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INTERNATIONAL COLLABORATION
IN SCIENCE AND TECHNOLOGY

PROBLEMS AND POTENTIAL
- AN OVERVIEW

A Joint MOSST/DEA Paper

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- AN OVERVIEW

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Dept. of External Affairs
Min. des Affaires extérieures

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MOSST
30 APRIL 1981

43-260-887

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INTRODUCTION

Background

At its meeting on 26 November 1980, the Cabinet accepted a recommendation for a joint review, to be made by the Ministry of State for Science and Technology and the Department of External Affairs, of measures "to increase international collaboration in science and technology." This paper presents the findings of the joint review.

Like many intellectual pursuits, science is inherently international in character, and cooperation between scientists is as old as science itself. It has its foundation in the stimulation of critical examination by peers and the need to exchange ideas. The results of fundamental and much applied research are published freely and finds other applications and uses in distant lands by different groups addressing similar problems. This natural exchange has taken on new dimensions since the Second World War as the pace of scientific discovery and application has accelerated and as new convenient means of communication and transportation have made joint activities easier and foreign facilities more accessible.

Technology, on the other hand, by its very nature presents a more restricted environment because of its importance to industrial development. Even here however, the purchase of patents, company-to-company exchanges of know-how and the sheer complexity of modern processes ensures a diffusion of knowledge across frontiers. Few discoveries are now made by the single researcher working alone; advances are more the result of many steps and many contributions from a diverse mix of sources.

Collaboration in S&T takes many forms: the exchange of correspondence, sharing of data and results, the exchange of views and experiences at conferences and the publication of results are common and valuable sources of information. Physical cooperation spans a broad spectrum from co-authorship of papers to joint work undertaken on a major multinational collaborative project.

Many studies have been made on various aspects of international collaboration. These have, however, concentrated on specific aspects such as fields or categories: no attempt has been made to quantify the overall level because it is too vast and all pervasive. It is, and probably always will be, a natural integral part of national S&T activity.

The Federal government, and to a lesser, though rapidly increasing extent, the Provincial governments, follows the general pattern as a major performer of research. However, it also has two additional and important roles which substantially influence the international activities of the other sectors. First, through financial and other forms of support, it can encourage, (or discourage), international activity. Second, it exercises on behalf of Canada the unique international role of representation and leadership vis-à-vis other nations and governments.

The last two decades have seen a growing interdependence amongst nations and a concomitant tendency for governments to become involved in major economic questions. As a major engine of economic development, science and technology (S&T) has therefore increasingly become the subject for government-to-government attention - a fact reflected in the almost explosive growth during this period of S&T activities in the major international organizations.

The Federal government has therefore obtained, through its international activities, a capacity to assist domestic S&T programmes. Through its membership in the many large multilateral organizations, it can nudge work programs into directions of value to Canadian domestic interests; through these programs and its bilateral relationship, it can facilitate the access of Canadian scientists and agencies to research and technologies of other countries; and it can secure participation in major joint collaborative activities beyond the national purse.

It is mainly, although not exclusively, with the opportunities presented by this role of the Federal government which has emerged in the 60's and 70's that this overview paper is concerned. Part I presents the case for international collaboration and a brief overview of its main characteristics and elements. Part II focusses on the Federal government context and, through it, the other sectors of the nation involved in S&T. Part III present a summary of main conclusions and recommendations.

Objectives of Paper

The objectives of this paper are to present for interdepartmental and subsequent Cabinet consideration:

1. An overview of international collaboration in S&T in which each individual issue can be viewed within the context of the whole;

2. The case for Cabinet support for the continued promotion of international collaboration in S&T;

3. A proposed strategic framework aimed at guiding future major collaborative activities;

4. Immediate measures to deal with already identified major obstacles inhibiting the optimum use by the Federal government of international collaboration in S&T.

Scope

It will be appreciated that a substantial amount of international collaboration in technological development is underway as part of the industrial development programme of the Federal government. This is reflected in the many international economic activities and agreements performed mainly under the aegis of the Department of Industry, Trade and Commerce. Technology stands squarely between science and industrial development and the blurred frontiers are reflected in interdepartmental structures and mandates. As this paper approaches the question of international collaboration from a science and technology rather than a technology and industrial development vantage point the emphasis is inevitably shaded towards the scientific.

It should also be appreciated that the use of the term "science and technology" includes the social as well as the natural sciences. Indeed, certain of the social sciences have key roles to play in international collaboration in its widest sense: the value of Canada's statistical expertise to the developing countries is a case to point.

Finally, because of their highly specialized and sensitive nature collaborative S&T activities in the defence and nuclear fields are not covered although much of what is presented does in fact apply to both.

Definitions

For the purposes of this paper:

"Science" is broadly defined as the search for new knowledge of natural and social phenomena, and the ordered accumulation of such knowledge.

"Technology" is understood to be the application of scientific knowledge to the development of new processes and products.

"Collaboration" is a narrower sub-set of the more general term cooperation. It embodies a sense of closer and more direct joint work towards the achievement of a more narrowly focussed objective.

PART I: THE FRAMEWORK OF INTERNATIONAL COLLABORATION IN SCIENCE AND TECHNOLOGY

THE CASE FOR INTERNATIONAL COLLABORATION

The Benefits

International collaboration is wide spread because it provides benefits of one kind or another to the participants: benefits as diverse as the differing categories of collaboration itself. There are nevertheless three major groups under which they can conveniently be discussed: the "natural" collaboration resulting from the existence of a problem or need of international dimension; economic benefits of many kinds and at many levels, and, as a relative newcomer, political benefits. The latter, being the primary concern of governments, is addressed in detail in Section II.

Many fields of research are global in nature and their study requires an international approach if it is to be done at all. Examples include meteorology, oceanography, astronomy and seismology. Cooperative programmes in these and like areas were some of the earliest examples of international collaboration producing shared data, expertise and facilities. Health is another major shared concern, not only in terms of contagious diseases such as small pox which demand concerted research and action at world level, but also in respect of others such as Parkinson's Disease where the combined efforts of Austrian, Canadian, Chilean, Swedish, Swiss and American scientists created the drug L-DOPA - the first effective treatment ever produced.

Two other areas of rather recent significance are certain transboundary environmental problems, such as air and river pollution, and the emergence of global technologies. The latter technologies, whose socio-political effects have a major trans-national element, include satellite communications, (in particular, direct broadcast satellites), weather satellites, seabed mining, new fish harvesting techniques and multinational data networks. Collaboration in these areas ensures that country members understand the ensuing problems as well as potential and can plan and negotiate appropriate standards, regulations and safeguards to national interests.

It is however in the economic area, defined very broadly, that the advantages and benefits of international collaboration in S&T are most numerous. As an illustration, some of the major possibilities are listed below:

- It can extend the capacity and impact of domestic S&T resources through the sharing of costs and expensive facilities and by permitting large scale efforts to be mounted where necessary. The Canada-France-Hawaii Telescope Programme is a case to point.
- By offering access to the results of research underway elsewhere it can avoid costly duplication and save time.
- It can bring together scientists in new fields, such as biotechnology, where not enough national specialists exist to mount a viable domestic programme.
- A relatively small "entrance fee" of funds and/or resources can obtain access not only to the direct results of the research project in question but often to relevant research carried out prior to or in parallel with the project, (the so-called multiplier effect).
- It can increase the international credibility of research findings.
- Technological collaboration can be valuable in opening a window on new market possibilities. Within the framework of the development of a major system it can offer both a wider market and the economies of scale. It can also produce important technological spin-offs leading to world product capabilities. The SPAR remote manipulator system development as part of the US Post-Apollo Space Programme falls into this category.

Costs

The benefits of international collaboration are usually obtained at the price of somewhat higher overall project costs although lower to each individual participant, than the purely domestic equivalent. These costs have to be identified and carefully weighed before entering into collaborative agreements in order to ensure that an adequate return is in prospect. Clearly they will vary according to the type of collaboration in view but for the purposes of this paper some "worst case" examples of possible additional resource demands and difficulties are given below:

- For optimum results a good match must exist between domestic needs and expertise on the one hand and the

opportunities offered by the particular international activity on the other. Thus surveys, studies and analyses have to be carried out and then reinforced by visits and meetings with prospective partners before choices can be made. Costs involved in these necessary preliminaries can be substantial, they are difficult to accurately predict and have, moreover, to be made on faith with no initial assurance of worthwhile returns.

- A key factor in assuring the effective and amicable development of a joint collaborative activity is the question of ensuring a "just return" for all participants. This can result in less than optimal solutions to such considerations as the need for a centralized location instead of a geographic splintering of sub-system developments. It can also lead to inefficiencies and difficulties where the technological capabilities of participating nations are widely different.
- Joint R&D projects between several nations are traditionally difficult to manage. They usually involve special complexity in staffing, planning and control. Different national sensitivities and interests have to be constantly borne in mind; there are usually language, monetary exchange and even legal (e.g., standards) difficulties. Extra travel costs are virtually certain.
- Because of political considerations, joint intergovernmental projects are difficult to terminate, a factor of some importance in view of the long term nature of research.

Future Prospects

It seems very probable that the future costs of research will mount as new and more complicated technological needs demand more sophisticated processes and equipment. Judiciously chosen international collaboration will be even more important if countries like Canada are to address simultaneously a wide number of national problems. For major programmes of the future, collaboration may in fact be the only means of access for smaller countries to new technologies. Future research on nuclear fusion is a case to point.

In the broader economic sphere it seems equally likely that economic difficulties will persist and will increasingly raise the spectres of market protectionism and technolo-

gical isolationism - a serious prospect for nations like Canada which lie outside major world economic blocs.

A number of problems will soon reach global proportions. The World's oceans are becoming polluted, the level of carbon dioxide in the atmosphere is rising and major national technological systems such as data networks will require interfacing. These concerns will need systematic attention at the international level if not outright international regulation.

Canada, as a major trading nation attempting currently to enhance its S&T capability cannot afford to be overtaken by these events. A major challenge for the future will not only be to raise the national capability in S&T but to maintain it at a level which will support future industrial development and supply the expertise necessary to protect and promote internationally the national interest. The potential of international collaboration to help achieve these goals should be aggressively - but sensibly - exploited.

MAIN CATEGORIES OF COLLABORATION

There are three main categories of international collaboration in S&T. The oldest, most tried, and by far the largest is the normal contact carried out through a variety of channels by individual scientists. Institution-to-institution and government-to-government comprise the other two. These arrangements can be entered into on either a bilateral or multilateral basis. The groupings are not exclusive: individual interaction, for instance, lies at the heart of all collaborative activities and institutional relationships may well form part of government-to-government agreements. Nevertheless the categories are formed to meet specific needs requiring different approaches and thus each has its own particular main characteristics.

