

29 Science Council of Canada Report 29

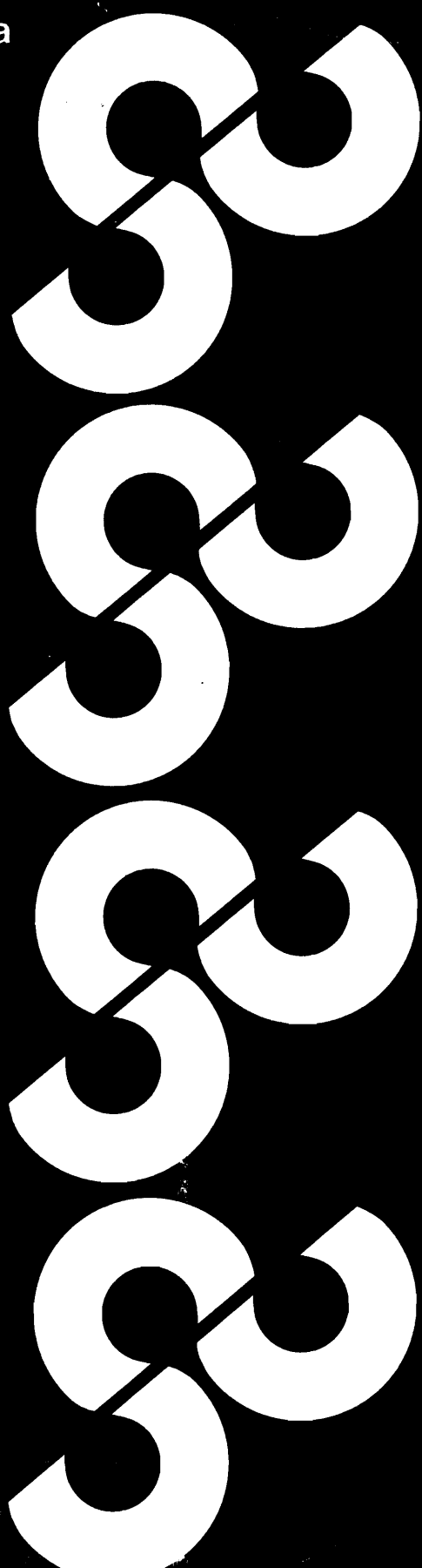
February 1979

ANALYZED

CANADA INSTITUTE FOR S.T.J.

MAR 2 1 1979

**OTTAWA
INSTITUT CANADIEN DE L'I.S.T.**



Forging the Links

**A Technology Policy
for Canada**

ANALYZED

**Science Council of Canada,
100 Metcalfe Street,
17th floor,
Ottawa, Ontario.
K1P 5M1**

©Minister of Supply and Services Canada, 1979

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. SS 22-1979/29
ISBN 0-660-10156-4

Price: Canada: \$2.25
Other Countries: \$2.70

Price subject to change without notice

February 1979

The Honourable Alastair W. Gillespie, PC, MP,
Minister of State for Science and Technology,
House of Commons,
Ottawa, Canada.

Dear Minister Gillespie,

In accordance with Section 13 of the Science Council of Canada Act, I take pleasure in forwarding to you the Council's Report No. 29, *Forging the Links: A Technology Policy for Canada*.

Yours sincerely,

Claude Fortier,
Chairman,
Science Council of Canada.

5 January 1979

Dr. Claude Fortier,
Chairman,
Science Council of Canada,

Dear Dr. Fortier,

This report is the culmination of three years work by the Science Council's Industrial Policies Committee. The Committee was officially formed in March 1976 in response to a concern amongst members of Council about the problems facing Canadian industry, in particular, the relationship between Canada's declining technological capability and the deteriorating performance of the country's manufacturing firms. The Committee's work has addressed both short range research on the immediate impact of government policies on industry's innovative capacity and longer range research concerning the structure of Canadian industry and the implications for Canada's technological competitiveness. In the former case, the Committee made recommendations to the federal government in the autumn of 1976 concerning incentives for industrial R&D. Later the Committee commissioned studies on assistance programs for industry in other countries and on tariff protection.

In its longer range research, the Committee initiated a major study on the structure of manufacturing industry in Canada. This resulted in a paper, published in October 1977, *Uncertain Prospects: Canadian Manufacturing Industry 1971-1977*, which highlighted some of the current problems of manufacturing in Canada. A background study which analysed the causes for the decline of Canadian industry, written by Dr. J. M. Gilmour and Professor J. N. Britton, was published in October 1978 under the title *The Weakest Link: A Technological Perspective on Canadian Industrial Underdevelopment*.

As Chairman of this large and energetic committee, I wish to mention that the considerable efforts and contributions of the members, individually and collectively, were invaluable. In addition, the direction provided by Council Members added significantly to this Report. The diligent and effective efforts of Council staff made the total project possible and they deserve much credit for the quality of the publication.

