

A national agency be established with responsibility for stimulating, assisting, and co-ordinating the development of information systems in all sectors of the economy.

National and regional university groups be organized to work with the national agency in developing the university information network.

VII. 2 Community Involvement

The university is usually the largest single scientific and technical information resource in a region, yet in only few instances are there effective procedures whereby this resource can be used by the community at large. Universities should consider establishing liaison officers to provide services that will assist local industry with problem-solving, and generally facilitate technology transfer.

It is recommended that as automated information network operations become more widespread, the universities should assume a responsibility for providing scientific and technical information outside the academic sphere.

VII. 3 Research

Little research in the field of information science is being conducted in Canada, and such effort as does exist is being funded from a variety of sources and is developing on a sporadic basis. For better results it will be necessary to establish goals and priorities in this field and to co-ordinate the research to achieve these goals. In particular, there is a great need for research into mechanisms of technology transfer, on man-machine interfaces, and on communications techniques.

Therefore it is recommended that goals and priorities be established for research on information science and adequate funds be provided to support such research.

VII. 4 Training

It would be desirable to reorganize the library so that it becomes an intellectual resource capable of serving users in many ways. However, a shortage of qualified professional people at all levels is seriously retarding the development of improved information resources. There are few advanced academic courses dealing with the new information technology that cater adequately to librarians and information scientists, and there is a need for at least two advanced training programs–one in French and one in English. Also, little appears to be done to make users aware of the resources available to them and how the resources may be exploited.

Therefore it is recommended that universities develop curricula to train the variety of personnel needed to plan, develop, and operate a comprehensive information network and encourage the development of courses which instruct and involve the user in the exploitation of information resources.

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[20]Asheim, Lester, *ed.* Library manpower needs and utilization; a conference co-sponsored by the Office for Library Education and the Library Administration Division of the American Library Association, with the co-operation of the National Book Committee, March 9-11. Chicago, Illinois, American Library Association, 1967.

[21]Marshall, J.M. *In* Library technicians: a new kind of needed library worker. Report of a conference on library technology, sponsored by Catonsville Community College, held in Chicago, Illinois, May 26-27, 1967. Washington, D.C., Communication Service Corporation, 1967. pp. 19-24.

[22]Canada. Dominion Bureau of Statistics. Survey of libraries, Part 3: library education 1960-65. Ottawa, Queen's Printer, 1967. (Catalogue No. 81-532.)

[23]Cohan, Leonard, and Kenneth Craven., *loc. cit.*, p. 26.

[24]*Ibid.*, p. 13.

Part C

Training Information Managers

Section I

INTRODUCTION

Since World War II the nations of the world have poured increasingly vast sums of money into research. Today, this expenditure amounts to an estimated 0.7 per cent of the Gross National Products of the world, while expenditure on what is described as research and development is even greater.[1] The results of this research eventually find their way into print, with the consequence that the amount of information recorded each year has been increasing exponentially. This rapid increase in the volume of scientific and technical information is now referred to as the "literature explosion". However, it would be better to think of it as the exponential growth of an international resource, which the technological nations of the world must exploit if their society is to advance. Bonn, in his report to the National Research Council in 1966,[2] touched on the resource concept of information and the responsibility for developing it, saying:

> "Ever since the 1958 International Conference on Scientific Information in Washington, there has been a growing conviction among responsible bodies of scientists, engineers and information specialists that *science information is a national resource* and that the development of science information as a national resource is the direct responsibility of the national government."

If scientific and technical information is to be regarded by Canadians as a national or international resource, we should concern ourselves with its efficient conservation, exploitation, and management. This means we must train people to manage the resource; it also means we must train our whole technical community to recognize the value of this resource and the rewards that will accrue from its efficient exploitation. The Training Subgroup directed its attention to this twofold problem. It concerned itself with the question of who should manage the resource, where they should be trained, and how they should be trained. It gave some consideration to who should help these resource managers, where they might be trained, and how. Finally, it turned its attention to how the people who ought to be using the resource should be trained to realize its value and to use it with enthusiasm.

Section II

INFORMATION MANAGEMENT

The term "Information Management" as used in this chapter involves the generation of information, its acquisition, its dissemination, its storage, and its retrieval.[3] It implies that all these things should be done efficiently, economically, and to the complete satisfaction of the user.

II.1 Information Generation

That people concerned with the management of information should concern themselves with its generation may at first appear surprising, but there are two very valid reasons for this concern. First, if a report or technical paper is written clearly and concisely, the information it contains is easier to disseminate and easier to index and retrieve—all of which benefits both the user and the information handler.* Second, people who have given serious thought to the volume of scientific and technical information being generated in the world today have begun to question whether the traditional method of transferring information by book, technical journal, etc. is in fact the best. New concepts have been advanced, various new and esoteric ideas for scientific communication have been suggested—generally by scientists working in their traditional disciplines and hence strongly influenced by their peculiar circumstances. Obviously, any new methods of information transfer, whether these are implemented early or late, or at all, must come within the information handler's sphere of interest. If the people managing the information resource are to be concerned with acquiring, disseminating, storing, and retrieving it, they must also concern themselves with seeing that it is generated in a form that will enable them to carry out all these functions efficiently and effectively, now and in the future.

In briefs submitted to the Study Group, in meetings that the Group held across Canada, in discussions with the Study Group's consultants, and in the literature, strong support was found for the production of "state-of-the-art" reviews as a means of both controlling the size of the information store and aiding in the transfer process. Most people who support the generation of this kind of "secondary information" see it as a function of information management.

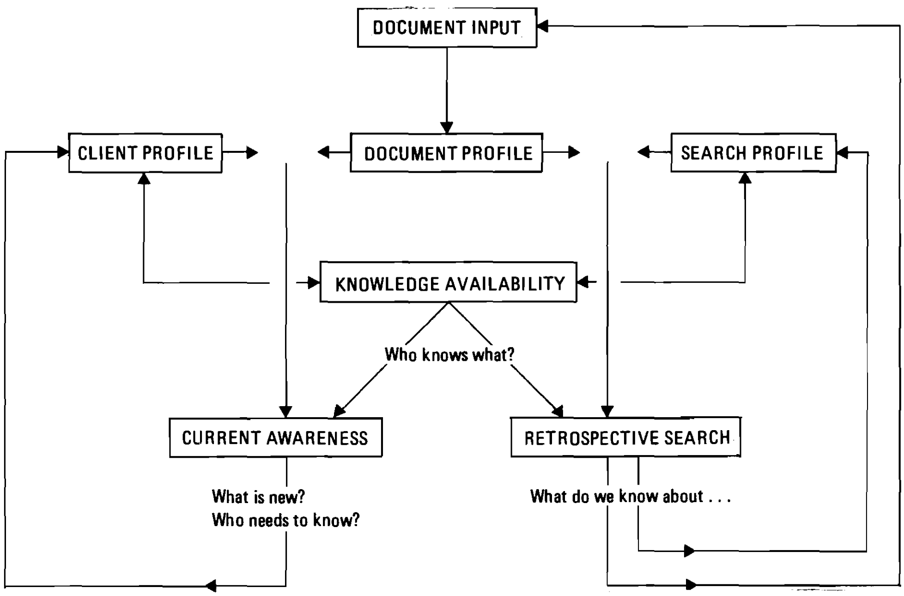
II.2 Information Acquisition, Dissemination, Storage, and Retrieval

Few people question that the management of the information resource involves the efficient and economical acquiring of information, its communication

*Incidentally, if the reports produced by graduates of Canadian universities entering industry are any criterion, something must be done to improve the standard of information generation.

to people in the "need to know" situation, and its storage (when this initial communicating function has been met), so that it can be found to meet the "what is known" function. Other subgroups have discussed the problems of doing this in Canada today, how it might be done better, and the techniques that might be applied to do it more effectively on a national scale. The Training Subgroup has devoted its attention to what people are available to do this today, how they are trained, and what people might be needed to build a comprehensive information "intelligence system" such as is illustrated schematically in Figure 1. In fact, it might be stated that the first problem the Training Subgroup addressed itself to was: "What personnel do we need to help us manage the vast international resource that scientific and technical information has become in the world today?"

Figure 1.–Information intelligence system



A document is defined as anything that contains information. It may be a textbook, a tape, a microfilm, a technical report, or a "memo to file"; just as long as it contains information it is a candidate document for the system.