Individual

The International Agricultural Congress of Brussels 1847 was one of the first examples of the need felt by individual scientists in different countries to exchange views and experiences and to make contacts with groups of peers working in the same field. Today there are thousands of conferences and seminars annually, most organized by the international bodies representing specific disciplines to which the individual scientist belongs.

These group activities are overshadowed by the extensive personal contacts between professionals who exchange correspondence, visit each other's laboratories and co-author papers presenting joint research findings. Some measure of the extent of this collaboration is given by a study of co-authorship patterns based upon the 1973 Science Citation Index. About one paper in thirty is co-authored by scientists of different nations, the highest level being attained in the Earth/Space Sciences where 4.5 percent are co-authored. 10.4 percent of Canadian papers are produced as the result of international collaboration.

The many private informal contacts are further enhanced by an extensive network of scientific and technical publications. Taken all together these international activities represent the single most important contribution to the health of Canada's science and technology and they are, moreover, carried on with very little demand upon the public purse.

Institution to Institution

Institutional collaboration, as its name implies, is a joint undertaking between organizations as distinct from individual scientists: teams of researchers, laboratories or agencies working in the same field or even two nations sharing similar problems and aspirations. Such associations form the backbone of international collaboration in S&T; because they are usually undertaken on a bilateral basis, they offer the benefits of joint activity with many of the inherent difficulties of international collaboration reduced by the involvement of only two partners. Thus, objectives can usually be more accurately matched, management and decision taking made easier and equitable benefit sharing less difficult.

For Canada, a major activity which might loosely be classed as bilateral is the joint US/Canada membership held in many North American scientific and professional societies. These memberships and similar close links between individual Canadian and American societies - and to a lesser extent between Canadian and other foreign societies - offer an invaluable source of new ideas and inspiration. Such non-governmental links are paralleled by the numerous bilateral relations existing between government laboratories and agencies, relations which have by and large proven to be some of the most satisfactory types of formal international collaborative agreement. They and the related general government-to-government bilateral agreements are dealt with in detail in Part II of this paper.

Multilateral

The third major category is that of the multilateral or association of more than two participants. It is the category which has grown most since 1945 because the advance of science during and after the Second World War created new needs for closer cooperation by means of new institutional arrangements. Between 1945 and 1955, 58 new non-governmental and intergovernmental scientific organizations were created giving by 1976 an overall total of at least 300 international organizations concerned with science. A 1979 UNESCO study presents an illustrative list of 55 multilateral S&T organizations operating in the European and North American regions alone.

In the non-governmental sphere the multilateral category of international collaboration in S&T is illustrated by such major societies as the World Federation of Engineering Organizations, the International Council of Medical Sciences and the International Council of Scientific Unions (ICSU). The latter represents 18 scientific unions and 68 nations and has as its main objective the international coordination of their activities. It also acts as the main link between the national scientific unions and the United Nations and its specialized agencies.

A characteristic of intergovernmental multilateral activities is the number of specialized S&T elements existing within larger organizations having wider than just scientific or technical objectives. These differ in scope (world, regional), in thrust (military, development assistance), and in function (research performer, funder). Within the United Nations for instance, are found amongst others the Food and Agricultural Organization, World Health Organization and the United Nations Educational, Scientific and Cultural Organization. None of these has its own research establishment but rather provides such services as organizing international conferences and subsidizing scientific work, institutions and research establishments. The UN's World organizations are reflected at the regional level by the special advisor groups and subsidiary bodies of the six UN regional economic commissions.

The Organization for Economic Cooperation and Development has several different functional types of S&T body. The Committee for Science and Technology Policy, as its name implies, is largely concerned with studies and exchanges of experience regarding national S&T policies. The International Energy Agency, on the other hand, acts as a focus for actual multilateral research projects carried out jointly by scientific establishments of member countries.

Defence research collaboration is underway in the North Atlantic Treaty Organization but is paralleled by a purely non-military program to support the exchanges of scientists and collaborative research activities within the Alliance. Other special function organizations operating purely within the international development assistance field include the Commonwealth Science Council, and the Agence pour la cooperation culturelle et technique. Finally, the International Institute for Applied Systems Analysis represents an almost unique body in that member country scientists from both East and West carry out research side by side on major world problems. Canada has membership in all the above and many more.

Multilateral collaboration is considered by many officials experienced in the international aspects of S&T, to offer substantial advantages to Canada. As one of several participants, Canada's influence can sometimes be greater than as the only partner in a bilateral activity with a larger nation, the USA or Japan for instance. It also permits access to the results of the research efforts of several partners instead of just one-including research carried out by other teams within the multilateral arrangement, teams on which Canada might not itself have actual membership. The IEA is an example of the latter. More generally speaking the multilateral organizations offer opportunities to assist in preparing international standards, to address, as a group, common problems and on occasions to participate in global scale programs such as the Global Atmospheric Research Programme and International Hydrological Programme.

Nevertheless, these benefits come with the familiar disadvantages associated with joint activities involving a number of participants. They also present Canada with the problem of deciding at the intergovernmental level on the allocation of priorities, and thus resources, between a series of major competing activities on which no analysis has yet been done. Such an analysis should be undertaken in order to provide:

- a comprehensive inventory and classification of Canada's international, multilateral S&T commitments, which does not at present exist;
- a set of evaluation criteria for use by science based departments and agencies, by External Affairs and MOSST;
- an assessment of the utility of Canadian involvement in a few selected important international multilateral S&T programs.

GENERAL APPROACH BY SECTOR

The University Sector

At the Institutional level, by far the major part of Canada's international collaboration in S&T is carried out, as in other industrialized nations, by the universities. International cooperation and association is a normal, integral and traditional part of university life. As much of the research undertaken by the universities lies in the basic or fundamental science area, collaborative activity is not generally speaking limited by proprietary or other secrecy requirements. It takes a variety of forms including the exchange of staff and students, the utilization of sabbatical years to work in foreign universities, the exchange of data between university researchers, and actual institutional collaboration at the laboratory and faculty level.

International collaboration between universities broadens the experience both of student and faculty staff as well as enriching the research activities underway in the social and natural sciences. As such, it undoubtedly contributes significantly to the health of Canada's S&T community and to the level of national research capability. This contribution should continue to be recognized and encouraged via the various government granting and scholarship programmes aimed at supporting international collaborative activities in S&T.

Universities in the industrialized nations have a special role to play in the international development assistance field. A large portion of the training of Third World scientists and engineers is still carried out in the universities of the developed nations, and staff exchanges and institutional building is a major factor in the development of needed indigenous S&T capabilities and infrastructures.

Canadian universities are similarly engaged. Apart from offering substantial training in the sciences, Canadian university staff are involved in collaborative research with counterparts in Third World universities and establishments either during secondments or as separate projects. This activity provides valuable and needed support to the developing countries and is useful to Canada in several ways, not the least being the experience gained of other environments by Canadian scientists. The potential for a greater involvement exists and should be borne in mind by Canadian international assistance organizations.

The Industrial Sector

Industry lies at the other end of the spectrum from the universities as far as international collaboration is concerned. For a number of reasons such collaboration is neither natural nor sought after as in university circles. Some of these are as follows:

- A company will carry out its own product R&D if it has the in-house capability and if such R&D makes economic sense. The object is to maintain secrecy over the results of market analyses which have resulted in the product development and to gain exclusive proprietary rights over the process or product itself.
- A characteristic of Canada's high technology industry is the presence of a large number of small companies and a few large ones, many of the latter being foreign owned. The small companies do not generally have the staff or resource strength to seek out and support international collaboration. Even when they do, they often feel at a disadvantage vis-à-vis a usually much larger foreign partner. Their success depends upon their ability to quickly and secretly exploit a new idea which will ride the crest of a rapidly developing technology and market.
- Foreign owned Canadian companies have inherent difficulties in respect to international collaboration other than with their foreign parents. Necessary R&D will often be undertaken by the parent in centralized research facilities even when the subsidiary has a world product mandate. In addition, joint research and thus sharing the proprietary rights with a foreign partner may not be acceptable to the parent corporation even when the Canadian subsidiary is doing the research itself.

For the above and other reasons research will normally be done within a corporation or will be contracted out characteristically as an entire sub-system development (e.g. engine). Sometimes there is a sharing of R&D results or ideas when one company licences a basic system from another and wishes to adapt or further develop it. Even so the collaboration is not true collaboration because the partner companies each develop their own sub-system or process. There is thus in industrial collaboration little of the shared learning process which takes place when scientists of different countries work together on a given problem under

the auspices of a university or government-to-government project.

There are two major exceptions to the normal run of things. First, the industrial research institutes and associations which tend to concentrate on solutions to general technical problems of interest to an industrial sector as a whole. Second, there are the multigovernment projects - often in the defence field. In these projects a closely identified shared requirement exists and cooperation in all phases is sought in order to share costs/risks and to establish a large captured market. A sub-set of such projects is the shared research that results either directly or as an "offset" benefit to a large government offshore purchase.

Most governments, including the Canadian, deliberately encourage and facilitate international industrial research collaboration through their industrial research support incentive programmes. In the high technology area, international research partners are routinely sought and the Department of Industry, Trade and Commerce, for instance, organizes many missions with this aim in Europe and elsewhere. Where a government project or funding is not involved, however, the assistance which can be offered by a government is limited though still valuable. Industry can and should be involved where at all possible in the identification of potential international collaboration as part of government-to-government S&T agreements and in its execution as appropriate. A relatively new and important possibility is the joint development of technology related to Canadian natural resources together with major purchasers: the Canada/Japan agreement respecting the onsite liquefaction of Canadian coal reserves is an example.

The Provincial Sector

A major policy study is currently underway in External Affairs respecting provincial involvement in the international sphere. The study also covers the S&T aspect. Nevertheless, a brief glance at the growth and current position of provincial activities in international S&T is considered worthwhile to complete the overall sectoral picture.

Provincial research varies from region to region with the effort generally reflecting the wealth of the individual province. Eight provinces have provincial research councils or foundations and the total expenditures on S&T by provincial governments have tripled over the last ten years.

The increasing involvement of the Federal government in international S&T has over the last decade been mirrored somewhat by the provinces as international emphasis has shifted to concerns of an economic nature. Many of these latter fall within fields of exclusive or primary provincial jurisdiction; ownership of natural resources, health and education being examples. Each represents an area of substantial S&T content.