The Report which follows draws together much of the work published by the Committee in order to provide an analysis of the current problems of Canadian industry and to set out a series of policy objectives which the Committee believes will help to address these problems. These policy objectives are directed to the provincial and federal governments as well as Canadian industry.

You will readily appreciate that industrial policy is currently the subject of intense concern and considerable controversy in terms of the analysis of problems and the solutions required. The Industrial Policies Committee of Council has discussed both problems and solutions with considerable energy and has witnessed some level of constructive dissent. Doubtless, the subsequent public debate will also amplify and reflect the various views which have been expressed in Committee. Nevertheless, the Committee commends its proposals to both the Council and the country.

Yours sincerely,

J. A. Pollock,
Chairman,
Science Council Industrial Policies Committee.

Abstract

The Canadian economy is faced with a serious crisis which is manifest in high unemployment, persistent trade imbalances, and a falling currency. These immediate problems reflect a deeper crisis in the structure of Canadian industry, and in particular, manufacturing, which precedes the recent recession in the Western economies.

High levels of technological and managerial truncation, and relative technological backwardness have placed Canadian industry at a particular disadvantage in light of the substantial changes taking place in world economies. The advanced industrial nations are moving into more technologically advanced forms of production — the “new” industrial revolution. This trend threatens to outpace the innovative capacity of Canadian industry to such an extent that our manufactured products will no longer be competitive with those of our principal trading partners. Further, a number of developing countries with lower labour costs are moving into many of the conventional areas of industrial activity (e.g., assembly manufacturing operations), thus threatening to displace a significant number of Canada’s traditional manufacturing activities through increased price competition. To maintain a high wage, high employment economy in the face of growing foreign competition, it is vital that Canada overcome the structural and technological weaknesses of its industry, quickly and effectively. A rebuilding of Canada’s industrial structure as well as improving its technological capability is required.

The Science Council believes that these objectives can be met most effectively if Canada implements an industrial strategy based on the principle of *technological sovereignty*: a strategy stressing the development of a technological capability in Canadian industry which would enable full participation in the “new” industrial revolution. Implementation of such an industrial strategy would require four initial policy objectives: 1) increase the demand for Canadian technology within the industrial system; 2) expand Canadian industry’s potential to develop technology; 3) strengthen the capacity for the absorption of technology at the level of the firm; 4) increase the ability of Canadian firms to import technology under conditions favourable to Canada. The adoption of these objectives, in conjunction with those measures necessary to improve the business climate in Canada, would be a positive step toward rebuilding the Canadian economy.




Table of Contents

Preface	11
I. Introduction	13
Symptoms of Industrial Decline	14
The Science Council and an Industrial Strategy	18
Past Industrial Policies	19
Institutional Problems	19
Policy Priorities	20
Lack of Commitment	20
II. Increasing Vulnerability in a Changing World	23
Nature of Canada's Economic Decline	24
Trade Failure	24
Invisible Trade	24
Trade in Manufactured Goods and High-Technology Items	24
Declining Employment Opportunities	28
Deindustrialization	28
Changing World Environment and Its Impact on Canada	30
The "New" Industrial Revolution	31
Growing Pressure on Canada's Resource Exports	32
Transformation of World Trading Conditions	33
Reasons for Canada's Industrial Weakness	35
Tariff Protection	35
Foreign Ownership and Truncation	37
The Weakness of Canada's Decision-Making Mechanisms	39
III. The Need for Innovative Industry in Canada	41
Selective Development in High Technology	42
Encouraging the Emergence and Growth of Firms with Innovative Capability	43

IV. The Goal: Technological Sovereignty	45
Background for an Industrial Strategy	46
A Developing Consensus	46
Recommendations for a Technology Policy	48
Increasing the Demand for Canadian Technology	48
Government Procurement	48
Major Programs	49
Trade Agreements	50
Expanding Canada's Potential to Develop Technology	51
Core Companies	51
Consortia and Joint Ventures	51
Aid to Small Firms	51
Strengthening the Capacity for Technology Absorption at the Enterprise Level	53
Increasing the Ability of Canadian Firms to Import Technology under Conditions Favourable to Canadian Industry	54
Postscript	56
Notes	57
Dissents	61
Index	62
Science Council Industrial Policies Committee	66
Members of the Science Council of Canada	67
Publications of the Science Council of Canada	69
List of Figures	
Figure I.1—Canada's Share of World Exports	15
Figure I.2—Canada's Share of World Manufactured Exports	16
Figure I.3—Imports as a Percentage of Total Spending on Goods in Canada	17
Figure II.1—Major Components of Canada's Trade Balance, Selected Years	25
Figure II.2—Canada's Trade Balance in Manufactured Products	26
Figure II.3—Occupational Composition, