The Peripheral Nature of Scientific and Technological Controversy in Federal Policy Formation

G. Bruce Doern

Science Council of Canada

Background Study 46

Science Council of Canada
100 Metcalfe Street
17th Floor
Ottawa, Ontario
K1P 5M1

Available in Canada through

Authorized bookstore agents
and other bookstores

or by mail from

Canadian Government Publishing Centre
Supply and Services Canada
Hull, Quebec, Canada K1A 0S9

Catalogue No. SS21-1981/46E
ISBN 0-0660-10903-4
Price: Canada: $4.95
Other countries: $5.80

Price subject to change without notice

The Peripheral Nature of Scientific and Technological Controversy in Federal Policy Formation

by G. Bruce Doern

G. Bruce Doern

Dr. G. Bruce Doern is Director and Professor of the School of Public Administration, Carleton University. He is the author or editor of several books and articles on Canadian public policy and public management including *Science and Politics in Canada* (McGill-Queen's Press, 1972); *The Politics and Management of Canadian Economic Policy* (co-authored with R.W. Phidd) (Macmillan of Canada, 1978); *The Regulatory Process in Canada* (Macmillan of Canada, 1978); *Government Intervention in the Canadian Nuclear Industry* (Institute for Research on Public Policy, 1980); and *Public Policy in Canada: Organization, Process and Management* (co-edited with Peter Aucoin) (Macmillan of Canada, 1979).

Contents

List of Tables

List of Figures

Acknowledgements

I wish to thank numerous federal and provincial officials, interest groups, and businessmen for their cooperation in the conduct of this study. Special appreciation is also due to David Harris, Percy Collas, Bill Fitzpatrick, Martha Madsen, and Joan Doern for their research and typing assistance.

The staff of the Science Council, Jack Basuk, Judith Miller, Howard Eddy, and Jill Morowski and others provided much appreciated critical commentary on an earlier draft.

G. Bruce Doern
School of Public Administration
Carleton University

Foreword

Many of the issues governments now face have been greatly complicated by rapid advances in science and technology. Whether or not our legal system can accommodate the introduction of complex and uncertain scientific factors is of concern to scientists, policy makers, and the general public.

In 1978 the Science Council undertook a major study on "Science and the Legal Process." The purpose was not only to examine how the law deals with social issues that have been created by scientific and technological research and development, focussing on the role of science in government decision-making processes, but also to recommend changes that would encourage greater cooperation between the two disciplines. The study is examining the relationship between science and law in commissions of inquiry, government departments, the courts and administrative agencies.

Dr. G. Bruce Doern, Director of the School of Public Administration at Carleton University, has written extensively about government operation and policy. He was therefore invited to write this background study. In *The Peripheral Nature of Scientific and Technological Controversy in Federal Policy Formation,* Dr. Doern looks at the activities of Energy, Mines and Resources; Consumer and Corporate Affairs; and Health and Welfare Canada from 1975 to 1979. He describes the broad range of departmental activities in order to understand the normal handling of scientific and technical advice and determine the amount of attention given to scientific controversy in each of their agendas. The Science Council is pleased to make this study available to the public. As an authored paper, the study represents the views of the author and not necessarily those of the Science Council.

Maurice L'Abbé
Executive Director
Science Council of Canada.

I. Introduction

The 1970s have witnessed a growing, but often ill-defined, concern about the role of science and technology in the making of policies and decisions in the public and private sectors. Concern has also increased about the effect of such decisions on scientific and technological development. The concerns have varied in scope and have embraced such diverse issues as the effect on human beings of long term exposure to low level radiation, the use of saccharin in diets, the effectiveness of seat belts to reduce fatal automobile mishaps, and the adequacy of information about Canada's oil and gas reserves. Concerns such as these are said in various ways to involve "scientific and technological controversy." There exists in many quarters a genuine desire to devise ways in which such scientific and technological controversies can be openly discussed and, to the extent possible, resolved.

As we shall see, the words "science," "technology," and "controversy" are subject to wide variation in definition. Moreover, in seeking to disentangle science and technology from other determinants of public and private decision making – political, economic, organizational, and legal – there are often insurmountable problems. It is hoped that this study will contribute some understanding of the problems by examining the concerns and by evaluating the feasibility of proposals for reform.

The major purposes of the study are:

- to survey the general characteristics of federal public policy and decision processes;
- to examine how scientific and technological data and advice are acquired and used in the context of the above processes;

- to describe and examine how scientific and technological controversy is viewed and handled, or resolved, in the context of the above decision processes;
- to examine how such controversies are defined by decision makers within the political and managerial operation of three federal departments: Energy, Mines and Resources Canada (EMR); Health and Welfare Canada (HWC); and Consumer and Corporate Affairs Canada (CCA); and finally
- to comment on the desirability and feasibility of possible reforms in order to secure a more regular and open debate of such controversies.

The difficult task of defining and recognizing scientific and technological controversy in a democracy will be left to later parts of this study. It is necessary, however, to stress at the outset that the study is *not* an effort to construct a pure definition of *scientific* controversy, to examine several such controversies, and thus generalize from these case studies. The terms of reference embrace the full continuum of scientific and technological activity. The focus of the study is to enquire into how scientific and technological controversies are defined and viewed by decision makers who must function in a broad political, economic and bureaucratic setting. Are such controversies differentiated from other issues decision makers must face? If such controversies (however defined) *are recognized* to be different, are they or should they be handled in special ways? If so, what special ways could be suggested? Would such mechanisms be feasible in view of the numerous conflicting purposes of government, the time needed to enable such mechanisms to function, and the potential number of such controversies during the 1980s?

The general conclusion reached by the author is that scientific and technological factors are recognized to be important elements of decision making. I also conclude, however, that scientific and technological controversy, because it is subject to a wide range of definitions and because of the nature of the decision making, is peripheral to the decision process. People seeking major reforms of government decision processes, especially those who assert the need for major reform based on the existence of a pure and clear definition of *scientific* controversy only, must place this vague class of controversies within this context.

The evidence from this and other studies suggests that some reforms are both desirable and feasible. It is also clear, however, that the limited nature of such reforms will disappoint those who believe that the web and substance of governing should be radically altered to alleviate scientific and technological controversy. In this subject, as in so many others, prior beliefs and expectations of the reader will greatly colour the reception given to the suggested reforms. The preparation of the study and its conclusions are based on a very rational

premise about government; namely that scientific and technological controversy is only one problem among a host of others with which decision makers and Canadian citizens must deal.

This study is intended to complement another Science Council background study by Liora Salter,[1] which focusses on a number of cases of scientific controversy in public inquiries: three nuclear-related inquiries, one on the non-medical use of drugs, one on satellites, and one on aluminum wiring.

Unlike the Salter study, this study examines the general policy and decision processes of the federal government, and then concentrates on the operations of three federal departments from 1975 to 1979. We examine, within the context of their jurisdiction, mandate, and role in the broader federal policy process, their general and specific approaches to scientific and technological issues.

The reason for the approach taken in this study is that the policy process can only be partly understood by following single policy cases over time, e.g., satellite technology, nuclear energy, aluminum wiring. Another dimension of policy reality is that, at any time, single departments and agencies (and, of course, the government as a whole) will face several policy issues, characterized by various degrees and kinds of scientific controversy. Departments and the government must somehow seek to "manage" their response to these several issues, and their response will affect the approaches they take to any single controversy. Departments will, in a sense, have to rank science-related controversies, and may, therefore, respond quite differently to any one of them even when they are objectively similar, and when some outsiders may think each is equally important.

There are clearly some limitations in our approach. The three departments selected provide a limited base, but lack of time and resources prevented the inclusion of other departments. The three departments were chosen for a number of reasons. They deal frequently with science- and technology-based problems, and represent both the social and the economic aspects of government activity. Moreover, their portfolios range in importance. EMR has moved to centre stage in the latter part of the 1970s as a central economic and resource department of the federal government. CCA is a much less central economic department and experienced a rapid turnover of ministers in the 1970s. HWC is the major social policy department but can be considered to occupy a middle position of influence (in comparison with EMR and CCA), particularly as the latter half of the 1970s has witnessed the consolidation of earlier social programs and the emergence of strong conservative criticism of what is viewed by some as excessive social welfare spending.

II. Federal Public Policy and Decision Processes: A Survey

It is tempting, but in the final analysis grossly misleading, to speak of *the* public policy and decision process. It is important, of course, and useful to visualize how a single policy or decision is made by following it (if one can) sequentially through its nominal stages of development – initial identification, definition, consideration of alternative solutions, decision to act, implementation, and subsequent evaluation or review. However, governments must govern; numerous policy and decision processes operate concurrently on a political and economic agenda that contains and is influenced by a variety of ideas and ideologies, personalities, and interests and organizations of unequal power.[1] It is an agenda by which governments attempt to achieve a judicious balance between the status quo and change, and in which policy and administration are often indistinguishable from one another.

The place of scientific and technological controversy must first be located within this broader context. This chapter presents a brief, but not simple, survey of the characteristics and realities of federal policy and decision processes and relates these to recent reforms of the decision process proposed for, or adopted by, the federal government. Such reforms include freedom of information legislation, parliamentary committees, program evaluation, environmental assessment, and regulatory reforms, such as the Socio-Economic Impact Analysis (SEIA) process launched by the federal cabinet in August 1978.

Central Policy and Decision Processes

Policy and decision making in the federal government embrace interlocking circles of activity, with different but usually related val-

ues, instruments of governing, and forms of contact between the executive-bureaucratic arena (the Cabinet and central agency secretariats) and other arenas of Canadian politics. These major central processes involve a struggle between the *status quo* and change, including the following:

- the priority-setting process;
- the economic policy and management process and its often conflicting struggle with social policy processes and redistribution;
- the expenditure-budgetary process;
- the regulatory process; and
- the federal-provincial relations process.

Each of these imposes or entails different time constraints on central and departmental policy makers, comprises various degrees of uncertainty, risk, and control, and requires different forms of information and knowledge. They also involve many different organizations and agencies, albeit all nominally linked to the Cabinet. In addition, they involve the personalities of individuals at the bureaucratic and ministerial levels.

The main priority-setting process evolves within the basic formal and informal elements of Cabinet structure and behaviour, including the role of the Prime Minister and of central agencies such as the Privy Council Office (PCO), the Prime Minister's Office (PMO), the Treasury Board Secretariat (TBS), the Finance Department, the Federal-Provincial Relations Office (FPRO), and the staff secretariats of the Minister of State for Economic Development, and the Minister of State for Social Development.[2]

Governments have always had to develop priorities. The formal expression of such priorities is reserved for Throne Speeches, Budget Speeches and the like. In recent years the annual priority-setting process has assumed somewhat more organizational visibility and formality because of the establishment of the Cabinet Committee on Planning and Priorities in the Trudeau era and the formation of an Inner Cabinet by former Prime Minister Clark. It is important at the outset to relate the other central policy processes already noted to the priority-setting process. For example, let us assume that the federal Cabinet, through its priority-setting exercises (which, in the later Trudeau years included full Cabinet "think" sessions in the rustic splendour of Meach Lake), determines that the government's priorities are: 1) the reduction of inflation; 2) the promotion of national unity through language policy; 3) the reduction of regional disparities; 4) the re-equipment of the armed forces; and 5) improving competition in the economy.

The political realities of governing are such that not all of these priorities require equal expenditure, or entail regulatory, legislative, political, or economic consequences. Moreover, they can involve vary-

ing degrees and kinds of federal-provincial relations. For example, the first priority could be addressed through regulatory means by creating a wage and price control board. Although the use of the regulatory instrument would have enormous impact on *private* expenditure, it would not have a major effect on the government's own expenditure budget, other than the cost of the control board. The second priority might be addressed by increasing the spending (through provincial governments) on language programs in primary and secondary schools. The third might be met by altering the regulation of transportation freight rates. The fourth might require an expenditure of, let us say, one billion dollars. The fifth could be recognized by creating a royal commission to study the problem; a symbolic and fairly inexpensive response.

In this hypothetical and deliberately simplified scenario, the second and fourth priorities have the largest impact on government *expenditure*. The first and third would have minimal effect on government budgets but would have a *regulatory* impact on private budgets and behaviour, and certainly on national and regional economies. The final priority might only be exhortative or symbolic, but could affect the climate of political discussion because businessmen and others might read it as a possible sign of changing government views.

Thus each of the above priorities has different implications for legislation, and hence for another scarce political resource, Parliamentary time.[3] Some may require no legislation; others may require extensive legislative changes, not to mention intensive federal-provincial bargaining. Thus governmental priorities and the economic and expenditure budget processes become entangled with different legislative and regulatory processes, as the values, priorities, and instruments of governing are chosen, altered, and balanced.

Keeping in mind the brief nature of the survey, federal policy and decision processes are reviewed under several headings: cabinet parliamentary government; ministerial – deputy ministerial relations; the media and other actors; and the instruments of governing.

Cabinet Parliamentary Government

The Prime Minister, the Cabinet, and the central agencies and senior officials are the centre of power, hence of the day-to-day policy and decision processes in the federal government. The Prime Minister and the Cabinet are, in constitutional theory, collectively responsible to an elected Parliament for their policies and decisions. Institutionally and constitutionally, the collective nature of the Cabinet is important, but the concept of collective policy making can be very misleading. This fact is always recognized with respect to the preeminent role of the Prime Minister, and to the differing powers of the individual ministries.[4]

The Canadian Cabinet, however, is also a representative or legitimizing institution, notwithstanding the existence of Parliament, in that it is judged not only on what it does but what it *appears* to do. The Cabinet has always had not only to represent, but appear to represent, the diverse regional and ethnic components of the Canadian population. Successive governments have not always been able to achieve optimum representation but all have been required to make a serious attempt. Although it is clear that the Prime Minister and some ministers and portfolios are more influential than others, it is important to stress at the outset the continuing role of collective norms in Canadian Cabinet organization and behaviour. These norms become visibly tested precisely when, as in recent years, efforts are made to establish special groups such as an Inner Cabinet or inner groups of advisers.

The norms and traditions of Cabinet collectivity, responsibility, and solidarity also influence decision making through the rules laid down for secrecy and confidentiality in the intra-cabinet and intra-bureaucratic decision-making processes. The dispersal of influence and responsibility among ministers is a function of the related constitutional practice in parliamentary systems of assigning responsibility for legislation and programs to individual ministers and departments in order to facilitate parliamentary accountability. The assignment of individual responsibility is also an outcome of the complexity of government and of the need to delegate functions to ministers and departments on administrative and technical grounds. The constitutional principles and administrative necessities that generate individual ministerial authority and influence both reinforce the collective nature of the Cabinet, in the broad sense of dispersing influence, and create an overriding need for central coordination and guidance.

In recent years many changes have been made to formal Cabinet organization and policy processes, including changes to its committee system and central support organizations (Figure II.1). This system evolved out of earlier changes, made in the Trudeau era, which required public policy proposals to run the gamut of evaluation and criticism, usually involving at least one subject-matter committee and more than one coordinating committee. Changes introduced by the short-lived Clark government in 1979 were intended to strengthen these processes by giving greater *de facto* decision-making power to the committees, with fewer appeals to the full Cabinet.

The major Cabinet committees have been assigned expenditure "envelopes" and are functioning in part as miniature treasury boards.[5] In the past, committees would consider policy proposals but could leave the contentious resource and financial questions to the President of the Treasury Board and the Minister of Finance. The new system is intended to force a more serious consideration of eco-

Figure II.1 - Government of Canada Cabinet Committees and Central Agencies, 1981

Cabinet

General Coordinating Committees

Priorities and Planning*
Treasury Board
Legislation and House Planning
Public Service
Security and Intelligence

Policy Field or Subject Matter Committees

Economic Development*
Social Development*
Foreign and Defence*
Government Operations*
Labour Relations
Communications
Special Committee of the Council
Western Affairs

Central Support Agencies

Prime Minister's Office (PMO)	Privy Council Office (PCO)	Treasury Board Secretariat (TBS)	Department of Finance	Minister of State for Economic Development (MSED)	Minister of State for Social Development (MSSD)
	Federal-Provincial Relations Office (FPRO)	Office of the Comptroller General (OCG)			

* Committees with direct responsibility for budget envelope.

nomic implications. Hopefully it will mean better assessment of which instrument, expenditure, regulation, or tax (see below) is best suited to resolving the problem at hand. Since the system is new it remains to be seen whether it will succeed in generating greater resource discipline and whether it will encourage the taking of a longer term view of policy and decisions. It should be stressed that such a system was not intended or designed to assess scientific and technological variables. To the extent that it works, however, the analysis it produces may help in addressing some scientific controversies.

The mere listing of the Cabinet committees illustrates all too clearly the difficulty of putting policy into watertight compartments. Overlaps abound in the committee process. Three other observations about federal experience with the committee process and with the workload of ministers are warranted. First, in the federal Cabinet, ministers are members of more than one committee. The impression of policy integration occurring through multiple membership must therefore be qualified by the time demanded by committee work and the widely different degrees of interest and preparation evinced by individual ministers. Second, it must be stressed that ministers are usually far better briefed by their officials to defend their own portfolio than to criticize the proposals of other ministers in Cabinet. Third, in the late 1960s and early 1970s, committees were intended to help give more control to ministers and less to senior officials; they were intended to replace some senior official interdepartmental committees. However, many ministers began to complain of burdensome committee duties and of their need to get out of Ottawa and visit their constituencies across the country. Consequently, by the late 1970s, official level committees were created more frequently and it was not uncommon for senior officials to participate in Cabinet committee meetings in a way virtually indistinguishable from that of their ministerial superiors.

It is thus important to stress that the committee process can result in a considerable amount of decentralization in that the committees have taken on *de facto* decision-making roles in areas of decision making that in early periods of Canadian cabinet government would have been decided by the full Cabinet.

Ministerial - Deputy Ministerial Relationships

Decision making is clearly influenced by the day-to-day relations between ministers and their deputy ministers (and other senior officials).[6] Several important points about these relationships can be made. First, it has become increasingly difficult to speak of an integrated Cabinet with full governing responsibility. Although most departments, agencies, and Crown corporations nominally report to or through ministers, there are different kinds of reporting relationships; hence ministers feel themselves responsible and deputies consider themselves accountable in varying degrees.

Second, administrative matters are increasingly the concern of deputy ministers. This is because ministers prefer to allocate time to their policy and political party duties and many have a distaste for administrative and managerial matters, at least until they get into political and media trouble over them. The relationship between ministers and their deputies is often less of a superior-subordinate nature and more a matter of a specialization of roles. Deputy ministers, however, must often function as an alter ego of the minister. Senior officials know they must be politically attuned, and must avoid getting the minister into unnecessary trouble. They must be conscious of the close connections between policy and administration, knowing full well that political controversy can arise as much from single cases and decisions as from the development of "high" policy.

Finally, deputy ministers must in some respects respond to at least three masters: their minister; the Prime Minister, by whom they are appointed (on the advice of the Secretary to the Cabinet); and the Treasury Board, which exercises general managerial authority. Federal deputy ministers must also pay heed to the activities of the federal Human Rights Commission, the Commissioner of Official Languages, the Comptroller-General and the Auditor General. They are subject to the multiple pressures and obligations that are subsumed in the larger concept of collective ministerial responsibility.

Deputy ministers thus face extraordinary and sometimes conflicting pressures. In the last decade, in addition to their normal roles as policy advisers and general managers, they have been deluged with a seemingly endless stream of reforms and directives, each of which separately may have been desirable, but cumulatively have often distracted them from their primary responsibilities for managing the program(s) of their departments.

Although ministers and deputy ministers are dependent on each other, their interests are not always the same. This fact deserves emphasis both in this discussion of decision processes and in the exploration of scientific and technological controversy later in this study.

The Media and Other Non-Governmental Actors

Ministers and deputy ministers must balance and respond to a wide variety of incentives and pressures. In particular, they must deal with the media, the leaders of industrial associations, corporate executives, other interest groups, and academics. A recent analysis by Douglas Hartle has succinctly summarized many of the interactions that characterize relations with these groups.[7] For ministers, they include the following:

> "(1) Never do anything substantial when a symbolic gesture will suffice. Substantial actions cost money and voters do not like high taxes (exception: if an expenditure is to be made to reflect

concern, ensure that the amount allotted appears to be sufficiently large that it cannot be treated as a token. The amount actually spent need *not* be equal to the amount allotted).

"(2) Hidden costs are better than open costs and open benefits are better than those that are hidden. This proposition is subject to the qualification that, if the losers are unpopular, the costs must appear punitive and benefits provided the unpopular must appear to be given most grudgingly.

"(3) Unpopular decisions must appear as inescapable and/or the fault of others. Popular and long-overdue decisions must be presented as voluntary, courageous, imaginative and bold.

"(4) Carefully select, in so far as possible, the year, the season, the day and the hour of the day for the release of news in accordance with the need to trumpet it or suppress it. Use the rhythm of fading memories, seasonal preoccupations, weekends and publication deadlines to maximum advantage.

"(5) Recognize the interest group leaders' necessity, because of their 'free-rider' problem, of appearing effective to their members. If not too costly, when they are basically in a weak position, assist them in appearing *publicly* (i.e., at least to their own members) as more effective than they are. They thus become beholden to you and therefore less effective than they otherwise might be at a later date.

"(6) Never admit that the government is powerless to do anything about the resolution of a problem *except* when facing up to it would create an even greater loss of support.

"(7) Never appear unconcerned. Anything that is a matter of some concern to someone is a matter of concern to you.

"(8) Pressure groups whose members are involved for charitable motives have little staying power and can often be silenced by establishing prolonged and expensive procedures (e.g., commissions of inquiry) that will gradually weaken their voice because of membership attrition.

"(9) Any information that will not obviously help the cause should be suppressed. It may later be used against you.

"(10) Leak information on a 'not for attribution' basis to the best (i.e., most dangerous) journalists. They are then less likely to be perspicaciously critical of you later for they would not wish to lose their 'insider' advantage relative to their competition."

Space will not permit a detailed analysis of these axioms, although I refer to some of them in the more detailed assessment of the three departments.

It is essential to stress another major point about public decision making, that is the need to stress and differentiate between decision makers' *perceptions* of need and reality from *actual* need and reality, and the need to regard each as separate determinants or aspects of public policy and decision making. Indeed, perceptions may be more important than reality. For example, in issues dealing with health and safety regulations ministers must often respond to media exposure of single cases, injuries, or deaths.

The Instruments of Governing

It is not enough to know that there are interests, classes, the media, ministers, and senior officials involved in the several policy processes. It is not enough to know that cabinets and prime ministers preside. One must know what they preside over in day-to-day governing. This in turn requires a careful appreciation of the basic governing instruments available to ministers and senior officials and of the relationships among such instruments.[8]

It is helpful to approach the role of governing instruments in a series of steps. Hence I begin by taking an elementary look at three basic governing instruments, followed by three more complex illustrations. The three instruments are first broken down into finer gradations of choice. Next, the basic governing instruments are linked to the major modes of government organization. Finally, I sketch how decisions involving these several alternative or complementary instruments are usually assessed by the central units of cabinet government.

An Elementary Categorization

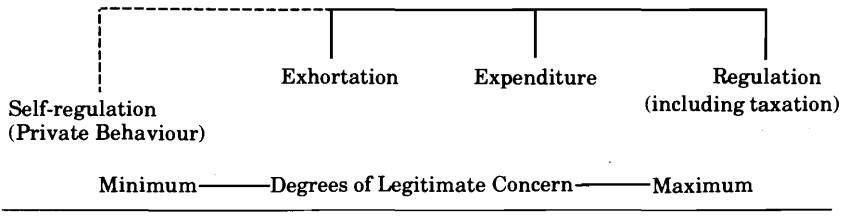
Figure II.2 portrays a very simple categorization of the instruments of governing.[9] The categories evolve out of a basic characteristic of politics and governing, namely that *in addition* to pursuing whatever goals they wish to achieve, politicians (and their officials) must select certain basic instruments of governing, each of which represents a different degree of application of the legitimate coercive powers of the state. Such degrees range from nil or minimum to maximum. The word "instrument" conveys the notion of means, but it must be stressed that they cannot afford to be treated as matters of mere technique because politicians are likely to be judged as much on the instruments they employ (including the sequence in which the instruments are used) as they are on their ability to achieve objectives. In this sense, politics in a democracy is much more an "ends-ends" chain of relations than a "means-ends" chain of relations.

In simple terms, only three instruments are available: exhortation, public expenditures, and regulation. Exhortation implies an effort by politicians to persuade individuals, interests, or groups to support or comply with government policies. Government expenditures are a more moderately coercive instrument because although

citizens are legally coerced through taxation, they are not necessarily aware of how much they have paid out of their own pocket when they receive, or are being induced by, government expenditures.[10] All in all, expenditure is not an "unpleasant" instrument of governing so long as winner and losers are not fully aware of their status in particular decisions. This is not too hard to accomplish in practice.

Regulation is a more directly coercive instrument of governing because it is the setting of rules of behaviour supported directly by the sanctions of the state.[11] Regulation includes taxation because it is essentially the extraction by the state, through regulation, of private incomes or wealth. Figure II.2 also indicates the logical opposite of regulation, which is self-regulation or private behaviour (including, in theory at least, the marketplace). Self-regulation is used here not in the sense of the self-regulating professions but in the much broader sense of all private behaviour, both market and non-market.