The growth of general provincial involvement in international activities is illustrated by formal representation abroad and by missions to and from foreign countries. In 1969, only six provincial offices abroad existed; currently, hardly a province remains without representation in at least one foreign country. By the mid-seventies the pace of official visits to and from abroad had also increased.

These general international activities often include an S&T element. Many of the trade missions undertaken by the provinces include representatives of high technology industries and discussions aimed at joint collaboration on research of mutual interest appear on many mission or visit itineraries. The October 1980 ten day visit to Japan by the B.C. Minister of Energy, Mines and Petroleum Sources is a recent example.

The provinces are also entering into more formal international arrangements of a bilateral and multilateral nature. In 1974, for instance, Quebec signed an economic and technical cooperative agreement with France and is also a member in its own right of the multilateral Agence de cooperation culturelle et technique. There is also an extensive network of activities and contacts between the provinces and the states of the USA. A State Department study commissioned in 1974 revealed a total of 766 state/provincial arrangements, approximately one-third being of an S&T nature.

Provincial cooperation with the Federal government within the framework of Canadian agreements with foreign countries also forms a part of provincial government involvement in international S&T. This cooperation is directed not only toward technical assistance and the needs of developing countries, but also to the fulfillment of obligations incurred through different exchange arrangements with industrialized nations.

There are, nevertheless, problems arising from provincial participation in major bilateral and multilateral activities in which Canadian interests are involved rather than those of one or more provinces. The appearance of

several federal and provincial representatives each claiming to represent Canada can seriously affect national negotiating strength. Yet provincial and regional interests must clearly be seen to be reflected in Canada's position at international meetings if provincial frustrations are not to lead to even more international activity on their part.

The sheer bureaucratic complexity of ensuring full provincial participation and awareness of an increasing number of government-to-government activities, however, tends to limit provincial involvement. Nevertheless, the need for a closer cooperation between federal and provincial levels is clear and pressing if opportunities offered by international collaboration are to be fully seized. The necessary rules must await the outcome of the External Affairs paper but the search for a more effective mechanism to ensure full and whole-hearted provincial participation in appropriate future government-to-government endeavours should go ahead with all speed.

MAIN FOREIGN COUNTRY GROUPINGS

The main strategic question regarding Canada's involvement in international collaboration in S&T concerns the emphasis to be placed on each of the main foreign country groups: the industrialized nations, the Warsaw Pact countries and the developing countries.

The Industrialized Nations

In excess of 95 percent of the World's S&T resources and capabilities lies with the industrialized countries of the West and East, the member nations of the OECD representing the most powerful single grouping of advanced technology and scientific knowledge. Canada not only belongs to the OECD group in its own right as an advanced industrial nation but also has special geographical and cultural links to some of the most powerful members. To the potential represented by these links must also be added the bargaining strength of Canada's large mineral and other resources, a highly developed S&T infrastructure and world leadership in certain technological areas.

Canada is therefore well placed to further exploit the possibilities offered by international collaboration with the industrialized nations of the OECD - possibilities which could make a substantial contribution towards bringing the level of R&D performed nationally more in line with the international norm. The main thrust of Canada's international S&T activities has traditionally lain in the direc-

tion of cooperation with the industrialized nations and this should continue in the future. The question then becomes one of whether any resources at all should be diverted from the main purpose and if so, broadly, under what conditions and to which country groupings.

The Warsaw Pact Countries

Cooperation with the Warsaw Pact countries began in the late Fifties with the thaw in the Cold War and the gradual emergence of detente. Relations with the USSR provide a useful example. Canada/USSR cooperation in S&T evolved from the 1959 NRC Exchanges Agreement with the USSR Academy of Sciences which was enlarged in 1972 to include the possibility of joint activities and symposia. In the previous year, 1971, two formal intergovernmental agreements in S&T had been signed: the Industrial Applications Agreement and the General exchanges Agreement, both having their origins in the 1956 bilateral trade agreement. Other agency-to-agency agreements followed.

Canadian objectives in seeking formal ties were four-fold: to obtain easier access to the Soviet market for Canadian goods, to foster closer political relationships and thereby assist the process of detente, to access Soviet experience and knowledge in areas of mutual concern like the Arctic, and, finally, to expose Soviet scientists to the West. Soviet aims were equally clear: first, to access badly needed Western S&T expertise and particularly advanced technology, second and for the individual Soviet scientist, to obtain travel to and contact with Western colleagues.

In the event, the USSR is generally perceived to have gained the most advantage from two decades of collaboration. A 1974 study carried out in Canada concluded that while Canadian business had made contacts and had secured market data, no major sale of goods could be directly linked to the Agreement. On the science side, 250 Canadian and Soviet scientists had visited each others' facilities but the Soviet visitors generally stayed longer. Interagency activities established institutional and personal links, yet determined attempts by Canada to establish cooperation in the social and physical aspects of Arctic science were seriously hampered by the Soviets, benefits to Canada being meagre in comparison with expectations and with those accruing to the USSR. Real political gains have - sadly - been dissipated in the mountains of Afghanistan.

Canada cannot afford to divert scarce S&T resources to gain modest returns from either the USSR or other countries of the Warsaw Pact. If, in happier future days, political

considerations dictate a re-opening of some S&T collaboration with these nations, it should be restricted to a very limited number of activities carefully chosen to offer real S&T benefit and with a Canadian expectation of full reciprocity being made crystal clear at the outset.

The Developing Countries (LDC)

The current S&T effort and capability of individual LDCs varies greatly. Even in the most advanced, however, the current level is not commensurate with development needs and in total the Third World as a whole only accounts for about 2-3 percent of World expenditure of R&D. Conscious of the potential of S&T to help meet their needs and aspirations, the Third World has, over the last decade, placed increasing emphasis on this element of development assistance - an emphasis culminating in the 1979 UN Conference on S&T for Development.

Canada's contribution and record in this area has been very good. In terms of bilateral technical assistance the Canadian International Development Agency (CIDA) disbursed in FY 1977/78, \$56.6 million which amounted to 5.4 percent of total Official Development Assistance (ODA). Even more was contributed over the same period to the support of the technical activities of the UN and other multilateral organizations, \$184.9M or 8 percent of total ODA. The International Development Research Centre (IDRC) for its part has, from its inception in 1970 until 1978, initiated over 800 projects calling for appropriations of nearly \$143 million. The Centre has been particularly appreciated by the Third World for its contributions to building up indigenous S&T capabilities. In 1979 it accepted an invitation from the Federal government to commence a new programme aimed at enhancing the application of Canada's domestic R&D capabilities to international development.

In terms of the S&T element of development assistance therefore Canada's programme is effective, substantial and well balanced. There is, however, a small but important group of developing countries who, because of their relatively advanced industrial status, represent special economic potential but attract low priority within Canada's assistance programme. These are the more advanced developing countries or MDCs.

The MDCs are the newly industrialized nations of the Third World; South Korea, Mexico, Venezuela, Brazil and China being typical examples. As the process of industrialization proceeds, they increasingly represent new and potentially valuable markets for the high technology goods

and services that Canada can provide. With increasing economic power, their influence has grown in international forums and within the group of developing nations. Finally, they are possessors of large natural resources, some of which are of particular value to Canada - oil being the prime example.

These countries are eagerly seeking the technical know-how of the industrialized nations and are building up indigenous S&T infrastructures to support their industrial development. Unwilling to become overly dependent upon the United States, they are actively seeking S&T collaboration with countries like Canada and in fact, formal requests for government-to-government agreements have been received over the last few years from South Korea, Mexico, Venezuela and Brazil. Canada is therefore presented with a golden opportunity to help develop valuable closer political and trade relationships and perhaps secure future oil supplies while at the same time being seen to fulfill its major international commitment to helping the developing countries.

The opportunity presented by the MDCs should be vigorously pursued but as a goal in its own right, and separate to the international assistance programme, because of the conflicting objectives involved. The thrust should concentrate on a few chosen areas within a limited number of MDCs selected on the grounds of appropriate S&T capabilities, market potential, natural resource importance and political influence.

Finally, a further rather special category of developing country is represented by the OPEC nations. Like the MDCs, to which group some of them belong, they are heavily concentrating upon building up their industrial capacities and are seeking assistance particularly in the technology and S&T infrastructure areas. While the strategy of cost recoverable assistance should be aimed at in relations with the OPEC nations, it is possible that the national interest may call for other forms of S&T collaboration. - Clear indications have already been given in major world forums that future oil supplies might in some way be tied to the transfer of technology or to S&T assistance. It would therefore be only prudent to study the situation and devise alternative approaches well in advance of such demands becoming an actual factor in secure oil supplies.

PART II: THE FEDERAL GOVERNMENT CONTEXT

THE MAIN ROLES OF THE FEDERAL GOVERNMENT IN INTERNATIONAL COLLABORATION

The Federal government fulfills three major roles as far as international collaboration in S&T is concerned. It is a major performer of R&D and thus a potential collaborator, it supports financially Canadian participation in a variety of international collaborative programs and it has a special, almost unique role, in representing Canadian S&T interests in a large number of government-to-government activities. These three roles are not neatly defined: formal agency-to-agency agreements are undertaken to further departmental performance of R&D, and participation as Canada's representative in the S&T programs of international multilateral organizations also brings individual benefits. This shading and overlapping has to be borne in mind when considering the roles.

The Performer of R&D

The Federal government is a major national performer of R&D. \$708 million are estimated to be spent in-house on R&D in 1980/81, (much more on S&T), by the science departments and agencies of the Federal government, a sum which represents over a quarter of the total estimated gross national expenditure on R&D for this period. The bulk of research is carried out in support of the missions of the departments themselves; the management of natural resources, setting and monitoring of standards and the compilation of basic scientific information being typical examples. Many of these activities have an international element, a few are basically international in character. Thus officials, laboratories and agencies of the Federal government participate to varying degrees in international collaborative activities as a normal extension of their domestic programs.

Statistics are available on the Federal government's expenditures respecting international S&T activities but these are intended to demonstrate support for such activities rather than their actual performance. Of the \$96 million identified as being expended in 1979-80 for instance, the vast bulk, \$78.9 million is in respect of the Canadian International Development Agency, (CIDA), and the International Development Research Centre, (IDRC), and represents, in the main, support to non-Canadian international R&D. The fact is that most of the resources actually committed on international S&T activities are hidden in the

salaries of officials and the travel budgets of departments.