Section III

INFORMATION PERSONNEL–MAJOR CATEGORIES

The Training Subgroup realized that it had to be concerned with people who would work at various levels of responsibility ranging from chief to clerk, and for agencies variously designated as public and university libraries, referral centres, information centres, information bureaux, special libraries, document-service centres, or information analysis centres. It found information personnel called–according to their tasks and qualifications and often according to sheer preference in nomenclature–librarians, science librarians, special librarians, documentalists, library technicians, indexers, information officers, information technologists, information scientists, and information specialists.

Influenced by the reported experience of the United States and Europe [4,5,6,7,8] and recognizing that synonyms for all the titles it selected exist and will continue to exist, the Training Subgroup is of the opinion that Canada's needs for information personnel can be met by three types of professional: Professional Librarians, Information Scientists, and Technical Information Specialists; and that these people will need the help of two types of non-professional: Library Technicians and Information Technologists. Because of the semantic fog that enshrouds this nomenclature, and with the hope that those who may prefer other titles will at least recognize the activities and roles of these five professional and non-professional types, they are individually defined and discussed below.

III. 1 The Professional Librarian

The Training Subgroup accepts the Dominion Bureau of Statistics definition:[9]

> "A professional librarian is a librarian with a university degree and at least one year of additional professional training, e.g. B.A., B.L.S."

and would point out that this is the professional group with the biggest involvement in information management in Canada today.

The professional librarian's work and, hence, experience tend to be specialized according to function (acquisition librarian, cataloguer, reference librarian, etc.), type of library (university librarian, public librarian, "special" librarian, etc.), or subject (science librarian, fine arts librarian, etc.). Of these specializations the most important, as far as scientific and technical information service is concerned, is that of science librarian. Ideally at least, the science librarian is someone with degrees in both science or engineering and librarianship, e.g. B.Sc., B.L.S. This means he has the subject background and the bibliographic training to provide the scientist or engineer searching for information with informed and skilled personal help. Furthermore, since he meets these people as a peer, his help is often more readily accepted. In practice, however (and this is a point worth emphasizing), this combination of qualifications is not readily found, and many perforce serve as science librarians who have not previously taken a degree in science; they have simply learned what they could of the subject on the job.

III. 2 The Information Scientist

Until about half-way through its work, the Training Subgroup had difficulty finding a definition for an information scientist. The field was both new and derivative, and to describe him as a graduate of a recognized school of information science would have been unilluminating and, in many cases, untrue. While a few universities and institutes in the United States, such as Georgia Institute of Technology, Lehigh University, and the Universities of Michigan, Pennsylvania, and Texas, now have separate schools of information science (see Figure 2 for sample curriculum) and generally grant a postgraduate degree in that subject,[10, 11, 12, 13, 14] in Canada the information scientist still tends to be the product of self-training in industry or the by-product of training in computer science.

Recently, the American Documentation Institute changed its name to the American Society for Information Science. In doing so it came up with a description of information science and, by inference, what an information scientist does. The Society said:[15]

> "Information science as a discipline seeks to create and structure a body of scientific, technological and systems knowledge related to the information transfer chain .... (It) investigates the properties and behavior of information, the focus that governs the transfer process and the technology required to process information for optimum accessibility and use. Its interests include information in both natural and artificial systems; the uses of codes for efficient message transmission, storage and recall; and the study of information processing devices and techniques such as computers and their programming systems.
>
> "It is an interdisciplinary field derived from and related to mathematics, logic, linguistics, psychology, computer technology, operations research, librarianship, the graphic arts, communications, management and similar fields."

The whole question of the information scientist, his training and his contribution in the field of information management, was presented in a position paper by Professor Doreen Heaps (see Appendix A, item 2).

III. 3 The Technical Information Specialist

The technical information specialist, at least by that name, is also new and difficult to categorize. Nevertheless, in the sense that it is used in this report, a technical information specialist is a scientist recognized by his peers as competent in his discipline, who is prepared to devote his energies to working with the literature of that discipline for the assistance of those peers. That is, he should be knowledgeable enough in the science of information management to be able to find material in the vast corpus of information being generated today, and be able to condense, synthesize, and direct or communicate the results so that they will be of

Figure 2. – Information science curriculum – Georgia Institute of Technology (circa 1960)

Modern Algebra Probability with Applications Mathematical Statistics Experimental Statistics Psychological Statistics Algebraic Topology Random Processes Information Theory Introduction to Game Theory Mathematical Logic Mathematical Linguistics (Seminar) Mathematical Techniques for Information Science Philosophy Methods for Information Science Topics in Linguistics Languages for Science and Technology Non-numeric Information Processing Electronic Data Processing Computer Organization and Programming Computer Techniques for Information Storage and Retrieval Compiler Writing (Special Problems Course)	Communication and Control of Information Human Information Processing Information Representation and Structures Methods of Information Control, I, II Theory of Classification and Indexing Scientific and Engineering Literature Information Sources and Search Techniques Special Problems in Literature Analysis Methods and Systems Analysis Work Systems Design Project Management Systems Design Systems Engineering I - V Information Systems Design Equipment of Information Systems Reliability Theory and Practice Operations Research I - III Principles of Feedback Control Development of Management Thought Organization and Management of Information Systems Special Problems in Information Science

benefit to his peers.[16] (Having examined that definition, some may recognize in the term "technical information specialist", as it is being used here, such titles as information officer, scientific information officer, information specialist, technical literature analyst, documentationalist, literature chemist, documentation specialist. Others may even question the difference between a technical information specialist and a science librarian as described earlier.)

III. 4 The Library Technician

To date, the major portion of the information-handling field has been left in the hands of the professional librarian. So, too, has been the training of the non-professionals whom these librarians need to help them in their daily tasks. Generally, this training has been done in-house and has naturally varied from unit to unit depending on local need. It has been suggested[17] that the lack of adequately trained personnel has forced the professional librarians to spend their time on tasks that neither demand nor exploit their professional education. It has further been suggested that formal, i.e. classroom, training of high-school graduates would produce a cadre of personnel equipped to handle semi-professional responsibilities, thus enabling a more efficient division of labour.

A number of provincial institutes of technology and junior colleges across Canada have introduced training programs for library technicians—people who would be for the librarian substantially what laboratory technicians are for the scientist. However, it cannot be too strongly emphasized that so far the librarians' acceptance of these technicians is by no means unanimous, and that some of the doubts about their value may at this stage be quite legitimate.[18, 19] Nor should this prove surprising: every profession that now avails itself of the contribution of technicians, e.g. engineering, nursing, has undergone a period of acute soul-searching before accepting this contribution fully. The whole question of library technicians, their acceptance by the library profession, their potential contribution to the field of information management, and their training, was discussed in a position paper prepared by Professor John Marshall (see Appendix A, item 2). It is Marshall's opinion that:

> ". . . as more and more (library technician training courses) have become *faits accomplis*, librarians have taken a second look. As a result their open opposition, vigorous heel-dragging and stubborn back-turning have for the most part given way to qualified support . . . . "

III. 5 The Information Technologist

The same reasoning that dictated the emergence of formal training for library technicians has already suggested that another kind of technician, the information technologist, might also make a very real contribution to efficient information management. Considerable support was found for the idea that people should be trained in Canada for this role. The constant appearance of new technology—which the forward-looking information service unit must exploit if it is to begin to cope with today's exponentially increasing volume of scientific and technical information—suggests that just as engineers have had to have the help of engineering technicians, so information scientists will need the help of information technologists. The need for, and the role of, the information technologist was discussed by Professor Heaps in her position paper.

III. 6 The Science Librarian - Technical Information Specialist - Information Scientist Interface

Having looked at the problem of what kind of people we need in Canada to help manage the information resource, the Training Subgroup examined the question of the actual roles of the professionals involved. It cannot be too strongly emphasized that, while most people with whom the problem was discussed agreed that the science librarian, the technical information specialist, and the information scientist had roles to play in Canada today, when it came to where they would play them there was no agreement at all. The science librarian school felt that, given the opportunity, it could do the technical information specialist's job; the dedicated librarian saw no real need for the information scientist; and the extremist information scientist would abolish the professional librarian entirely. Debate on this subject is generally heated and almost invariably biased.