Figure II.2 - The Instruments of Governing



It is obvious there are limitations to this categorization. We shall see this as more detail is revealed in each successive portrait. In the meantime, three important issues raised by this simple approach are worth stressing. First, what is coercive depends greatly upon the eye of the beholder. Someone who has been accustomed to receiving the benefits of a government expenditure or grant, but has been advised that he or she no longer will, may perceive this as a very coercive act. In contrast, an infant firm that heretofore has been prevented from gaining access to a market because of regulation, may view the benefits of deregulation as a new government incentive.

Second, it is important to stress that politicians "trade" in a market of governing instruments. This is true both in the narrower confines of a single policy field at any one time, and in the broader context of governing in many fields over long periods. The supply, demand,and price of instruments (economically and politically) may change. Pressure for regulatory reform and deregulation is in part a product of a conservative resurgence in the late 1970s. It is also part of the anti-spending and reduce-taxation campaigns mounted during this period. To cut back both spending and regulation sug-

gests that, aside from doing nothing, governments would have to rely solely on exhortation, an instrument that is unlikely to be effective in the long run on its own, given the kinds of problems that beset modern industrial states.

Third, the price of instruments is also affected by the relative visibility of different instruments. It is clear, for example, that many kinds of regulation including tax incentives (tax expenditures) have been largely hidden from public view and analysis; hence there is some attraction in seeking and giving government favours through this instrument.[12]

A Secondary Categorization: Finer Gradations of Choice

As Figure II.3 shows, within each of the three instruments a number of alternatives exist. Some are likely to be classed as being in the stodgy realm of administration. In reality they are often simply more subtle kinds of politically-loaded instrumentalities. It is true to say that political administration is generally a more accurate term to describe the implementation of public policy than public administration.[13] It is not political in a partisan sense but rather in the sense of the need to strike continual bargains with interests, groups and individuals. Usually these bargains are struck under such acceptable headings as "be fair," "be flexible," "be reasonable." This political administration may be especially necessary or prevalent in regulatory matters, because regulations are in theory rules of behaviour backed by the sanctions of the state.

Exhortation may, therefore, include numerous symbolic and substantive kinds of activity including speeches, conferences, the provision of information, the creation and subsequent operations of advisory bodies and councils, the use of studies, research and royal commissions. At times, the reorganization of agencies and departments or the creation of new ones constitutes a symbolic form of exhortation, demonstrating to a constituency that government is concerned.

Expenditure instruments can include grants, subsidies, conditional grants (of infinite variety), block grants, and transfer payments, to name only a few. Regulation may take the form of legislation, statutory instruments, taxes, tariffs, guidelines, rules and orders. Technically, even public ownership could be considered a form of regulation because it is a more extreme form of regulating ownership. In reality, however, it is viewed as a separate, highly coercive instrument of governing. Regulations, moreover, vary according to the severity of the sanctions applied (fines, penalties, imprisonment).

Figure II.3 alerts us to several other realities about governing instruments and decision processes. First, regulation is more than just delegated legislation.[14] It can include the statute itself, e.g., the

Figure II.3 - A Secondary Categorization of the Instruments of Governing: Finer Gradations of Choice

Exhortation	Expenditure	Regulation
Ministerial speeches	Grants	Taxes
Conferences	Subsidies	Tariffs
Information	Conditional grants	Guidelines
Advisory and consultative/bodies	Block grants	Rules
Studies/research	Transfer payments	Fines
Royal commissions		Penalties
Reorganizing agencies		Imprisonment

Criminal Code, and a host of other activities, which in the nomenclature of public administration is often not called regulation. As a practical matter within government, however, regulations are usually taken to be delegated legislation, or rules of behaviour promulgated through the authority conferred in a parent statute. Second, listing these finer gradations of choice suggests how regulatory reform proposals affect decision making. For example, one of the purposes of recent efforts to achieve more prior evaluation of regulation is to encourage decision makers to think about, and perhaps adopt, *non-regulatory* alternatives to achieve policy objectives.[15] They are urged to give consideration to the use of incentives or even voluntary consensus approaches. As a result of analysis of the purpose of an instrument, or because of the practicality of applying it, the solution may require moving from one column in Figure II.3 to another. In turn, such a move may well result in transferring the resolution of policy from one organization to another depending on which agency or branch of an agency has custody of the specific instrument in question. In this sense, government is like a balloon: squeezing a regulatory part of the balloon, e.g., deregulation, may produce a bulge somewhere else. Both the nature of scientific and technological controversy and the responses to it are potentially affected by the balloon effect and by the use of different instruments.

Some General Relationships to Modes of Government Organization

Figure II.4 provides a somewhat more complex but still capsule view of some of the relationships between instruments and modes of organization. It follows logically that most units of government (departments, agencies, boards, etc.) could utilize all the major instruments.[16] But some types of organization tend on the whole to favour some instruments over others. The largest volume of spending, for example, is carried out by regular line departments headed by ministers. Such departments also regulate, to a degree much greater

Figure II.4 - The Instruments of Governing: Some General Relationships to Modes of Government Organization

Exhortation	Expenditure	Regulation
All agencies, but focused on ministerial consultations, speeches, etc., advisory/ consultative mechanisms and bodies.	All agencies, but focused on major line departments headed by ministers.	All agencies but focused (especially in so-called economic regulation) on quasi-independent agencies.
e.g. - Ministers - Science Council - Economic Council - Royal Commissions	e.g. - Health and Welfare - Employment and Immigration - Industry, Trade and Commerce - Secretary of State	e.g. - National Energy Board - Canadian Radio and Telecommunication Commission - Canadian Transportation Commission - National Parole Board

than we ordinarily think. Regulation – especially so-called economic regulation – tends to be identified with quasi-independent regulatory agencies, boards, and commissions. These are called regulatory agencies even though they usually employ the full range of instruments, not just regulations, i.e., they also adjudicate, spend, advise, and exhort.

Given the existence of these instruments, as well as the important legal and political determinants of degrees of independence of different modes of organization, it is clear that coordinating the use of instruments is an important problem for modern governments. Within particular policy fields, e.g., energy, consumer, social policy, and across the spectrum of government action, it is distinctly possible, indeed probable, that government will be spending to achieve one goal and regulating and/or exhorting to achieve a contradictory one. Efforts to coordinate are made but the reality of politics is such that coordination attempts are often sporadic and temporary; the public agenda is almost always crowded with good things to do or at least to be seen doing.

The addition of organization to the complex portraits of public decision making brings with it all the rationalities and irrationalities of bureaucratic and organizational behaviour. Custody over objectives, programs, and instruments is also important. Tasks must be allocated both among many cabinet ministers and among many organizations within any one government and, of course, in Canada, among eleven governments. Tasks must also be aggregated, coordinated, and managed at the centre by cabinets and prime ministers. To this must be added the human dimension of personalities, ambitions, individuals' self-interest, and the unequal abilities of numerous, usually well-intentioned, people.

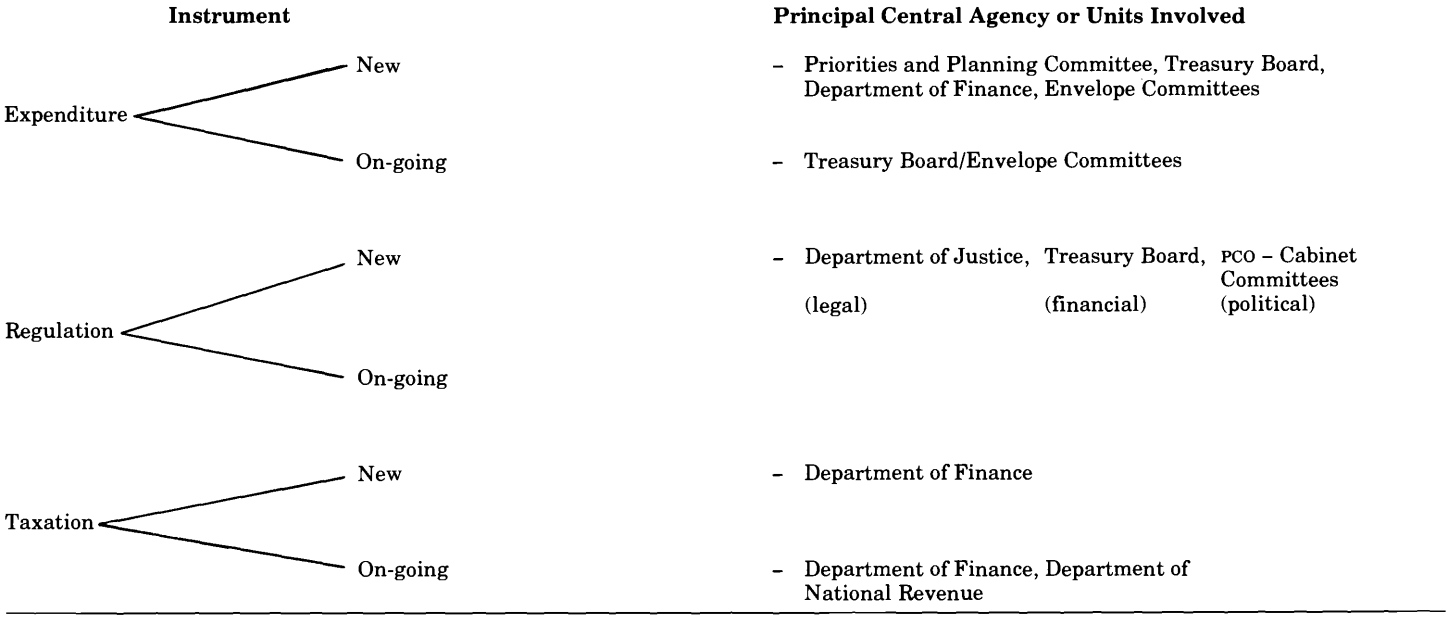
Central Evaluation

Figure II.5 presents another aspect of the picture by showing, in a simplified form, how the instruments of governing relate to the central units of government involved in evaluation. I use the word "evaluation" in the most general sense, particularly as it applies to regulation. Thus, evaluation could mean:

- formal, written cost-benefit evaluation;
- general registering or vetting of proposals by central agencies and other line departments through cabinet documents, and
- political vetting and criticism, i.e., old-fashioned political analysis by politicians and senior officials.

I also attempt to differentiate new from on-going instances in which instruments are evaluated. This is analogous to what in the expenditure budgetary process the federal government calls the "A" (on-going) and the "B" (new) budgets. In other terminology, the categories might be referred to as the "base" and the "margin." I also

Figure II.5 - The Instruments of Governing and Central Evaluation



display taxation as a separate instrument because it is a frequently used instrument of policy.[17]

The foregoing step-by-step discussion of governing instruments is important for any serious understanding of how policies and decisions are made. It is also important in the more specific context of a study of scientific and technological controversy. This is because in one sense those who are concerned about the role of scientific and technological variables in the decision process are really asking in what ways (if any) we could insert a further item into the evaluation process portrayed in Figure II.5. That is, what regular ways are there to ensure that scientific and technological variables, *especially* when they evoke major controversy, can be regularly rather than sporadically evaluated in public decision processes? This theme is examined in more detail in the last part of this chapter and in Chapter III.

Ideology, Ideas and Paradigms

All fields of public policy are multi-valued; that is, they invoke concern about a range of ideologies, objectives, and paradigms and the ranking of these change at different times among different participants.[18]

At the level of major competing political and economic ideologies (e.g., conservatism, liberalism, and socialism), concern exists about the proper role of governments and markets. What aspects should best be left to government and what aspects should be left to the market?[19]

Under the umbrella of competing general ideologies about the proper role of governments and markets, there are, of course, a number of more specific objectives that also provide the normative justification for intervention by government. It is important to stress that these objectives encompass purposes for public policy in the field in question as well as in closely related fields such as economic and foreign policy.

Public policy and hence government intervention in any policy field is also influenced by what some observers have called "paradigms," that is, a series of principles that "express the current assumptions from which specific policy-making can proceed, . . . limit the appropriate choice of policy instruments, and. . . summarise the world view of the policy-making community."[20] Examples of such paradigms are the Keynesian paradigm in macro-economic policy, the preventive versus curative assumptions about medical care, and the need for universality versus selectivity in social welfare programs. Such paradigms can sometimes be distinguished from the broader general ideologies already noted above. Paradigms change slowly over time but can function independently of the broader ideological "isms" because they may apply to a smaller cluster of policy issues or even to a single policy field.

Such paradigms of contending ideas are almost always excessively simple but they are an important factor in understanding intervention at different times. The development of new or competing paradigms can, at different times, be opportunities for thought and learning or obstacles to thought.

It is also clear that the several policy and decision processes are viewed differently according to the importance that various participants attribute to the bases upon which the legitimacy of Canadian political processes rest. Consultation and public involvement is made particularly difficult in Canada because there are different bases of political legitimacy, and these bases often compete.

First, Canada is a federal state in which legitimacy rests on a regional base, a geographic base, and a cultural/ethnic base. This requires consultation of a costly but usually necessary kind.

Second, legitimacy resides in a cabinet held accountable in theory and sometimes in practice by a popularly elected House of Commons.

Third, legitimacy rests in what some call group pluralism. It is accorded in proportion to the real power and influence exercised by major economic interests. Big business ranks at the top but labour, agriculture, and others share this base of legitimacy.[21]

Finally, relatively new, less cohesive interests such as environmentalists and consumers have emerged. These so-called public interest groups frequently challenge, and are deeply suspicious of, the other bases of legitimacy.[22]

These bases of legitimacy intersect and overlap in numerous ways and so are often difficult to disentangle. There can be no doubt that the competing bases affect both the appearance and the reality of decision making in Canada. It is next to impossible for any single formal decision-making body to embrace all these bases adequately.

There are of course other elements and characteristics of federal policy and decision processes that have not been surveyed. Chief among these is the role of departments as organizations. I shall postpone discussion of this important and often little understood dimension until Chapter IV, when EMR, CCA, and HWC are examined.

Recent Efforts to Reform General Policy and Decision Processes

Behind the concern about scientific and technological controversy there exists a vague, ill-defined search for reforms to make the decision process more public, more open, more participatory, more effective, more rational, more compassionate and humane. The search for better decision processes is merely a part of a stream of policy process reforms that the federal government has tried to absorb in the last two decades. The search follows efforts in the 1960s and 1970s

to rationalize government decision making through such devices as planning, programming and budgeting (PPB) and management by objectives (MBO). As a result, reformers of all kinds, including those who want better science and technology assessment processes, are often properly viewed as part missionaries and part used-car salesmen. Governments increasingly feel overloaded with, and sceptical about, the latest reforms and the latest reformers.[23]

This factor is not noted because it is an impediment to reform, but because it places proposed reforms in the climate of the 1980s, a climate not entirely sympathetic to "yet another" reform. Reforms need to be brought about in the context of the real incentives and constraints in which decision makers decide and governments govern.

Recent changes to the Cabinet committee system, including the expenditure envelopes, have already been noted. Five other efforts at reform need to be outlined briefly because I shall later examine their suitability for dealing with issues characterized by scientific and technological controversy, and because all strive to secure better evaluation of decisions, policies, and programs. Each of them, however, has been launched in response to a different criticism of government decision making; they are not coordinated with one another in any explicit way. Moreover some are efforts at *prior* and others at *post* evaluations.

The five efforts at reforms are: environmental assessments, program evaluation, the Socio-Economic Impact Assessment (SEIA) process for prior evaluation of proposed new major regulations, freedom of information legislation, and the reform of Parliamentary committees. They are all complex topics but the intention is to relate them later to processes of dealing with scientific controversy. At this point we are interested only in describing their basic origins and features.

Environmental Assessment Processes

In response to the pressures of the Canadian environmental movement and to the passage of the US Environmental Protection Act, the federal government established, in December 1973, the federal Environmental Assessment and Review Process (EARP).[24] EARP was created by Cabinet directive and has no statutory basis. Its purpose was to ensure that environmental effects and impacts were assessed and taken into account at the earliest planning stages of federal programs and projects. EARP operates in two phases. The first is at the departmental or agency level; agencies make the initial determination if proposals or projects are likely to have significant environmental consequences. If so, then the second phase begins, namely a formal review of major projects conducted by the Federal Environmental Assessment and Review Office (FEARO). A panel of experts appointed by FEARO and the Department of the Environment undertakes a pub-

lic review, including hearings, of a detailed impact assessment document prepared by the proponent agency in accordance with guidelines specified by the review panel.

Since 1974, EARP has reviewed several major federal projects but critics of the process point to several weaknesses such as its lack of legal influence and its purely advisory status. Much like the Ministry of State for Science and Technology in respect of science, EARP functions as "little more than the 'ecological conscience'" of the federal government, its authority being based more on moral suasion than on legal force.[25] Ardent environmentalists want it to become a central agency of government. Critics also point out the weakness of the hearing process. Although they are grateful for the existence of the panels as one of the few avenues of public participation, and acknowledge improvements in the review process as experience has been gained, they still regard the process as much weaker than its US counterpart.

Technological impacts were certainly expected to be part of a properly functioning environmental assessment process and some have been referred to at hearings. It is fair to say, however, that EARP has not given much systematic attention to such concerns nor has it designed its procedures to address, much less resolve, scientific controversies as opposed to mere scientific or technological impacts.

Program Evaluation

A second effort at reform is centred on program evaluations. The most recent efforts to encourage or require systematic and continual evaluations of existing federal programs have originated in the Office of the Comptroller General (OCG).[26] The establishment of the OCG and the call for program evaluation were the products of persistent and vocal criticism by the Auditor General of Canada. The Auditor General voiced his concern about the rampant growth of public expenditure, the absence of proper financial management practices and the absence of evaluation information. He called for "value for money" auditing and assessment practices. His criticisms were reinforced by the Lambert Royal Commission on Financial Management and Accountability which reported in 1979.

The role of the Comptroller General is to act as a catalyst for more efficient, effective, and responsive administration of government expenditures. He stresses that his office will not attempt to implement "grand and expensive systems, thinking that they will provide easy cures to diverse and complex problems."[27] He cites his own sobering experience in the private sector where, in the latter 1960s, the systems' advocates bit off more than they could chew. The Comptroller General's comments indicate a search for a more precise definition of program and whether all programs can be evaluated. For example, the Comptroller General has attempted to distinguish the

so-called "big P" or Estimates programs from "small p" programs of individual departments. Well over a thousand of the latter have been designated as capable of being evaluated.

The call for formal program evaluations raises some of the oldest and most enduring problems about the contending criteria for such evaluations.

The criteria to be applied in the assessment of various governmental activities are numerous, both in general and as they apply to specific programs. Irwin Gillespie has suggested that evaluation of the desirability of government initiatives, even in the simplest terms, could be viewed in the context of conflicting criteria derived from voters with conflicting interests.

> "Let us suppose for example, that we have a community with three voters who interest us. The Glastonian voter places value solely upon allocative efficiency: if the only way to purchase certain goods – collective consumption goods – is through a collective organization, called government, he wants to purchase his benefits at as low a tax cost as possible. The Keynesian voter values efficiency in public spending, but he also places a high value upon having a stable flow of income through time, uninterrupted by periods of inflation and massive unemployment of resources. This voter is prepared to direct taxing, spending, and monetary policy to purchase a stable flow of income.
>
> "The 'Ksanian voter puts some value on efficiency in public spending and stability in the flow of income over time, but he places a much higher value on an equitable distribution of income. Such a voter does not necessarily desire an equal income for all, but he does desire – and is prepared to contribute resources to assist in achieving – a more equal sharing of the resources of the community. This voter is prepared to direct the taxing and spending policy of his government to purchase a more equal distribution of income."[28]

These criteria for establishing the merits of expenditures, efficiency, stability, and equity, are not easy to deal with, but must even be expanded when one deals with specific program areas such as energy, health care, defence, and agriculture, to name only a few.

Evaluations are affected also by other contending views of the analysis of public programs. Many evaluators of government programs argue that one cannot really relate the effects of a program to the government's stated goals and objectives for that program. Rather, one should simply look at actual effects of the program on the public environment and assume that they *are* the intended goals.[29] Such analysts are doubtful about the sanctity of stated goals because there is a strong tendency for all interests (departments,

groups) to cloak their own self-interests in public interest statements.

Some evaluators place greater reliance on the need to relate official objectives to program effectiveness and efficiency. The Auditor General's value for money concept and the Comptroller General's approach favour this emphasis.[30] Others involved in assessing government activities, including many Members of Parliament, are likely to favour rough-and-ready and individualistic criteria. They are often sceptical of stated objectives and officially published studies, and are inclined to judge programs either on the basis of perceived effects, on their own electoral constituency or on ideological grounds. Each of these approaches has its virtues and its faults.

The Federal SEIA Program for Regulatory Evaluation

The Socio-Economic Impact Analysis (SEIA) program for major proposed health, safety, and fairness (HSF) regulations (economic regulations are excluded) was jointly announced by the President of the Treasury Board and the Minister of Consumer and Corporate Affairs on 14 December 1977, and came into effect on 1 August 1978 (Figure II.6).[31] It was a more particular response to the growing criticism, primarily by business interests, of growing government regulations; a criticism strengthened by the declining state of the economy and increasing rate of inflation. Health and safety regulations are defined as those concerning the health or safety, in the broadest sense, of the general public or of particular segments thereof, and the protection of the environment. The term fairness essentially refers to protection against fraud or deceptive practices.

The main objectives of the federal government in developing the SEIA program are threefold.[32] The first is to promote a more thorough and systematic analysis of the socio-economic impact of proposed HSF regulations in order to prevent misallocative effects or negative effects of a non-allocative nature. In effect, the federal government is concerned not only with the impact of HSF regulations on market efficiency, but also with their impact on the distribution of income, technological progress, market structure, international competitiveness, regional balance, and inflation. The second is to ensure uniformity in the assumptions and methodologies used to perform the analysis by the departments and agencies currently administering statutes that confer the power to make regulations in the HSF area. These departments and agencies are: Agriculture Canada; Consumer and Corporate Affairs Canada; Energy, Mines and Resources; Fisheries and Oceans; Environment Canada; Indian Affairs and Northern Development; Health and Welfare Canada; Labour Canada; Transport Canada; Canadian Transport Commission; Atomic Energy Control Board; National Energy Board; and Canada Mortgage and Housing Corporation. The third is to provide an opportunity for increased public participation in the regulation-making process.

The main features of the SEIA program are as follows:

i) Only new HSF regulations will be subject to the system of evaluation. Price and entry regulations are excluded. The term new is used to distinguish HSF regulations (or amendments thereto) made after the proposed procedures came into effect from the large stock of existing HSF regulations.

ii) Only the major new HSF regulations will be subject to the system of evaluation. The magnitude of the expected social costs, e.g., $10 million or more in any one year, is the main criterion for distinguishing between major and minor HSF regulations. The departments proposing new regulations are responsible for making this preliminary assessment, and for determining whether or not a new HSF regulation, which would not meet the cost criterion but might nevertheless have other important implications of potential concern to interested groups or the public at large, should be subject to a SEIA.

iii) There will be special procedures for major new HSF regulations related to emergencies, given the need of the government to act rapidly in critical situations to prevent unacceptable damage to the health and safety of the population or the environment.

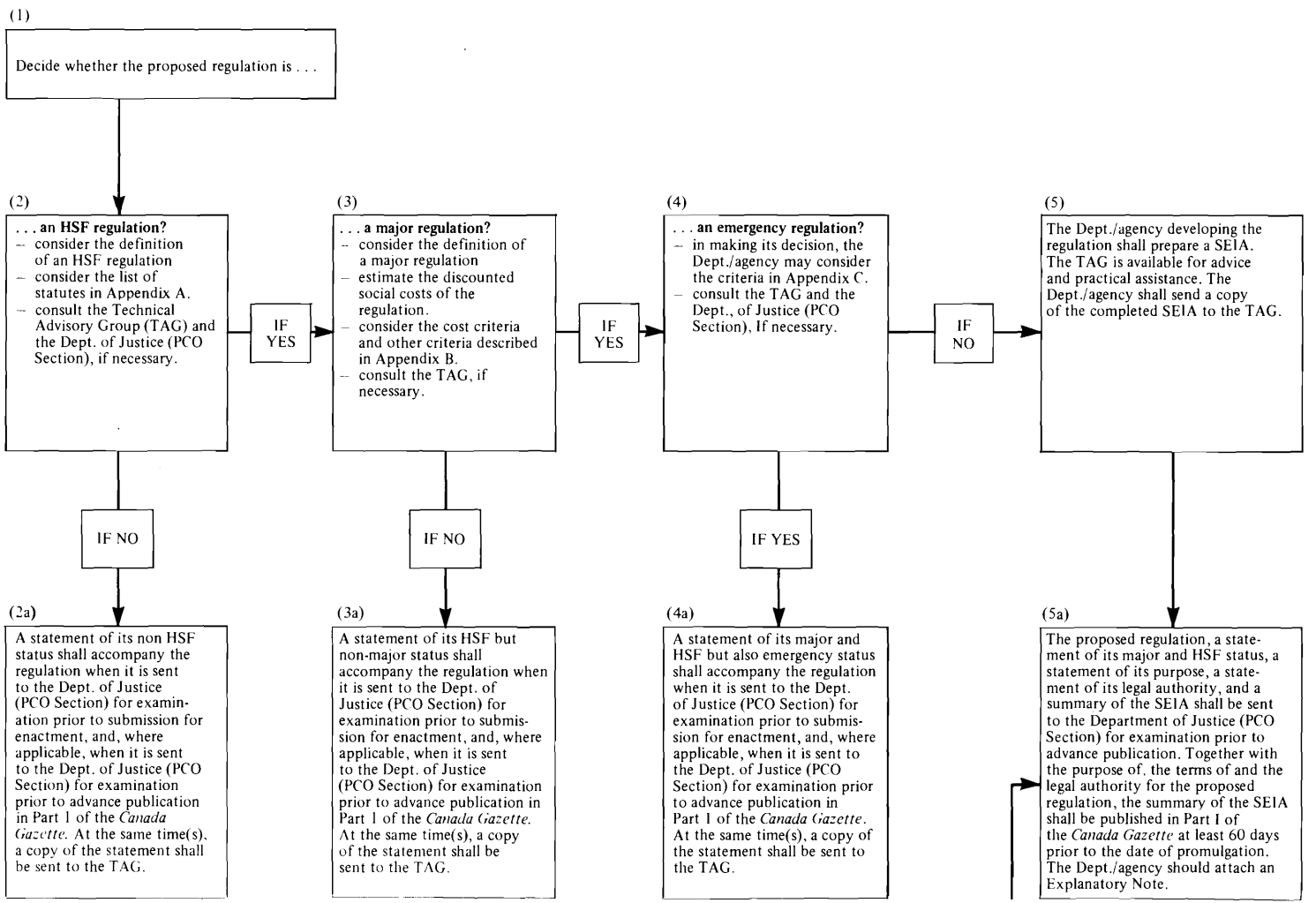
iv) The SEIA will be performed by the departments proposing new regulations, using guidelines for the various analytical techniques and assumptions. The guidelines will be provided by the Technical Advisory Group (TAG) and published.