Some indication of the amount underway can, however be obtained from a glance at certain individual segments. Thus, in 1973 and 1974, MOSST compiled a 90 page report detailing a host of various bilateral S&T activities between the US and Canada alone - many of them involving government officials. In terms of more formal agreements, Canada has, since 1945, entered into 80 bilateral agreements related to S&T (excluding defence, regulatory and technical development assistance agreements). Less is known of Federal government participation in international multilateral S&T activities, although it is probably quite substantial. Science Council Report No. 20 (1973) cites, as an illustration only, Canadian membership in 62 intergovernmental organizations.

Supporter

The international elements of the many departmental research programs constitute in themselves a "support" for international collaboration in S&T. The Federal government, however, provides a more direct support in the form of grant programs within Canada and funding to certain international bodies involved in research of common regional or world interest.

Recognizing the broadening of experience and value to Canadian scientists of opportunities to work with foreign colleagues, all three Canadian research granting councils have undertaken a number of initiatives aimed at encouraging international research collaboration. The Social Sciences and Humanities Research Council (SSHRC), has entered into bilateral exchange agreements with the Soviet Union, Japan, France and Hungary. The Medical Research Council (MRC) signed a similar agreement in 1978 with France, and the Natural Sciences and Engineering Research Council, (NSERC), has continued the exchange agreements with Brazil, Czechoslovakia, France and Japan originally entered into by the National Research Council (NRC).

In addition, each granting Council has other programmes designed to provide financial encouragement for Canadian scientists to visit and work in foreign countries and indeed for foreign scientists to work in Canada on joint collaborative research projects. Some indication of the degree of support provided under these programmes is given by their budgets which, for 1980/81, amounted to \$175,000 in respect of the SSHRC programme and about \$100,000 each for those of the MRC and NSERC.

For its part, the NRC provides substantial financial support for the international activities embodied in a number of non-government organizations. This amounted to some \$230,000 in 1980/81. To Canadian scientists, geographically remote from many other major centres of scientific activity, such programmes and encouragement offer important opportunities to learn new techniques and jointly address shared problems with foreign colleagues.

Similar financial support to promote the exchange of scientists and collaborative activities is provided at an international level and is accompanied by funding of actual research under the auspices of various regional and world bodies in which Canada has membership. Participation in some of this research is by individual choice but much is funded via overall, routine membership contributions. The benefits accruing to a given country from these activities therefore often directly depend upon the nature of its participation. A well prepared delegation can influence programs in the direction of Canadian interests and an efficient domestic organization can ensure that Canadian scientists are fully aware of opportunities offered and encouraged to take them.

Government-to-Government

The period commencing with the 1950s witnessed an entirely new phenomenon - the rapid and very substantial involvement of governments in international S&T activities of all kinds. During this time S&T elements were established in virtually all the major international multilateral organizations and formal bilateral S&T agreements between nations and between agencies of nations became commonplace. Canada, as a highly industrialised nation, has membership in most of the major international organizations and has entered into various forms of S&T agreement with several nations.

There are many reasons for governments assuming this new and demanding role. As far as science itself is concerned, the costs of research and particularly equipment in many fields - nuclear physics being perhaps the best example - have placed it beyond the means of all but the biggest nations and left collaboration as the only feasible alternative. In addition, science has a substantial role to play in many major areas of global consideration such as pollution, health, food supply, space and oceans exploitation.

There are, however, other considerations of at least equal importance in the eyes of governments. There has been

a realisation of the key role of S&T in economic development which has been reflected in the substantial increase of government involvement in major economic initiatives within and between nations. S&T has its place within many of these. There is also the realisation that other countries have valuable experience to share in the development and execution of policies and programs designed to stimulate national R&D capacities.

Finally, there has been a growing awareness of the value of a nation's capabilities in S&T as a tool in foreign policy and strategy. S&T activities jointly undertaken can build or cement friendly relations between countries - as witness its use to assist the process of detente. It has, in addition, become a major element in international development assistance.

As a small, but highly industrialized nation, independent of major trading and economic blocs, Canada stands to gain considerably from the opportunities offered by this relatively new dimension in international affairs. The Federal government, in exercising its role in government-to-government relations, can substantially assist the other sectors of Canada's S&T community by facilitating access to new knowledge, experience and technology possessed by other countries in areas of mutual interest, making possible actual participation in joint international programs, and assisting in the development of the new markets essential to the health of Canada's high technology industry.

These opportunities, will, however, only be fully utilized to the degree that their existence is recognized and adequate planning and resources are devoted to their exploitation.

THE ANCILLARY ROLES OF S&T IN INTERNATIONAL COLLABORATION

Substantial potential value but also major problems are presented to the Federal government by what can conveniently be referred to as the "ancillary roles" of S&T. By ancillary roles is meant the use of national S&T resources to achieve national goals other than those strictly related to domestic S&T programmes. The securing of S&T benefits will always be important but these constitute only one element - and often not a major one - of the particular package sought. As a new concept, foreign to established bureaucratic mechanisms, the exploitation of the ancillary roles demand fresh innovative approaches which in Canada have not as yet been fully developed. It is a matter of

prime concern to this paper and no excuse is offered for examining it in some detail at this stage.

Foreign Policy

Scientific and technological capability has increasingly become a reflection of the economic and intellectual power of a nation and thus, is a source of international influence. In order to use this influence to advance national interests and to gain access to global S&T advances, however, a country must be seen to contribute its fair share of S&T talents and expertise to the common goal. Thus, industrialized countries like Canada have an obligation to participate actively in the major S&T forums of the world, the World Health and Food and Agriculture Organizations being pertinent examples. Canada's scientists have earned enviable reputations in these and other similar organizations and have undoubtedly contributed to Canada's stature and influence in World affairs.

Bilaterally the establishment of S&T exchanges between nations has long been regarded as a useful way of improving general relations - as witness the many bilateral agreements currently existing. The development of scientific relations, as the Science Council has observed, is one of the most unobtrusive ways of opening doors. The general bilateral S&T agreements with France, Belgium, and the Federal Republic of Germany, (FRG), illustrate the use of Canada's S&T in this role, while the similar agreement with the USSR and less formal arrangements with Czechoslovakia, China and Poland represent special categories. The latter reflect the need for formal government-to-government bilateral frameworks to facilitate the production, within Warsaw Pact countries, of necessary travel permits and funds for their scientists. Substantial use has been made within the West of this relatively inexpensive means of promoting detente. While recognizing the main objective of the Warsaw Pact countries as being access to Western technology, the value of reciprocal contacts between scientists has generally been considered to be worthwhile.

One special and major example of the use of the bilateral S&T agreement technique has been its application to the question of Canada's technological overdependence upon the United States. The perceived need to diversify somewhat the overwhelming interrelationships between Canada and the USA in all walks of scientific endeavour provided the main motivation for the general S&T agreement with the EEC and was certainly one of the major considerations underlying the decisions to enter into similar agreements with Belgium and the FRG.

Economic Development

By far the most important aspect of government-to-government S&T activities aimed at economic development is that of industrial technological cooperation. This type of international cooperation includes some of the most rewarding of joint activities and is of particular importance to the further development of Canada's high technology industries.

Unfortunately, it is also the most difficult to arrange because of inherent problems of intellectual property rights and industrial secrecy - which cast a shadow of competition across the bright potential of collaboration. It is here that governments have, through formal agreements, the ability to assist companies with portions of specific major R&D programmes and more generally to furnish the receptive climate so essential to the penetration of new foreign markets. Thus, the intergovernmental agreement between NASA and NRC for Canadian participation in the development of the space shuttle is enabling Canada to become a world leader in remote manipulator systems for use in hostile environments.

As regards the application of the government's S&T resources per se to international collaboration undertaken with an eye to national economic benefits, two particular areas exist in which useful assistance can be given to other sectors. First and generally, joint work can expose foreign scientists to Canadian expertise, processes and equipment; second and more specific, government scientists alert to industrial possibilities can transfer new technology gained to Canadian industry and can advise of pending or possible contract work. The latter action is still somewhat foreign to Canadian officials but, as witness the case of Japan, can be of substantial value to high technology industries: it should be more actively encouraged.

International Development Assistance: the MDCs

As pointed out in Part I, the development of closer relations with the Most Advanced Developing Countries, (MDCs), constitutes an important economic and political objective for Canada because of their future market potential, increasing influence in world affairs and natural resources riches. Their burgeoning S&T capabilities and needs for technological assistance make the use of S&T collaboration a particularly appropriate tool to assist the development of closer relations. Moreover, there are sufficient shared needs and problems to hold out the real prospect of mutually beneficial joint projects.

Unfortunately, the Federal government has not yet been able to fully exploit the potential offered by S&T collaboration with a few carefully selected MDCs. Except for the special case of nuclear cooperation, the only bilateral S&T agreements with MDCs listed in the Canada Treaty Series are in respect of Brazil and China. Neither has resulted, as yet, in any major specific joint collaborative projects. Similarly, attempts made to develop useful collaboration on a less official level, as for instance, in the case of Venezuela have not produced concrete results. The same applies to the case of Mexico in spite of calls for closer S&T cooperation by Cabinet Ministers and legislators of both countries. That the desire for collaboration is still held was eloquently demonstrated in the final communique of the 1980 visit of the President of Mexico to Canada which referred to the Mexicans' desire for S&T cooperation as an inducement to future oil sales.

There are three main reasons for the inability thus far of Canada to develop significant S&T collaboration with the MDCs.

- Since 1975, general assistance, including S&T support, to MDCs has been given low priority in Canada's international development assistance programme.
- the science-based departments of the Federal government are understandably reluctant to commit scarce resources to activities for which they, until quite recently, held no mandate and foresaw little of value in terms of S&T substance.
- Until mid-1979, the main thrust of the S&T - as opposed to the technical assistance - element of Canada's international development programme consisted of financial support to international research or of direct support of research undertaken by local scientists in the developing countries themselves. Though meeting a major demand of the Third World, this has meant that Canada's domestic S&T resources, including those of the Federal government, have not been involved to any significant degree in the nation's development assistance programme.

In 1979, at the request of Cabinet, the IDRC accepted a new role aimed at deliberately applying more of Canada's S&T resources to helping satisfy the needs of the Third World. This will undoubtedly enhance the level of contact between the S&T communities of the MDCs and Canada and will help both, to some degree at least, to obtain a better knowledge of each others' capabilities. However, the Centre

will understandably have its eyes firmly fixed upon the requirements of the developing countries and cannot be expected to take into account, in its assistance activities, the broader economic and commercial potentials for Canadian industry or the needs of foreign policy. If the latter considerations are to be addressed it will have to be as an effort in its own right and separated from the assistance programme though drawing on the expertise available within it.