With some trepidation, and realizing that it may be stirring up even further argument, the Training Subgroup has attempted in Figure 3 to summarize the areas of major commitment of these professionals. It is realized, of course, that emphasis will vary from unit to unit and that no line in the diagram should be regarded as hard-and-fast or immovable. In fact, the interface will undoubtedly stay ill-defined for some time, until the demands of the present fluid market for information

Figure 3. – Work relationship between science librarian – technical information specialist – information scientist

Duties		Librarian	Information Specialist	Information Scientist
1. Information awareness (Finding out what has been generated? where?)	(a) Books			
	(b) Government reports			
	(c) Articles from periodicals			
	(d) Preprints and reprints			
2. Selection of:	(a) Books			
	(b) Government reports			
	(c) Articles from periodicals			
	(d) Preprints and reprints			
3. Acquisition (purchase? loan? copy?)				
4. Dissemination				
5. Abstracting				
6. Indexing	(a) Books			
	(b) Government reports			
	(c) Articles from periodicals			
	(d) Preprints and reprints			
7. Storage (physical)				
8. Retrieval	(a) Reference (fact retrieval)			
	(b) Literature search (bibliography)			
	(c) Literature surveys (state-of-the-art reports)			
9. Data flow and control				
10. System maintenance				
11. System research and development				

personnel themselves crystallize and, in turn, dictate an appropriate division of duties among these groups. The Training Subgroup has not sought and will not seek to render debatable and useless *ex cathedra* judgments in this matter. It simply points out that three kinds of professional information workers now exist and will continue to be wanted in the foreseeable future. The matter of how, where, and to what degree they should contribute is not only far from being resolved but in many instances is still the subject of involved and bitter debate–a debate that goes far beyond the Training Subgroup's power to resolve.[20,21,22,23,24,25]

Section IV

INFORMATION PERSONNEL–SUPPLY AND DEMAND

IV. 1 Supply

The supply of information personnel in Canada today is reasonably easy to assess. As has already been pointed out, until very recently the field of information management in this country has been left to the librarian, and only for librarianship is the structure of educational preparation at all well established.

At the present time (summer 1968), Canada has six operating library schools. These schools are at McGill University, the University of Toronto, the University of British Columbia, the University of Western Ontario, the University of Ottawa, and the University of Montreal. The first three are "accredited" schools, i.e. they have sought and received approval by the American and Canadian Library Associations as having met the standards for accreditation. The others are working toward accreditation.* Two additional schools, one at the University of Alberta and one at Dalhousie University, are to begin operating in 1968. The University of Alberta Library School, as one of its priorities, hopes to fill the gap in school librarians. This may in time improve the general situation by improving the training of school pupils in handling information material. The University of Montreal also has a special concern in this area.

Of the six operating schools, one (McGill) offers a two-year course leading to the master's level; another (Western Ontario) grants a master's degree for an 11-month course. At British Columbia, Toronto, and Ottawa the basic program is an eight-month course leading to a Bachelor of Library Science degree; in the last two schools a second-year course, leading to the master's degree, is also available. The University of Montreal's *École de bibliothéconomie* has a unique program of two years' duration, combining librarianship courses with those in subject fields. All the library schools call for a bachelor's degree as a prerequisite to admission. The Dominion Bureau of Statistics reports that in 1967 the existing schools graduated 377 librarians, 63 of whom had M.L.S. degree and 314 B.L.S. degrees.

It is believed that no university in Canada today offers formal courses or degrees for the technical information specialist, and much the same statement can be made about the information scientist, although here the prospects are brighter. In the fall of 1967, the University of Alberta's Department of Computer Science began teaching "Fundamentals of Information Retrieval", and an introductory computer course which includes "text processing and other retrieval illustrations". The University of Manitoba will implement certain formal courses for information

9 *The University of Western Ontario Library School was accredited in January 1969.

scientists in 1968-69. (These activities and plans are discussed in some detail in Professor Heaps's position paper.) However, it appears that it will be some time before Canadian universities are producing any significant numbers of information scientists.

Programs for the training of library technicians began only in the 1960s, but the last three years have seen remarkable developments. There are now 13 schools that offer training in this field, of which seven began as recently as 1967. It is confidently expected that there will be 20 to 25 schools offering this training by 1971-72, by which time they could turn out some 500 technicians a year, provided these people do prove acceptable to the library profession. To the best of the Training Subgroup's knowledge, no information technologists are being trained in Canada today.

In summary, then, it can be said that to meet its needs for information personnel today, Canada graduates about 400 professional librarians and that is all, except for a few library technicians who are beginning to enter the field. Through the next few years we may expect to see the number of librarians graduating increase to about 500 a year. A few information scientists may be graduating, but the number will continue to be fairly small until the schools are properly established. By 1971 some 500 library technicians may be entering the field annually. Unless some immediate and drastic change occurs, however, there still will not be any technical information specialists or information technologists appearing.

IV. 2 Demand

Demand for information personnel is not nearly as easy to assess as supply. It is on the whole conceded that it considerably exceeds supply but, paradoxically, although this shortage is generally thought to be severe, its dimensions cannot be specified with precision and reliability. Canada does not now have any agency formally responsible for the collection of scientific and technical information manpower needs, and it will be one of the prime recommendations of the Training Subgroup that such investigations be regularly and carefully conducted by a special agency appointed and funded to conduct them, and that the results of these investigations and the statistical data derived from them be released for public examination as expeditiously as possible.

It should be noted that the absence of current, accurate, and reliable data in this field is not unique to Canada. The United States was early to recognize the value of the information resource and has been concerned with it since the publication in 1961 by the Senate of *A Study of Federal and Non-Federal Science Information Processing and Retrieval Programs.* Nevertheless, a recent study deplored the "noticeable drawbacks" of American statistics on this subject,[26,27] and it is interesting to note the announcement of several significant studies currently being funded by the U.S. Office of Education, the National Science Foundation, and the National Library of Medicine, to investigate or to try to collect these data.[28]

Clearly, no unofficial and intermittent attempts to gather data can hope to yield information of the requisite completeness and authority. In fact, some feelings of frustration at these attempts were noted among information personnel. Equally clearly, any attempt to gather such data was beyond the scope and abilities of the Training Subgroup. Nevertheless, from the data now available in Canada one can, with reasonable confidence, determine at least the order of magnitude of this shortage of information personnel, and the principal items of evidence are presented below.

First, however, it is probably appropriate to re-emphasize that, while ideally the management of scientific and technical information calls for each information centre or library to employ staff encompassing a variety of specialized knowledge and skills,[29] in Canada today formal training exists only for librarians and, to a limited extent, information scientists and library technicians. Even in the one area where Canada is exerting real training effort, i.e. the production of professional librarians, there is evidence to suggest that it is not doing enough. In 1965 Rothstein[30] made a count of the "beginning professional vacancies listed with Canadian library schools" in the belief that "an unduplicated count of vacancies listed with the schools represented reasonably well the market for new graduates". He found that the demand was for 499 graduates, or 25 per cent more than the library schools produced that year.

Other studies suggested that the demand and, hence, the shortage, is likely to increase. In 1964, Bassam[31] estimated the number of librarians needed to meet Canadian requirements from 1964-65 through 1970-71. Starting with a figure lower than Rothstein's, she projected a steady growth, rising to well over 500 in 1970. More recently (1967), a Canadian Library Association survey[32] estimated that through the next five years 500 to 750 graduates would be needed annually. The Dominion Bureau of Statistics,[33] basing its figures not on the positions likely to be actually budgeted for but on the number of people who would be needed to give optimum library services, stated that "18 850 (would be) required as of January 1, 1966".

The DBS figure may well be regarded as completely utopian, but it should not be disregarded altogether. On the other hand, the gap between demand and supply of librarians might be estimated at a minimum to be running at about 150 to 200 graduates a year. Newly established library schools at the University of Western Ontario, the University of Alberta, and Dalhousie University will augment the supply of new graduates; so will the expansion of enrolment at existing schools. However, it is believed that the shortage of trained personnel is likely to persist and, unless positive action is taken to attract more people into the profession, may even increase as Canada faces the need to exploit the scientific and technical literature of the world.

More important from the point of view of this study is the fact that, even if library school enrolment increased considerably, the output of science librarians will still, under present conditions, fall far short of requirements. In 1962, Dr. J. E. Brown[34] found that in 71 Canadian libraries specializing in the handling of scientific and technical information, only 19 per cent of the librarians held science degrees. This was in spite of the fact that the libraries reporting felt "it was highly desirable for the ... librarians to have training in librarianship and the subject specialty of their library". More recently, Piternick and Brearley[35] found that the proportion of science graduates enrolled at accredited Canadian library schools in 1966-67 was only 8 per cent.