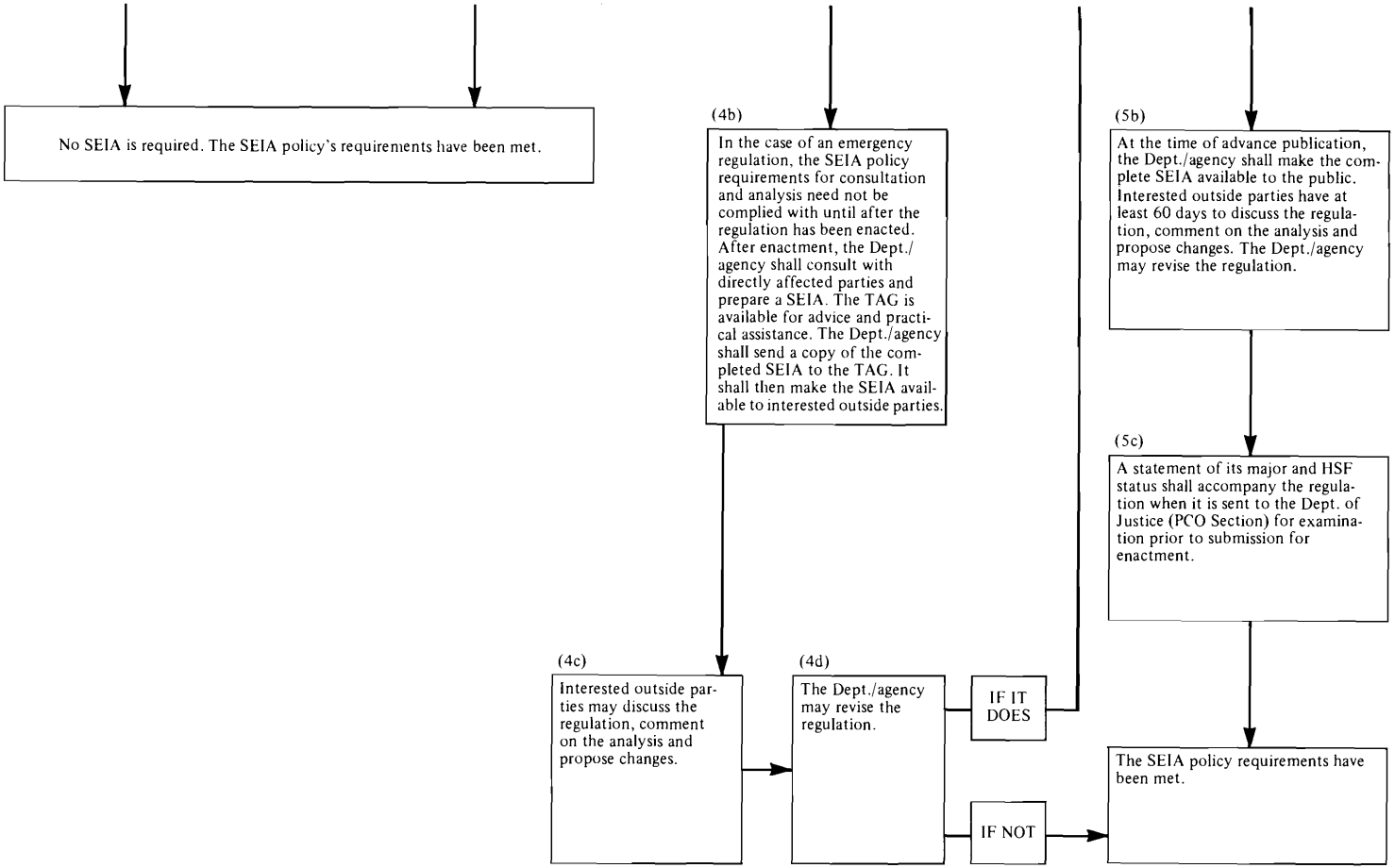
v) The TAG, located within the Treasury Board Secretariat, provides assistance and advice. The TAG and the Department of Justice advises departments, on request, whether or not proposed statutes should be added to the list of statutes identified as conferring the power to make regulations in the HSF area, as well as on the question of whether proposed regulations under the listed statutes are HSF regulations. The TAG provides guidance on the preparation of SEIAs and, on request, assists departments in the completion of SEIAs.

vi) The terms of, the legal authority for, and the purpose of a major new HSF regulation will be published in Part I of *The Canada Gazette*, along with a summary of the SEIA, at least 60 days before the regulation comes into force. The Department of Justice will ensure that the format established for the summary of the SEIA is respected by the sponsoring departments. In addition, the complete SEIA will be made publicly available. In the period between publication and promulgation, representations made by interested parties to the sponsoring departments will be assessed.

Only a few regulations have been subject to the full SEIA process, although several others were underway at the time of writing. It is

Figure II.6 – Steps to be Followed Under the Socio-Economic Impact Analysis (SEIA) Policy





Source: Treasury Board of Canada, Administrative Policy Manual, *Socio-Economic Impact Analysis*, December 1979, Chapter 490.

important to stress that the SEIA process, like the EARP, is a process for prior evaluation and assessment. It is hoped that it will induce departments to think more systematically about whether proposed major regulations are necessary, or if some non-regulatory alternative instrument (taxes, guidelines, subsidies) might be more effective and efficient. Chapter III primarily relates the formal documentation and criteria required to scientific and technological controversy.

Freedom of Information Legislation (FOI)

After a decade or more of media, political, and public interest group pressure, the federal government has introduced Freedom of Information Legislation (FOI). The short-lived Clark government introduced its FOI legislation late in October 1979.[33] Its bill supported the principle of openness and right of access by Canadians to government information. It provided a specified process for acquiring such information, and established an appeal process to an independent information commissioner or ombudsman and to the courts. It also contained a number of very broad exemptions with which officials could deny access to information. These exemptions included defence and international relations, federal-provincial relations, commercial privacy, individual privacy, and information directly related to Cabinet deliberations. Interestingly, exemptions existed that would have denied access to scientific and technical testing data and studies when officials believed they might be misleading. In addition, the bill did not override or supersede other statutes that do restrict access to information.

The Liberal bill, introduced in July 1980, has received all-party support in the House of Commons but could be amended, especially to reduce the number of exemptions.[34] It is likely nevertheless that exemptions will remain numerous, a problem to which I shall return in Chapter IV.

Reform of Parliamentary Committees

In late November 1979, the Clark government introduced a series of proposals for parliamentary reform, the central feature of which was the proposed granting of new powers and resources to parliamentary committees, including the independent power to investigate issues and questions of a committee's choosing.[35] At present, it is necessary to secure the Cabinet's approval for any such inquiry. The litany of inadequacies of parliamentary committees in scrutinizing legislation, expenditures and regulations is by now familiar: government dominance, excessive partisanship, lack of staff and resources, high turnover of members, etc.[36]

With the return to power of a Liberal majority government, it is not clear that a Liberal package of reforms will be introduced. If it is however, it will present another possible forum for reform, permitting the airing of some issues in which scientific and technological controversy is present.

III. Scientific and Technological Advice and Controversy in Decision Processes

Scientific and technological data and advice are required in virtually all fields of public policy.[1] There is therefore a potential for scientific and technological controversy to arise in many policy fields and at several stages in the policy process. Before examining this question in the context of the three selected departments, it is essential to address a number of aspects of scientific and technological controversy in the general government-wide context, in the light of the review of broad decision processes in Chapter II.

This chapter will first examine how scientific and technological data and advice are acquired and used in normal policy and decision processes. This will serve as a useful reference point for examining the way scientific and technological controversies are dealt with. The second section of the chapter will focus on how senior officials usually define and approach the issue. To provide a further perspective, I shall locate both the normal and the controversial science and technology roles in the broader debate on how government should develop science policies. Finally I shall relate this to the still broader problems of how scientific and technological variables are dealt with in the *formal* policy analysis and evaluation exercises of the federal government. The focus in this last part will be on the formal analytical exercises listed briefly in Chapter II, namely regulatory, environmental program, and parliamentary assessment processes.

Science and Technology in Normal Decision Processes

Most cabinet ministers, their political advisers, deputy ministers, and even assistant deputy ministers are not scientists or technolog-

ical experts. A recently published study of the backgrounds of decision makers shows that there are very few ministers with scientific and technical backgrounds.[2] Among senior public servants (deputy minister and assistant deputy minister level), data from 1973 shows that 26.2 per cent had a formal university education in science or engineering. This percentage has remained fairly constant since 1953.[3] Interestingly, the percentage of senior public servants with degrees in the social sciences doubled from 23.9 per cent in 1953 to 47.8 per cent in 1973.[4]

Such senior political and bureaucratic officials could not be expected, regardless of circumstances or personal brilliance, to be knowledgeable in a detailed sense about any more than a small part of the many activities carried out by their departments. They have to acquire their scientific and technological data and advice from a number of sources, including the technical personnel in their own or other departments, published literature, other governments, outside consultants and experts, and the private sector.

The need for such data and advice varies according to a number of factors, including the mandate of the department, the type of policy instrument, the scale of the decision or project, and the pace or volume of case work or small individual decisions. The nature of the data and advice is dependent on the differences between science and technology, on the difficulty of separating facts from values, and on the question of how both facts and values are transmitted to senior decision makers verbally and in writing.

Science and Technology as a Continuum

Science and technology are usually portrayed as constituting the extremes of a continuum of activities, sometimes characterized as basic versus applied research or, in a comprehensive sense, as research and development (R&D).[5] At the science or basic research end of the spectrum exists activity to determine or establish causal or correlational knowledge using recognized scientific and research methods, and being subjected to open, systematic peer-group criticism and assessment. This is best understood in the context of the natural sciences, but the social sciences also are influenced by, and practise, this kind of activity. At the applied or developmental end of the spectrum, activities concentrate on taking an existing stock of knowledge and applying it to the development of practical, marketable products, goods, production processes, or services of social or economic value.

The Advice-Giving Process: Facts and Values

The use of science and technology in government must not only deal with and incorporate these two broad kinds of knowledge but also requires the capacity to distinguish, in the advice-giving process, the scientists' or technical experts' scientific and technological advice, i.e., "the facts," from the advice-givers' own preferences and values.[6]

Although this distinction can be, and is, often made, in a majority of cases the two aspects of advice-giving become hopelessly blurred.

Blurring is all the more likely when one recognizes that advisory and decision processes are affected by the limited time available to assemble all the facts and data, by the personal relationships between senior technical advisers and their ministerial and deputy ministerial superiors, and by the need to communicate such advice both verbally and in writing. These characteristics combine to create opportunities to withhold facts, especially unpalatable ones, to postpone their delivery for a few strategic days or weeks, to flood a decision maker with too much data, and to create several "middle men" who channel and interpret both facts and values within the organization as well as between the organization and its clientele, e.g., other departments, central agencies, and interest groups.

Within a government department, especially in those with significant technical responsibilities, the development and acquisition of scientific and technical data often occurs at several levels of the department at the same time. Not all of it is communicated to the top of the organization and senior decision makers are not always aware of the kind of science and technology being generated.

The pace of decision making and the competing demands on their time prevent senior officials from knowing with certainty what kind of science, technology, and data might be required in the near or distant future. Senior officials are often reassured by their technical personnel that "we have people working on that problem," only to discover later that all is not as it seemed. They are also often alerted to problems about the adequacy of data by individual technicians outside government, or by the department's critics.

Sources of Data and Advice

In general, however, ministers and senior officials look first for technical advice in their own department or another department of government. Tables III.1 and III.2 show the aggregate pattern of dollar and person-year resources of the major science- and technology-based departments over the past several years. I shall refer later to the recent declining levels of R&D resource allocation in these departments; the tables are used here merely to show in aggregate terms that the federal government has much technical expertise to call on. The government is in general staffed with competent and dedicated technical personnel.

Numerous technical reports and memos are circulated and discussed on a daily basis and decisions are routinely based and made on such data and advice. It is of course a moot point whether the data and advice are good, or as good as they should be; opinions about their quality vary. The fact is, however, that such advice is tendered on a regular basis, and produces decisions that are, perhaps grudgingly, accepted by those most directly affected.

Table III.1 – Federal Expenditures on the Natural and Human Sciences by Major Funding Departments, in Millions of Dollars

Department	1976/77	1977/78	1978/79	1979/80	1980/81
Total Science	1 577.9	1 673.0	1 809.0	1 883.8	2 093.9
Total Major Funders	1 424.3	1 511.5	1 661.2	1 719.9	1 992.5
Agriculture	106.5	117.9	127.2	142.0	155.7
Communications	17.8	30.3	61.9	65.0	66.3
Energy, Mines & Resources	95.4	118.4	124.5	143.7	167.8
Atomic Energy of Canada Ltd.	99.6	77.2	92.0	91.3	96.5
Environment	269.3	290.3	206.4	215.4	229.8
External Affairs					
Canadian International Development Agency	22.6	25.3	35.6	37.8	38.7
International Development Research Centre	32.4	34.5	36.7	35.7	40.0
Fisheries and Oceans	*	*	122.5	112.7	116.4
Industry, Trade & Commerce	115.2*	92.8*	61.4	74.8	104.8
National Defence	74.4	83.2	83.3	93.4	104.0
National Health & Welfare	49.5	62.6	58.2	48.4	54.0
Medical Research Council	51.9	57.9	64.2	70.1	80.0
Science & Technology					
National Research Council	145.3	172.6	197.2	211.2	227.7
Natural Sciences and Engineering Research Council	94.3	99.5	111.9	121.1	163.0
Secretary of State					
National Library	–	–	13.1	14.7	17.2
National Museums of Canada	42.2	45.7	55.1	51.2	52.5
Social Sciences and Humanities Research Council	29.2	33.2	34.6	36.6	42.6
Transport Canada	33.3	40.0	42.1	27.1	25.6
Treasury Board					
Statistics Canada	145.4	130.0	133.3	127.7	139.9
Others	153.6	161.5	147.8	163.9	171.4

* The Department of Fisheries and Oceans was established as a separate department in 1979; expenditure data prior to 1978/79 are included in those of the Department of the Environment.

* Includes payments under the Industrial Research and Development Incentives Act; 1976/77 $45.9 million; 1977/78 $16.4 million.

Source: Canada, Ministry of State for Science and Technology, *Federal Science Activities 1980-81*, Supply and Services, Canada, Ottawa, 1980, p. 5.

Table III.2 – Person-years Devoted to Activities in the Natural and Human Sciences by Major Funding Departments

Department	Person-years				
	1976/77	1977/78	1978/79	1979/80	1980/81
Total Science	34 496	34 726	34 035	33 035	33 100
Total Major Funders	31 188	30 409	30 581	29 518	29 644
Agriculture	4 186	4 176	4 168	4 105	4 091
Communications	422	425	635	640	646
Energy, Mines & Resources	2 434	2 422	2 458	2 421	2 415
Atomic Energy of Canada Ltd.	2 321	2 275	2 363	2 343	2 473
Environment	7 177	7 332	4 989	4 665	4 645
External Affairs					
Canadian International Development Agency	51	51	56	56	56
International Development Research Centre	331	344	217	237	230
Fisheries and Oceans			2 423	2 325	2 325
Industry, Trade & Commerce	183	171	170	281	349
National Defence	2 126	2 142	1 909	1 916	1 952
National Health & Welfare	1 104	1 205	1 099	966	971
Medical Research Council	39	39	40	40	39
Science & Technology					
National Research Council	3 055	3 073	3 083	3 105	3 131
Natural Sciences and Engineering Research Council	48	57	59	61	75
Secretary of State					
National Library	–	–	494	500	500
National Museums of Canada	997	1 002	1 026	1 014	1 006
Social Sciences and Humanities Research Council	96	97	98	107	105
Transport Canada	221	166	183	202	200
Treasury Board					
Statistics Canada	6 397	5 432	5 111	4 534	4 435
Others	4 308	4 317	3 627	3 517	3 456

Source: Canada, Ministry of State for Science and Technology, *Federal Science Activities 1980-81*, Supply and Services, Canada, Ottawa, 1980, p. 5.

The processes through which departments acquire their scientific and technical advice and research for individual and general decisions vary considerably from department to department. Some departments, such as CCA, maintain only a modest technical group within the department. It is on this group that senior decision makers rely for their first line of advice. The technical group maintains a watching brief on incoming scientific and technical literature, including scientific journals, trade journals and reports, and studies of comparable international and US regulatory agencies. There is little or no in-house laboratory capability. Such departments have to rely on other agencies, e.g., HWC and NRC, which do have a more substantial in-house research capability. From time to time, outside academic and industrial laboratories will also be employed on contract.

Because there are varying degrees of dependence on others for scientific and technical advice, there are bound to be some inadequacies in its timely availability. There is no easy answer to this difficulty. On the one hand, each department cannot be expected to be allowed to assemble, under its own roof, the full scope of scientific and technical research capability. There are simply too many competing demands on governmental resources. On the other hand, one department may then become hostage to another department's research priorities.

An important example of inter-agency difficulties is the unsuccessful effort in the late 1970s to create a national toxicology laboratory. At that time it was recognized there would be an increasing need for this research capability because of growing concern over regulating environmental and occupational contaminants.[7] Health and Welfare Canada (HWC) had the federal government's main research capability in this field, but it was acknowledged to be inadequate for the task at hand. The prospect was, and is, that Canada would be excessively dependent on foreign, primarily US, testing data. The concern over the need for a toxicology laboratory arose, however, at a time when both R&D and general expenditure budgets were being cut. Discussions among NRC, HWC and other departments led at one stage to the idea of creating a toxicology facility at a major university so that it could be related to the teaching and the research of future toxicologists. This effort came to nothing when it became clear that no new money would be available and the several departments involved would have to make the funds available by eliminating other departmental activities. In the meantime, however, some funds from the granting councils have been given to individual researchers at several universities. The result is that no one centre of research capability in this field is comprehensive enough to undertake the necessary work.

The Ministry of State for Science and Technology (MOSST) might logically be seen as the place for departments to go, not so much for

direct research but for support when a pressing controversy exists or is pending. MOSST, however, is not usually seen in this role by other departments. It is more often considered an irritant; as another, miniature central agency. MOSST's difficulties in the eyes of other line science departments have been caused in part by the very nature of its role,[8] and by the rapid turnover of both its ministers and its senior officials. And while MOSST has tried to influence other policy areas through a sector strategy, e.g., space and energy, it has not sought to be a repository of research activity.[9]

The timely acquisition of research, whether or not controversy is involved, has also been affected in the 1970s by the federal government's "Make or Buy" R&D policy[10] and by the general decline in R&D funding by government.[11] The Make or Buy policy was begun in 1972 and required departments to contract out their new R&D to the private sector rather than do it in-house as had been the common practice. Later, this policy applied to all R&D, not just new R&D. The object was to enhance general industrial R&D and Canadian economic productivity. One of the exceptions to the policy was research needed to support the regulatory function of government. This could be done in-house because it would be inappropriate to contract it out to the industry being regulated. The policy has resulted in increased contracting out but may also have adversely affected the general availability of research for regulatory purposes. This is not easy to determine because the same core of research personnel is often used for a variety of purposes. When combined with the general decline in federal budgetary resources for R&D, the effect could be significant. This is especially so when one realizes that federal science-based departments are frequently engaged in responding to immediate exigencies and have little time for longer range research.

Another issue facing individual departments is the freedom of their scientists to publish scientific opinion, and is related to what might be called a code of ethics for government scientists. Are they scientists first and bureaucrats second, or vice versa? Again, there are no clear-cut answers. On the one hand, a case could be made that because they are public servants like any other government employee their advice is intended for their minister or the government. On the other hand, in some departments scientists are allowed and encouraged to publish and give technical opinions at conferences and meetings. On occasion, however, departments refuse to release background studies done by the same research personnel. In many ways this issue is merely a part of the larger question of freedom of information already examined, but it is not entirely resolved by such reforms. For example, it could also be dealt with in collective bargaining between scientific personnel and the government.

The speed, competence, and nature of scientific and technical advice has also been influenced by criticisms of the other advice

available to senior departmental management. During the 1970s, departments were criticized for their lack of proper economic advice and their financial management. Scientific advice is therefore only one element in the management and decision-making tasks of senior departmental personnel. In recent years it is probably fair to say that the adequacy of scientific and technical advice has not been a priority of most departmental deputy ministers and their ADM, not because they are unaware of its importance but because they are under even greater pressure in other aspects of their work.

In addition to their own departmental experts or those of other departments, senior officials have turned to other sources for data and advice. NRC is often used as a source of advice because it is a respected national research institution. Reference can be made to other academic scientists through NRC's associate and advisory committees. In recent years NRC's ability to respond has been severely restricted by its resource constraints.

In addition, individual scientists in federal departments and research managers will have their own network of experts, contacts and friends located in universities and businesses on whom they will frequently call, either informally or on contract.

When other forms of scientific or technical research or opinion are required, however, Canada does not possess a wide array of scientific institutions to which decision makers can turn, either in normal circumstances or when scientific controversy is evident or suspected. The Medical Research Council functions almost exclusively as a granting body. The Science Council has avoided specific controversies, preferring to deal with more general policy questions. Moreover, it has not been used, as the Economic Council has, for assigned references by the federal Cabinet. Other bodies such as SCITEC (Association of the Scientific, Technological and Engineering Community in Canada) or the Royal Society of Canada have rarely been used for this purpose nor do they appear to have actively coveted such a role.

From time to time the federal government has resorted to inquiries, task forces, and royal commissions. These are rarely created or designed as devices for resolving scientific issues. Their creation is usually attributable to broader political factors.[12] The companion study by Liora Salter examines the role of inquiries in resolving scientific controversy.[13]

Federal departments and agencies also utilize the knowledge, expertise, and experience of international and foreign organizations involved in research and testing. International bodies like the International Committee on Radiological Protection (ICRP) and the American Conference of Governmental Industrial Hygienists (ACGIH) are invaluable sources of expertise and advice. Canadian involvement with other international research and advisory bodies such as the

International Labour Organization, the World Health Organization, the Organisation for European Co-operation and Development, and the International Atomic Energy Agency are also immensely valuable. Canadian agencies have benefited as well from close day-to-day professional contacts and exchanges with their counterparts in the United States and in other countries, particularly in the Nuclear Regulatory Commission, the National Institute of Occupational Safety and Health (NIOSH) and the Environmental Protection Agency (EPA). Canada's proximity to the United States and the greater resources there thus confer a considerable advantage.

No one would argue that these international and foreign resources should not be utilized, but it is important to recognize the dangers if Canadian regulatory authorities depend excessively on them. It is easy for a sense of deference to an international peer group to develop. Standards developed in an international arena are frequently subject to the wider trade-offs and compromises that might arise not only out of scientific controversy but also out of the differing views of producer and consumer countries.

On the other hand, it frequently occurs that Canadian decision makers fail to utilize international research findings of direct relevance. Worse still, as studies have shown, they sometimes fail even to inform those most affected about the meaning and possible impact of such research.[14]

Scientific and Technological Controversy: The Views of Senior Officials

It is clear from the brief survey of how science and technology are used and obtained in normal decision processes that an examination of the place of scientific and technological controversy in the policy and decision process involves a number of important conceptual problems. The problems arise because science and technology encompass research, data, knowledge, and information and involve the behaviour of technical personnel both as experts and citizens. As has been stressed, virtually all public policy areas in a general sense can be considered to contain facets of scientific and technological activity.

Interviews with senior officials in the three departments and in other departments and central agencies demonstrated the range of concerns which the literature on science and politics and on the sociology of science and knowledge suggests.[15] All officials were asked at the outset to describe or define their understanding of what "scientific and technological controversy" meant to them. The majority instinctively defined it with examples. They avoided abstract definition by relating it first to the kinds of problems they typically had to deal with. Eventually, however, in the course of discussion, they

mentioned many, if not all, elements that could be embraced by the phrase.