Of all the prospective ancillary roles to which the Federal government's S&T resources could be turned, modest collaboration with the MDCs is considered to be the best example of the greater national good, in terms of political and economic gain, being well worth the diversion of a few domestic resources. It is also the role in which the existence of S&T infrastructures within the MDCs offers a real possibility of genuine mutual benefit provided proper investigation and planning is done and that the valid demands of S&T, trade and aid are carefully orchestrated into a mutually supporting whole.

Legitimation of the Ancillary Roles

The judicious application of the S&T capabilities of the Federal government to the furtherance of major national goals in the international area is considered to be no less valid than its use domestically to promote another major national goal in the domestic area - that of the economic development of the nation. Yet the advantages to be gained have to be weighed carefully in terms of both the competing demands of the ancillary roles versus the main domestic S&T goals and between the ancillary roles themselves. To which international goal should domestic S&T be applied and to what extent? Should the more focussed pragmatic need to exchange Canadian S&T for industrial benefits and oil supplies take precedence over the generation of general diplomatic goodwill?

These questions, difficult though they are, must be addressed if a coherent national approach is to be developed and optimum results obtained. A necessary first step, however, will be to obtain Cabinet agreement that the ancillary roles are the legitimate concern of the science-based departments.

One class of international collaboration which clearly illustrates the dilemmas currently posed by the emergence of the foreign, economic and other policy demands upon domestic S&T resources is the Bilateral General Agreement. Known as the "umbrella agreement" because it provides an overall

framework or umbrella within which collaboration can be encouraged, this type of S&T agreement is unique in representing a substantial commitment of domestic resources for reasons other than the expectation of returns of a purely S&T nature.

THE GOVERNMENT TO GOVERNMENT BILATERAL GENERAL (UMBRELLA) AGREEMENTS

The Current Position

Canada currently has umbrella type S&T agreements with five nations, (Belgium, FRG, USSR, France and, though not actually as a formal agreement, Japan), and with the European Community, (EEC). In each case the prime reasons for Canada entering into these agreements have been their perceived importance to foreign policy and commercial goals or both. S&T collaboration has been seen to be a tool or mechanism towards achieving the larger national goals with the achievement of purely S&T benefits being only one of several objectives. Diversification away from a perceived scientific over-dependence upon the United States as part of the third option, (the umbrellas with EEC, FRG and Japan), international assertion of biculturalism (Belgium and France), reduction of East/West tension, (USSR), and penetration of foreign high technology markets (EEC, FRG, Japan, USSR) have all been valid strategic grounds for the signing of the general or umbrella agreements. From a scientific viewpoint, the major benefit expected has been the impetus given to collaborate provided by the very act of entering into a major and politically very visible international agreement.

Results Obtained

In the event, the umbrella agreements have not lived up to expectations. There have been some modest foreign policy benefits. Scientific links with the USSR have contributed to detente and have opened, for some Soviet scientists, a small window upon the Western world; the few years experience in trying to develop S&T relations with the FRG, Japan, and the EEC have demonstrated the real and practical difficulties of an S&T Third Option. In the main, however, substantial foreign policy advantages are difficult to perceive and indeed in one case - that of Belgium - the umbrella agreement has demonstrated in a public and embarrassingly visible manner the inability of Canadian and Belgian scientists to develop any useful joint activities.

The record in the commercial or export market areas is equally disappointing. It is difficult to identify sales

which have directly resulted from the substantial effort put into exploring the possibilities from the umbrella agreements.

The biggest disappointment - and surprise - has, however, been the low level of S&T benefits emerging from an activity which has been protracted over several years and has involved the participation of substantial Canadian S&T resources. There have been useful exchanges of both information and scientists but few concrete joint collaborative research ventures have so far materialized. Certainly, none of the S&T activities so far resulting have justified the high cost of administration which is the umbrella's principal feature.

The mixed commission type mechanism adopted as a standard approach demands a full-time coordinating effort from MOSST and External Affairs, the substantial participation by the science-oriented departments of the government and on occasions the involvement of other sectors. This activity peaks at regular, (usually biennial) intervals, as bilateral review meetings, often involving substantial participation, are prepared and carried out.

Reasons for Poor Results

The fundamental mistake made by Canada in opting for the umbrella type agreement has been the assumption that its very existence - as a public declaration of the intention of two governments to collaborate in S&T - would automatically guarantee such collaboration. Thus a "shot gun" approach was initially adopted to the problem of identifying and initiating joint activities. Under this approach large delegations, (the Canadian ministerial mission to Japan in 1971 consisted of 40 members), representing a broad spectrum of disciplines were exchanged or met in the expectation that at least some cooperation was bound to develop.

In fact because quantity was substituted for quality, in terms of sound pre-investigation and analysis of potential, initial results were bound to be general in nature. Thus both the size of the initial effort and of its results raised entirely unrealistic expectations. They also ensured the use of a large and cumbersome administrative mechanism - first to organize the large scale missions and/or meetings and subsequently to attempt to turn as many as possible of the resulting general initiatives into viable practical collaboration. In the Japanese example for instance no less than 72 possible "areas of cooperation" were identified by

the Canadian mission of 1971. By 1974 only one collaborative project had materialised.

Such a broad, unfocussed, "top down" approach is difficult to justify even when substantial S&T resources are at hand. Thus in recent years it has been Canadian policy neither to seek broad agreements nor to agree to proposals from other nations to enter into such agreements. What has been lacking has been any broadly accepted policy in favour of the active pursuit of more focussed, and hence more practical, opportunities for collaborative activity.

Two further major and related factors contributing to the failure of the bilateral S&T agreements to live up to expectations have been departmental mandates and the availability of funds. Both factors are important major obstacles to international collaboration in S&T and are dealt with in more detail in a later section. Suffice it to say, however, that departmental mandates do not as yet recognize as valid the use of domestic S&T resources to meet non-departmental goals. In the absence of some central finances specifically earmarked to help support such international activities therefore, funding represents a diversion of resources from those domestic programs for which the funding has been provided. As matters presently stand even the modest resources needed to bring knowledgeable Canadians together to identify and examine potential possibilities in cooperation and to carry out necessary preliminary visits are available only to the extent that they represent "spare" departmental resources. Such a procedure is hardly the basis for the efficient execution of a major international agreement.

The disappointing results of the general agreements are considered to be due, in the main, to the approach taken rather than to a lack of promise in the concept of bilateral collaboration per se. The general umbrella agreement as presently conceived and structured should therefore be discarded in favour of a more limited and focussed approach.

The One Exception - the USA

One type of situation where a substantially modified umbrella agreement could be useful does exist. This is the case where a substantial amount of joint collaboration is already underway. Collaboration, like all dynamic activities, needs nourishment to remain on peak form. There could be occasions when the highly visible and politically important mechanism of a government-to-government treaty

could help further cement existing collaboration, help free funds and inspire or at least facilitate further efforts.

In such a case however, the present large, highly structured and inflexible Mixed commission mechanism should not be used. Instead a small, flexible group should be put together as needed to support infrequent meetings of Ministers and senior officials of each country. Only broad matters of policy and major problems should be addressed.

Only one of Canada's current relationships is considered to merit consideration for a "policy umbrella": the USA. Canada has a uniquely close and virtually all pervasive relationship with the World's greatest source of S&T. In fact it could be claimed that for science, although perhaps not for technology, the Canada/US border hardly exists. The value of the relationship to Canada is incalculable, all its well known disadvantages notwithstanding, and it has undoubtedly been a major factor in the achievement of Canada's present level of S&T capability.

Two major questions arise: First, is Canada's S&T collaboration with the United States still healthy and progressing without major problems? Or is it in serious decline as claimed by the US Government, (through statements in 1975 and 1976 by two US ambassadors to Canada). Second, has the time come to consider carefully the value of some more formal government-to-government assertion of the will to continue and enhance the level of S&T collaboration between Canada and the United States?

There can be no answer to the first question simply because no attempt has been made to maintain the early efforts of MOSST to monitor the level of formal exchange. As to the second, in view of the Reagan Administration's budget cuts and general tendency towards a more isolationist approach, at least a good hard look at the benefits of a formal agreement seems justified - but of the "policy" not the traditional type.

A STRATEGIC FRAMEWORK

Need

The amount of resources available for international activity depends very much upon the economic climate at any given time; as an extension of a domestic program however such activity clearly takes second place. Resources are thus at a premium and this is particularly true of those departmental S&T resources available for foreign policy or other ancillary roles. It is therefore imperative that they

be applied within a coherent strategic framework in which shorter term goals can be set, choices made and scarce resources allocated to obtain maximum benefit.

This overall strategic approach to certain elements of Canada's international collaboration has not yet been fully adopted for a variety of reasons. The rapid expansion of international S&T activities has posed new problems not the least of which being the blurring and overlapping of responsibilities engendered by multidisciplinary or "horizontal" activities. The required central coordinating mechanism was late in being established and its effectiveness further reduced by early competition between the central agencies concerned. It still has little capability to carry out needed analyses from which pragmatic choices can be made nor does it possess even a modest fund with which to initiate or encourage collaborative activities.

These weaknesses and the experiences of the last ten years have resulted in an understandable - but nevertheless regrettable - tendency by officials to avoid bilateral government-to-government initiatives except in those infrequent cases where individual departments are willing and able to develop specific projects aimed solely at meeting domestic departmental objectives. At present, therefore, Canada has, by default, a strategy which largely precludes the use of Canadian S&T capabilities to help meet valid national foreign policy, economic and development assistance goals. A strategy moreover which has already seen, over the past two or three years, countries such as Mexico, Brazil and Venezuela sent away empty handed without any really serious attempts to develop S&T collaboration being made by Canada in spite of a clearly expressed political desire for closer relations.

Canada can no longer afford to leave major opportunities and potential unexplored. An effort should be made to develop a simple, flexible strategy which would facilitate the most effective application of those resources available for commitment to international collaboration. The key elements of such a strategy are considered to be:

1. The selection of major bilateral and multilateral target activities chosen for their potential importance to Canadian domestic S&T programs, foreign policy, economic or development assistance goals.

2. The establishment of a simple effective mechanism to facilitate the planning and initiation of these activities.

Strategic S&T Sector Targets

The benefits of international collaboration can be expected to be greatest when the limited resources available are concentrated on those areas and technologies of prime importance to the achievement of Canada's domestic S&T goals. This is particularly true of the new high technology fields, such as biotechnology, which are extremely complex and require substantial resources in order to keep current, let alone to forge ahead.