During its deliberations the Training Subgroup was asked: "Is there in fact a shortage of librarians? That is, if Canada had the information scientists, technical information specialists, the library technicians, the information technologists it should have to manage the information resources efficiently, would there be a surplus of librarians?" In the absence of definitive data this is, of course, an almost impossible question to answer. It might, however, be pointed out that in the United States, where these people have already entered the field, a 1967 report observed:[36]

> "... predictions indicate that the ratio of librarians to scientists and engineers is declining. Such data tend to highlight an unfortunate trend which has long-term ramifications. This growing shortage of trained librarians ... can be broadened to include all types of information science personnel."

In summary, then, although reliable figures on demand for information personnel in Canada were not available, there is considerable evidence to suggest that demand for all types of these people far exceeds supply, that this shortage of trained people is likely to increase, and that unless remedial action is taken, and taken immediately, the effectiveness of Canada's scientific and technical community will be jeopardized.

Section V

NATIONAL GOALS IN TRAINING FOR INFORMATION PERSONNEL

V. 1 General Problems

Attention was next directed to the problem of how and where additional personnel to fill this national lack might be trained, and how more of the right kind of people might be attracted into the field of information management. The task was not made easier by a conviction that, with the time and expertise available, it would be presumptuous in the extreme to attempt to tell the universities and other educational institutions how to design their curricula. In fact—and this cannot be too strongly emphasized—it was recognized from the very outset that the Training Subgroup had neither the time, the expertise, nor the audacity for such a task. Rather, the approach adopted was in keeping with certain sentiments expressed recently by Dr. O. M. Solandt, Chairman of the Science Council of Canada:[37]

> "Any plan for the management of science must have a goal or some goals explicitly stated.... Scientists... would be presumptive (sic) if they tried to formulate national goals, but they have a duty to point to the lack of goals and to suggest means of formulating them."

In this spirit, the following paragraphs attempt to:

(1) Point to some of the restrictions that ignoring the problems associated with the need to train adequate numbers of the right kind of information personnel has imposed on the nation;
(2) Show where lack of clearly defined goals is leading the nation and how such goals might be formulated.

While Canada needs to train an adequate supply of information personnel (regardless of the synonyms used to describe them), the matter of what constitutes "an adequate supply" of these people is far from resolved, as is the matter of how, where, and to what degree they should contribute. Consequently, it is of paramount importance that the national governments address themselves to the problem of collecting data that will make it possible to remove this debate from the realm of personal sentiment into that of statistical tolerance.

The Training Subgroup with its colleagues in the Study Group believes that Canada needs and must develop a national information network which will both take advantage of today's advanced technology and be capable of evolving to take advantage of tomorrow's. It yields to none in its acceptance of the Information Centre and its concept of specialized service to the scientific and technical community. Specifically and immediately, it believes that Canada's information personnel must, in order to advance their efficiency and services, avail themselves of all that the digital computer and telecommunication have to offer them. However, it also believes—and this again cannot be too strongly emphasized—that Canada cannot hope to make the most of this "brave new world" without the understanding and wholehearted co-operation of its professional librarians. It is of basic importance that they appreciate:

(1) The inestimable advantages to be derived from having a cadre of information personnel specifically trained for the various roles that we see as essential to the management of the information resource;

(2) The ability of the recently developed computer techniques to banish much of their formerly inevitable drudgery.

By the same token, it is equally important that the personnel with other roles, notably the information scientists, appreciate the invaluable contribution that professional librarians can make to their efforts; that all, in fact, in the field of information handling accept and profit from their interdependence.

As a result of having ignored the problems of information management through a critical period of that science's evolution, probably the greatest restriction Canada suffers today is the deplorably small number of people who are qualified to teach the science. In 1967, six library schools reported a total of 51 full-time faculty members, of whom 6 were deans or directors, 12 held the rank of professor, 13 were associate professors, 19 assistant professors, and 1 a lecturer.[38] As the library schools attempt to introduce the M.L.S. course, the problem of finding adequate staff will become even more acute. In this connection it is worth noting that the new schools—Alberta, Dalhousie, and Western Ontario—had to go outside Canada for their directors. Nor do we find the situation reversed if we look at the information scientist route to information management via computer science.

To compound the difficulties, if the Ph.D. degree is to be taken as the desired diploma for the university faculty, then Canada is training no potential instructors for either its library schools or the schools of information science it may need in the near future. Certainly, Canada must strive to overcome these deficiencies, but this cannot be done overnight. Equally obviously, until these deficiencies can be overcome Canada must organize and plan to get maximum returns from the minimum work force she has available. These facts should seriously concern those who are responsible for the training of Canada's information personnel through the next decade.

Just as Canada has done little to train the people she needs to teach the science of information management, so has she contributed little in the way of research in the field. No substantial resources for this purpose have been made available to the library schools, nor were there signs of many sizable contributions that would enable the Departments of Computer Science to undertake research into information science problems. Yet Canada's information management calls for research by Canadians in a Canadian context, in the light of this country's peculiar problems. Just as it believes that Canada's professional information personnel must work as an integrated team, so too the Training Subgroup believes that research in information management must be thoroughly integrated and directed to the areas from which Canada will derive maximum benefit.

V. 2 The Science Librarian

Probably the greatest problem that confronts those responsible for librarian training is that of attracting the right kind of person into the profession. This becomes particularly acute in the case of the science librarian. Undoubtedly, to attract more of the right kind of person into this profession should be a national goal.

As it addressed itself to the problem of how this goal should be achieved, the Training Subgroup became confirmed in its opinion that the profession of librarianship is much maligned. There can be little doubt that, if Canada is to get the people it needs to manage the scientific and technical information resource, this situation must be rectified. As it recalls with pleasure the dynamic and dedicated professional librarians it met during its visits across Canada, the Training Subgroup is confident that these people, with the help of their professional association, can achieve this, and it is suggested that they make a deliberate effort to do so. (By the same token, the Training Subgroup would join them in regretting the necessity.)

To date, the profession of librarian, and of science librarian in particular, has not received the same kind of scholarship support as have the scientific and engineering disciplines. This question is discussed in detail in the position paper of the University of British Columbia's School of Librarianship (see Appendix A, item 2). Suffice it to state here that the whole competitive position of science librarianship vis-à-vis the other professions is poor.[10] Piternick and Brearley[35] showed that, in respect to both scholarship assistance for graduate study and salaries offered after completion of training, science librarianship now offers far less than other professions seeking to attract science graduates. In 1965 the median salary for library school graduates was about $1 000 less than for engineers who had put in the same number of years study.[39] In 1967, scholarship funds for science graduates at UBC School of Librarianship averaged $468 as compared with $2 500 for science graduates in other departments of the university. One obvious step toward achieving the national goal of inducing more of the right kind of people to become science librarians would be to make a serious attempt to close this scholarship gap. (The rules of the marketplace must be left to take care of the salary gap.)

Apparently, one of the reasons the library profession has been unattractive to the science graduate is "the unglamorous image which the subject presents, particularly to the engineers, mathematicians and scientists who ought to be recruited into this branch of activity".[40] (To these people, the typical librarian has continued to be a little old lady in tennis shoes.) There may have been some truth in this kind of statement when the Canadian library schools were strongly oriented to the B.L.S. degree; after all, there is only so much that can be taught in an eight-month course. Recently, however, (and not entirely uninfluenced by "formula financing"), a significant new development has been getting under way as to the length of course and type of degree awarded by Canadian library schools. It seems likely that the one-year course leading to the B.L.S. degree will be dropped in favour of a longer one (either 11 months or two years) leading to a M.L.S. degree. It should be a national goal to ensure that these courses are not only attuned to turning out people who know and can work with today's and tomorrow's advancing technology to further information management, but challenging enough to attract the graduate scientist and engineer.

V. 3 The Technical Information Specialist

Other countries that have faced up to the need for technical information specialists (albeit they may have described them by other titles) have tended to set up separate courses specifically for their training. Most of these courses include a good many of the fundamentals of librarianship, plus instruction in "presentation of information", "language, writing and editing", and "flow of information". Proponents of such separate courses claim that the techniques with which the technical information specialist is concerned "include a variety of subjects not relevant in a librarian's training (and) also require . . . a fundamentally different approach and emphasis on what might appear to be common ground".[41]

Nevertheless, what is good for other countries is not necessarily good for Canada, and in a number of these countries the conditions that induced the decision to separate training do not necessarily exist here. It must also be borne in mind that Canada lacks teachers in the information field. Even today, Canada's B.L.S.-slanted schools offer some courses directed specifically toward the scientific and technical information field. The present curricula usually include courses in the literature and bibliography of science and technology; indexing, abstracting, and literature-searching; advanced reference service; "special library" methods; introduction to automation and systems analysis. Restructuring and extending these curricula may well make it possible for the existing library schools to undertake the training of the technical information specialists needed. This is, however, by no means an endorsement of the library school as the training ground for the information specialist; it merely points out that the possibility does exist. By the same token, the possibility also exists that the information science programs, when these are firmly established and if their curricula are appropriate, may also provide a training ground for the technical information specialist.