Causal or Correlational Knowledge

The concept of science as pure science, or as the establishment of causal or at least strong correlational knowledge about the relationships between variables or events was recognized as one part of the definition. For example, within the EMR mandate the question of the effects of long-term exposure to low levels of radiation was cited as a prime example of scientific controversy because the science was still developing and was, moreover, a matter of dispute (controversy?) among the experts.[16] Most senior officials, however, did not immediately relate their mandate and functions to scientific controversy but said these fell more properly into the domain of technological or technical controversy, particularly involving testing and monitoring in support of regulatory activity.

Testing and Monitoring

Therefore a second focus for definition was testing and monitoring activity, especially that carried out in relation to the regulatory, standard setting and compliance responsibilities of the department. For this element of the definition, the officials interviewed expressed their concerns in phrases such as "insufficient data," "data that does not mean what the researcher thinks it means," and above all (especially in a department like HWC) lack of "human data," the transference of animal testing data to human beings.[17] There is also concern about premature exploitation of data by the media and by some media-conscious scientists or technical experts.

The Absence of Knowledge: Coping with Uncertainty

Discussion of testing and monitoring shaded very easily into yet another element of the definition problem, namely the absence of knowledge or information, the existence of uncertainty, and the problems of how agencies avoid uncertainty or hedge their bets against an unknown future.[18] It is in this murky water that issues of "social science" controversy versus "hard science" controversy are also most in evidence. An example will help illustrate the difficulty.

The Department of Energy, Mines and Resources (EMR) has been constantly criticized in the 1970s for its inability to know or determine the extent of Canada's oil and gas reserves. EMR possesses the same geological test data and samples as the oil and gas industry but cannot possibly examine all such data to the same extent because it lacks staff. At one and the same time, therefore, it "knows" and it "doesn't know." Furthermore, despite strenuous efforts to strengthen its economic analysis of the industry the department has often lacked economic knowledge, such as understanding how the oil industry will respond to different taxing and pricing decisions and incentives. This

problem is not cited as a criticism of EMR *per se*, but rather to illustrate how the shadings of definition are viewed.

Social and Policy Science and the Withholding of Information
There is a strong and quite natural tendency for senior officials to treat all knowledge (and controversy) at the social science end of the definitional spectrum as being part of policy advice.[19] In this regard, the officials interviewed frequently drew attention to the tendency within the government to withhold information from other departments or to delay its delivery, because this is part of the coinage by which interagency power and influence is exercised. There has been a tendency in academic and professional circles to call such activity policy science or even management science, but it can happily be reported that none of the persons interviewed operated under such illusions. Social science and policy advice were, however, used as a residual category into which was dumped all that did not conveniently fit the earlier facets of definition.

Facts, Values, Ideas and Controversy
As the definition trail wends its way into an increasingly impenetrable forest, it can be seen that inevitably it must confront the relationship between facts and values and hence take us to the heart of what constitutes a controversy. Some students of public policy and politics assert that the greater our uncertainty about cause and effect relations and knowledge, the more we shall and should rely on our ideologies, values, and ideas as guides to behaviour.[20] In Chapter II, I discussed the importance of ideas and ideologies in the policy and decision process, particularly as it is too often uncritically asserted that we live in an era when ideology is dead and pragmatism prevails. It is clear that remnants of the classic facts-values or expert-versus-layman dichotomy are central to the elusive definition of scientific and technological controversy. As often as not, groups and individuals are recoiling against the perceived and often real power of experts or technocrats. They see it as a problem of political *power* rather than as a problem of the merits of a particular decision or policy, although the latter may be in dispute too.[21]

Senior officials interviewed were able, in an abstract sense, to differentiate some so-called factually-oriented science aspects of controversy from value-oriented aspects of such controversies, but said they rarely dealt with them as distinctive problems. This was not because of any opposition to the view that, in theory, they should be treated differently. The view was simply that the realities of decision making in both the political and bureaucratic domains seldom allowed such different problems to be resolved in distinct ways.

We come finally to the question of what constitutes controversy. It is clear that the policy and decision process generates and is embedded in dispute, conflict, and differences of opinion. Conflict and its

resolution are at the core of political behaviour where self-interest and public interest are in a constant state of ill-defined tension.

How major does a dispute have to be before it is judged to be a controversy? The views of senior officials, as one might expect, offer no clear guide. Many officials link controversy to the role of the media. A controversy exists when the media is involved, even though such controversies can be short-lived and an official's instincts are often to ride out the storm and, especially, to keep one's minister out of trouble.[22]

In the realm of health and safety, controversy is instantly associated with incidents involving deaths, babies, pregnant women, and cancer. The size of the group or number of people affected also partly determines whether a controversy will result, although not necessarily whether it will be perceived as a scientific controversy.[23]

Alas, not all controversies are necessarily media-related or media-induced. Parliamentary critics may be the source of dispute, although MPs often take their lead from the media. Powerful industrial interests may, however, generate controversy through quiet but strenuous and persistent lobbying.

These diverse sources and definitions of controversy, when added to the equally diffuse concepts of science and technology, do not seem to present us with much of a conceptual base from which to launch specific reforms or to devise practical criteria for reform. On the other hand, it could be reasonably argued that merely because I have outlined various aspects of definition and reported on interviews with senior officials in three departments does not mean that there is not a problem and that there are not reasonable reforms to pursue. After all, many problems are hard to define but we still instinctively search for solutions. Accordingly, two other aspects of the role of science and technology will be examined to illustrate further the difficulties in dealing with scientific and technological controversy in the policy and decision process. I shall relate my analysis to the role of science and technology as an input to and output from the policy process especially in relation to the continuing debate about science policy in the late 1960s and early 1970s. Finally, I shall show how scientific and technological variables are not a central part of the formal, especially written, modes in which policy analysis and advice are communicated.

Science and Technology as Policy Input and Output

The problems of scientific and technological controversy can be further understood by reviewing briefly the science policy debate of the late 1960s and early 1970s and by examining other aspects of how

science and technology are used in the decision process, including differing perceptions of the role of technology in regulation.[24]

The debate about the general state of Canadian science and technology defined science policy as encompassing both science *in* policy and policy *for* science. There was genuine concern about both. The former was about how science and technology influenced policy. The latter involved concern about policies and programs directed at the development of science and technology as components of economic and educational policy and even as a cultural activity worthy of support for its own sake.

Space does not permit a full review of these questions. The debate did, however, spawn policy advisory agencies such as the Science Council of Canada and the Ministry of State for Science and Technology. Within some departments it helped launch smaller science policy units to focus on these questions. In EMR for example, an ADM for science and technology was appointed. The difficulty these units faced, as several analyses have shown, is that they could not establish or exercise influence on the basis of their science policy mandate or analytical capabilities.[25] Power and influence resided in the use of other attributes, which they did not possess. When, on occasion, they were successful, they appealed to basic economic arguments and bases of influence, rather than to science and technology *per se*.

Science policy enthusiasts also failed to understand, or at least were reluctant to acknowledge candidly, that scientific and other kinds of research were often used, sometimes necessarily but at other times strategically, as an *output*. As explained in Chapter II, science in this sense was consciously used as a substitute instrument for other kinds of more overt action, e.g., regulation, expenditure, taxation. To be seen studying or doing research on a problem was often preferable politically than to be seen doing nothing.[26]

This use of science as an output did not arise because scientists and senior officials were necessarily Machiavellian manipulators. The reasons and incentives for such behaviour are more complex than that. Science as output and substitute instrument was partly a product of normal, and often healthy, scientific caution about asserting the existence of causal and correlational knowledge.[27] On a government-wide basis, given the facts that governments are under considerable media and political pressure to be seen doing something, and that the governing agenda is always crowded, the instinct to use studies and research as output is in part understandable. It is obvious that such practices, when applied to specific cases and areas of decision making, can be viewed positively or negatively by different groups depending on their point of view and their self-interest. Hence, scientific controversy can arise either because there is too much or too little research.

For example, the role of science in regulation is affected by the

different views about the existence of causal knowledge possessed, on the one hand, by scientists, and by workers or other interest groups directly affected by the regulatory process. Scientists are naturally and necessarily cautious about the statements they make about causal and correlational knowledge. They have a more cautious perception of evidence about standards or TLVs (threshold limit values), for example. They are therefore likely to advocate that the standards be viewed as guidelines and that more research needs to be done. Economic interests that stand to gain by loose standards will exploit this argument and use it to justify looser standards or to postpone action until more conclusive cause-and-effect evidence is produced. Unions and others who must seek more precise administrative and legal criteria of evidence will opt for legislated precise standards, and will point to a number of cases where occupational disability or death has occurred.

The history of occupational health in particular bears witness to the constant presence of two kinds of experience with causal knowledge and evidence. One kind is found in the more rarified level of scientific journals and symposia. The second is found in union halls, on work sites, or in workmen's compensation cases. The first kind of experience tends to view the second as being merely a series of cases and not causal evidence. The second tends to perceive the first as being remote, foreign, and largely subservient to interests other than its own. The bridging of the gap between these two kinds of experience, each of which ought to have a compelling claim to legitimacy, is a major problem to be overcome as it affects the burden of proof and who must bear it. The ignorance of the other's world by the custodian of each of these kinds of experience is enormous and affects the nature of scientific controversy and its resolution.

Basic research and applied technology are also essential for other aspects of decision making, particularly regulation. Regulators have to arrange or otherwise ensure that there are qualified scientific personnel to carry out the work needed now or in the future. Because of the independence of major research funding bodies, this capacity to plan for scientific and research needs is not usually within the department's or agency's exclusive domain. Equally important is the development of technology that can make regulatory objectives achievable in practice. Technology to measure exposures in work areas, for example, is essential for practical day-to-day regulatory compliance. So also is the technology of epidemiological studies and related medical record linkages.

Science and technology are obviously important aspects of government decisions. Yet, paradoxically, science and technology ministries, or units in the science policy process, for the most part operate on the periphery of decision making. Science and technology also operate on the periphery of formal policy analysis processes. This has

been especially true in the 1970s when a policy analysis industry grew both within the government and outside it.[28] I shall illustrate this paradox with reference to two further examples of the formal aspects of decision making: the nature of cabinet documents, and the documentation required by the SEIA process (introduced briefly in Chapter II). It is essential to re-emphasize the distinction between formal written decision processes and informal verbal advice and analysis.

Although it must be stressed that the form and content of such documentation are not themselves evidence of how decisions are made (for they may not be read), they do illustrate the formal position of scientific and technological variables. Such documents are required for most major Cabinet decisions taken either by the Cabinet as a whole or by its committees.[29] Of particular interest is the kind of basic information they require and the criteria inherent in such information.

Example 1: Cabinet Documents

Federal guidelines for the preparation of Cabinet discussion papers prescribe that the body of a paper contain the following headings:

- Object
- Background
- Factors
- Alternatives
- Financial Considerations
- Federal-Provincial Considerations
- Other Considerations
- Interdepartmental Consultation
- Public Information Considerations
- Conclusion.

Memoranda to Cabinet are much shorter decision documents whose headings are:[30]

- Object
- Decision Required
- Considerations
  - financial
  - federal-provincial
  - other
  - interdepartmental
  - public information
  - political (e.g., caucus consultations, party policy conference)
- Conclusions
- Recommendations.

For comparison, Ontario cabinet guidelines for policy proposals, legislation, and regulations have the following headings:[31]

- Problem
- Background
- Options
- Program priorities
- Liaison with other Ministries, Management Board and intergovernmental implications
- Legislative implications
- Economic impact – private sector, public sector (see below)
- Communications plan
- Conclusions
- Recommendations.

The economic impact category is further divided as follows:

i) Private Sector
   - job creation/job loss
   - effect on investment capital
   - encouragement to the formation of new business
   - duplication of the intent and functions of existing organization
   - effect on consumer prices
   - reduction of the incentive to work
   - the cost of compliance;

ii) The Public Sector
   - effect on the government work force
   - expenditure increases.

To repeat, the listing of these headings does not in itself show how decisions are actually made. The headings convey no sense of whether ministers have time to read them, or to understand them. They do suggest that scientific and technological variables do not formally appear, although they may be partly contained under other categories.

Example 2: Documentation for the SEIA Process for Regulatory Review

It is instructive to observe the formal written criteria now required under the federal SEIA process to assess major new health, safety, and fairness (HSF) regulatory proposals.

The SEIA criteria differentiate allocative from non-allocative effects of proposed government actions. I shall quote from SEIA guidelines at length:[32]

> "3.1.1 Resource allocation effects
> Whenever possible, benefit-cost analysis shall be used to analyze the allocative effects of a proposed HSF regulation. In those instances where political and/or analytical problems (for example,

of placing a value on the loss of life, or on the pain and suffering which accompanies a serious injury) preclude the use of benefit-cost analysis, the cost-effectiveness methodology shall be used. In those instances where low probabilities are attached to the potential social benefits, the probabilistic information shall be presented and, for regulations that can have a relatively substantial impact, risk analysis or risk-benefit analysis shall be used. General equilibrium methodologies (e.g., macro-economic models, input-output models) shall be used to evaluate the impact of a regulation if its impact is not marginal to the economy as a whole.

"All social costs and benefits of the proposed regulations shall be considered and compared to those of possible technological and policy-instrument alternatives. The social costs shall not only include those that will be incurred after the implementation of the proposed regulation, but also those incurred in anticipation of the proposed government action.

"3.1.2 Non-allocative effects
An analysis of the proposed HSF regulations on the following non-allocative factors shall be presented wherever appropriate; income distribution and regional balance, technological progress, market structure and competition, output and employment, balance-of-payments and international competitiveness, energy consumption, inflation.

"3.2 Assumptions
Various assumptions will be used by the sponsoring departments in carrying out the SEIAs. Some will be general in nature in that they will pertain to the socio-economic variables (e.g., demographic projections, expected real rate of growth of GNP). Others will be specific to the proposed HSF regulation considered (e.g., expected useful life of a product, a vehicle, a technology).

"Since sponsoring departments can be expected to have the required technical knowledge, experience and expertise, the definition of the *specific* assumption is the responsibility of individual departments. If a department feels that an assumption is outside its area of expertise, it should contact the TAG. The TAG will determine, when necessary, appropriate assumptions related to the socio-economic environment. These assumptions will be those for which there are potential benefits to be gained from ensuring uniformity across departments.

"The Technical Group can be expected to play a *residual* role with respect to the definition of standard assumptions. It will have to ensure that the assumptions are changed in view of new

information. In addition, it will have to make judgements in defining standard assumptions for socio-economic variables which do not fall under the statutory responsibility of a department within the federal government or which are not related to matters included under the duties of the Minister of a federal department. Although it is not possible at this time to either foresee all the general assumptions which might be required by the various departments responsible for performing the SEIAs or to seek an exhaustive list, the standard assumptions outlined in Appendix F include most of those likely to be needed.

"3.3. Contents of analysis

"3.3.1 Contents of the SEIA

At present, a prescribed format for all SEIAs is not considered appropriate. However, it is possible that a suitable format for the majority of SEIAs may emerge as the number of SEIAs performed increases. Until such time, departments shall ensure that each SEIA provides the following information presented in the order outlined below:

a) background information on the proposed regulation: a description of the proposed regulation including its terms and legal authority; its purpose and objectives; brief outline of how the concern arose; the nature and role of consultations which took place in the development of the proposed regulation; and why a SEIA was performed.
b) analysis of the potential allocative effects:
   - identification of methodology used to carry out analysis; identification of time horizon in analysis;
   - section on costs: identification and estimation of all costs associated with compliance with the proposed regulation including all assumptions made; identification of data sources used in estimates; the discounted present value(s) of the total costs including identification of real rate(s) of discount used; outline of any sensitivity analysis performed; tables, graphs, etc. as is appropriate;
   - section on benefits: same information as for costs; when cost-effectiveness methodology is used, a brief explanation of why estimates were or were not discounted;
   - cost-benefit *or* cost-effectiveness comparisons: ratios for all cases (i.e. including different hypotheses used in performing sensitivity analyses or when different sets of data are available, etc.);
   - section on alternatives: identification of all (i.e. technological and policy-instrument) alternatives considered and discussion of feasibility of each alternative (including status-quo alternative); for each feasible alternative, costs

and benefits should be identified, estimated and compared as is appropriate.

c) analysis of the non-allocative effects: a discussion of the potential impact of the proposed regulation on distribution of income, market structure and competition, technological progress, international competitiveness, output, employment, the balance of payments, inflation, etc.; details of the size and/or direction of such impacts which are significant.
d) summary and conclusions including the reasons for omitting any pertinent information.
e) identification of the office and/or person(s) to contact regarding the SEIA.

"3.3.2 Contents of the summary of the SEIA

The terms of, the legal authority for, and the purpose of a major new HSF regulation shall be pre-published in Part I of the *Canada Gazette*, along with a summary of the SEIA. The following paragraphs list the type of information which shall be included in the summary of the SEIA to be pre-published:

- a statement of the reason(s) for the proposed HSF regulation is considered as major (e.g., the proposed HSF regulation was identified as major and subjected to a socio-economic impact analysis because it could lead to increased social costs for the national economy of $10 million or more in any one year);
- a statement on the methodology (e.g., benefit-cost, cost-effectiveness) and on the time horizon used to analyze the allocative effects of the proposed HSF regulation;
- a summary of the expected social costs (e.g., capital expenditures, operating and maintenance costs required for compliance) and of their present values under the real social discount rates suggested (and, when appropriate, under different sets of assumptions);
- a summary of the expected social benefits (e.g., to save energy, to reduce injuries, to save lives, etc.) and either of their present values under the real social discount rates suggested (when cost-benefit analysis can be used) or of their magnitude (when the social benefits can only be expressed in physical terms). When appropriate, a range could be provided in view of different sets of assumptions;
- a statement on the cost-benefit or cost-effectiveness ratios obtained from using various sets of assumptions;

  a summary of the technological or policy-instrument (when appropriate) alternatives considered in order to meet the same objective(s) as the proposed HSF regulation. For those alternatives which are practicable, the cost-benefit or cost-effectiveness ratios shall be provided;

- a summary of the potential non-allocative effects considered within the complete SEIA (e.g., impact on the distribution of income, on prices, on international trade, on market structure and competition, etc.). For those variables on which the proposed HSF regulation is expected to have an impact, the size and/or direction of the impact shall be provided;
- when appropriate, a statement of the reason(s) for which information on one or more of the above items cannot be provided;
- the address of the office from which the complete SEIA can be obtained."

The SEIA documentation does not envisage a central place for scientific and technological variables. Some concerns about such variables were expected to arise in the prior consultation phase required by the SEIA process. Treasury Board officials emphasize that the SEIA process is ultimately intended to foster better analysis in the departments of allocative and non-allocative effects, but the peripheral nature of scientific and technological criteria is illustrated by the fact that they are only one of several listed in the non-allocative category.

The practical limits of prescribing formal criteria and analysis are illustrated in the cabinet documents and SEIA process. New regulations and expenditures both impede technological adoption and encourage or require it. For example, in the 1960s and early 1970s a case was made for developing a "science budget" through which the government's aggregate R&D expenditures would be assessed in relation to science and technology policies.[33] A similar special case could be made for a "technology regulatory budget." Through such a budget, SEIA-style data or cabinet document analysis could be collected (perhaps through the Ministry of State for Science and Technology) to understand better the aggregate effects of regulation on technology. As an analytical exercise this would be useful. So would similar analyses of regional, urban or redistributive criteria, each of which has a home department anxious to collect data that would aid its mandate, influence, and power.

There is, however, a vast difference between the objective value of analysis and the inconvenient fact that such analysis must traverse a tortuous interagency path, ultimately landing on the desks of besieged cabinet ministers and senior public servants. Suggestions to reform science and technology evaluation processes that fail to recognize these realities are doomed to failure.

In this section of the chapter, only two kinds of documentation have been referred to. Much the same conclusion could be reached, however, about the other kinds of evaluation briefly summarized in Chapter II. Program evaluations, environmental assessments, and

parliamentary reviews are all separately valuable and easy to justify as being useful. So too is the call for science and technology assessments. But how does one put all these good things together without incapacitating the decision process and without overloading the human beings who must make the decisions?

The "doing" of analysis is also affected by who does it. Often technical personnel initiate changes and are not inclined to ask cost-benefit questions. In some departments policy and planning branches have been involved, but their role is often fraught with a series of quite independent issues. Such staff agencies are often suspect among line managers, especially as they often represent both the best and the worst aspects of earlier policy analysis and evaluation attempted in the late 1960s and 1970s. Such branches are generally staffed by younger and more formally educated persons and this creates conflicts over and above those that arise from normal staff-line tension.[34]

Observers such as Aaron Wildavsky stress the need for analysis but focus strongly on its links to political feasibility. Wildavsky wisely counsels that:

> "Policy analysis is an art . . . . Policy analysis must create problems that decision makers are able to handle with the variables under their control and in the time available. Only by specifying a desired relationship between manipulable means and obtainable objectives can analysts make the essential distinction – between a puzzle that can be solved definitely, once all the puzzles are put into place and a problem for which there may not be a programmatic solution.
>
> "The technical base of policy analysis is weak. In part its limitations are those of social science: innumerable discrete propositions, of varying validity and uncertain applicability, occasionally touching, but not necessarily related, like beads on a string. Its strengths lie in the ability to make a little knowledge go a long way by combining an understanding of the constraints of the situation with the ability to explore the environment constructively. Unlike social science, however, policy analysis must be prescriptive; arguments about correct policy, which deal with the future, cannot help but be willful and therefore political."[35]

In focusing on formal documentation I merely wish to illustrate the relative position of scientific and technological variables in the government's written modes of communication. Analysis, however, is carried out and transmitted verbally as well. Indeed, there are those who assert that verbal advice will increase even more in the 1980s because senior decision makers are now deluged by a flood of documentation; they do not have the time to read. Freedom of infor-

mation legislation may increase this trend because a greater number of written communications will see the light of day.

It should not be assumed that scientific and technological variables do not enter the decision process at all. Indeed, verbal advice-giving is probably the mode in which most of it is most effectively communicated. In this verbal mode its adequacy may then be dependent on highly personalized and unique situations. Is the deputy minister technically trained or at least knowledgeable? Is he or she new to the department or an old hand, familiar with the department and its clientele? Does the department's agenda allow ministers and senior officials the time to consider scientific and technological variables, regardless of whether they induce controversy or not? I shall return to some of these questions in Chapter IV, when EMR, HWC, and CCA are examined in greater detail.

IV. Decision-Making in Three Departments: A Comparative Profile

The three departments compared in this chapter, EMR, HWC, and CCA, function partly as autonomous units. They interact on a day-to-day basis with a familiar program clientele, primarily those groups and sectors of Canadian society that see themselves as the prime beneficiaries of the departments' policies, programs, and decisions. Hence, their role in the policy and decision process, and in scientific and technological controversies must be understood partly by their behaviour as organizations.[1] As Chapter II emphasized, however, they also function in a broader institutional and political context. They frequently bargain and trade off their preferences with other departments, central agencies, or the Cabinet, whose support they may need now or in the future.

Internally, each department is best seen as a kind of holding company, whose major components often function with little contact with other sections. Indeed, some sections of the department could easily be located in other departments, and formerly often were. The department is also affected by the fact that its minister has to share his or her time with other agencies that report to him or her.[2] A department is influenced, especially in recent years, by different patterns of internal resource allocation. Which departments and which components within each department have been winning and losing in the struggle for budgetary and personnel resources?[3] The decision process within departments is affected by ministerial and deputy ministerial abilities, personalities, and styles, not to mention the frequency with which departmental leaders are changed by the Prime Minister. For example, some DMs are more inclined to function in a collegial fashion, considering their several ADMs as an executive

committee. Others function in a bilateral context, preferring to deal with each ADM one at a time and often keeping others in the dark.

In a single chapter one can only give some of the flavour of departmental organizational behaviour. All the varied activities of the three departments cannot possibly be discussed, let alone assessed. How departments perceive and deal with scientific and technological controversy cannot be even remotely understood, however, unless some central features of departmental life are examined. The comparative profiles of EMR, HWC, and CCA will therefore focus first on three elements: legislative and policy mandates; structure and organization; and the department's policy and decision agenda in the 1975-1979 period. In the fourth section of this chapter, I shall examine each department's "habits," drawing both on the general analysis of scientific controversy contained in Chapter III and on observations about selected decisions. The profile will, I hope, relate the departments' general decision agenda to their perceived agenda of scientific controversy items. This is a necessary final task because one of the things we are interested in knowing is whether departments are overloaded with such controversies, in which case reforms that require special decision processes will be less likely and less manageable, or whether they are somewhat more sporadic occurrences, in which case special decision processes may be both desirable and feasible.

Legislative and Policy Mandate

The ministers of the three departments exercise responsibility over a diverse array of statutes and policies. In simple numerical terms EMR has 16 statutes, HWC has 26, and CCA has 21.[4] Statutes themselves, of course, convey little of the real scope of a department's mandate or how they affect industry and society. Expenditure and regulations convey other aspects of reality. In expenditure terms, HWC is by far the largest of the three; in regulatory terms, CCA probably has the largest array of potential powers. In terms of recent political priorities, EMR has clearly been most prominent because of the critical place of oil and gas supply and pricing in current economic policy debates. Brief descriptions of each department's mandates will give a better appreciation of the scope and nature of its activities, and of its central preoccupations.

Energy, Mines and Resources

The department was formed in 1966 by incorporating parts of the previous Department of Mines and Technical Surveys with sections from other departments.[5] The goal of the new organization was to increase its energy policy capability, and hence develop better integrated energy and resource policies and programs within the federal

government. The department develops policy based upon research and data collection in the earth, mineral, and metal sciences and on economic and some social analysis. It also carries out an earth sciences program directed towards the conservation and use of the Canadian land mass. A wide range of mapping, remote sensing, and other services is also provided for many industries and customers.