Fortunately, a conscious and deliberate effort has been underway within the Federal government over recent years aimed at identifying sectors of priority concern and, within these, technologies in which Canada has or is developing special expertise. These domestic priorities should now be reflected in, and reinforced by, efforts to identify and develop appropriate international collaboration activities.

It is considered that this approach to grasping the initiative can be best done by the use, in selected areas of national priority, of small ad hoc groups of knowledgeable people representing where appropriate the industrial research, university, Federal government and provincial research communities; in some cases they could be the Task Forces now being established by MOSST to define priorities in specific technological areas. The groups would be tasked with the analysis of potential areas of collaboration and the subsequent development of specific, narrowly focussed objectives. The process would continue with visits to and from the target country with the aim of confirming preliminary analysis and where possible actually initiating early collaborative activities. These steps could be carried out at modest cost, with some help from the central agencies, MOSST and External Affairs and with no requirements for a major bilateral agreement or agreements to be signed.

The findings of these surveys and preliminary activities should be widely published and follow on action - in particular to involve Canadian industry - vigorously pursued. Parallel efforts on a broader country-to-country basis, including the visit of ministers where appropriate, should be made to reinforce the narrower sector specific initiatives.

Strategic S&T Country Targets

Considerations similar to those underlining the need for a choice of strategic target sectors in the S&T field are expected shortly to motivate the selection of priority

bilateral country targets to meet major Canadian foreign policy goals. Collaboration in S&T will be expected to play its part, as in the past, in developing these key bilateral relations.

An attempt should therefore be made to draw up a list of countries rated according to their perceived potential value to the development of Canada's S&T capacity. Country reviews should, where possible be carried in concert with the similar broader bilateral reviews planned by External Affairs with priority given to those nations with which Canada presently has bilateral umbrella S&T agreements.

Aims should be twofold: First, to assist External Affairs in rating the overall importance of a country to Canada by providing a judgment of its S&T potential and promise in regard to joint collaborative activities. Second, to have identified, albeit in a preliminary fashion, major fields of S&T endeavour by a country which match Canadian expertise and which could be quickly examined in more depth should foreign policy considerations require the development of closer bilateral relations.

A series of time consuming in depth reviews are not meant. Instead, a pragmatic approach should be adopted whereby a number of criteria could be applied to decide whether relations with a given country stand a fair chance of being developed on the basis of a judicious mix of perceived foreign policy/economic benefits and S&T potential. Examples of such criteria are:

- similarities in major S&T needs/fields of endeavour;
- total R&D expenditure as percentage of GNP;
- R&D manpower levels;
- number of universities and students;
- sophistication of industry;
- value of high technology imports/exports;
- market potential for high technology products;
- political influence in major international forums;
- importance as a resource supplier (e.g. oil) or as a customer for Canadian resources (e.g. coal).

Future Bilateral Approach

Bilateral government-to-government collaboration in S&T can, under certain circumstances, offer benefits and it is inevitable that Canada will wish, or be urged, to consider this form of cooperation in the future. The lessons learned from the umbrella agreements should therefore be carefully noted. They suggest that the best value is likely to accrue when narrowly defined fields of endeavour are carefully chosen in areas offering at least some matching in capability and need between the prospective partners. In addition, the emphasis should be placed very clearly upon the direct involvement of the performers of S&T with the role of the central coordinating bodies being restricted to facilitating, assisting when and where needed, and to monitoring reciprocity. Above all, the practical limitations imposed by Canada's limited S&T resources demand that they should be concentrated upon a few worthwhile targets.

Such an approach constitutes a step-by-step development of collaboration with clear objectives in mind and with a focus deliberately applied to specific Canadian S&T needs. If early hopes turn out to have been overly optimistic, activity can be quickly reduced and then terminated without major adverse diplomatic effects. If fruitful collaboration does ensue it will be based upon sound foundations and will thus offer the best chance of future healthy growth.

The Science Counsellors

Canada's science counsellors possess a special blend of skills and knowledge. They have to have a broadly based grasp both of science and technology in general and of Canadian domestic programs in particular in order to produce valid judgments regarding their country of accreditation. People with such qualifications, and the support they require to operate effectively, are expensive - which has considerably limited their number. Science counsellor posts abroad should therefore be carefully reviewed at regular intervals and in more depth than currently practiced as part of the country review program.

The substantial potential, as well as the high cost of placing a science counsellor in a foreign country also demands that all available time be carefully and fully directed towards meeting the main objectives justifying the establishment of the position. In certain posts for instance, Bonn and Brussels being possible examples, the Science counsellor does not appear to have the support staff necessary to deal with the numerous requests for documents and publications - to say nothing of the even more onerous

administrative and travel arrangements required to support the many visits by Canadian scientists. These activities are legitimate and necessary but should not be permitted to divert a highly skilled and paid professional from other far more important responsibilities.

Financial restraint and a growing disenchantment with general bilateral S&T agreements has effectively held the number of Canadian science counsellor positions stable since 1975. The time is now ripe for an assessment of the situation and it is suggested that the proposed strategic bilateral country reviews would provide a convenient opportunity.

THE RESOURCE QUESTION

Introduction

The best conceived strategic plans will not produce optimum results unless sufficient resources are at hand to carry them through. The lack of reliable long-term resources has from the outset bedevilled Canada's government-to-government S&T relations and has all too often reduced the return from these activities. There are three main and interrelated reasons for this; the nature of international collaboration itself, uncertainties regarding mandates, and the question of funding.

The Nature of International Collaboration

International collaboration is an extension of domestic programs and thus by definition must take second place to them when hard financial decisions have to be made. End benefits of collaboration are very difficult to demonstrate at the outset of some planned joint activity - particularly as the initial period of investigation and travel extends the already long period of gestation normally associated with R&D. Furthermore these benefits are often difficult to quantify (e.g., increased effectiveness through shared knowledge).

The upshot of all this is that the will of departments to use international collaboration to help attain domestic objectives varies greatly with the economic climate, with the importance of R&D to departmental programs and with the individual perception of senior management. Paradoxically, in times of financial restraint when such collaboration should, because of shared cost and resources, be most sought after, domestic concerns and priorities reduce it most. Above all there is still a widely held view of international

activities as luxurious - if not frivolous - peripherals to a more solid domestic purpose.

A further important factor closely related to the poor perception of international activities is the shortage of trained people. To reap the full benefits of future opportunities in the international S&T area, Canada will need more scientists with experience at government-to-government level and more diplomats with a broad understanding of Canadian S&T needs and capabilities. Departments should seriously consider enlarging the policy role of their international units so that advice on international opportunities can be readily available when new programs are being established or current ones reviewed. There should be a conscious effort to substantially increase the number of exchanges and secondments between External Affairs and the science based departments. Above all, the possession of combined S&T and international experience should be recognized in career development as a desirable asset.

Mandates

Until recently, the international extension of a given S&T activity was considered by officials to be merely an element of that activity and thus the sole concern of the departmental scientists concerned. It is now being appreciated that many such activities go well beyond their purely scientific importance and have a bearing in other areas such as the enhancement of national industrial R&D capabilities, trade opportunities, and international prestige and influence. These "ancillary" roles for domestic S&T have, however, not as yet been recognized in departmental mandates nor in resource allocations within External Affairs.

As matters presently stand therefore, the application of Canada's S&T capabilities to national goals other than those directly related to the domestic mission oriented programs of the science based departments has to rely solely on those "spare" resources the departments are prepared to make available after their own domestic priorities are met. These spare resources are understandably meagre in the current climate of severe financial restraint and are subject moreover to frequent fluctuations.

Clearly domestic departmental priorities should exert the main influence over Canadian interest and involvement in international activities in those areas in which departments themselves are best qualified to judge. These represent the vast majority of cases. There will however, be occasions when the interests of major national goals in the foreign

and economic policy areas will demand the diversion of some modest resources from domestic programs or require that departments efforts be made to develop S&T collaboration in areas where this would not be sought in the natural run of things.

It should, nevertheless, be recognized that the intrinsic S&T value received by a department fulfilling such ancillary roles is limited and that a need is being met which is peripheral to basic departmental concerns. There is thus a requirement for a clear government policy which encourages the commitment of departmental S&T resources to these ends and legitimizes where necessary appropriate budgetary allocations.

Funding

A major obstacle to the full exploitation of international collaboration has been the initial high cost of identifying potential partners and of laying the ground work for joint planning and execution of programmes. Except in a few areas (e.g., space) no clear and systematic policy has been developed for the provision of reliable and readily available funds. In the absence of some central fund, the necessary finances can only come from the budgets of the science departments and these, as has been pointed out, are not mandated to deal with international collaboration other than to meet their own objectives.

The science based departments already routinely produce scientific staff to assist interdepartmental consideration of government-to-government collaboration, to examine the possibilities of undertaking as a department the joint activities arising, to report on such activities once underway, and to attend mixed commission type meetings in Canada and abroad. Budgetary reductions and restraint have however severely affected the capability of the departments to produce actual funds to support foreign travel and living expenses.

The problem is additionally exacerbated by the normal long budgetary cycle. First, it is extremely difficult to accurately forecast funds needed to initiate international collaboration and second, opportunities frequently occur at short notice. In the latter case they must either be ignored or funds must be diverted from other programmes to support an investigation.

The lack of reliable funds frequently places Canada at a disadvantage and sometimes also in a poor light vis-à-vis the foreign partner. Lack of resources soon becomes appar-

ent as joint planning progresses and can only be interpreted as either a lack of real commitment or as a sign of a poor administrative approach.

In terms of substantive value the lack of funds affects Canada's ability to initiate projects of national interest or to respond adequately to potentially useful proposals made by the partner; politically the lack of real progress becomes an embarrassment. Eloquent examples taken from very different country groupings include Canada's general agreement with the FRG where the situation has twice moved the ambassador to report S&T cooperation with the Germans as being close to the point of no return; and Brazil where in 1973 the Canadian International Development Agency had to assume the costs of the 1968 exchange agreement between the National Research Council and the Conselho Nacional de Pesquisas.

It is worth noting that other nations have established central funding arrangements of one kind or another with the object of supporting the initiation and execution of international collaboration in S&T. The science ministry of the FRG, for instance, has available a fund, amounting in 1980/81 to the equivalent of about C\$5 million, which is used to catalyse collaboration, priority being given to the more advanced developing countries. The French Direction générale de la recherche scientifique et technique has a similar fund, approximately C\$½ million annually, used solely to initiate international collaboration. Belgium and Japan also recognize the need for some modest funds readily available to take advantage of opportunities offered.