It is one thing to see a need in a particular field; it is quite another to convince other people of this need and that they should train themselves to fill it. Even when they become available there could be a continuing difficulty in recruiting students for technical information specialist courses. Today, such specialists are usually senior scientists who are long past their student days and naturally reluctant to undertake formal courses. Attractive scholarships may help convince some that such courses are worthwhile but to start with, as Dean Bernard Fry[42] suggests, most of these information techniques will have to be imparted by way of workshops and symposia. Once, however, a younger generation realizes that this field offers the chance of a rewarding and challenging career, other training possibilities can be entertained.

As an evolutionary step from workshops and symposia toward a full academic course, Canada might consider a course of the type offered by the Northampton College of Advanced Technology, in London, England. This school offers a two-year postgraduate course in information science to people who have specific science degrees and are employed in "information service". The courses are held two evenings a week and prepare students for the examinations of the Institute of Information Scientists. (It is interesting to note that "students are required on completion of the course to carry out a 12-month practical assignment in a respective commercial or industrial institute"[43].) However, it must be confessed that it is difficult to visualize a community in Canada today that has so many people wanting training in this field as to make this kind of extension course worthwhile.

V. 4 The Information Scientist

Professor Heaps suggests that no definitively "best" route for training information scientists in Canada has yet been found. There are in effect three routes available today: one through a "souped-up" School of Librarianship, another through information science courses in the schools of computer science, and a third, Western Ontario's combination of a School of Librarianship and Information Science. There is also a fourth route that deserves consideration–the establishment and support of a School of Information Science independent of both established library schools and schools of computer science, along the lines of the information science schools of the United States.

As yet the plans of the library schools as they move from the B.L.S. degree toward the M.L.S. degree are necessarily somewhat fluid. Certainly they have the opportunity to do more for the information scientist. They have the opportunity to include his training in their new curricula. Yet, giving them the computer expertise and access to the type of computer they need to develop information scientists might prove costly and inefficient at this particular time. By the same token, placing too much faith and emphasis on the schools of computer science may be to ignore the knowledge and understanding that generations of librarians have built up, and to risk developing a specialist who can neither communicate with his fellow information managers nor understand the information store and its clients' needs in any practical way.

Given these considerations, one cannot fail to be excited about the Western Ontario venture, though one must remember that the school only began in 1967-68 and has not had a chance to analyze the results of its training. However, if it lives up to its early promise it may prove to be the training route for both the science librarian and the information scientist.

By and large, the problem of where information scientists should best be trained in Canada is so far from being resolved, and the need for them is so acute that a national goal should be the support of all four training routes until definitive study, in the marketplace, can show which one produces the scientist best suited to the manifold and varied tasks to which he has been called.

Finally, as in the case of science librarians and technical information specialists, there is the need to attract the right kind of people into the profession, and those charged with developing curricula in any of the three present routes or the potential fourth would be well advised to make this one of their primary goals. Certainly, as was suggested in the case of the science librarian and technical information specialist, the provision of postgraduate scholarships at least equivalent to those available in the science and engineering faculties would appear to be a minimum incentive.

V. 5 The Library Technician

The training of library technicians is dealt with in the position paper prepared by Professor John Marshall, and the Training Subgroup agrees with Marshall's statement that:

> "No development is likely to have such far-reaching implications for the future of libraries and librarians as the rapid emergence of library technician training courses in both Canada and the United States."

Marshall draws attention to certain weaknesses in many of the existing training programs, being careful to point out that most of them are "familiar characteristics of pioneering programs and result often simply from the haste with which they have been arranged". The elimination of these weaknesses is undoubtedly an attainable national goal. A statement of Marshall's that carries serious implications for all concerned is:

> "In some areas (there is) a noticeable lack of support from the profession, meaning of course, primarily, the administrators who must give the lead. The library technician programs depend for their success upon the advice, co-operation and active support of local librarians, in recruitment, shaping curricula, opportunities for observation and practice work, use of local collections, guest lectures, placement, evaluation and feedback. Consequently, the programs are extremely vulnerable to any withdrawal of support, especially in their initial stages."

Surely it is not too much to suggest, as a national goal, that this support be forthcoming. In this connection, the Canadian Library Association's efforts to provide "some uniform guidance as to standards applicable in every province" are most commendable.

V. 6 The Information Technologist

Although the Training Subgroup recognizes the need for an adequate supply of information technologists, during its investigations it encountered little expression of this need. Rather, those who had considered the contribution such technologists could make appeared to see them emerging as a kind of concomitant to the emergence of the information scientist. The national goal, however, should surely be to recognize the need for the information technologist as inevitable, and to prepare now to meet it.

One cannot escape the thought that the development of the information technologist might be linked with that of the computer technologist, in the schools of technology and junior colleges. Certainly, as the computer and computer technology continue to make their increasing contributions to the operation of libraries and information centres, there can be no doubt that the profession will need what the information technologist can offer, and that he will have to be trained accordingly.

V. 7 Continuing Education of Information Managers

To quote Professor Kurmey:[23] "Today's knowledge has a high obsolescence rate." In no field is this more true than in information management. New concepts and new techniques are being announced almost daily, and it is significant that an activity that was generated by an expressed need to help the scientists and technicians control the literature of their disciplines now has some difficulty in keeping pace with its own literature. New abstract journals designed to help the information manager follow or control the literature of his field are proliferating–a sure sign that this literature too is becoming so voluminous that the information manager now has trouble managing his own information. In fact, one industry-oriented information centre was encountered which, to keep its four information scientists and two science librarians up to date with their interests, subscribes to 10 journals, 4 current awareness serials, and 1 abstracting journal.

All this suggests that today's graduates from the schools of information management, no matter what they are called, must have access to some kind of continuing education if they themselves are not to become technically obsolete. It should be a national goal to see that this continuing education is available for them. Nor will this be easy: the available teaching staff is already very thinly spread, and it may be necessary to supplement their efforts by arranging special visiting lecture tours and the like. However it is arranged, this is a training goal of prime importance and one which, tackled now, could yield amazing returns.

V. 8 User Education

It would be an exercise in futility to foster scientific and technical information as a national resource if the nation's scientific and technical community ignores it or finds the store unusable except by specialists. It is, therefore, of paramount importance that this community learns how to use this resource, a problem that is dealt with in some detail in the position paper by Mara Karnupe (see Appendix A, item 2). In this sense, "use" goes far beyond knowing how to find material in a library or how to take advantage of the facilities of an information centre. It reaches out to embrace the fundamental belief that all research and every project should start with a survey of the appropriate literature, and the equally fundamental belief that the scientist or technician who does not read invites professional obsolescence.[44,45,46,47,48] Nor is this entirely a one-way street. Those information personnel concerned with the systems of the future would do well to accept the fact that:[49]

> "Any application of technology to (information) activity will have to be engineered to be humanly acceptable, since there will be resistance to them all–to the use of microform in place of books, to console-typed texts instead of print, to engaging in complicated interaction with a machine, to reading in a fixed place without moving around. The machines will breed their own resistance to the extent that they place restrictions on people."

Be that as it may, in considering how Canada is to train its scientists and technicians to exploit the world's outpouring of scientific and technical information, it became apparent that there were really two problems: (1) What can be done to help educate scientists and technicians already practising? (2) What can be done to help educate those now entering the scientific and technical professions?