The department's rise in the 1970s into both political controversy and influence is also a function of the growing importance of supply management issues in Canadian economic policy.[6] In contrast to the 1950s and 1960s, when short-term demand management was the dominant focus of economic and fiscal policy, the concern over the long-term supply of resources and energy has grown; it is an aspect of economic life less subject inherently to short-run fine tuning.

It should be stressed that the department itself does not possess elaborate regulatory powers, but must interact with regulatory agencies like the Atomic Energy Control Board (AECB) and the National Energy Board (NEB), which do possess such powers. EMR must also interact with other departments that have sometimes a competing and sometimes a complementary interest in the energy and resource field. Chief among these are the departments of Finance; Industry, Trade and Commerce; and Environment. Since 1978, EMR has also had to cope with a central component in the federal government's strengthened cabinet committee system, described in Chapter II.

The department's mandate brings it into strategic conflict with the growing power of provincial governments whose affluence and enhanced political strength is based on their custody over increasingly valuable resources.[7]

Health and Welfare Canada

Health and Welfare Canada (HWC) is best thought of as a giant holding company sitting astride the major federal health, social, and welfare programs.[8] The two sides of the department, health and welfare, used to have a deputy minister each. Although this is no longer the case, the two sides often function as if they were separate departments. The health side consists of the medical services branch, and the fitness and amateur sports branch. The welfare side of the department consists of branches for income security and social service programs. The department has a long-range planning branch to serve its needs.

The scope of the department's activities is, to say the least, vast. It encompasses the health treatment, education, or assessment of many different categories of persons including Indian and Northern Affairs' health services, civil aviation medicine, immigration and emergency health services; it undertakes regulatory, standards setting, research and monitoring activities to protect Canadian consumers from chemical and other hazards in food and drugs; it pro-

vides services and research related to environmental health and disease control; and it operates fitness and amateur sport programs. HWC administers the two major national health insurance programs, hospital insurance and medicare; the major income security programs such as the Canada Pension Plan, Old Age Security benefits, and family allowances; and major welfare and social service programs such as the Canada Assistance Plan, programs for disabled persons, and a host of other social services.

Consumer and Corporate Affairs

The department was formed in 1967 and can be looked on as an "attorney general" for the marketplace.[9] It was established to deal with economic law, with special responsibility for the marketplace. It must play an often very ambivalent role because it is intended to see that the market and competitive forces flourish and at the same time to regulate and remove their excesses. It ensures that citizens as consumers, investors, inventors, and managers are treated fairly.

The department was expected to perform at least three critical roles in the planning and management of economic policies in Canada. First, it was expected to perform a coordinating and enabling function in the marketplace. In effect, the department endeavours to establish the general rules of the game for the private sector so that business may be carried on in an orderly fashion. Second, the department was established to ensure there is a reasonable balance of power amoung the various participants. A major problem here has been the growth of corporate power in relation to the individual citizen. Third, the department was established to ensure that there is adequate output (to the extent output influences price reduction) within the market system. In this regard, the departmental objectives encompass effective functioning of the market to achieve the best allocation of both human and natural resources. In short, the department was established to bring together three interrelated and interdependent components of the economic system, namely the law, the economy, and the public interest.

The minister has responsibility for such policies, programs and activities as competition policy (especially under the Combines Investigation Act), support for consumer groups, legal metrology, product safety, the incorporation of businesses, bankruptcy, and patents, trade-marks, and other aspects of intellectual property. In some of these areas CCA shares jurisdiction with the provinces.[10]

In addition to being perilously balanced between consumers and business, the department also finds itself delicately placed among other economic management departments, especially those of Finance and Industry, Trade and Commerce.[11] The artful dodging which is the almost inevitable tactic of the department has taken its political and managerial toll. In twelve years it has had five deputy ministers and seven ministers.

Organizational Evolution

Although departmental ministers and deputy ministers may come and go, the underlying evolution of a department is generally slow. Only over a period of several years are important changes of emphasis or growth detectable.

Energy, Mines and Resources

The department's expenditure data show the preoccupation in recent years with the oil pricing and supply questions. In organizational terms this has meant that the old Geological Survey, or scientific and technical components of the department, have suffered as a result of the need to build up the department's capacity for economic analysis. In the last three years of restraint, senior officials confirm that additional resources have been taken from the technical side of the department to strengthen the other. These trends have been symbolized by changes at the DM level as well. The deputy minister for most of the 1970s was Gordon McNabb, an engineer, while the two deputies in the past two years, Mickey Cohen and Ian Stewart, are persons with previous careers in central agencies; Finance, and the PCO respectively.

A further organizational feature of some importance is that EMR's nuclear policy capability was, until quite recently, dependent on the expertise of AECL and the AECB.[12] Steps have been taken to strengthen this capability somewhat but it is not an EMR strength. EMR is also the only department among the three being examined to have an ADM for Science and Technology. Although the ADM has some involvement in policy within the department as a whole, he is largely preoccupied with day-to-day managing and defending the shrinking technical base of EMR, centred in the Geological Survey; a role that has not allowed the original concept of an ADM for science and technology to flourish.

In summary, then, EMR has functioned almost as if it were two departments. The traditional technical base of the department and the newer economic thrust have often worked in isolation from one another because of the compelling demands made on senior management by the oil and gas supply and pricing issues.

Health and Welfare Canada

This department is perhaps the most amorphous in the federal government. If expenditure growth is the chief evidence of priority concerns, then HWC has been preoccupied with such dominant health and welfare issues as medicare, pensions, and the Canada Assistance Plan. The sheer size of the department virtually necessitates a bilateral approach to decision making between the deputy minister and each of the ADMs. There is little collective executive decision making and each ADM is involved only to the degree that his or her branch

of the department is affected by a particular decision, controversy or policy.

Two other elements of HWC organization deserve particular mention in the context of this study. First, the department is served by a long-range planning branch. Like most similarly titled branches in other departments, such planning units have had difficulty finding a proper role in relation to program managers.[13] They are usually neither planning nor long-range in their focus, not necessarily through any fault of their own but because day-to-day concerns simply overwhelm the future. This point is stressed lest it be thought that such units could have a role in examining long-term scientific and technological controversies and consequences.

A closely related second point about HWC is the considerable *de facto* autonomy given to the Health Protection Branch. This is the regulatory heart of HWC and the focal point for most of the scientific and technological controversy in which the department finds itself engaged. When many such controversies arise, the ADM of the Health Protection Branch usually deals directly with the Minister, a relationship necessitated by the fact that such controversies are frequent and involve technical judgement and knowledge that the DM does not possess.

Consumer and Corporate Affairs

The ambivalent refereeing role of CCA has already been stressed. This ambivalence has affected its structure and organization. The department has experienced by far the highest turnover of ministers and deputy ministers. This arose partly over the great political difficulty the department experienced in gaining passage for its Competition Bill, the dominant issue in the 1970s' agenda.[14]

In the realm of scientific and technological controversy the department's product safety branch is the one that first comes to mind. In an indirect way, however, the ADM for Intellectual Property can often become involved. For example, changes in the Patent Act were intended to allow drug companies to produce certain generic drugs in competition with the original patent-holding company. This would facilitate greater competition and reduce prices. On occasion, this branch of CCA has found itself confronting HWC's drug testing requirements, which require all firms to replicate all development tests in the interests of health and safety.

One organizational feature of note is that CCA does not possess a large in-house technical capability. In the realm of product testing it must often rely on contracting to private or university laboratories or depend on other federal agencies such as HWC and the National Research Council (NRC).[15]

Although CCA is a somewhat more compact department than the others examined, it too has some of the holding company attributes;

hence its internal decision making often functions as if it were several departments rather than one.

The Departments' Policy Agenda, 1975-1979

A principal concern is to understand the relationship between the departments' scientific and technological controversies and other controversies. It is, therefore, essential to develop an appreciation of the departments' agendas from 1975 to 1979 period. What were the departments' principal concerns as seen by their senior officials and their political critics? Measures of these agendas are difficult to quantify because what is important and what is controversial may not be the same thing. One index of importance could be the proportion of departmental activity that most required the time of the Cabinet.

Three sources of information were used to assess the agenda: the views of senior departmental management; the nature of questions raised by the Parliamentary opposition; and media coverage.[16] Individually these are subjective sources, but collectively they are of use because they serve to identify dominant controversies to which we can then relate scientific and technological controversy. I have already referred in part to these dominant controversies; I shall summarize them below.

Energy, Mines and Resources

The EMR agenda was dominated by oil pricing and supply issues. Controversies centred on several components of pricing and supply, including specific price negotiations, frontier oil and gas development, the Arctic Pipeline, electricity costs in Atlantic Canada, the possibility of supply disruption and the consequent need for emergency allocation arrangements. With the emergence of the Clark government, the related concerns of jurisdiction over offshore resources and the role of the federal Crown corporation, Petro-Canada, became additional focal points. These were the dominant controversies whether viewed by EMR officials, political critics or the media.

The only major issue on which differences in perception arose concerned nuclear power. Although the media gave this issue considerable attention, parliamentary critics surprisingly did not. Interestingly enough, it is in the nuclear field that one can find more agreement than in most others that genuine scientific controversy does exist.[17]

The overwhelming focus on oil and gas pricing and supply issues was of course reflected in the organizational changes noted in earlier sections. The department devoted much of its time to increasing its economic analytical capacity at the expense of its traditional scientific and technical functions. These shifts are gradual in nature but

they do give an indication of the EMR agenda. The scientific and technical functions did not become totally dormant or starved of resources. For example, in the mid-1970s the department formed a uranium assessment group to strengthen EMR's ability to assess uranium reserves in response to the burgeoning demand for Canadian uranium and the increased level of exploration.[18]

Health and Welfare Canada

Unlike EMR, the HWC agenda was less dominated by a single issue. Its principal concern, however, centred on cost-sharing arrangements with the provinces over various health care and welfare programs.[19] New arrangements were necessary because of increasing and largely open-ended costs of such programs at a time when the federal government was attempting to reduce the growth rate of public expenditure. Parliamentary and media criticism also focused on this central concern, but in addition reflected a fairly wide range of other controversies and issues. These included such questions as the development of a guaranteed annual income and the possible elimination of family allowances and other targeted programs,[20] the adequacy of support for medical research, the swine flu vaccination program, programs for the physically handicapped, cigarette advertising and anti-smoking campaigns, the ban on saccharin and the general question of hazardous chemicals and their health effects (see below), health care for native peoples, doctors fees and extra-billing practices and the emigration of doctors.

For much of the period in question, expenditure restraint was paramount, and social programs became increasingly vulnerable. However, the mere listing of some of the central themes on the HWC agenda (i.e., swine flu, saccharin, anti-smoking) suggests the presence of more issues with a potential for scientific controversy than at EMR and CCA. The media placed more emphasis on these issues than did other political critics. The health protection and regulatory roles of HWC, especially in relation to hazardous substances, continually faced it with questions involving some scientific dispute.

Consumer and Corporate Affairs

From 1975 to 1979, the political agenda of CCA was dominated by its numerous efforts to secure passage of the Competition Bill. Indeed this legislation has been its preoccupation throughout the 1970s. The legislation encountered strong criticism from business and accordingly made the minister's job hazardous. The department was also heavily involved in the issue of price and wage controls, both in the general context of the 1975 to 1978 Anti-Inflation Board experiment and in earlier concerns over food prices.[21] The department was affected as well by the creation and work of the Royal Commission on Corporate Concentration whose report dealt with the heart of the CCA role.[22] Other aspects of the departmental mandate functioned in a far

less visible and controversial context. These included changes in the patent law and intellectual property fields. The department was also active in the field of regulatory reform; part of its work led to the establishment of the SEIA process described in Chapter II.[23]

CCA's administration of the Hazardous Products Act was not a central issue. As might be expected, it attracted considerably less media attention than the competition policy and price and wage control issues noted above. As we shall see below, scientific controversy was most evident in CCA's consumer protection role.

The foregoing summary of the three departmental agendas shows that the preoccupation of the departments was not scientific controversy. This should not be a surprising finding because the sources of political controversy are many. The agendas do illustrate, however, the limited amount of room that exists during any brief period in a department's life and how difficult it is to highlight scientific concerns when they genuinely exist.

It must be remembered that the summary of agendas has dealt with only three departments. When placed in a government-wide context, the proportion of attention given to scientific controversy becomes even more limited. Although the issues faced by the three departments were of central importance to the government's agenda in the 1975 to 1979 period – energy supply and price, competition policy, and the costs of social programs – they were not the only items competing for Cabinet attention. Inflation, unemployment, Quebec separation, relations with the labour movement, the decline of the industrial manufacturing sector, and other issues were often even more important. Certain issues are persistently present in a governing agenda; others bob up and down like pistons in an engine. Departments must consciously gauge the relative position of these issues in the context of the medium- and short-term agenda. This sets limits on what they can do in decision making and resource allocation in general, and, even more so, when dealing with particular scientific controversies.

We do know, however, that scientific and technological controversies arise within the three departments. With the above elements of the departmental profile as background, the analysis can now be taken to its logical conclusion by examining departmental responses to decisions involving scientific and technological controversy.

Scientific and Technological Controversy: Departmental Operating Habits

It was stressed in Chapter III that senior officials in all three departments gave a broad definition to the meaning of scientific and technological controversy. It meant different things depending in part on the day-to-day nature of a department's mandate. Despite the

difficulties of definition and the problems of determining when controversy occurs in such matters, one can still make some tentative observations about each department's operating habits and about the relative incidence of such decisions in a department's total agenda. Once again, I shall present a profile of each department including, where feasible, examples of decisions including scientific and technological controversy. These illustrative examples are not analyzed as full case studies for a case study of individual decisions is the central approach used in the Salter study, and because it is often difficult to judge how typical the examples are in the broader context of departmental decision making.

Energy, Mines and Resources

The previously discussed elements of the EMR profile suggest strongly that scientific and technological issues were several steps removed from the mainstream of departmental thinking. During the four years under examination, only three issues were identified as having the potential for scientific and technological controversy, but even here the department's response was conditioned by the economic and political aspects of these issues. The issues were the environmental consequences of offshore drilling (off the east coast and in the Arctic), the long standing question of the adequacy of information about Canada's oil and natural gas reserves, and the management of Canada's nuclear wastes. Embedded in the last of these concerns were more particular controversies over the long-term effects of exposure to low levels of radiation and the technological problems of disposing of uranium mine tailings.[24]

The first two issues in particular were not perceived as ones requiring special decision processes to resolve latent scientific problems. Although there were uncertain and unknown effects of offshore drilling in both east coast and arctic waters, there were no special public inquiries to air these questions.[25] Arctic offshore drilling created scarcely a ripple of concern. This was largely an outcome of the absence of strong political pressure by native and environmental groups about the issue of northern development. Pressure was greater, however, in the case of east coast development due to a larger population and the influence of provincial governments.

Concern about the inadequacy of information on Canada's oil and natural gas reserves was a scientific and technological controversy of a different kind. EMR was fully aware of the nature of the problem but its response was conditioned by the fact that this issue went to the very heart of the struggle for power, information, resources, and money among the federal government (with EMR at the centre), the major foreign owned oil companies, the aggressive new Canadian-owned exploration companies, and the Alberta government.[26] The growing controversy over Petro-Canada as the federal

government's "window" on the oil and gas industry was central to the question of whose information could be trusted.[27] Although genuine technical concerns and disputes among geologists were a part of this issue, EMR viewed it quite properly as a political and economic controversy and saw little need to devise special ways to resolve the matter except to press for the creation of Petro-Canada itself.

Only in the case of nuclear waste management did the department see fit to create special mechanisms for decision making, namely the Hare committee.[28] Established in April 1977, largely on the initiative of the then Deputy Minister Gordon McNabb, the study group consisted of F.K. Hare of Queen's University, A.M. Aikin, a former Vice-President of AECL, and J.M. Harrison, a former ADM in the department. The group was to:

> "carry out a study on the safe long-term storage of radioactive waste and to submit a report that would contain information of a quality and scope sufficient to serve as a general document for wide distribution, both within government and to the public, in order to facilitate a better understanding of the waste disposal problem."[29]

The group held informal meetings with citizens' groups, experts, and various Canadian nuclear organizations. Its report was published in the fall of 1977 some five months after its establishment.

The report concluded that the potential methods for the safe disposal of nuclear wastes were satisfactory and that this issue need not delay Canada's nuclear program.[30] It did stress the urgency of testing the disposal approaches.

When the Hare committee was created scientific issues were a matter of major concern. The Hare committee was seen as a useful device to air views on nuclear policy, which were becoming increasingly polarized. In areas of nuclear waste management, EMR officials felt caught between the extreme claims of AECL and Ontario Hydro on the one hand, and increasingly vocal anti-nuclear groups on the other. The Hare committee was seen by the department as a responsible, independent, technically-competent forum that would strike a useful middle ground or at least clearly identify areas of dispute.

The Hare report provided the department with some specific advice and helped shape a subsequent agreement with Ontario Hydro.[31] It is doubtful that it could have resolved the waste management controversy in any final sense, nor was it designed to do so. The decision to create the committee was undoubtedly influenced by the existence of that controversy. But more importantly EMR felt it could take some time to review the issue, given that nuclear policy was not its major preoccupation and that there were other nuclear inquiries (the Porter and Bayda inquiries) underway in Ontario and Saskatchewan.[32]

The Hare committee should not be considered a model of how scientific and technological controversy should be publicly aired. Its

mandate clearly embraced such controversies but little effort was made to structure it as a vehicle for public debate either among technically qualified experts or between experts and non-experts. Nuclear waste management is an imporant problem, and there is a great deal of uncertainty about the scientific and technological issues related to it. Above all it is a subject that could and should have been debated in a more thorough way than was done by either the Porter or Bayda inquiries (with their broader mandates). More time and resources would have been required as well as more careful preparation by EMR officials as to *how* to air the technical controversies. But there is no question that it could have been done. It should be stressed that, on an interdepartmental basis, Environment Canada and Health and Welfare Canada exerted some pressure on EMR to strengthen the mandate of the Hare committee, but without success.

This brief profile shows that although EMR was preoccupied with broad economic and political concerns, its agenda was such that it could have undertaken a more carefully designed review of the scientific and technological controversy embedded in the nuclear waste management issue.

Health and Welfare Canada

As previously noted, HWC's agenda was focused on the rapidly increasing costs of health care and other social programs. It was also pointed out that the department is best viewed as a holding company in which several of its branches function as virtually autonomous agencies. The Health Protection Branch of the department is perhaps the best example of such an agency, and is also the focal point for actual or potential scientific and technological controversies in which the department may be involved.

The Branch acts under the authority of several statutes, including the Food and Drugs Act, the Narcotic Control Act, the Hazardous Products Act, the Atomic Energy Control Act, the Environmental Contaminants Act, the Canada Labour Code, the Radiation Emitting Devices Act, and the Department of National Health and Welfare Act.[33] Numerous sources of controversy arise from the scope of the regulatory, advisory, research, and monitoring roles required by these statutes. For example, the Branch provides a comprehensive service for radiation workers. In enforcing the Radiation Emitting Devices Act and Regulations the Branch has designated responsibilities for radiation devices under the Canada Dangerous Substances Regulations and acts as adviser to the Atomic Energy Control Board. It provides the national radiation dosimetry service and registry. The Branch also conducts research on the toxic properties of selected materials used in industry and has undertaken surveys, in cooperation with provincial governments, to evaluate health hazards in industrial plants. It advises Agriculture Canada on the occupa-

tional risks to pesticide applicators and farmers and the CCA on matters related to the Hazardous Products Act.

In addition to its existing responsibilities for advice and research under the Clean Air Act and for regulation under the Food and Drugs Act, the Health Protection Branch is assuming major research and monitoring functions under the reporting provisions of the Environmental Contaminants Act, which is administered by Environment Canada.

In general terms, therefore, the Branch tends to play a research and monitoring role. It is a major centre of research and expertise on which several of the other more directly regulatory departments must depend. The Health Protection Branch now faces and will face serious manpower problems as it tries to respond to the new responsibilities thrust on it by statutes like the Environmental Contaminants Act. The Branch has historically focused on food and drug regulations, so that other components of its role have had to struggle for resources.

The potential for scientific and technological controversy can be gauged by the Health Protection Branch's workload. In 1975-76 the Branch had to deal with 7500 consumer complaints.[34] In 1976-77 and 1977-78 the complaints numbered 5700 and 5500 respectively. In 1976-77, 1100 establishments were inspected. In 1977-78 the figure was 1300. Following the reorganization in 1975 of the Drugs Directorate Program, hundreds of new drugs were tested: 384 in 1975-76, 412 in 1976-77, and 404 in 1977-78. In addition, about 2000 drug samples were tested each year.

The Branch's workload is not only a function of statutory obligations. It is also conditioned by a growing alarm among Canadians, encouraged by extensive media coverage, about the use of chemicals and additives in food. A recent survey of 25 000 consumers in Canada confirmed this concern.[35] The Branch's agenda is particularly influenced by media attention and criticism, which, as often as not, is triggered by published studies of decisions announced by US or international bodies or research groups.[36]

Senior officials estimate that on an annual basis they must answer about 300 inquiries a month from the press. They estimate that about 50 cases or issues per year are potential scientific and technical disputes. This "hazard-of-the-week" pace keeps officials on their political toes and constitutes a formidable agenda. Not all of these, however, result in widespread controversy. In comparison with EMR and CCA, HWC has a far heavier agenda.

In the latter half of the 1970s, several HWC decisions can be said to have aroused a high level of controversy. As pointed out in Chapter III, scientific and technological controversy was most often equated with disputes over testing, especially the problems of transferring animal test data to human beings. At one extreme can be cited the

example of controversy over whether the so-called boat people should be tested for hepatitis. Medical opinion differed on whether it was necessary. Finally, the department decided to carry out tests not because it was technically necessary but because it felt that, politically, a failure to do so would provide ammunition to groups that opposed the immigration program and would use the hepatitis scare as an argument to prevent such immigration.[37]

Somewhat more typical, however, were decisions on the swine flu vaccination program, salmonella,[38] the ban on saccharin, arsenic in the Northwest Territories,[39] the safety of hamburger meat, and the "Red Dye No. 2" (Amaranth) controversy, to name just a few. The Amaranth decision is interesting.

The controversy over Amaranth arose early in 1976 when the US Food and Drug Administration (FDA) banned its use in all future production of foods, drugs, and cosmetics in the United States.[40] Dispute over its safety had occurred before and its use had been the object of criticism by consumer interest groups in the US. The American decision aroused immediate interest and concern in Canada, both in the media and among consumer groups, but especially the former.

On 2 February 1976, the then Minister of Health and Welfare Canada, Marc Lalonde, announced that the Health Protection Branch had concluded "there is insufficient evidence available at this time to justify the removal of the food colour Amaranth from foods sold in Canada."[41] The Minister's statement elaborated on the reasons for this decision, citing the weaknesses of the US study as well as the opinion of its own scientists and those of such expert world bodies as the World Health Organization and the Food and Agriculture Organization. It is instructive to quote the department's rationale at some length:[42]

> "The U.S. decision to ban Amaranth resulted primarily from a study conducted in the FDA's own laboratories. In the FDA study, rats of both sexes were fed Amaranth at 3.0, 0.3, 0.03 or 0.003 per cent in the diet for approximately 2 1/2 years, with a control group of rats, also of both sexes, receiving no Amaranth in their diet. A variety of benign and malignant tumors was observed. A mix-up in the dosing of some of the animals of the low dose groups for part of the experiment precludes the possibility of establishing a dose response relationship. However, it was apparently possible to compare the group fed 3 per cent Amaranth with the control group. Female rats, but not males, fed 3 per cent Amaranth showed a statistically significant increase in the number of animals with malignant tumors. From the data available, HPB scientists consider this increase in tumors of no biological significance for the following reasons:
>
> "1) The effect was not organ specific.
> Experts in the cancer field consider that for a study to have bi-

ological significance, it is necessary to demonstrate the presence of a number of tumors of an unusual tumor type for the particular species and strain of animal or an increase in the number of tumors for a particular organ. In both instances the increase would have to be significantly greater than in control animals. The tumors found in the FDA study were similar in number and type to those previously encountered in rats of the same strain and age, reared and housed under similar environmental conditions and fed diets free of the colour.

"2) Amaranth has a chemical structure similar to other dyes that are non-carcinogenic and different from those that are carcinogenic.

"3) The tumor increase was confined to female rats and except for the mammary tumors the cancers were not sex related. This is very unusual, particularly since the number of malignant tumors in control male rats was greater than in male rats given 3 per cent Amaranth in the diet. This latter observation could, by the same reasoning apparently used by the FDA, be used as evidence that in male rats, Amaranth actually prevents the production of cancer.

"4) Preliminary mutagenicity screening tests conducted by HPB indicate that Amaranth is not mutagenic and hence not likely to be carcinogenic. Almost all substances which are known to be mutagenic are also carcinogenic.

"5) As indicated above, in the FDA study, there was a mix-up in the animal numbers and in the diets fed to certain groups of animals. Many tissues were in a state of advanced decomposition making microscopic examination extremely difficult to carry out properly. This would appear to indicate inadequate experimental control, and makes it well-nigh impossible to adequately assess the U.S. study.