The need for some central funding system to assist departmental involvement in international S&T activities in support of broader economic and foreign policy objectives has in fact been recognized since the early 1970's. Some funding was provided under the agreement with the USSR and a special fund was established for two years to cover certain travel costs incurred under the Sino-Canada S&T program. External Affairs still provides half a million dollars annually under the Canada France agreement - but only to cover the costs of sending Canadian scientists to France. A permanent central fund has however never been established: it now should be.

Not all the funding needed for the effective pursuit of collaborative projects under an agreement needs to be centrally produced. It can be reasonably argued that as the domestic programs of the departments involved will eventually benefit, some call on departmental funding is justified. It is however the initial stages, when projects have to be identified and initiated, which require some central finan-

cing assistance with departmental funding assuming the full costs as projects prove feasible and are developed.

The absence of some modest seed funds available to encourage the process of initiating joint activities has undoubtedly contributed significantly to the difficulties encountered and lack of return obtained from many of Canada's government-to-government international S&T activities. If, for good and valid reasons, intergovernmental cooperation in S&T is to be undertaken then the necessary resources to give such cooperation a chance to succeed should obviously be provided. Departments should not be morally obliged to participate at the cost of competing with their own domestic programs nor should officials of the coordinating agencies be put in the position of requesting such participation without at least having some contribution to offer.

A Catalytic or Seed Fund

The basic key function of the proposed central fund is to catalyse international activity which would otherwise not happen or, by the judicious application of some modest financing, to revitalize a flagging initiative. It aims at attracting other resources to an activity rather than itself providing the main means of support. Its main purposes would be to encourage international collaboration in S&T within a government-to-government framework by:

- Supporting collaborative S&T activities undertaken primarily to meet Canadian foreign, economic or international development assistance policy needs for which funding would normally not be provided under existing domestic programmes; and
- Supporting initial steps to identify and organize collaborative international S&T activities.

The fund will never be large and should not be dissipated in a large number of small activities. To obtain maximum benefit resources should be applied in a highly selective manner and concentrated on a relatively few important initiatives chosen both for substantive promise and for their potential to attract other sources of support. Examples of main categories of activity qualifying for support are:

- Travel, and where necessary, basic living costs involved in bringing representatives of industry, research institutes and the universities together in Canada to:

(a) plan international S&T collaboration as part of a government-to-government programme or agreement,

(b) participate in meetings in Canada attended by foreign S&T missions;

- Travel and basic living costs involved in sending small, usually mixed groups of representatives from the industrial and other sectors on short exploratory missions to a foreign country.

The overriding principle should be to use the fund primarily in the initial stages of establishing collaboration and then only to the degree that other funds are not available. It is assumed that Federal government officials participating in activities in Canada could normally meet their own costs and, as some domestic benefit should eventually be obtained, should contribute 50 percent of the costs associated with foreign travel.

Used strictly as a catalyst, it is considered that a central seed fund of only \$750,000 could realistically support the new strategic approach recommended. A sum of \$500,000 is recommended for fiscal 1982-83 to get needed activities immediately underway. As a comparison, \$500,000 is currently provided annually by External Affairs to support one element (the travel of Canadian scientists to France), of one bilateral agreement.

A case can be made for the proposed central seed fund to come out of the budgets of either the economic development or the foreign and defence policy envelopes via the budgets of MOSST or External Affairs respectively.

Since one major element of the proposed strategy concerns the identification and involvement, in collaborative activities, of selected areas of S&T expertise of major domestic importance to Canada, it could be argued that economic development considerations are of prime interest and hence should be appropriately funded.

The main thrust, however, of all the collaborative activities lies squarely in the international field and indeed much of the activity itself will be aimed at helping achieve major foreign policy goals rather than specific mission oriented objectives of the science based departments. The international activities of the latter will, as in the past, have to be entirely supported by departmental budgets. It would thus appear most logical for the fund to be provided out of the foreign and defence envelope and to be controlled by External Affairs in its

capacity of final arbiter where international affairs are concerned.

The question of how the fund should be administered and the mechanism through which allocations should be made are dealt with in succeeding sections.

A FOCAL POINT

As emphasized in the various elements of the overall strategy proposed, the role of the actual R&D performer is central to the planning and execution of joint collaboration. Coordination and other common services should be provided only where absolutely necessary and then with as light a touch as possible. Nevertheless certain major common functions will have to be carried out. They are:

- The initiation and coordination of the strategic sector and bilateral country activities including the review of existing umbrella agreements.
- The coordination of existing bilateral umbrella agreements and future response to requests from other nations for S&T collaboration.
- The administration of the "seed fund".
- The monitoring of reciprocity.
- The execution of major studies.
- The provision of secretariat functions to the interdepartmental committee responsible for coordinating major international S&T activities.

Some of these functions are already being performed by either External Affairs or MOSST and it could perhaps be argued that the new central responsibility devolving from the overall strategy could also be shared. It is considered, however, that the impetus needed to successfully get the strategy underway and the effective application of the new financial resources envisaged demand the continuity of commitment best provided by a single, clearly designated, responsibility centre. The establishment of a simple, modest permanent focal point is therefore urged on the understanding that the basis of such a focus already exists in the central agencies most concerned.

Ideally a central focal point should have all of the following main characteristics:

- A broad knowledge of the international and foreign policy area with particular emphasis upon the S&T element.
- A sound knowledge of Canada's domestic S&T scene; close contacts with the S&T community, awareness of major strengths, weaknesses, needs, capabilities and government policies.
- It should not be located within a major potential user of the "seed fund" because of the danger of a clash of interests.
- It should have a general relationship to Canada's S&T endeavour rather than being a performer in one specific field.

Possible Contenders

Three major contenders for the role of focal point exist: the International Office of the NRC, the Science, Environment and Transportation Policy Division of External Affairs and the International Division of MOSST.

NRC. Is the largest and most diverse performer of R&D in Canada with an intimate knowledge of, and influence with, the S&T community. It additionally has a long experience with international science and with the administration of funds to support international science activities. Unfortunately the NRC itself could well become one of the major users of the fund.

External Affairs. The ultimate arbiter of all Canada's international S&T activities. However, the necessarily generalist skills of the diplomat coupled with the lack of continuity engendered by the routine rotation demands of an External career tend to militate against a focal point based on External Affairs.

MOSST. Exercises a central policy role in S&T and has close contacts with the domestic S&T community on whose behalf it works. Through its International Division, MOSST has a close association with the international S&T area, presently coordinating several major bilateral and multilateral activities. Finally, it has carried out, on behalf of the interdepartmental S&T community, several major policy studies on international S&T issues. However MOSST is a

wholly policy ministry with as yet no operational responsibilities.

Recommended Option

The prime responsibility could equally well be given to any of the three contenders considered. Each has its own individual and substantial contribution to make. To bind the three together in a common purpose yet retain the necessary single authority, it is recommended that a modified joint approach be made. Under this approach, MOSST would house, staff and manage the focal point with one official being seconded full time from External Affairs and from NRC. The latter two would provide the direct intimate link required to tap needed foreign policy and S&T expertise.

Finally, in recognition of the need for close and knowledgeable links to Canadian industry, it is recommended that the Department of Industry, Trade and Commerce name an officer to act as point of contact with the focal point.

INTERDEPARTMENTAL ARRANGEMENTS

The focal point would be a small central group providing common services to the key executors of the overall strategy - the science based departments and agencies of the Federal government. In order to bring their expertise and skills to bear as a single coherent group, however, some simple effective mechanism is needed. Such a mechanism already exists to some degree in the shape of the Interdepartmental Committee on International Science and Technology Relations, (ICISTR).

ICISTR

ICISTR was established in 1975 to provide coordination of the Federal government's overall participation and policy respecting international S&T cooperation. Chaired by External Affairs, it brings together involved and interested departments two or three times a year.

ICISTR has never had a permanent secretariat or research staff but has had to look elsewhere for the provision of the basic data and recommendations on which to focus interdepartmental policy considerations. To some extent, therefore its priorities and concerns have depended upon chance rather than rational choice. In 1977, a reorganization within External Affairs diverted main responsibility for bilateral S&T activities from the Science, Environment and Transportation Policy Division to

the appropriate geographical divisions and thus further diffused ICISTRs central role. Finally though attempting to call the interdepartmental tune ICISTR had no funds to pay the departmental piper. Its current function has therefore largely become that of a forum for information exchange and general discussion. It has, in other words, become a "paper retort".

An Enhanced Role

To properly support a new coherent strategic approach ICISTR will have to fulfill the following main functions:

- Using papers and studies produced by the focal point, develop an overall strategy for major government-to-government bilateral and multilateral S&T activities.
- Provide overall guidance and evaluation of such activities.
- Provide general direction to the focal point.
- Decide upon the general lines of allocation of the central "seed" fund.

Committees reflect their membership and particularly their leadership. To realign the energies of ICISTR into new, far more active channels, will require strong and vigorous direction. External Affairs are therefore urged to strengthen their internal central S&T focus by reassigning it responsibility for bilateral S&T relations. The interface between the scientific and other aspects of foreign relations with a country should lie within External Affairs and not between its many geographical divisions and individual science based departments.

Proper review and decision making is badly needed if a national, integrated and effective Canadian approach to future government-to-government S&T activities is to be forthcoming. This in turn will only occur if continuity, adequate resources and firm leadership is available. The combination of a permanent focal point, a modest "seed" fund and a revitalized ICISTR should amply meet these needs.

OTHER SECTORS

Full advantage of international collaboration can only be taken to the degree that knowledge is held of the existence somewhere of research of possible interest and subse-

quently that the possibility also exists of accessing such knowledge. Governments, through their government-to-government relations, possess the unique capability of being able to open up a window on the research being performed by a foreign country and of facilitating access to such research.

Though of value to all sectors, this service is of particular importance to high technology industry because much of what is going on in this field is shrouded in tight industrial secrecy. In Canada's bilateral S&T relations with the FRG, the latter have provided examples of how conscious and determined efforts can involve national industries either directly in bilateral collaborative activities or can open possibilities of contract work resulting from such activities. Canada has not yet been able to develop this facility to the same degree.

In government-to-government collaboration there is a natural and powerful bias in favour of involving the Federal government's own S&T resources. Departmental research performers are immediately at hand, through their representation on interdepartmental committees, to provide the advice and actual resources so important particularly in the early stages of international collaboration. This natural bias is further emphasized by the very real practical difficulty of identifying potentially interested firms and of providing some coherent coordination to what could easily become an unwieldy group of provincial, university and industrial participants. The result has been a very uneven approach to international collaboration opportunities varying from an all sector involvement in the bilateral agreement with the FRG to an almost purely Federal government approach regarding Japan.