With the present drastic shortage of information workers, it would appear that Canadian scientists and technologists cannot avoid having to do much of their information work themselves. It would also appear that, at least for some time to come, the education they need to do this efficiently will have to be extracurricular and offered under the heading of "continuing education". The most effective way of providing such continuing education would be to stage a regular series of short courses and seminars in various parts of the country.[50] These would involve some form of practical work as well as lectures, and should be buttressed by an array of specially commissioned teaching aids, including films. In this connection, the successful experience of the National Lending Library for Science and Technology (NLLST), in the United Kingdom, in designing and mounting such courses might well provide an appropriate model for a Canadian effort.[23,25,51,52,53]

The development of teaching aids appears to be a matter of considerable importance, since most people attending the courses offered by the NLLST felt the need for teaching aids in this field. Canadian scientists and engineers seem to share this view, for it was found that many were enthusiastic about the possibility of providing text and films to guide scientists and technologists to the literature of their specialties. Such guides, however, take time to produce and also need regular updating. Nevertheless, they are definitely needed and should be made available to the public and, specifically, to the scientific and technical community, at a nominal cost.[54]

Turning to the training of people entering the scientific and technical professions, the Training Subgroup found it could support a concept which others might regard as utopian: that both universities and high schools should teach the value of scientific and technical information by involving their undergraduate students with it in a practical manner.[10,55] By this is meant a situation whereby students, having been introduced to the library or information centre in their first year, are given through subsequent years assignments that involve searching the literature and that could be marked on both technical content and success in finding the recorded information. This kind of formal instruction in the use and value of scientific literature should be abetted and reinforced by ample personal assistance from reference librarians. A reference librarian with good knowledge of the scientific literature can, in personal interviews with the individual student, do much to make clear just how the general principles of literature searching can be applied to the specific subject he is investigating. In short, both personal tutoring and classroom instruction should begin in high school and continue through university.

This idea was discussed with various university groups without arousing any general enthusiasm. Lack of time and staff were cited as militating against its acceptance. This extremely negative reaction must be overcome. In fact, it should be a national goal to ensure that the knowledge of how to gain entry to the world's store of scientific and technical information is taught to every Canadian and not just to its embryo scientists and technologists. Unless this can be made a national goal, Canada's national prospects will be extremely dim.

At this point attention should be drawn to the outstanding brief submitted by the Canadian Library Association. A survey that the Association conducted found the libraries of the elementary schools, secondary schools, post-secondary schools, colleges, and universities barely adequate, and the Association makes some recommendations for improvement. The Training Subgroup would express the very sincere hope that those responsible will continue to regard these libraries as inadequate until use of the information in their stores is an integral and natural part of the educational process–as, it might be remarked, it already is in a good number of other countries.

One other aspect of user education must be mentioned: education in the information services of government agencies. Federal Government agencies spend, directly or indirectly, millions of dollars each year in information service; yet outside of Ottawa the scientific and technical community of Canada has strangely little knowledge of what it could and should expect for this enormous investment of the taxpayer's money. The Training Subgroup, therefore, strongly recommends that the Federal Government initiate, at the earliest possible moment, a campaign to educate information personnel, scientists, and technologists–in fact, the whole of Canada–in what information is available from their government agencies, in what form they might expect this information, how they should ask for it, and how long they might have to wait to get it.[45,56] Nor should this be done by producing yet another piece of paper, or by circulating more copies of an agency's annual report. Rather, this activity could be part of the continuing education effort. Teams of experts might tour the country, giving seminars and conducting discussions, educating the people about what is available in the scientific and technical information field for them to exploit today.

V. 9 Summary

Our national goals in this field should emphasize the training and development of the people needed, not only to operate libraries and information centres, but also to develop and maintain the information systems of tomorrow (and the subgroup agrees with Professor Kurmey that these are two very different things[22]). To do this, the right kind of people must be attracted into the ranks of information personnel: engineers, chemists, physicists–scientists who see the challenge of information management, the stimulation of interdisciplinary ideas and approaches, and the rewards that accrue from devoting their energies to serving others in this way.

In planning their training, Canada can profit from, without slavishly following, the pioneer efforts of other nations. The need for information personnel is so immediate and acute that moves might be made on four fronts: the conventional library school, the school of computer science, the new combined front as exemplified by the University of Western Ontario, and the proposed school of information science front. Graduates tested in the field of operation could point to where future emphasis should be placed. However, it is essential that some action be taken now: already we are a fair distance behind the technological nations (Kurmey[23] suggests that in certain areas of librarian education Canada may be as much as five years behind the United States), and delay in this field bids fair to have an exponentially detrimental effect on a nation's welfare.

Nor should the field of scientific and technical information be the nation's sole concern. The arts and social sciences will need information managers, and the interests of scientific and technical information should not be considered out of context just because of the urgency of their need. Balance in this area, i.e. training of the information managers, is of paramount importance to the nation. In this connection, a position paper prepared for Educational Facilities Laboratories Inc.* (EFL)[49], entitled *The Impact of Technology on the Library Building,* points out that:

> "Between the myths and the realities, between the over-simplifications of the space-age writers and the arcana of the new sciences, planners are caught in a web of dilemmas."
>
> "To probe for viable answers, EFL ... arranged a symposium of experts from the relevant disciplines. Communications and information technologists, librarians and architects ... met at EFL's offices in New York City .... Broadly they addressed themselves to the impact of technology on library buildings. Their task was to separate rhetoric from reality, fact from fancy. Specifically, they explored the wisdom of continuing to build libraries along traditional lines, and plumbed available knowledge for cues on how to prepare buildings to adapt to the new era. Two days of discussion explored four principal areas of relevance: computer technology, microform technology, communications technology, and the relationship of human beings to the possible changes ahead."

Although this consortium of experts—and their names and positions are most impressive—was concerned with the impact of technology on library buildings, the consensus they reached on the libraries of tomorrow bears strongly on the training of information handlers today. They found, basically, that "conflicting claims have created confusion about the entire field of computerization in libraries". They anticipate that "the first general impact will be in the area of housekeeping chores—order records and reports, fiscal control, circulation systems, etc." where "experience in many libraries to date indicates clear cost advantages in large operations". Next, they agreed, would come "computerization of the library card catalogue" which, despite "technological and intellectual problems of the greatest magnitude to be overcome before computerized catalogues will be generally usable", they expect will be widespread within 10 to 20 years.

Anything resembling a wholesale use of the computer technology in the storage and retrieval of text, however, the group felt was much further off.

> "It would appear that most of the literature in the humanities and social sciences will remain primarily useful in book form .... The change to computer storage of full texts, when it comes, will be evolutionary, not revolutionary, and it is unlikely that the library as a repository of books will be replaced in the near future by a computer in the basement consulted by remote consoles."

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*Educational Facilities Laboratories Inc. is a non-profit corporation established by the Ford Foundation to help schools and colleges in the United States and Canada with their physical problems by the encouragement of research and experimentation and the dissemination of knowledge regarding educational facilities.

Even publication, they are certain:

> "... will (continue to) be in conventional print form, with a gradual increase in the production of microform texts. Retrospective conversion of texts to machine-readable form is not expected to any great degree for a very long time in the future. Therefore, the bulk of a scholar's negotiations in a library will be with books even 30 years from now."

The group gave its reasons for these conclusions, and there seems no doubt they are practical ones. Regarding microforms, it states that their usefulness is minimized by the fragmented nature of the industry and resultant lack of standardization.

> "Progress in the field is slow, since there is no single firm in the industry that plays a dominant role in setting the pace for all the others, as was the case with IBM in the computer field."

Certainly, it does not anticipate microforms replacing the book in any significant way over the next 20 years or so.

On communications technology it had this to say:

> "The recent development of machines for facsimile transmission which print out text at the receiving end has added a new dimension to communications technology ... (but) since this requires a broadband transmission channel, the (conventional telephone) line costs are very high. The costs of microwave transmission are even higher."

And even with these difficulties overcome:

> "... the lack of an adequate switching system on a national scale would prevent facsimile transmission of text from becoming a common means of information exchange for librarians."

After discussing the eventual development of a common carrier network equipped with adequate switching (which is within the present technology), it goes on to say:

> "Initially, the service may be too expensive for libraries. Also, such a network cannot be suddenly created but must grow over a period of years.... Regional, national and special purpose libraries will become increasingly important... it would be unwise for the next generation of libraries to depend on its (facsimile text) general availability."

Summing up its whole discussion, the group concludes that:

> "... for at least the next 20 years the book will remain an irreplaceable medium of information.... Library planners can proceed at this time with confidence that technological developments in the foreseeable future will not alter radically the way libraries are used."

To the forward-thinking information manager this concept may sound like heresy: it need not. It concentrates on the evolutionary aspects of advances in information management. It corrects the unspoken but strongly implicit idea that information handling will be revolutionized overnight, and that suddenly Canada will be involved in a "brand new ball game". Properly considered, it shows the need to develop all of the five types of information personnel that have been discussed, for Canada needs modern, dynamic people to manage the existing information stores, to improve their operations by exploiting today's technology, and to plan and develop the systems of tomorrow.