"Other research in the U.S., not evidently considered by the FDA in its decision-making process, included teratogenic studies conducted by Dr. J. Verrett, an FDA staff-member. Dr. Verrett expressed particular concern about possible adverse reproductive effects from Amaranth on the CBC program Market Place, January 25, 1976. She stated that Amaranth caused deaths and birth defects in chick embryos. Dr. Verret's observations are not considered relevant in terms of the safety of Amaranth to humans. The chick embryo is not considered to be a suitable test species by teratologists generally. One reason for this unreliability is its unusual sensitivity to a wide variety of compounds. Common agents such as salt, sucrose and sand cause teratogenic

effects in the chick embryo but not in man or other animals. During its embryonic growth the avian embryo remains isolated from its mother and thus the metabolizing and detoxifying mechanisms which protect the mamalian embryo do not operate in the avian embryo. This, and the ultrasensitivity of the avian embryo, have led most laboratories to discontinue its use for chemical safety evaluation. Dr. A.C. Kolbye, a senior official of the FDA has stated that 'while the test can be useful for detecting toxicity of compounds, further evaluation of this test is needed before its usefulness in predicting birth defects in animals can be determined.' The chick embryo technique was replaced in 1966 at HPB by more reliable techniques that employ mammalian species. HPB deplores the fact that CBC-Market Place did not check on the reliability of the chick embryo test.

"In the FDA cancer study on Amaranth, the rats which purportedly developed tumors as a result of receiving Amaranth, were given the colour at 3 per cent in the diet, equivalent to approximately 1500 mg/kg body weight/day. This means that every day a person would have to eat more than 1600 pounds of food containing approximately 100 parts per million (ppm) of Amaranth to be exposed to an equivalent amount to that purported to cause an increase in total malignant tumors in female rats. (Although the maximum permitted level of Amaranth in Canada in 300 ppm, the actual level of use averages 100 ppm).

"It is important to point out that HPB has discussed the validity of the FDA rat study with a number of university-based toxicologists and cancer experts in the United States. All those contacted agree with the Canadian assessment of the FDA experiment."

The HWC press release then went on to cite evidence from the international bodies mentioned earlier, which they said supported their view. The Amaranth controversy stayed in the media for a few weeks but did not arouse much attention in political forums such as Parliament. Although consumer articles were published, there was no call for special mechanisms to review or debate the decision. In HWC's view, there was not even much scientific controversy as it felt that the overwhelming majority of scientific opinion supported its stand. The only issue in dispute was the testing methods used in the studies that preceded the US decision.

Had Amaranth been banned in Canada as in the United States it would have had a significant economic impact; a fact undoubtedly known to HWC officials. So also was the fact that although there is consumer concern about food additives there is also strong consumer preference for certain coloured food products. If the scientific evi-

dence had been more controversial, or if it becomes so on the basis of future studies, then the stakes in the issue will undoubtedly be higher.

The Amaranth case is not typical for HWC because it involved a decision that the department could take on its own. HWC had full legal jurisdiction. In some other aspects of the HWC role, the legal responsibility resides elsewhere and HWC is more an adviser, albeit an influential one. Needless to say, some technical disputes arise from jurisdictional origins within departments.

The Amaranth case highlights some of the difficulties and issues involved in technical controversies. The Health Protection Branch's response was a measured, careful critique of the testing methods used in the United States. In one sense, this kind of detailed critique does not greatly interest the media, and so the issue abated. This in itself points out the difficulty of placing scientific testing disputes before the public. Whether a public inquiry would have helped is a moot point. It is possible, however, that if Parliamentary committees were able to hold brief but immediate hearings, overall scrutiny of controversial issues would be improved. Such hearings, however, could clearly not be held at the "once a week" rate at which potential controversies arrive on HWC's doorstep. We will return to the issue of the suitability of parliamentary scrutiny in Chapter V.

As previously mentioned, problems can arise when Canadian regulators defer excessively to international regulatory standards or testing data. This clearly was not done in the Amaranth case. HWC was very critical of the US data, and reached two different decisions.

One could conclude, at least at first glance, that HWC operated swiftly and correctly in the Amaranth case, but other issues and other similar potential hazards lie beneath the surface of the Amaranth case. Although, in this instance, HWC stood ready to make public its own testing data, at other times it has been unwilling to release data. The department pressed hard to ensure that the Freedom of Information Act would enable it to withhold data that officials believed might be misleading. Thus HWC retains extraordinary and unwarranted discretion as to the data it will release, if any, and the form of its release.

Arising from the Amaranth case and others like it is the general issue of the adequacy of toxicological and other basic testing capability which exists in Canada. As noted in Chapter III, the effort in the late 1970s to create a major national toxicology facility failed largely due to budgetary restraint and to interagency bickering, primarily between HWC and NRC but also involving other departments.

Despite the difficulty in defining scientific and technological controversy, and in drawing public attention to major disputes, two conditions must prevail in the future if there is to be any public confidence that these issues are being handled properly. The first is that

the release of testing data must not be left to the discretion of HWC and other departmental officials. The second is that toxicological and other testing capability must be significantly strengthened and a national facility created to do this, preferably at a major university where its work would be conducted in an environment somewhat less restricted by bureaucratic secrecy.

In summary, HWC is a department whose agenda is potentially quite crowded with scientific and technical disputes. Such disputes, though important, have centred around the Health Protection Branch, away from the political mainstream of the department's broader and persistent controversies over health care and welfare programs. The prevailing hazard-of-the-week syndrome clearly affects the political response of the Branch, and makes it unlikely to seek out special mechanisms for the resolution of scientific and technological disputes.

Consumer and Corporate Affairs

The analysis given earlier in this chapter stressed the ambivalent role of CCA. It is an attorney general for the marketplace, both refereeing its functions and encouraging its development. The department has been preoccupied, moreover, with issues such as competition policy and price controls. An examination of CCA's recent history reveals that departmental participation in issues appearing to be most scientific in character (or at least issues requiring or suggesting the interplay of scientific elements) was the result of its status as administrator of the Hazardous Products Act (HPA) and associated regulations. Operationally administered by the Consumer Standards Directorate's Product Safety Branch in the Bureau of Consumer Affairs,[43] its HPA-related regulatory functions seem to ensure that this branch, more than any other CCA organizational unit, is likely to find itself at the centre of scientific issues.

The HPA deals with consumer goods such as those designed for household, garden, or personal use, for use in sports and recreation and for use by children. Because it also includes products "without reference to end use" that are poisonous, toxic, flammable, explosive, or corrosive, the Act can be applied to broader end use or even workplace situations. The Cabinet may include in the schedule to the Act any product the Minister is satisfied is, or is likely to be, a danger to the health or safety of the public. The Act defines a hazardous product to be any included in Part I or Part II of the schedule. Products in Part I cannot be advertised, sold, or imported into Canada. Products in Part II can only be advertised, sold, or imported as authorized by regulations. An offence is punishable on summary conviction by a fine of $1000, or imprisonment for up to two years. Inspectors have full powers of search and seizure.[44]

The Product Safety Branch, part of a larger Consumer Standards Directorate, has responsibility for legal metrology and economic fraud as well as product safety. The field staff, located in five regional and twenty-five district offices, is organized under a separate assistant deputy minister to serve several functions of the department. The inspections for hazardous products are carried out by personnel who also have heavy responsibilities in other areas, such as economic fraud. The Product Safety Branch retains its own basic capability to monitor and evaluate literature and to maintain contact with bodies such as the US Product Safety Commission, but must rely on HWC for more extensive research capability and for advice concerning toxicological hazards. Where necessary, the branch has also initiated laboratory work at other institutions, including universities, other government departments, and research institutes.

Senior officials stress that, unlike the heavily legalistic and adversarial regulatory process in this field in the United States, the Product Safety Branch does not generally operate through "government hearings which tend to involve armies of lawyers."[45] They prefer a consultative approach, and only after they have exhausted this are they prepared to use the considerable powers under the HPA.[46]

Recent CCA annual reports highlight several scientific and technological issues faced by the Product Safety Branch. The 1975-76 *Report* notes that:

> "New regulations were issued to eliminate the use of lead pigments in paints for use in buildings frequented by children. Other regulations established flammability standards for carpeting materials and regulated the packaging and labelling of fast-acting cyanoacrylate adhesives. . . . new regulations for Children's Car Seats and Harnesses also came into effect."[47]

The categories of items and concerns associated with the branch's HPA imperatives also suggest a measure of scientific content. Observing that "several product categories were investigated (in 1975-76) for potential hazards and for possible scheduling under the Hazardous Products Act," the *Report* listed these subjects of CCA interest: "mesh playpens, asbestos and products containing asbestos, prop-type infant feeders, life jackets, synthetic fire logs, children's clothing containing flammable materials, and electrical products."[48]

CCA's annual reviews underline the value of science as the provider of the means and decisional yardsticks by which a product or substance can have its acceptability measured. In addition to the establishment of regulations covering playpens, for example, the 1976-77 CCA *Annual Report* recorded the banning, under the HPA, of "liquids containing polychlorinated biphenyls for use in microscopy. . ., metallized kites, modelling materials containing asbestos, and relight candles."[49] Proscription of these items can only be explained sensibly in the light of scientific examination.

"Under investigation for potential hazards and for possible scheduling under the Hazardous Products Act" during this period were other products that, at some stage in any debate, involved scientific discussion and testing:

> "Included were flammability requirements for tents and tarpaulins; mattresses; the use of fire retardant *tris*(2,3-dibromopropyl)phosphate (a possible carcinogen) on wearing apparel, the dimensions of rattles; nitrosamines in cutting oils; extension of the use of child resistant closures to cover many houehold chemicals; infant carriers, children's life jackets."[50]

In addition to the already-mentioned items, policies of relevance to science appeared in 1977-78 in the form of scheduling under the HPA and amendments to the Hazardous Products Regulations, mandating, among other things, child-resistant closures for various sizes of containers for methyl alcohol, pine oil, petroleum distillate, and turpentine. Other science-related issues arose in connection with "the combustibility of upholstered furniture, cellulose and plastic thermal insulating materials," and still others manifested themselves in such policy forms as "regulations covering hazardous chemicals, matches and the flammability of children's sleepwear."[51] In 1978-79 the Branch had to deal with such issues as the possible release of asbestos fibres during the operation of hand held hair dryers, the safety of 1.5 L soft drink bottles, the safety of cellulose insulation, and beer labelling.

Although a multitude of policy *issues* with some claim to a scientific designation can be identified, it must be recalled that this study deals with scientific and technological *controversy*. It is evident that the existence of scientific issues can be demonstrated, although more than a little imagination is needed in some cases. Whether the intensity of Canadian public awareness and concern about these issues has elevated them to the level of scientific controversy is more doubtful.

The history of CCA in the last four years is only sparsely populated with significant controversy. Indeed, only issues involving a very small sphere of interest or a very restricted constituency seem to have attracted much attention. Few, if any, of the earlier-mentioned scientific or quasi-scientific issues appear to have induced the Canadian public or Members of Parliament to participate in the major forms of popular debate which help define controversy. The media took more interest, but even their interest was not usually given much prominence.

It is the restricted constituency involved in much of the department's policy subject matter that seems to explain this small level of participation. The better-known issues, among them the Ford motor car rusting case (which did not, of course, involve the HPA), and the mesh playpen and rattle dimension questions, illustrate the point

that even these relatively major CCA issues were of immediate importance only to limited categories of people – Ford automobile owners and infant guardians.

The observation might be made that this apparent limiting of popular interest in, and contribution to, issue resolution has evidently extended to product areas involving possible threats to the health and safety of various categories of Canadian citizens. Impregnation of infants' apparel with an allegedly carcinogenic substance (*tris*) and the use of laboratory fluids containing PCB, both examples of issues having potentially lethal consequences, hardly attracted the level of public response that such life-and-death policy questions might lead one to expect. Again, this was probably because only limited categories of citizens were threatened by these products. By contrast, policies relating to products or situations that potentially affect a larger number of more widely distributed persons seem to attract more attention, notwithstanding that they may not pose such severe risks as those facing users of more exclusive (in numerical terms) products. Cyanoacrylate adhesives, thermal insulating material, and mattresses may serve as examples of widely distributed products that have attracted more discussion than has attended other product appraisals. It is perhaps banal to suggest that this phenomenon could be partly explained by human self-interest and partly by making the self-evident observation that, *ceteris paribus*, more people generate more discussion than fewer people. In any case, there never seems to have developed the kind of widespread and intense popular concern about a scientific or quasi-scientific issue that would be needed if the issue were to be identified as a controversy.

Senior officials acknowledge that they function mostly in a reactive manner. There is little time and few resources to monitor the market for new products whose hazards might occasion the greatest concern and for which testing might be done. There are simply too many new products. At the same time, officials acknowledge that only about six or seven issues per year reach the stage of being modestly controversial, i.e., attract significant media attention. They point out that the special board of review provision contained in the HPA has only been utilized twice. This allows interested parties to request a board, which then reviews the regulatory decisions taken. The infrequent use of this provision is cited as one explanation of the absence of high level controveries.

Because so few issues become controversial, it seems practical to suggest that special mechanisms could be utilized on those occasions when scientific controversy does arise. The problem, as we have seen throughout this study, is to determine whether controversy is based on scientific or testing dispute or on political and economic factors. A brief account of the regulatory process involved in securing motor vehicle crash protection for infant and child passengers will illustrate a few of the problems.

The process began late in 1970 at the behest of the Consumers' Association of Canada (CAC) and involved consultation among the CAC, CCA, Transport Canada, provincial highway safety authorities, the Canadian Standards Association (CSA), and commercial interests.[52] A CSA subcommittee chaired by a CAC representative was established to develop a safety standard for child restraint. This consensus approach was to no avail because a suitable compromise over safety, convenience, and price could not be reached.

There were also disputes over test methods and results. The CSA subcommittee intended to develop a product standard based on crash simulation or dynamic tests, for which there was little precedent. Consequently, in 1972, the Minister of CCA announced interim regulations based on static testing. These were similar to US regulations (still in effect in the US today). Under continued CAC pressure, the Minister directed that regulations be drafted to include crash simulation tests. A recent CCA brief summarized the technical dispute at that stage as follows:

> "This was done, in very large measure, on the basis of the draft standards prepared by the CSA subcommittee to that point. However, the particular draft specifications for maximum movement of the head of the anthropometric device (test dummy) in the crash tests developed by the subcommittee were rejected as totally inadequate. No reference points relative to the vehicle seat or test sled were then specified (i.e. the total movement was to be measured regardless of the initial or final position) and the limits suggested appeared to bear no rational relationship to actual vehicle interior dimensions and configurations. Rather, they were apparently based on unimproved performance capabilities of a range of child restraints then available. Admittedly, precise data on vehicle interiors was limited. On the other hand, the overall limit of 26 inches suggested in the subcommittee proposal for forward head movement, for example, appeared very likely to permit violent head contacts in the large majority of vehicles on the road. In tests conducted for the department in a *full-sized Buick* body configuration, 26 inches of dummy head *movement* resulted in an off-scale (over 200 G) reading for impact of the head of the test dummy against the instrument panel. Tests were also conducted in a smaller Ford body.
>
> "The CAC was unimpressed, and apparently remains unimpressed, by those arguments. The data base was questioned and there were suggestions that head impacts against parts of vehicle interiors were acceptable provided they were not too violent. On the other hand, neither the CAC nor any authority on the subject seemed prepared to offer advice on just how 'excessive' violence might be determined and judged."[53]

When the Minister's intentions to proceed were made public, strong opposition arose from manufacturing interests. Despite these objections, regulations were promulgated under HPA in May 1974. Static tests were used to devise these regulations. By November 1975, new requirements were added based on crash simulation tests but an eighteen-month delay in implementation was allowed because of the major effect foreseen. In 1978 the American Consumers' Union tested safety devices against the stronger (than US) Canadian safety standards and judged them to be unsafe. CCA tested them again but did not replicate the US results. Some devices exceeded allowable limits in other aspects of safety. The CAC protested and the ensuing publicity resulted in a rapid fall-off in sales.

To respond to this latest round of the regulatory process, CCA felt compelled to employ a special device. Interestingly enough, it did not utilize the board of review mechanism allowed by the HPA; instead it created a special task force to advise the Minister. At time of writing the task force is still deliberating.

In its brief to the task force, CCA summarizes its view of the net effect of federal regulatory efforts as follows:

> "All of the foregoing history might reasonably lead the Task Force to conclude that the general public would by now be disinclined to place any confidence in the regulations, in their administration or in products meeting their requirements. However, self-fulfilment of frequent prophesies about consumer rejection of these products has thankfully *not* occurred. It appears that, while often controversial, public statements by the CAC and others may have had a very helpful effect in heightening public awareness of the need for child crash protection and the foregoing historical perspective is not to deny such beneficial aspects of the opposing positions.
>
> "A report prepared by McGill University (31, 31A) indicates that over 80% of 919 parents surveyed own (or, in the case of older children, have owned) children's car seats. It also indicates that a majority of current users are conscientious in taking advantage of the available added protection afforded by installing the supplementary anchor and connecting the "top tether" to the anchor when the seat is in use. At the same time, it is pointed out that this added protection would not be *available* if the current performance requirements had not been put in place in spite of objections. Moreover, less than 10% of those surveyed gave their reason in not currently using car seats or using them improperly as 'inconvenient for parents,' 'difficulty installing' or 'difficulty using.' It is also impossible to reconcile the frequent suggestions that the current regulations underlie problems of non-use or mis-use with the fact that much more serious prob-

lems of this kind exist in the US *where current regulations include no crash performance requirements whatever*. In that country, 93% of children are not properly restrained in the available products."[54]

Although the above account cannot possibly do justice to the controversy over child safety in cars, it does illustrate the continuing problem. Testing methods and results were a central issue and perhaps could have been aired in a more public forum. But economic interests and CAC/CCA political sparring were equally important factors in the process. CCA, however, thought the situation important enough to launch a task force, even though it felt that its own standards were already much more stringent than those in the US. The task force, however, was not particularly designed to resolve scientific and technological controversy as such. Its purpose was to gather views from all parties, and provide the Minister with another considered opinion.

This case spans almost a decade and hence is probably not typical of others the CCA faces. It does show, however, the difficulty in identifying criteria that would help determine when a technical dispute is sufficiently strong to be both the major determinant of controversy and as well to be called a scientific controversy. No criteria readily emerge either from this case or from the six or seven modest controversies which CCA faces each year.

Like EMR and HWC, CCA's general operating habits are not conducive to dealing with scientific and technological controversy even where there is agreement one exists. It prefers to keep issues under its control. The task force on child safety functioned in a very quiet behind-the-scenes fashion. CCA must function, moreover, with only a modest, technical capability of its own, and is dependent primarily on other departments or private laboratories for testing. It is certainly much more dependent on external resources that is HWC.

The child safety issue involved considerable interplay with American testing data, although CCA clearly did not entirely defer to it. The availability of US and other foreign data however, cannot be dismissed lightly. It presents both problems and advantages for regulators and those being regulated. Costs alone suggest that some international division of labour in testing is helpful. At the same time, however, regulators cannot afford to accept such data in an unquestioning fashion because it may well be invalid. Moreover, parties with an interest in the question will often demand that Canadian tests be carried out.

Conclusions

Although there are limitations to the kinds of decision-making evidence provided in this chapter, the brief profile of three departments does allow some concluding observations. Decisions involving real or

potential scientific and technological controversy were not the central concerns of the three departments during the last half of the 1970s. Departmental priorities resided elsewhere, whether viewed by senior officials, the media, or parliamentary critics. Among the three departments, however, there was considerable variation in the annual incidence of potential scientific and technological controversies, or at least disputes. EMR had on average about one per year, CCA had six or seven, and HWC about fifty.

When, from time to time, a department deemed it necessary, or was required, by political pressure, to create special mechanisms for review (as in the case of the Hare reports and the child safety task force), such mechanisms were only partly triggered by scientific and technological controversy as such. Broader political and economic factors were also present and were necessary to create the impetus for review. Consequently, review mechanisms were not specifically designed to address whatever scientific and technical dispute may have been present.

As could be expected, the variables that determine whether a dispute becomes a controversy are numerous and it is therefore difficult to predict which issues will reach the status of a controversy. The size and geographic dispersal of the constituency of people affected by a good or product, the number and size of producer firms involved, the degree to which there are several departments with a jurisdictional stake, and the amount and persistence of media criticism are all factors that could influence the determination of a dispute's status.

The analysis shows that departments are essentially reactive agents. In this context, several issues affect the possibility of reform. First, there are a number of disputes that are of minor consequence; either they require no review or, on occasion, they could be reviewed very quickly if a proper forum were available. Second, it is important to link the departmental profiles to the earlier discussion of central decision making in Chapter II. Not only is there a government-wide agenda, but many of the individual disputes and decisions are delegated to departments precisely to enable government to function properly. Not all decisions are made at the centre; they are assigned to departments to secure a speedier and more efficient resolution of a problem. Not all disputes require Cabinet resolution, and agenda are not so overloaded that departments are incapable of making and reviewing their own decisions. The central problem, which is stressed in the final chapter, is the degree of control over who has the power to launch a review mechanism regardless of the nature of the dispute or the scale of its consequences.

It should be stressed, however, that departments are often dependent on each other and face interdepartmental pressures, criticisms and restraints. CCA is dependent on the scientific and technical

bases of HWC and others. In many cases HWC can only act in an advisory capacity because the statutory authority resides with other agencies, e.g., Agriculture or Environment. EMR faced internal criticism over the Hare report from HWC and Environment, but EMR's views prevailed.

Therefore, between the centre of government (the cabinet and central agencies) and individual line departments with individual legal and political powers, there is an important middle realm of interagency relations that cannot be ignored. These relations are affected and reinforced by the general norms of cabinet government, by desires to keep ministers out of trouble (especially media trouble), by normal bureaucratic inertia, caution and habit, and by real or perceived restraints on the use of financial and personnel resources.

V. Concluding Observations

The central purpose of the study has not been to construct a narrow pure definition of scientific controversy alone. Rather it has been an attempt to discover how the broader notion of scientific and technological controversy is defined, viewed, and dealt with by decision makers. This required a look at several kinds and levels of evidence. First, one must fully understand the general policy and decision processes and their numerous conflicting characteristics; second, one must appreciate, in general, the way scientific and technological data and advice are acquired in government; and third, one must appreciate the nature of individual departmental mandates, agendas, and operating habits, as well as the nature of relationships among interdependent departments. Finally , it is helpful to look briefly at illustrative examples, as we have in Chapter IV (i.e., Hare committee, the Amaranth case, and the child car seat safety question).

My conclusions are drawn from each of the above elements of the study. They are also couched in full recognition of the limitations of the study, i.e., resource and time constraints necessitated a concentration on only three departments. Obviously a more complete understanding could be obtained if more departments were examined over a longer period, and if decision processes were seen from the point of view of outside interest groups or the media as well as from the inside viewpoint of senior officials. In the context of the strengths and limitations of my approach several concluding observations can be made.

Scientific and Technological Advice and Controversy in Federal Decision Processes

As pointed out in Chapter III, the federal government has many ways

of acquiring scientific and technological data and advice for its regular policy and decision-making processes. Among the sources available are its own departmental experts and those from other departments. Government can also acquire data by periodic recourse, formally and informally, to bodies like the National Research Council, to consultants and international and foreign agencies, and to inquiries and task forces. Scientific and technological variables are thus an essential and important influence on government decision-making processes.

One can conclude, on the basis of the approach used in this study, that these processes of obtaining scientific and technological data and advice are very often quite inadequate. Acceptable decisions are made on the basis of such advice, and it is competently and conscientiously tendered. However, we identified in Chapters III and IV some general problems that are a cause for concern. These include the declining levels of R&D funding as well as manpower in the 1970s, the absence of readily available outside sources of advice from the organized scientific societies, the problems of utilizing the data of international and foreign scientific and regulatory bodies, and the dependence of some individual agencies on the research and data acquisition priorities of other federal departments.

These problems could lead to a decline in the overall quantity and quality of scientific and technological advice, and hence in a general way reduce the ability of decision makers both to resolve controversies when they arise, and equally important, to anticipate them well in advance of the time when decisions are made. A more complete judgement about the general quality of scientific and technological data and advice would require a much broader study, although a consensus about its adequacy would, under any circumstances, be difficult to achieve or measure. This study suggests, however, that there are strong grounds for concern about this question and that more resources are justified.

Although scientific and technological variables are important aspects of decision processes, one is forced to conclude that scientific and technological controversies are, on balance, viewed by decision makers as peripheral to the formal decision process in comparison with competing political, economic, legal and other elements. This is partly due to the problem of definition and perception. The analysis has shown that science and technology is perceived by officials to include causal or correlational knowledge, testing, and even the absence or withholding of information. It must be remembered, however, that economic and political variables are not subject to definitional unanimity either, particularly in specific decision-making situations.

The peripheral status of scientific and technological controversy is also caused by the difficulties in knowing when a scientific and

technological dispute *has become* a controversy, for decision makers must constantly deal with dispute and conflict. The policy and decision-making process has numerous elements and is characterized by contending ideas, ideologies, priorities and agendas as well as the need to utilize and assign political value to several instruments of governing, including exhortation, regulation, expenditure and taxation. This complexity is found particularly when decision making is viewed in a total governmental context. Complexity is also applicable, however, at the departmental level.

Other kinds of evidence also revealed the peripheral status of scientific and technological controversies. Such evidence included the views of senior officials, the form of written cabinet documentation, recent experiments in regulatory reform such as the SEIA process, and other published literature on the decision-making process in Canada and abroad.