No artificial mechanism can match the knowledge of sector needs and capabilities possessed by the individual sector expert. The collective experience of the research element of any science based department is well aware of those university faculties, provincial and industrial research groups working on major problems within their particular area. There is, therefore, no substitute in international activities for a government official, highly motivated and on the alert to identify opportunities for other sectors - in particular the industrial sector - and prepared to take the time and trouble to involve appropriate members of these sectors.

This attitude already exists to some extent but it needs constant encouragement from senior management and central coordinating bodies until it becomes second nature; it also needs some simple mechanism(s) to help individual officials in their task of bringing other sectors in. Such

mechanisms will not be easy to develop and will vary according to the needs of the particular international activities they serve. They must however be sought if Canada's S&T community as a whole is to fully benefit from the international S&T activities of its government.

PART III: SUMMARY OF CONCLUSIONS/RECOMMENDATIONS

General Recommendation

1. Carefully chosen and planned joint collaborative activities represent a valuable method of enhancing Canada's national S&T capabilities. Their potential should be vigorously exploited.

The Sectors

2. A major part of Canada's international collaboration in S&T is carried out as a normal integral part of university life and makes a substantial contribution to the national research capability.

- This contribution should continue to be recognized and encouraged via the various government granting and scholarship programmes aimed at supporting international collaborative activities in S&T.

3. The requirements of industrial secrecy and proprietary rights make international collaboration within the industrial sector difficult to arrange although it is routinely sought when government defence and industrial development programmes are concerned. Where a government project or funding is not involved the assistance which can be offered is limited though still valuable. Therefore:

- Industry can and should be involved where at all possible in the identification of potential international collaboration as part of any S&T agreements entered into by government, and in their execution.

Main Foreign Country Groupings

4. The main thrust of Canada's international S&T activities has traditionally lain in the direction of cooperation with the industrialized nations and this should continue in the future.

5. If, in happier future days, political considerations dictate a re-opening of some S&T collaboration with the Warsaw Pact nations, it should be restricted to a very limited number of activities carefully chosen to offer real S&T benefit and with a Canadian expectation of full reciprocity being made crystal clear at the outset.

6. Canada has an excellent record in supporting research for the developing nations. The newly industrialized nations (MDCs) of the Third World, however, because of their advanced stage of development attract low priority in Canada's international assistance programme. As the process of industrialization proceeds they increasingly represent new and potentially valuable markets for Canadian high technology goods, useful sources of raw materials and powerful centres of influence within the Third World. They have, over the last few years, been unsuccessfully seeking close S&T relations with Canada.

- *The opportunities presented by the MDCs should now be pursued but as a goal in its own right, and separately from the international development assistance programme because of the conflicting objectives involved. The thrust should concentrate on a few chosen areas within a limited number of MDCs selected on the grounds of appropriate S&T capabilities, market potential, natural resource importance and political influence. In devising optimum future approaches, particular attention should be paid to the possibility that the OPEC nations might tie future secure oil supplies to the transfer of technology and S&T assistance.*

The Government-to-Government Dimension

7. The period commencing with the 1950s witnessed an entirely new phenomenon - the rapid and very substantial involvement of governments in international S&T activities of all kinds.

- *As a small, but highly industrialized nation, independent of major trading and economic blocs, Canada stands to gain considerably from the opportunities offered by this relatively new dimension in international affairs. The Federal government, in exercising its role in government-to-government relations, can substantially assist the other sectors of Canada's S&T community by facilitating access to new knowledge, experience and technology possessed by other countries in areas of mutual interest, making possible actual participation in joint international programs, and assisting in the development of the new markets essential to the health of Canada's high technology industry.*

The Ancillary Roles of S&T

8. Substantial potential value but also major problems are presented to the Federal government by what can conve-

niently be referred to as the "ancillary roles" of S&T. By ancillary roles is meant the use of national S&T resources to achieve national goals other than those strictly related to domestic S&T programmes. The securing of S&T benefits will always be important but these constitute only one element - and often not a major one - of the particular package sought.

- The application of the S&T capabilities of the Federal government to the furtherance of major national goals in the international arena is no less valid than its use domestically to promote another major national goal - that of economic development. A necessary first step is, however, to obtain Cabinet agreement that the ancillary roles are the legitimate concern of the science-based departments.

General Bilateral Umbrella Agreements

9. The broad, unfocussed, "top down" approach used by Canada in the general bilateral umbrella agreements in S&T has been expensive in resources and disappointing in results. It has led to a general discrediting of this type of agreement.

- Thus in recent years, it has been Canadian policy neither to seek broad agreements nor to agree to proposals from other nations to enter into such agreements. What has been lacking however has been any broadly accepted policy in favour of the active pursuit of more focussed, and hence more practical, opportunities for collaborative activity.

10. One exception to the general rule is Canada's S&T relations with the United States. Bilateral connections at the institutional level are so extensive and valuable that their smooth functioning must continue to be an important element of government concern. The relationship is so intimate that policy changes by one government can well give rise to extensive impacts upon bilateral arrangements.

- It would therefore seem wise to initiate some regular policy discussions at Ministerial or high official level between Canada and the United States within the framework of a carefully defined bilateral agreement. Such discussions could also deal with major operational difficulties should these arise but should not be used for the exchange of routine proposals concerning specific bilateral projects.

A Strategic Framework

11. Bilateral government-to-government collaboration in S&T can, under certain circumstances, offer benefits and it is inevitable that Canada will wish, or be urged, to consider this form of cooperation in the future. Departmental S&T resources are, however, at a premium and this is particularly true of those available for foreign policy or other ancillary roles. *It is therefore imperative that they be applied within a coherent framework which permits rational choice to be made and optimum benefits obtained. The key elements of such a strategy should be:*

1. *The selection of major bilateral and multilateral target activities chosen for their potential importance to Canadian domestic S&T programs, foreign policy, economic or development assistance goals.*
2. *The establishment of a simple effective mechanism to facilitate the planning and initiation of these activities.*

Strategic S&T Sector Targets

12. A conscious and deliberate effort has been underway within the Federal government over recent years aimed at identifying sectors of priority concern and, within these, technologies in which Canada has or is developing special expertise.

- *These domestic priorities should now be reflected in, and reinforced by, efforts to identify and develop appropriate international collaboration activities on a government-to-government basis.*

13. It is considered that this approach to grasping the initiative can be best done by the use, in selected areas of national priority, of small ad hoc groups of knowledgeable people representing where appropriate the industrial research, university, Federal government and provincial research communities; in some cases they could be the Task Forces now being established by MOSST to define priorities in specific technological areas. The groups would be tasked with the analysis of potential areas of collaboration and the subsequent development of specific, narrowly focussed objectives.

Strategic S&T Country Targets

14. *An attempt should be made to draw up a list of countries rated according to their perceived potential value*

to the development of Canada's S&T capacity. Country reviews should, where possible be carried out in concert with the similar broader bilateral reviews planned by External Affairs, priority attention being directed at those nations with which Canada presently has bilateral umbrella S&T agreements.

Resources

15. The best conceived strategic plans will not produce optimum results unless sufficient resources are at hand to carry them through. The lack of reliable long-term resources has from the outset bedevilled Canada's government-to-government S&T relations and has all too often reduced the return from these activities. There are two main and interrelated reasons for this; uncertainties regarding mandates, and the question of funding.

16. Departmental mandates do not as yet recognize as valid the use of domestic S&T resources to meet non-departmental goals. In the absence of some central finances specifically earmarked to help support such international activities therefore, funding represents a diversion of resources from those domestic programs for which the funding has been provided.

Each nation with which Canada currently has a general bilateral S&T agreement has established a central funding arrangement of some kind with the object of supporting the initiation of international collaboration in S&T.

- Such a fund should now be introduced in Canada.

A Catalytic or Seed Fund

18. The key function of the proposed central fund is to catalyse international activity which would otherwise not happen or, by the application of some modest financing, to revitalize a flagging initiative. It aims at attracting other resources to an activity rather than itself providing the main means of support.

- Used strictly as a catalyst, a central seed fund of \$750,000 could realistically support the new strategic approach recommended. A sum of \$500,000 is recommended for fiscal 1982-83 to get needed activities immediately underway.

Institutional Arrangements

19. The main executors of the proposed strategy will be the science-based agencies and departments of the Federal government although the beneficiaries will include the other sectors. Nevertheless some coordination and common services will have to be provided. This includes the initiation and coordination of the activities proposed, the monitoring of reciprocity, execution of major studies and administration of the central fund.

20. Such activities are, with the exception of the fund, already being provided by External Affairs and MOSST. However, the impetus needed to successfully get the strategy underway demands the continuity of commitment best provided by a single responsibility centre.

- The designation of a permanent focal point is therefore urged.

21. External Affairs, NRC and MOSST all possess to some extent the characteristics ideally required by such a focus: the broad knowledge of the international S&T scene and an awareness of Canada's domestic S&T strengths, capabilities and needs.

- To bind all three together in a common purpose yet retain the necessary single authority, it is recommended that MOSST house, staff and manage the focal point with one official being seconded full time from External Affairs and NRC.

22. Finally, it is recommended that the necessary orchestration of departmental participation, overall policy guidance and direction be provided by the existing Interdepartmental Committee on International S&T Relations, (ICISTR), chaired by External Affairs.

The Future

23. The March 1981 Declaration of the OECD Science and Technology Ministers Meeting reflected a general belief that the importance of international collaboration will grow even further in the years to come. In particular, the government-to-government element is expected to become more significant as costs of major S&T projects increase, as the difficult World economic situation reduces access to foreign technologies and markets, and as the number of major scientific related international issues increases.

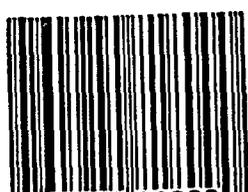
24. This situation holds out both opportunities and challenge for Canada: opportunities to significantly assist, in certain selected areas, the national thrust towards increasing the level of R&D performed; to use these burgeoning capabilities to open new high technology markets, and to enhance Canada's international development assistance programme. The challenge lies in the achievement of these goals with the limited resources available for commitment to the international sphere.

25. Proper review and decision-making is needed if a national, integrated and effective Canadian approach to future government-to-government S&T activities is to be forthcoming. This in turn will only occur if a clear strategy, continuity, adequate resources and firm leadership is available.

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