Section VI

CONCLUSIONS AND RECOMMENDATIONS

VI. 1 A Federal Stimulus for Action

The science of information management is at a critical and rapidly changing phase in its history. As the literature of science and engineering continues to grow at an exponential rate, the task of determining quickly and accurately what is already known becomes steadily greater. Nevertheless, more and more it is coming to be realized that the progress of science and technology, and therefore of industry, depends directly on the effective utilization of information–that scientific and technical information is, in fact, a national resource. At the same time, the development of telecommunications offers powerful tools to help manage this resource, when and as their contribution can be economically justified. In this context of growing needs and the offer of new methods to help fulfill them, Canada finds herself markedly lacking in information personnel. There are not enough people trained to work in the information field; many of the people working in it do not have the qualifications needed today.

The solution to the problem of providing more and better information personnel cannot be quick, easy, or simple. It calls for a multi-faceted approach that must include all of the following: realistic and accurate studies to determine specific manpower requirements; scholarships to induce recruitment; establishment or expansion of training programs for librarians, information scientists, and technical information specialists; grants in aid of specific and nationally co-ordinated research; provision of fellowships for the training of faculty members; encouragement and support of user education; inauguration of plans for exchange of information personnel and interneships; assessment and co-ordination of non-professional training; assessment and adoption, where appropriate, of new techniques, devices, and information technology.

The responsibility for taking such action will have to be shared by many groups and institutions. Universities, technical institutes, industry, professional associations, provincial governments, and the Federal Government all have large roles to play in the training and employment of information personnel. They must all be concerned to see that Canada has the numbers and kinds of information people needed. However, no matter how concerned each group or institute may be, it will tend somewhat naturally to view the problem in local terms and to have regard only for local need.

To provide the broad-scale approach necessary to develop Canada's interests and to provide the leadership, co-ordination, and money that will be needed, is beyond the capacities of any local group or institution. It demands the participation and the commitment of the Federal Government.

The Training Subgroup submits as its basic recommendation that a Federal Government agency be set up as an essential instrument in assuring that Canada develops and maintains an adequate supply of people trained in the field of information management, and that her scientific and technical community is trained to find and use the information of its specialties. The Federal Government should establish such an Agency at the earliest possible moment to provide leadership, co-ordination, and support of plans for the development of adequate information personnel in Canada.

It is believed that the country's welfare demands that the Federal Government invest in this endeavour, and that Canada would receive real economic gains–in fact, optimum returns–from this investment.

VI. 2 Statistical Studies

A great deal more specific and accurate knowledge of the situation with regard to information personnel is needed; for example, the kind and number of such people, the dimension of the demand for them, the courses available or contemplated for their training, the courses available or contemplated for "user education". These subjects are now susceptible only to the grossest kind of descriptive or quantitative estimates, often influenced strongly by sentiment or vested interest. At present Canada provides no means for definitive and continued studies in this area, and assuredly she must do so.

It was suggested that the Training Subgroup attempt to collect these data. However, such a suggestion grossly underrates the magnitude of the task which, no matter how convinced they may be of its necessity, is beyond the efforts of amateurs. During the last several years the Canadian Library Association has devoted considerable time, effort, and money to running surveys to collect such data, with results that still fail to be definitive. This in no way reflects on the Association's efforts or dedication; it simply confirms that collecting these essential data calls for experts trained in the art, who know what questions should be asked, how they should be phrased to avoid ambiguity, and, most important, how to analyze the replies correctly when they are returned.

Finally, it should be pointed out that information personnel and the people responsible for training them are weary of answering questionnaires from which they see not even the prospect of results. If they are to regain the enthusiasm such a task demands, they will have to feel reasonably assured that the time and pains they take in answering the questions of a data-collecting survey will lead to some direct action.

The Training Subgroup, therefore, strongly recommends that the Agency be mandated to gather and publish the statistical data that will precisely identify the problems that bedevil those responsible for the training of information personnel.

It has been suggested that, rather than a special government agency, the Dominion Bureau of Statistics be authorized to compile the statistics described above. On the whole, however, the Training Subgroup favours assigning this duty to the Agency, since data-gathering is best done in close conjunction with the people who must identify and solve the problems these data illuminate.

VI. 3 Scholarships

Earlier in this submission some evidence was presented to support the thought that, despite the effusions of the "science fiction" school, Canada's science and technical libraries are not going to be completely computerized tomorrow; that, on the contrary, progress in this direction will be evolutionary and that, through the next three decades, science librarians, technical information specialists, and information scientists will all play a most essential role in this evolution. Some data were also presented which indicate that all of these people are in short supply in Canada today. To provide the requisite number of qualified professional information personnel, Canada must offer science graduates some real inducement, now lacking, to enter the information management field.

The Training Subgroup strongly recommends that considerable expansion of the present scheme of federal scholarships (offered through the National Research Council) for science and engineering graduates to enroll in library schools and schools of information science be initiated, and that this scholarship funding be a responsibility of the Agency.

Ideally, the science graduate wishing to take degrees in librarianship or information science should be offered the same assurance of scholarship assistance as he would receive if he continued in his particular discipline. This means that a graduate of a certain standing, e.g. 70 per cent, would know that he could get a scholarship of, say, $4 500 to attend a school of librarianship or information science. If such a scale of support cannot be established, at least the present plan ought to be considerably increased. One hundred and fifty scholarships of $4 500 each, for Masters' programs in a school of either librarianship or information science, suggest themselves as quantities that would make a good start toward attracting students in numbers sufficient to provide for present demands and those of the future. The total cost of such programs of scholarship support would be small indeed compared with amounts at present being spent in support of education and research in science and technology.

Quite possibly, the data and statistics to be collected by a specially appointed agency on a continuous basis may indicate a need for flexibility in awarding these scholarships. For example, it might be established that, at a given point in time, demand for information scientists exceeded that for science librarians. It is so as to adjust to this need for flexibility that the Training Subgroup, while it admires the continuing efforts of the National Research Council, recommends that this scholarship funding be made another responsibility of the Agency.

VI. 4 Establishment and Support of Information Management Programs

Librarians have been criticized for their failure to make effective use of computers and the new technology in the main stream of library service. In their defence it must be recognized that library schools, with only the support of provincial universities, have not had access to the very large funds needed to incorporate this kind of training into their programs. To teach the required computer technology effectively, schools need additional faculty members and what is, for them, expensive equipment such as the newer audio-visual facilities and electronic data-processing machines.

The Training Subgroup, recognizing a national need, recommends that the Agency be funded and authorized to administer federal grants to library schools and schools of information science, paralleling those that the National Research Council, the Defence Research Board, *et al.* now make for equipment and staff in scientific and engineering departments of universities.

VI. 5 Research

Very little research is now conducted in Canada in library or information science. This is not because the existing schools would not enjoy entering the research field or are barren of research ideas; rather, the Training Subgroup was impressed with the number of areas both the library schools and the schools of computer science listed as worthy of investigation—and investigation from a Canadian source. In fact, research in library and information science in Canada today is hampered by one thing and one thing only: the fact that almost no money is allocated to its support. The two main funding agencies of the Canadian Government—the National Research Council and the Canada Council—by tradition or regulation direct their attention to other fields. It is questionable, indeed, whether research in library science, for instance, would normally be considered by either. If research in the information field is to be encouraged, then funds must be specifically earmarked for this purpose.

However, while recognizing the need for research in both library and information science as acute, it is felt that such research should be co-ordinated and directed toward national goals or aims.

Therefore, the Training Subgroup has no hesitation in recommending that the Agency be funded to support and co-ordinate Canada's research efforts in the information field.

VI. 6 User Education

The ultimate answer to the problem of user education is to have all scientists and engineers trained, from high school on, to value and use the world's scientific and technical literature. The use of information sources must become an integral part of the scientific and technical curriculum. We are told, for example, that in Russia every science curriculum includes 34 hours of information work.

The Training Subgroup strongly recommends that university science and engineering faculties and technical institutes consider making a good working knowledge of the scientific literature an essential requirement for graduation.

Meanwhile, short courses and special seminars, along the lines successfully pioneered by the National Lending Library for Science and Technology, would assist in closing the training gap. So would the development of teaching aids in this field. The Training Subgroup therefore suggests that the Agency be funded to develop and maintain these teaching aids, and that the provision of the necessary short courses and seminars for user education be included in its terms of reference.