While the three illustrative cases – the Hare report, Amaranth, the child car seats – do not in themselves provide a basis for generalization, they do highlight several important issues. Despite the fact that its subject (the management of nuclear wastes) involved considerable scientific and technological controversy and public concern and did not require immediate resolution, the Hare committee was not structured to deal with these issues publicly, although it could have been. The Amaranth controversy showed, among other things, the difficulties of presenting a scientific testing dispute between US and Canadian regulators and experts, and also how the media interest can be quickly lost when detailed explanations are necessary. It was a case, moreover, in which a department, HWC, had sole jurisdication and could and did act swiftly. In the child car seat controversy, CCA was much more dependent on others for testing data. This issue shows how, despite almost a decade of dispute, CCA did not act upon its own statutory provision to create a special review panel. Instead, it chose a less visible and less public task force to review the question.

These cases differ and one cannot generalize, but they give some indication of the flavour and texture of detailed controversy and of the difficulty in deciding to what degree scientific and technological issues are the dominant concern.

In general, it is understandable why scientific and technological controversies are not recognized automatically by decision makers, although technical and scientific factors are accepted as essential requirements for informed decisions. The inability to recognize controversies can be costly in some cases. Departments are capable of doing much better. Reform is needed to ensure better scientific advice in government, and to find means of dealing more effectively with special controversies when there is agreement that they exist.

The Reform of Ongoing Scientific and Technological Decision Processes Within Departments

It is difficult to propose specific reforms for day-to-day scientific input into departmental decisions. Ministers and deputy ministers are not usually scientific and technological experts. However, it would be both unwise and impractical to recommend that senior managers require better education in science and technology or that more deputy and assistant deputy ministers should be scientists; an equally strong case could be made that they should be economists or financial experts. Indeed, if one added the ideal attributes of senior decision makers, they would have to become experts in everything, which means, of course, that they should be generalists – which, indeed, is what most of them are!

There may be some merit, however, in the idea of a senior ADM for science, or a science adviser, for the larger science-based departments. As we have seen, EMR has an ADM for science but this official has been preoccupied with preserving the technical personnel base of EMR against budget cutters, and has had a more limited role in ongoing strategic technical advice to other ADMs. Nevertheless, a good case could be made that such a senior adviser could act as a catalyst to ensure that scientific and technological issues and controversies are identified, aired, and when possible, resolved at the department's executive level.

The executive levels (DM and ADM) of individual line departments function in different ways depending in part on the managerial style of the deputy minister (and of the minister) as well as the size of the department. Thus, there are differences in the way scientific and technological advice is communicated to, and shared among, these senior officials. Legislation to improve communication is impossible because decision making at this level is highly personalized and depends on individual relationships. Moreover, the deputy minister is often beseiged by other demands and governed by other general norms of cabinet parliamentary government.

Despite these difficulties, however, it should not be too difficult for departments to ensure that the documentation they produce for senior decision makers contains sections specifically dealing with scientific and technological issues. Such a section should also be included in Cabinet documents and background papers. This suggestion does not imply that all such documents should be read by every senior official or minister of all departments involved in any given issue, but that a greater number of scientific and technical issues should be examined and discussed, and taken into account, than would occur without such a provision. A case can certainly be made that scientific and technological consderations deserve a paragraph in policy documents, particularly when there is perceived scientific and technological controversy, as much as do other items in the cur-

rent documentation, such as economic, financial, political, federal-provincial and inter-departmental considerations.

It should also be reiterated that departmental capability to provide senior management with timely scientific and technical advice cannot help but deteriorate if government-wide budget cutting continues to be directed primarily at science budgets and personnel.

There are some reforms in day-to-day decision making that are worth trying, but reforms on a broader front are even more necessary. Before examining this broader area of reform, I shall summarize my views about whether criteria for creating special mechanisms for the review of scientific controversies can be devised.

The Absence of Criteria for Creating Special Mechanisms for Scientific Review: Departmental Agendas Versus Government-Wide Agendas

This study points out the peripheral place of scientific and technological controversy in the decision process, but it also shows that there are numerous instances in the total governmental agenda where scientific and technological controversy is perceived to exist, and that the number of these instances varies among particular departments. One of the expectations I had before carrying out the study was that the frequency of such controversies on a government-wide basis would be so great in any short period, one to three years, that creating special mechanisms (e.g., inquiries, boards) to review all such controversies would be impossible or would merely duplicate other review mechanisms (e.g., economic, political) already available. In the light of the study, I still hold this view.

The analysis of the three departments does show, however, that any single department's agenda of real or potential scientific and technological controversy varies greatly. For example, EMR's agenda probably consisted of three or four issues over the four years examined, while CCA's contained about eight decisions per year and HWC's about fifty per year. Thus, all other things being equal, some departments could quite easily, if they were willing, accommodate special mechanisms of review for *some* controversies without imposing intolerable burdens on themselves. For other departments this would present very real problems, and could seriously detract from the proper management and implementation of their other numerous duties and programs. Even for those departments that function at the "hazard-of-the-week" pace, a better and more open review of some of the controversies is both possible and desirable.

Given that the study shows special review mechanisms could be utilized, the key questions remain. Are there criteria that could help establish or automatically result in a review mechanism? And, if so, how would such mechanisms relate to other avenues of review? Moreover, how does one ensure that the mechanism chosen is especially

suited to examining scientific and technological controversy rather than other kinds of controversy? This study concludes that it is impossible to devise acceptable criteria for the establishment of special review mechanisms. Whether there is sufficient scientific and technological controversy to warrant a special review of a specific project or policy is inherently a political decision, as is the question of whether political and economic variables should be weighted more heavily than scientific and technological variables. There are no criteria that would *a priori* command consensus on ultimate political judgement and the ranking of priorities.

A General Approach to Decision-Making Reform

The inadequacy of current decision processes to deal with some major and minor decisions remains. A central problem with Canadian federal institutions is that decisions about creating special reviews are left, far too exclusively, in the hands of ministers and senior officials. In part, of course, this situation flows from the very nature of cabinet parliamentary government. Wholesale reforms to the decision process must be made so that an increased number of points of leverage and decision-making power rest in the hands of those outside the political executive, who can then exercise greater pressure for special review mechanisms when certain decisions are deemed worthy. It is within this context that the several reforms cited in earlier chapters deserve comment.

In Chapter II, the Cabinet Committee and envelope system, the Environmental Assessment Review Process (EARP), program evaluation, the SEIA process for regulatory evaluation, freedom of information legislation, and the reform of parliamentary committees were reviewed. Each of these reforms had its own particular origin, and was not necessarily coordinated into a systematic process of evaluation. Coordination is probably not possible. Some processes are inherently *ex-post* and others *ex-ante* systems of evaluation.

Each of these elements of reform are desirable. So also are evaluation mechanisms that allow scientific and technological variables, effects, and controversies to be assessed. Can they all be integrated without inducing paralysis in the decision process? Can or should they all be made statutory in nature? Which kind of evaluation should be judged to be the most important? For how long? Who should make such judgements?

A perfectly rational federal government, which has the time to think soberly about its decisions and then to evaluate them, should presumably be able to balance at least the following variables, values, or ideas:

- economic and financial
- political
- legal and legislative

- regional and urban
- social and redistributive
- environmental
- foreign and international
- scientific and technological.

All are valuable, desirable bases upon which to make decisions.

There can be no doubt that the federal government should consider carefully and systematically how scientific and technological data and advice are utilized, and how controversies can be aired and, where possible, resolved. A centralized system of alerting decision makers and the public to the existence of controversies is not necessarily the answer. For example, making environmental assessments statutory will not automatically result in publicizing controversial issues, but careful consideration of how environmental hearings could deal with controversies might lead to improvements. Normal program evaluations might well reveal similar instances.

The SEIA process for reviewing major new regulatory proposals could be one vehicle of airing, from time to time, scientific and technological controversy. The prior consultation with interested parties, required by the SEIA process, will generate some concerns about science and technology. But it is my view that on balance, the SEIA process is of limited use because it was designed to improve economic assessment. There are already numerous difficulties in dealing even with this aspect of the regulatory process without burdening it with even less well-understood variables. Far more fertile ground for reform can be found in the combination of freedom of information legislation and the reforms of Parliamentary committees.

New federal freedom of information legislation should bring more scientific and technological controversies to light. Unfortunately Sections 20, 22 (3) and 23 of the proposed legislation contain indefensible clauses that restrain optimism about reform; clauses under which product, environmental, and other testing reports and studies may be withheld. These include instances where "the head of the institution believes, on reasonable grounds, that the results are misleading." These clauses should be deleted from the bill before it is passed by Parliament. An amended freedom of information bill would have considerable potential to bring to light issues that did not contain scientific and technological controversy.

Not all scientific and technological controversies will be contentious or important enough to warrant time-consuming review. However, they should still be made public. Some issues that are controversial deserve a forum for scrutiny and this is where Parliamentary committees, in combination with freedom of information legislation, could provide a useful basis for reform, albeit limited reform. The key is to give committees the power to investigate and the necessary staff. At the very least, committees could determine if issues really are

scientific or if the scientific concerns are actually a smokescreen for economic and political factors.

The avenues for reform must be kept in perspective. The reforms suggested here would air and resolve only *some* of the problems that may arise *some* of the time, but they would be a major improvement on existing conditions. They would probably not be useful in resolving major controversies that require such extensive new research that only extraordinary devices can be used. In such cases, royal commissions, task forces, and the like could be used.

When political pressure is strong enough to force the creation of such mechanisms there is no automatic guarantee that they will be well-suited to explore scientific and technological issues, or that commissioners and ministers will reason on the basis of evidence presented to them. This study has tried to focus on the realities of decision making. It shows that some reforms are both desirable and feasible, and encourages thorough consideration of the kinds of reform that can contribute to real rather than theoretical solutions to an ill-defined but important aspect of public decision making in Canada.

Notes

I. Introduction

1. Liora Salter and Debra Slaco, *Public Inquiries in Canada*, Background Study 47, Science Council of Canada, Ottawa, 1981.

II. Federal Public Policy and Decision Processes: A Survey

1. G. Bruce Doern and Peter Aucoin, eds., *Public Policy in Canada: Organization, Process and Management*, Macmillan, Toronto, 1979; and Douglas Hartle, *Public Policy, Decision Making and Regulation*, Institute for Research on Public Policy, Montreal, 1979.

2. Doern and Aucoin, eds., *op. cit.*, chapters 2 and 3; C. Campbell and G. Szablowski, *The Superbureaucrats*, Macmillan, Toronto, 1979; and R. French, *How Ottawa Decides*, Canadian Institute for Economic Policy, Ottawa, 1980.

3. See R. Jackson and M. Atkinson, *The Canadian Legislative System*, 2nd edition, Macmillan, Toronto, 1980.

4. See M. Punnett, *The Prime Minister in Canadian Government and Politics*, Macmillan, Toronto, 1977; and W.A. Matheson, *The Prime Minister and the Cabinet*, Methuen, Toronto, 1976.

5. Canada, Department of Finance, *The New Expenditure Management System*, Ottawa, December 1979. See also G. Bruce Doern, ed., *Spending Tax Dollars: Federal Expenditures 1980-81*, School of Public Administration, Carleton University, Ottawa, 1980, Appendix 1.

6. See D. Hartle, *A Theory of the Expenditure Decision Process*, Ontario Economic Council, Toronto, 1976, chapter 3; T. Denton, "Ministerial Responsibility: A Contemporary Perspective," in *The Canadian Political Process*, ed. R. Schultz et al., 3rd edition, Holt Rinehart, Toronto, 1979, pp. 344-362; and Canada, Royal Commission on Financial Management and Accountability, *Final Report*, Supply and Services Canada, Ottawa, 1979.

7. D. Hartle, *Public Policy, Decision Making and Regulation*, Institute for Research on Public Policy, Montreal, 1979, p. 73-74.

8. See G. Bruce Doern, *Rationalizing the Regulatory Decision Making Process: The Prospects for Reform*, Working Paper. Regulation Reference, Economic Council of Canada, Ottawa, 1979.

9. My concept of governing instruments has been introduced elsewhere and is a derivation of the complex typology developed by Lowi, Salisbury, and Heinz. See G. Bruce Doern, *The Regulatory Process in Canada*, Macmillan, Toronto, 1978, chapter 1; and R.W. Phidd and G. Bruce Doern, *The Politics and Management of Canadian Economic Policy*, Macmillan, Toronto, 1978, chapters 2, 3 and 14. For other views of the role of instruments see Albert Breton, *The Economic Theory of Representative Government*, Aldine, Chicago, 1974; and J. Robert S. Pritchard, *The Instruments of Regulation*, paper presented to Learned Society Meetings, Saskatoon, May 1979; and Ken Woodside, "Tax Incentives vs. Subsidies: Political Considerations in Governmental Choice", *Canadian Public Policy*, vol. 2, Spring 1979, pp. 248-256.

10. Some authors have divided the expenditure or allocative category into "distributive" versus "redistributive" sub-types. While this is itself fraught with numerous problems of measurement, its most unsatisfactory feature is the fact that redistribution can be a consequence of the use on on three instruments. Hence, I prefer to simplify the classification and to deal with redistribution as a pervasive factor whose measurement and assessment, while difficult, are essential to regulatory reform and to assessing all instruments. For a critical review see W. Jenkins, *Policy Analysis*, Martin Robertson, London, 1978, chapter 3.

11. See G. Bruce Doern, ed., *The Regulatory Process in Canada*, Macmillan, Toronto, 1978, chapter 1; and Economic Council of Canada, *Responsible Regulation*, Supply and Services Canada, Ottawa, December 1979.

12. See Allan Maslove, "The Other Side of Public Spending: Tax Expenditures in Canada," in *The Public Evaluation of Government Spending*, ed. G. Bruce Doern and Allan M. Maslove, Institute for Research on Public Policy, Montreal, 1979.

13. On the critical importance of political administration or, if you like, "implementation," see Aaron Wildavsky, *Speaking Truth to Power: The Art and Craft of Policy Analysis*, Little Brown, New York, 1979.

14. This is shown by the advocacy of "sunset" laws as a regulatory reform; it is a reform directed at the parent statute.

15. Economic Council of Canada, *Responsible Regulation*, Supply and Services Canada, Ottawa, December 1979.

16. See John Langford, "Crown Corporations as Instruments of Policy," in *Public Policy in Canada: Organization, Process and Management*, ed. G. Bruce Doern and Peter Aucoin, Macmillan, Toronto, 1978, chapter 9; and Canada, Royal Commission on Financial Management and Accountability, *Final Report*, *op. cit.*, chapters 17, 18, and 19.

17. See David Good, *The Politics of Anticipation: Making Federal Tax Policy*, School of Public Administration, Carleton University, Ottawa, 1980.

18. Peter Aucoin, "Public Policy Theory and Analysis," in *Public Policy in Canada: Organization, Process and Management*, ed. G. Bruce Doern and Peter Aucoin, Macmillan, Toronto, 1979, chapter 1.

19. See C. Lindblom, *Politics and Markets*, Basic Books, New York, 1978; and *The Canadian State*, ed. Leo Panitch, University of Toronto Press, Toronto, 1977.

20. Ronald Manzer, "Public Policy in Canada: A Developmental Perspective," Paper presented to the Canadian Political Science Association, Edmonton, June 1975.

21. See R.W. Phidd and G. Bruce Doern, *The Politics and Management of Canadian Economic Policy*, Macmillan, Toronto, 1979; and Conference Board in Canada, *Consultation and Consensus: A New Forum in Policy Formulation*, Ottawa, 1979.

22. See Andrew Roman, "Formal Consultation: A New Era in Policy Formulation?" Ottawa, 1979, Paper given to *Conference on Consultation and Advocacy: Influencing Public Policy*, Conference Board in Canada, Ottawa, 20 November 1979.

23. G. Bruce Doern and Peter Aucoin, eds., *Public Policy in Canada: Organization, Process and Management*, Macmillan, Toronto, 1979, chapter 11.

24. See Reg Lang, "Environmental Impact Assessment: Reform or Rhetoric?" in *Ecology Versus Politics in Canada*, ed. William Leiss, University of Toronto Press, Toronto, 1979, pp. 233-251; William Rees, "Reflections on the Environmental Assessment and Review Process: A Discussion Paper," unpublished paper, School of Community and Regional Planning, University of British Columbia, November 1979; Michael Whittington, "The Department of the Environment," in *Spending Tax Dollars*, School of Public Administration, Carleton University, Ottawa, 1980, ed. G. Bruce Doern, pp. 99-118; and Federal Environmental Assessment Review Office, *A Guide to the Environmental Assessment and Review Process*, Ottawa, 1977.

25. Rees, *op. cit.*, p. 5.

26. See J.M. Jordan and Sharon Sutherland, "Assessing the Results of Public Expenditure: Program Evaluation in the Canadian Federal Government," *Canadian Public Administration*, vol. 22, no. 4, Winter 1979, pp. 581-609.

27. Harry Rogers, "Program Evaluation in the Federal Government" in *The Public Evaluation of Government Spending*, ed. G. Bruce Doern and Allan M. Maslove, Institute for Research on Public Policy, Montreal, 1978, p. 79.

28. Irwin Gillespie, "Fools Gold: The Quest for a Method of Evaluating Government Spending," in *The Public Evaluation of Government Spending*, ed. G. Bruce Doern and Allan M. Maslove, Institute for Research on Public Policy, 1978, pp. 43-44.

29. See George Stigler, *The Citizen and the State: Essays on Regulation*, University of Chicago Press, Chicago, 1975, p. 140.

30. Jordan and Sutherland, *op. cit.*, pp. 581-609.

31. See Economic Council of Canada, *Responsible Regulation*, Supply and Services Canada, December 1979, chapters 5, 6, and 7; see also G. Bruce Doern, *Rationalizing the Regulatory Decision Process, The Prospects for Reform*, Working Paper Regulation Reference, Economic Council of Canada, Ottawa, 1979, chapter 3. The details of the SEIA policy can be found in Treasury Board of Canada, *Administrative Policy Manual*, Supply and Services Canada, Ottawa, December 1979, chapter 490.

32. *Regulation Reference: A Preliminary Report to First Ministers,* Economic Council of Canada, Ottawa, 1978, p. 75. The description of the SEIA program is taken from this source, pp. 75-79.

33. See President of the Privy Council, *Freedom of Information Legislation*, Discussion Paper, Privy Council Office, Ottawa, October 1979.

34. See Bill C-43, introduced by the Honourable Francis Fox, Secretary of State, 17 July 1980.

35. President of the Privy Council, *Discussion Paper on Parliamentary Reform*, Privy Council Office, Ottawa, November 1979.

36. See T. D'Aquino, G. Bruce Doern, and C. Blair, *Parliamentary Government in Canada: A Critical Assessment and Suggestions for Reform*, Research Study prepared for the Business Council on National Issues, Intercounsel, Ottawa, 1979.

III. Scientific and Technological Advice and Controversy in Decision Processes

1. For a general range of views see Dean Schooler Jr., *Science, Scientists and Public Policy*, Free Press, New York, 1971; and Guy Benveniste, *The Politics of Expertise*, 2nd edition, Boyd and Fraser Publishing Co., San Francisco, 1977; Alvin Weinberg, "Science and Trans-science," *Minerva*, Vol. X, No. 2, April 1972, pp. 209-222; Allan Mazur, "Opposition to Technological Innovation," *Minerva*, Vol. X111, No. 1, April 1975, pp. 58-81; Allan Mazur, "Disputes Between Experts," *Minerva*, Vol. XI, No. 2, April 1973, pp. 245-249; Ian D. Clark, "Expert Advice in the Controversy About Supersonic Transport in the United States," *Minerva*, Vol. XII, No. 4, October 1974, pp. 416-432; R.W. Nichols, "Some Practical Problems of Scientist Advisers," *Minerva*, Vol. X, No. 4, October 1972, pp. 603-613; Wolf Hafele, "Hypotheticality and the New Challenges: The Pathfinder Role of Nuclear Energy," *Minerva*, Vol. XII, No. 3, July 1974, pp. 303-322; and Harvey Brooks, "Science and Trans-science," in Correspondence, *Minerva*, Vol. X, No. 3, July 1972, pp. 484-486.

2. Dennis Olsen, *The State Elite*, McClelland and Stewart, Toronto, 1980, p. 27.

3. *Ibid.*, p. 75.

4. *Ibid.*

5. See for example Norman Stoner, *The Social System of Science*, Holt, Rinehart and Winston, New York, 1966; and Stephen Cotgrove and Steven Box, *Science, Industry and Society*, Allen and Unwin, London, 1970.

6. A classic discussion of this is found in Herbert Simon, *Administrative Behavior: A Study of Decision Making*, Free Press, New York, 1965, originally published in 1947; and Sir Geoffrey Vickers, *The Art of Judgement*, Basic Books, New York, 1965.

7. Science Council of Canada, *Policies and Poisons: The Containment of Long-term Hazards to Human Health in the Environment and in the Workplace*, Report 28, Supply and Services Canada, Ottawa, 1977.

8. See Peter Aucoin and Richard French, *Knowledge, Power and Public Policy*, Background Study 31, Science Council of Canada, Ottawa, 1974.

9. See Ministry of State for Science and Technology, *Annual Report 1978-79*, Supply and Services Canada, Ottawa, 1980; and G. Bruce Doern, "Planning Science and Technology Policies in Canada: A Review and Assessment," Paper presented to the United States Congressional Committee on Science and Technology, Washington, D.C., 28 July 1980.

10. See M. Skinner, "The Federal Make or Buy R & D Policy: A Preliminary Analysis of Policy and Implementation," MA Thesis, School of Public Administration, Carleton University, Ottawa, 1978.

11. See Ministry of State for Science and Technology, *Federal Science Activities 1980-81* Supply and Services Canada, Ottawa, 1980, pp. 5-6.

12. See V. Seymour Wilson, "The Role of Royal Commissions," in *The Structures of Policy Making in Canada*, ed. G. Bruce Doern and Peter Aucoin, Macmillan of Canada, Toronto, 1971, chapter 6.

13. Liora Salter and Debra Slaco, *Public Inquiries in Canada*, Background Study 47, Science Council of Canada, Ottawa, 1981.

14. See Science Council of Canada, *Policies and Poisons*, Report 28, *op.cit.*

15. See notes 1, 2 and 3 above.

16. See David Bates, "Occupational and Environmental Health," in *Canadian Nuclear Policies*, ed. G. Bruce Doern and R.W. Morrison, Institute for Research on Public Policy, Montreal, 1980, pp. 218-230.

17. See for example, William R. Havender, "Ruminations on a Rat: Saccharin and Human Risk," *Regulation*, vol. 3, no. 2, March/April 1979, pp. 17-25.

18. This is of course a familiar problem in organizational analysis. See R.M. Cyert and J.G. March, *A Behavioral Theory of the Firm*, Prentice Hall, Englewood Cliffs, N.J., 1963.

19. This finding merely confirms other studies. See Aaron Wildavsky, *Speaking Truth to Power: The Art and Craft of Policy Analysis*, Little Brown, New York, 1979; and Arnold J. Meltsner, *Policy Analysts in the Bureaucracy*, University of California Press, Berkeley, 1976.

20. See Peter Aucoin, "Public Policy Theory and Analysis," in *Public Policy in Canada: Organization, Process and Management*, ed. G. Bruce Doern and Peter Aucoin, Macmillan, Toronto, 1979, chapter 1.

21. See Schooler, *op. cit.*; and H. Rose and S. Rose, eds., *The Political Economy of Science*, Macmillan Press, London, 1976.

22. The role of the media is central to an understanding of modern political behaviour. See D. Hartle, *A Theory of the Expenditure Decision Process*, Ontario Economic Council, Toronto, 1976, chapter 3.

23. See G. Bruce Doern, "Science and Technology in the Nuclear Regulatory Process: The Case of Canadian Uranium Miners," in *Canadian Public Administration*, vol. 20, no. 1, pp. 1-35.

24. G. Bruce Doern, *Science and Politics in Canada*, McGill-Queen's University Press, Montreal, 1972.

25. See Peter Aucoin and Richard French, *op.cit.*

26. See G. Bruce Doern, *The Regulatory Process in Canada*, Macmillan, Toronto, 1978; and D. Hartle, *op. cit.*

27. See Science Council of Canada, *Policies and Poisons*, Report 28, *op.cit.*

28. See Michael Prince, "Policy Advisory Groups in Government Departments," *Public Policy in Canada*, ed. G. Bruce Doern and Peter Aucoin, chapter 10.

29. See Richard French, "The Privy Council Office: Support for Cabinet Decision Making" in *The Canadian Political Process*, ed. R. Schultz et al., 3rd edition, Toronto: Holt Rinehart, 1979, pp. 363-394.

30. See Privy Council Office, "Directives for the Preparation and Handling of Memoranda to the Cabinet and Discussion Papers," Ottawa: January 1977, pp. 17-18.

31. Government of Ontario, *Guidelines for Preparing Cabinet Submission*, Cabinet Office, Toronto, February 1979, pp. 405. See also the Quebec guide-

lines in "Arrêté en Conseil, Chambre du Conseil exécutif" Numéro 4150-76, Annexe "A".

32. Treasury Board of Canada, "Socio-Economic Impact Analysis of Health, Safety and Fairness Regulations." Unpublished paper, Ottawa, 1979.