VI. 7 Faculty

In describing the need for information personnel and national goals for their training, it was pointed out that today Canada is short of people to train the information personnel needed and that, if a Doctor's degree is a prime requisite for their appointment, none are being trained today. It cannot be too firmly stated that the principal impediment in establishing or expanding curricula in information management is the present deficiency of faculty competent to teach it. Since this country does not now have facilities for training such teachers, it must compete with the United States for them.

To rectify this situation, three proposals are made:

(1) The proposed Agency be funded and authorized to establish endowed chairs and visiting professorships where and as they are most needed (this purely as an interim measure);

(2) The Agency provide funds for fellowships large enough to allow faculty members to complete doctoral studies;

(3) Consideration be given to subsidizing the establishment in some Canadian universities of doctoral programs in both science librarianship and information science.

VI. 8 Exchange and Interneship Programs

A simple means of expanding knowledge of new and effective techniques in scientific and technical information management is to share it. Canada does have some notable scientific libraries and information centres but their presence (chiefly in Ottawa, Toronto and Québec) does not now mean much in a country of such tremendous size. The establishment, at the national level, of interneship programs on the lines sponsored by the National Library of Medicine in the United States would make the expertise of, say, the National Science Library effective in both Calgary and Halifax.

The Training Subgroup therefore advocates that the Agency be empowered to provide funds and arrange for staff from other libraries and information centres to gain experience at the major centres.

VI. 9 Library Technicians

The provincial governments have already moved vigorously to contribute to the training of library technicians, and this venture is advancing apace. However, attention was drawn to the pressing need to develop national standards in respect to staffing and curricula, and for acceptable textbooks and other teaching aids.

> To assist the provincial governments' already considerable effort to see that satisfactory numbers of adequately trained library technicians are available as needed, it is suggested that the Agency be encouraged to help meet these expressed needs and, in a more general way, consider the assessment and co-ordination of library technician programs as being within its purview.

VI. 10 The Agency

The task that faces Canada, if she is to have the kind and number of people needed to give adequate information service to the scientific and technical community and if this community is to be taught the value and virtue of using these services, will call for considerable effort. This effort must come from many groups: the universities and the technical institutes that will have to provide the formal training programs; the professional societies that will fill their traditional continuing education role; and the scientists and engineers themselves who must supply the strong "consumer voice" that defines and underlines the needs and, in the final analysis, decides whether the devices designed to meet these needs are acceptable. All these groups have, in fact, already been active but their efforts have not had and, it is suggested, cannot have the necessary effect for three reasons: they lack national leadership; they lack co-ordination at the national level; and they lack adequate financing. To achieve what is needed, the Federal Government must be involved.

The case for Federal Government participation is simple. First, to quote Professor Bonn again, "the development of science information as a national resource is the direct responsibility of the national government". Second, to achieve the goals that must be won, and won in "real time", an Agency is needed to view problems nationally rather than locally, and to supply the financial resources that individual universities, associations and companies cannot provide.

> **The Training Subgroup therefore strongly recommends that the Federal Government establish such an Agency, at the earliest possible moment, to provide leadership, co-ordination, and support of plans for the development of adequate information personnel in Canada.**

Specifically, the Agency should be user-oriented. To that end its policies should be determined, or at the very least guided, by a steering committee or controlling board made up of representatives from government departments involved in information management, from universities, from industry, and from other users of technical information. It should not have a large staff. Basically, the Agency is seen as the instrument for prompting and supporting developments rather than carrying them out. In that it commissions and co-ordinates many projects but does not itself conduct them, the Agency should not be encouraged to develop illusions of "empire". It could be an independent agency, part of an existing government department, or part of a new government department or agency: the Training Subgroup does not presume to say which. What is important is that it be established promptly, that its mission be clearly delineated, and that it have the resources to carry out its mission.

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Appendix

Appendix A

METHODS OF STUDY AND SOURCES OF INFORMATION

The report of the Training Subgroup is based on the following main sources of information.

1. The personal knowledge of the four members of the subgroup. The experience and views of these members may be inferred from the degrees and positions they hold:

J. W. Cherry, B.Sc. (Hons. Geology), M.Sc. Manager, Technical Information Services Department, Western Producing Region, Imperial Oil Limited (Chairman).

Edmond Desrochers, S.J., B.A., L. Ph., L.Th., M.L.S. Professor, École de bibliothéconomie, Université de Montréal.

Mrs. Doreen Heaps, B.A., M.A. Assistant Professor, Department of Computing Science, The University of Alberta.

Samuel Rothstein, B.A., M.A., B.L.S., Ph.D. Professor and Director, School of Librarianship, The University of British Columbia.

2. "Position papers" prepared at the invitation of the Training Subgroup by:

(*a*) Doreen Heaps, Assistant Professor, Department of Computing Science, The University of Alberta. "Education in Information Science".

(*b*) John Marshall, Assistant Professor, School of Library Science, University of Toronto. "The Training of Library Technicians".

(*c*) Mara Karnupe, Science Librarian, Carleton University. "User Education in Science and Technology".

(*d*) Edmond Desrochers, Professor, École de bibliothéconomie, Université de Montréal. "Information Scientists and French Canada".

Copies of these four position papers, together with the brief prepared by the School of Librarianship, The University of British Columbia, may be obtained from the Science Council, 150 Kent Street, Ottawa 4.

3. An examination of some 200 briefs submitted to the Study Group by firms, institutions, professional associations and individuals.

4. Individual correspondence, discussions, and visits.

5. Contributions by members of other subgroups and by the consultants whom the Study Group employed.

The compilation of the Training Subgroup's report was preceded by the following steps:

(*a*) Planning sessions by the four members of the subgroup.

(*b*) Preparation of the position papers.

(*c*) Discussion of the position papers and the preliminary recommendations of the subgroup at a special meeting held in Ottawa on February 6, 1968. The following people attended the meeting:

David Wilder, Director of Libraries, University of Manitoba;

Mara Karnupe, Science Librarian, Carleton University;

D. A. Young, Associate Professor, Computer Centre, University of Manitoba;

John Marshall, Assistant Professor, School of Library Science, University of Toronto;

Andrew Osborn, Dean, School of Library and Information Science, The University of Western Ontario;

Beryl Anderson, Assistant Professor. Graduate School of Library Science, McGill University;

L.F. MacRae, University Librarian, University of Guelph;

W.J. Kurmey, Assistant Professor, School of Library Science, University of Toronto;

A. M. Morisset, Director, Library School, University of Ottawa;

Keith Crouch, Director of Libraries, McGill University;

Bernard Fry, Dean, Graduate School of Library Science, Indiana University (Consultant).

The four members of the Training Subgroup and L. G. Vagianos, Director of Libraries, Dalhousie University (representing the Universities Subgroup) also attended the meeting. Sarah Rebecca Read, Director, School of Library Science, The University of Alberta; and A. D. Booth, Dean of Engineering, University of Saskatchewan, who were invited to the meeting but could not be present, sent letters of comment.

While the meeting was not intended to produce formal resolutions, it did indicate that among a group representing a broad spectrum of experience in the field of education for scientific and technical information service there was general agreement in favour of the views expressed in the position papers and in favour of the subgroup's proposal for the establishment of an Agency.

(*d*) The Chairman of the Training Subgroup prepared a first draft of the final report in February 1968 and circulated it for comment by the chairmen of other subgroups.

(*e*) On the basis of these comments, plus those of the Training Subgroup itself, a second draft of the report was prepared in March 1968. This second draft was considered at a meeting of the Training Subgroup on March 29 and 30 in Edmonton, and a number of revisions, deletions, and additions were made. These changes were incorporated in Draft III of the report which was prepared in April 1968.

(*f*) The third draft was discussed at a meeting of the subgroup chairmen in Ottawa in May 1968, and on the basis of the changes thereupon suggested, the present Final Report was prepared.

The Final Report is thus a culmination of a long process of investigation, discussion, and study by very many people. The Training Subgroup's submission has tried to take proper cognizance of the views and experience of the Canadians best qualified to speak on the topic of training information personnel. We are, in fact, confident that our Report will ultimately receive substantial agreement from the people we consulted and heard from. In the meantime, however, we are aware that our Report does not speak for anyone but ourselves. We appreciate the help of the many others, but the responsibility for the present Report is ours alone.