33. See Doern, *Science and Politics in Canada*, Chapter 7.

34. Prince, *op. cit.*

35. Wildavsky, *op. cit.*, p. 16.

IV. Decision Making in Three Departments: A Comparative Profile

1. For general analyses of the origin and functioning of departments in the decision process, see J.E. Hodgetts, *The Canadian Public Service*, University of Toronto Press, Toronto, 1976; V.S. Wilson, *Canadian Public Policy and Administration: An Introduction to Theory and Practice*, McGraw-Hill, Toronto, 1980; and R.W. Phidd and G. Bruce Doern, *The Politics and Management of Canadian Economic Policy*, Macmillan of Canada, Toronto, 1978.

2. On the place of independent agencies and crown corporations see Hodgetts, *op. cit.*, and Royal Commission on Financial Management and Accountabilty, *Final Report*, Supply and Services Canada, Ottawa, 1979.

3. See G. Bruce Doern, ed., *Spending Tax Dollars: Federal Expenditures 1980-81*, School of Public Administration, Carleton University, Ottawa, 1980.

4. Government of Canada, *Organization of the Government of Canada 1978-79*, Supply and Services Canada, Ottawa, 1979, pp. 129, 155, and 327.

5. *Ibid.*, p. 155.

6. See Phidd and Doern, *op. cit.*, pp. 365-367.

7. See Marsha A. Chandler and Wm. M. Chandler, *Public Policy and Provincial Politics*, McGraw-Hill Ryerson, Toronto, 1979; John Richards and Larry Pratt, *Prairie Capitalism*, McClelland and Stewart, Toronto, 1979; and Garth Stevenson, *Unfulfilled Union*, Macmillan, Toronto, 1979.

8. For general analysis of the department in relation to particular policy controversies, see Malcolm Taylor, *Health Insurance and Canadian Public Policy*, McGill-Queen's University Press, Montreal, 1978; K. Bryden, *Old Age Pensions and Policy Making in Canada*, McGill-Queen's Press, Montreal, 1974; and Simon McInnes, *Federal-Provincial Negotiation: Family Allowances 1970-1976*, unpublished Ph.D. thesis, Carleton University, Ottawa, 1978; and R. Van Loon, "Reforming Welfare in Canada," *Public Policy*, Fall 1979, vol. 27, no. 4, pp. 469-504.

9. See Phidd and Doern, *op. cit.*, chapter 11.

10. Government of Canada, *Organization of the Government of Canada 1978-1979*, *op. cit.*, pp. 129-130.

11. Phidd and Doern, *op. cit.*, chapters 11 and 12.

12. G. Bruce Doern, *Government Intervention and Canadian Nuclear Policy*, Institute for Research on Public Policy, Montreal, 1980, chapter 5.

13. See M. Prince, "Policy Advisory Groups in Government Departments," in *Public Policy in Canada*, ed. G. Bruce Doern and Peter Aucoin, Macmillan of Canada, Toronto, 1979, chapter 10.

14. See W.T. Stanbury, *Business Interests and the Reform of Canadian Competition Policy, 1971-1975*, Carswell Methuen, Toronto, 1977; Phidd and Doern, *op. cit.*, chapter 11; and J.W. Rowley and W.T. Stanbury eds., *Competition Policy in Canada: Stage II Bill C-11*, Institute for Research on Public Policy, Montreal, 1979.

15. Interviews.

16. Thirty senior officials (DM, ADM, and Director General levels) were interviewed by the author. Parliamentary questions included those raised in question period and in the committee to which each department's estimates and legislation are referred. Media coverage was assessed on the basis of the author's examination of clippings from several newspapers and other media transcripts during the 1975 to 1979 period.

17. See G. Bruce Doern and R.W. Morrison eds., *Canadian Nuclear Policies*, Institute for Research on Public Policy, Montreal, 1980; and *Nuclear Issues in the Canadian Energy Context*, Royal Society of Canada, Ottawa, 1979.

18. G. Bruce Doern, *Government Intervention and Canadian Nuclear Policy*, Institute for Research on Public Policy, Montreal, 1980, chapter 5.

19. See M. Taylor, *op. cit.*, and R. Van Loon, *op. cit.* See also Stanley Winer, "The Department of National Health and Welfare," in *Spending Tax Dollars: Federal Expenditures 1980-81*, ed. G. Bruce Doern, School of Public Administration, Carleton University, Ottawa, 1980, chapter 5.

20. See McInnes, *op. cit.*, and Van Loon, *op. cit.*

21. See Allan Maslove and Gene Swimmer, *Wage Controls in Canada,* Institute for Research on Public Policy, Montreal, 1980; and Phidd and Doern, *op. cit.*, chapter 11.

22. See Royal Commission on Corporate Concentration, *Final Report*, Supply and Services Canada, Ottawa, 1978; and P.K. Gorecki and W.T. Stanbury, eds., *Perspectives on the Royal Commission on Corporate Concentration*, Institute for Research on Public Policy, Montreal, 1979.

23. See Economic Council of Canada, *Responsible Regulation*, Supply and Services, Canada, Ottawa, 1979.

24. See Doern and Morrison, eds., *op. cit.*, chapter 1, 3, 11 and 12.

25. Interestingly, this issue was the subject of an earlier Science Council study intended to show the value of advance technology assessments. See M. Gibbons and R. Voyer, *A Technology Assessment System: A Case Study of East Coast Offshore Petroleum Exploration*, Background Study No. 30, Science Council of Canada, Ottawa, 1974.

26. For a different view, see Peter Foster, *The Blue Eyed Sheiks: The Canadian Oil Establishment*, Collins, Toronto, 1979; and Larry Pratt, *The Tar Sands*, Hurtig, Edmonton, 1976.

27. See Larry Pratt, "Petro Canada," in *Crown Corporations and Public Policy in Canada*, ed. G. Bruce Doern and Allan Tupper, Institute for Research on Public Policy, Montreal, 1981, chapter 2.

28. Canada, Energy, Mines and Resources, *The Management of Canada's Nuclear Wastes*, Supply and Services, Canada, Ottawa, 1977.

29. *Ibid.*, p. 1.

30. *Ibid.*, p. 52.

31. See Malcolm Rowan, "Nuclear Policy and Federal Provincial Relations," in *Canadian Nuclear Policies,* ed. G. Bruce Doern and R. W. Morrison, Institute for Research on Public Policy, Montreal, 1980, chapter 14.

32. See Cluff Lake Board of Inquiry, *Final Report*, Queen's Printer, Regina, 1978; and Royal Commission on Electric Power Planning, *A Race Against Time*, Queen's Printer, Toronto, 1978.

33. Government of Canada, *Organization of the Government of Canada 1978-79*, p. 359.

34. National Health and Welfare Canada, *Annual Report*, Ottawa, 1977. The following data are taken from the 1975-76, 1976-77, and 1977-78 annual reports of the department.

35. Reported in *The Citizen*, Ottawa, 17 November 1979, p. 13.

36. See G. Bruce Doern, *Regulatory Processes and Jurisdictional Issues in the Regulation of Hazardous Products in Canada*, Background Study 41, Science Council of Canada, Ottawa, 1977, pp. 31-32 and pp. 160-162.

37. Interviews.

38. Health and Welfare Canada, *News Release on Salmonella*, mimeo., 20 November 1975.

39. For one view of this controversy see Lloyd Tataryn, *Dying for a Living*, Deneau and Greenberg, Toronto, 1979, chapter 4.

40. See Health and Welfare Canada, *News Release* on Amaranth, 2 February 1976, Ottawa.

41. *Ibid.*, p. 1

42. *Ibid.*, pp. 1-6.

43. Government of Canada, *Organization of the Government of Canada, op. cit.*, pp. 132-133. See also departmental annual reports.

44. Doern, *Regulatory Processes and Jurisdictional Issues in the Regulation of Hazardous Products in Canada, op. cit.*, pp. 35-36.

45. Quote attributed to J. Black, Director, Product Safety Branch, *The Citizen*, Ottawa, 10 November 1979, p. 21.

46. This approach is characteristic of other departments engaged in health and safety regulation as well. See G. Bruce Doern, *Regulatory Processes and Jurisdictional Issues in the Regulation of Hazardous Products in Canada*, Background Study 41, Science Council of Canada, 1977, Chapters 1 and 2.

47. Canada Consumer and Corporate Affairs, *Annual Report, 1975-76*, Supply and Services Canada, Ottawa, 1976, p. 16. For more detail see CCA News Releases: NR-76-41 (flammability of rugs and carpets); NR-76-6 (cyanoacrylate adhesives).

48. *Ibid.* More information on some of these items is available from CCA News Releases NR-76-25 (metal-coated, plastic film kites); NR-76-33 (asbestos-

containing playthings/modelling materials); NR-76-42 (playpen design). Note also the anthrax yarn case (February 1976), involving Canada's importation of "a yarn suspecting of carrying anthrax organisms." See the joint press releases of Health and Welfare Canada and CCA (NR-76-8).

49. CCA, *Annual Report, 1976-77*, Supply and Services, Canada, Ottawa, 1977, p. 16. See also CCA News Releases in above footnotes, and NR-76-8 (spontaneously re-lightable candles).

50. CCA, *Annual Report, 1976-77, op. cit.* See also CCA News Releases NR-77-53 (child-resistant containers); NR-77-22 (cradles and cribs); NR-76-75 and NR-77-44 (baby rattle dimensions/standards).

51. CCA, *Annual Report, 1977-78*, Supply and Services, Canada, Ottawa, 1978, p. 16. See aforementioned News Release NR-77-53.

52. Canada Consumer and Corporate Affairs, Product Safety Branch, "*Motor Vehicle Crash Protection for Infant and Child Passengers*," Submission to the Minister's Task Force for Review, 30 May 1979.

53. *Ibid.*, pp. 9-10.

54. *Ibid.*, p. 12.

Publications of the Science Council of Canada

Annual Reports

First Annual Report, *1966-67* (SS1-1967)
Second Annual Report, *1967-68* (SS1-1968)
Third Annual Report, *1968-69* (SS1-1969)
Fourth Annual Report, *1969-70* (SS1-1970)
Fifth Annual Report, *1970-71* (SS1-1971)
Sixth Annual Report, *1971-72* (SS1-1972)
Seventh Annual Report, *1972-73* (SS1-1973)
Eighth Annual Report, *1973-74* (SS1-1974)
Ninth Annual Report, *1974-75* (SS1-1975)
Tenth Annual Report, *1975-76* (SS1-1976)
Eleventh Annual Report, *1976-77* (SS1-1977)
Twelfth Annual Report, *1977-78* (SS1-1978)
Thirteenth Annual Report, *1978-79* (SS1-1979)
Fourteenth Annual Report, *1979-80* (SS1-1980)
Fifteenth Annual Report, *1980-81* (SS1-1981)

Annual Review

First Annual Review, *1980* (SS1-1/1980)

Reports

Report No. 1, **A Space Program for Canada,** July 1967 (SS22-1967/1, $0.75)
Report No. 2, **The Proposal for an Intense Neutron Generator: Initial Assessment and Recommendation,** December 1967 (SS22-1967/2, $0.75)
Report No. 3, **A Major Program of Water Resources Research in Canada,** September 1968 (SS22-1968/3, $0.75)
Report No. 4, **Towards a National Science Policy in Canada,** October 1968 (SS22-1968/4, $0.75)
Report No. 5, **University Research and the Federal Government,** September 1969 (SS22-1969/5, $0.75)
Report No. 6, **A Policy for Scientific and Technical Information Dissemination,** September 1969 (SS22-1969/6, $0.75)
Report No. 7, **Earth Sciences Serving the Nation - Recommendations,** April 1970 (SS22-1970/7, $0.75)
Report No. 8, **Seeing the Forest and the Trees,** 1970 (SS22-1970/8, $0.75)
Report No. 9, **This Land is Their Land. . .,** 1970 (SS22-1970/9, $0.75)
Report No. 10, **Canada, Science and the Oceans,** 1970 (SS22-1970/10, $0.75)
Report No. 11, **A Canadian STOL Air Transport System - A Major Program,** December 1970 (SS22-1970/11, $0.75)
Report No. 12, **Two Blades of Grass: The Challenge Facing Agriculture,** March 1971 (SS22-1971/12, $0.75)
Report No. 13, **A Trans-Canada Computer Communications Network: Phase 1 of a Major Program on Computers,** August 1971 (SS22-1971/13, $0.75)
Report No. 14, **Cities for Tomorrow: Some Applications of Science and Technology to Urban Development,** September 1971 (SS22-1971/14, $0.75)

Report No. 15, **Innovation in a Cold Climate: The Dilemma of Canadian Manufacturing,** October 1971 (SS22-1971/15, $0.75)

Report No. 16, **It is Not Too Late – Yet: A look at some pollution problems in Canada. . .,** June 1972 (SS22-1972/16, $1.00)

Report No. 17, **Lifelines: Some Policies for a Basic Biology in Canada,** August 1972 (SS22-1972/17, $1.00)

Report No. 18, **Policy Objectives for Basic Research in Canada,** September 1972 (SS22-1972/18, $1.00)

Report No. 19, **Natural Resource Policy Issues in Canada,** January 1973 (SS22-1973/19, $1.25)

Report No. 20, **Canada, Science and International Affairs,** April 1973 (SS22-1973/20, $1.25)

Report No. 21, **Strategies of Development for the Canadian Computer Industry,** September 1973 (SS22-1973/21, $1.50)

Report No. 22, **Science for Health Services,** October 1974 (SS22-1974/22, $2.00)

Report No. 23, **Canada's Energy Opportunities,** March 1975 (SS22-1975/23, $2.75, other countries: $3.30)

Report No. 24, **Technology Transfer: Government Laboratories to Manufacturing Industry,** December 1975 (SS22-1975/24, Canada: $1.00, other countries: $1.20)

Report No. 25, **Population, Technology and Resources,** July 1976 (SS22-1976/25, Canada: $2.00, other countries: $2.40)

Report No. 26, **Northward Looking: A Strategy and a Science Policy for Northern Development,** August 1977 (SS22-1976/26, Canada: $2.50, other countries: $3.00)

Report No. 27, **Canada as a Conserver Society: Resource Uncertainties and the Need for New Technologies,** September 1977 (SS22-1977/27, Canada: $2.25, other countries: $2.70)

Report No. 28, **Policies and Poisons: The Containment of Long-term Hazards to Human Health in the Environment and in the Workplace,** October 1977 (SS22-1977/28, Canada: $2.00, other countries: $2.40)

Report No. 29, **Forging the Links: A Technology Policy for Canada,** February 1979 (SS22-1979/29, Canada: $2.25, other countries: $2.70)

Report No. 30, **Roads to Energy Self-Reliance: The Necessary National Demonstrations,** June 1979 (SS22-1979/30, Canada: $4.50, other countries: $5.40)

Report No. 31, **University Research in Jeopardy: The Threat of Declining Enrolment,** December 1979 (SS22-1979/31, Canada: $2.95, other countries: $3.55)

Report No. 32, **Collaboration for Self-Reliance: Canada's Scientific and Technological Contribution to the Food Supply of Developing Countries,** March 1981 (SS22-1981/32, Canada: $3.95, other countries: $4.75)

Background Studies

Background Study No. 1, **Upper Atmosphere and Space Programs in Canada,** by J.H. Chapman, P.A. Forsyth, P.A. Lapp, G.N. Patterson, February 1967 (SS21-1/1, $2.50)

Background Study No. 2, **Physics in Canada: Survey and Outlook,** by a Study Group of the Canadian Association of Physicists, headed by D.C. Rose, May 1967 (SS21-1/2, $2.50)

Background Study No. 3, **Psychology in Canada,** by M.H. Appley and Jean Rickwood, September 1967 (SS21-1/3, $2.50)

Background Study No. 4, **The Proposal for an Intense Neutron Generator: Scientific and Economic Evaluation,** by a Committee of the Science Council of Canada, December 1967 (SS21-1/4, $2.00)

Background Study No. 5, **Water Resources Research in Canada,** by J.P. Bruce and D.E.L. Maasland, July 1968 (SS21-1/5, $2.50)

Background Study No. 6, **Background Studies in Science Policy: Projections of R & D Manpower and Expenditure,** by R.W. Jackson, D.W. Henderson and B. Leung, 1969 (SS21-1/6, $1.25)

Background Study No. 7, **The Role of the Federal Government in Support of Research in Canadian Universities,** by John B. Macdonald, L.P. Dugal, J.S. Dupré, J.B. Marshall, J.G. Parr, E. Sirluck, and E. Vogt, 1969 (SS21-1/7, $3.00)

Background Study No. 8, **Scientific and Technical Information in Canada, Part I,** by J.P.I. Tyas, 1969 (SS21-1/8, $1.00)
Part II, Chapter 1, Government Departments and Agencies (SS21-1/8-2-1, $1.75)
Part II, Chapter 2, Industry (SS21-1/8-2-2, $1.25)
Part II, Chapter 3, Universities (SS21-1/8-2-3, $1.75)
Part II, Chapter 4, International Organizations and Foreign Countries (SS21-1/8-2-4, $1.00)
Part II, Chapter 5, Techniques and Sources (SS21-1/8-2-5, $1.25)
Part II, Chapter 6, Libraries (SS21-1/8-2-6, $1.00)
Part II, Chapter 7, Economics (SS21-1/8-2-7, $1.00)

Background Study No. 9, **Chemistry and Chemical Engineering: A Survey of Research and Development in Canada,** by a Study Group of the Chemical Institute of Canada, 1969 (SS21-1/9, $2.50)

Background Study No. 10, **Agricultural Science in Canada,** by B.N. Smallman, D.A. Chant, D.M. Connor, J.C. Gilson, A.E. Hannah, D.N. Huntley, E. Mercer, M. Shaw, 1970 (SS21-1/10, $2.00)

Background Study No. 11, **Background to Invention,** by Andrew H. Wilson, 1970 (SS21-1/11, $1.50)

Background Study No. 12, **Aeronautics - Highway to the Future,** by J.J. Green, 1970 (SS21-1/12, $2.50)

Background Study No. 13, **Earth Sciences Serving the Nation,** by Roger A. Blais, Charles H. Smith, J.E. Blanchard, J.T. Cawley, D.R. Derry, Y.O. Fortier, G.G.L. Henderson, J.R. Mackay, J.S. Scott, H.O. Seigel, R.B. Toombs, H.D.B. Wilson, 1971 (SS21-1/13, $4.50)

Background Study No. 14, **Forest Resources in Canada,** by J. Harry G. Smith and Gilles Lessard, May 1971 (SS21-1/14, $3.50)

Background Study No. 15, **Scientific Activities in Fisheries and Wildlife Resources,** by D.H. Pimlott, C.J. Kerswill and J.R. Bider, June 1971 (SS21-1/15, $3.50)

Background Study No. 16, **Ad Mare: Canada Looks to the Sea,** by R.W. Stewart and L.M. Dickie, September 1971 (SS21-1/16, $2.50)

Background Study No. 17, **A Survey of Canadian Activity in Transportation R & D,** by C.B. Lewis, May 1971 (SS21-1/17, $0.75)

Background Study No. 18, **From Formalin to Fortran: Basic Biology in Canada,** by P.A. Larkin and W.J.D. Stephen, August 1971 (SS21-1/18, $2.50)

Background Study No. 19, **Research Councils in the Provinces: A Canadian Resource,** by Andrew H. Wilson, June 1971 (SS21-1/19, $1.50)

Background Study No. 20, **Prospects for Scientists and Engineers in Canada,** by Frank Kelly, March 1971 (SS21-1/20, $1.00)

Background Study No. 21, **Basic Research,** by P. Kruus, December 1971 (SS21-1/21, $1.50)

Background Study No. 22, **The Multinational Firm, Foreign Direct Investment, and Canadian Science Policy,** by Arthur J. Cordell, December 1971 (SS21-1/22, $1.50)

Background Study No. 23, **Innovation and the Structure of Canadian Industry,** by Pierre L. Bourgault, October 1972 (SS21-1/23, $2.50)

Background Study No. 24, **Air Quality - Local, Regional and Global Aspects,** by R.E. Munn, October 1972 (SS21-1/24, $0.75)

Background Study No. 25, **National Engineering, Scientific and Technological Societies of Canada,** by the Management Committee of SCITEC and Prof. Allen S. West, December 1972 (SS21-1/25, $2.50)

Background Study No. 26, **Governments and Innovation,** by Andrew H. Wilson, April 1973 (SS21-1/26, $3.75)

Background Study No. 27, **Essays on Aspects of Resource Policy,** by W.D. Bennett, A.D. Chambers, A.R. Thompson, H.R. Eddy, and A.J. Cordell, May 1973 (SS21-1/27, $2.50)

Background Study No. 28, **Education and Jobs: Career patterns among selected Canadian science graduates with international comparisons,** by A.D. Boyd and A.C. Gross, June 1973 (SS21-1/28, $2.25)

Background Study No. 29, **Health Care in Canada: A Commentary,** by H. Rocke Robertson, August 1973 (SS21-1/29, $2.75)

Background Study No. 30, **A Technology Assessment System: A Case Study of East Coast Offshore Petroleum Exploration,** by M. Gibbons and R. Voyer, March 1974 (SS21-1/30, $2.00)

Background Study No. 31, **Knowledge, Power and Public Policy,** by Peter Aucoin and Richard French, November 1974 (SS21-1/31, $2.00)

Background Study No. 32, **Technology Transfer in Construction,** by A.D. Boyd and A.H. Wilson, January 1975 (SS21-1/32, $3.50)

Background Study No. 33, **Energy Conservation,** by F.H. Knelman, July 1975 (SS21-1/33, Canada: $1.75, other countries: $2.10)

Background Study No. 34, **Northern Development and Technology Assessment Systems: A study of petroleum development programs in the Mackenzie Delta-Beaufort Sea Region and the Arctic Islands,** by Robert F. Keith, David W. Fischer, Colin E. De'Ath, Edward J. Farkas, George R. Francis, and Sally C. Lerner, January 1976 (SS21-1/34, Canada: $3.75, other countries: $4.50)

Background Study No. 35, **The Role and Function of Government Laboratories and the Transfer of Technology to the Manufacturing Sector,** by A.J. Cordell and J.M. Gilmour, April 1976 (SS21-1/35, Canada: $6.50, other countries: $7.80)

Background Study No. 36, **The Political Economy of Northern Development,** by K.J. Rea, April 1976 (SS21-1/36, Canada: $4.00, other countries: $4.80)

Background Study No. 37, **Mathematical Sciences in Canada,** by Klaus P. Beltzner, A. John Coleman, and Gordon D. Edwards, July 1976 (SS21-1/37, Canada: $6.50, other countries: $7.80)

Background Study No. 38, **Human Goals and Science Policy,** by R.W. Jackson, October 1976 (SS21-1/38, Canada: $4.00, other countries: $4.80)

Background Study No. 39, **Canadian Law and the Control of Exposure to Hazards,** by Robert T. Franson, Alastair R. Lucas, Lorne Giroux, and Patrick Kenniff, October 1977 (SS21-1/39, Canada: $4.00, other countries: $4.80)

Background Study No. 40, **Government Regulation of the Occupational and General Environments in the U.K., U.S.A., and Sweden,** by Roger Williams, October 1977 (SS21-1/40, Canada: $5.00, other countries: $6.00)

Background Study No. 41, **Regulatory Processes and Jurisdictional Issues in the Regulation of Hazardous Products in Canada,** by G. Bruce Doern, October 1977 (SS21-1/41, Canada: $5.50, other countries: $6.00)

Background Study No. 42, **The Strathcona Sound Mining Project: A Case Study of Decision Making,** by Robert B. Gibson, February 1978 (SS21-1/42, Canada: $8.00, other countries: $9.60)

Background Study No. 43, **The Weakest Link: A Technological Perspective on Canadian Industrial Underdevelopment,** by John N.H. Britton and James M. Gilmour, assisted by Mark G. Murphy, October 1978 (SS21-1/43, Canada: $5.00, other countries: $6.00)

Background Study No. 44, **Canadian Government Participation in International Science and Technology,** by Jocelyn Maynard Ghent, February 1979 (SS21-1/44, Canada: $4.50, other countries: $5.40)

Background Study No. 45, **Partnership in Development: Canadian Universities and World Food,** by William E. Tossell, August 1980 (SS21-1/45, Canada: $6.00, other countries: $7.20)

Background Study No. 46, **The Peripheral Nature of Scientific and Technological Controversy in Federal Policy Formation,** by G. Bruce Doern, July 1981 (SS21-1/46, Canada: $4.95, other countries: $5.80)

Issues in Canadian Science Policy

Issues 1, September 1974 (SS21-1/1, $1.00)
Issues 2, February 1976 (SS21-2/2, Canada: $1.00, other countries: $1.20)
Issues 3, June 1976 (SS21-2/3, Canada: $1.00, other countries: $1.20)

Perceptions

Vol. 1, **Population Growth and Urban Problems,** by Frank Kelly, November 1975 (SS21-3/1-1975, Canada: $1.25, other countries: $1.50)
Vol. 2, **Implications of the Changing Age Structure of the Canadian Population,** by Lewis Auerbach and Andrea Gerber, July 1976 (SS21-3/2-1976 Canada: $3.25, other countries: $3.90)
Vol. 3, **Food Production in the Canadian Environment,** by Barbara J. Geno and Larry M. Geno, December 1976 (SS21-3/3-1976, Canada: $2.25, other countries: $2.80)
Vol. 4, **People and Agricultural Land,** by Charles Beaubien and Ruth Tabacnik, June 1977 (SS21-3/4-1977, Canada: $4.00, other countries: $4.80)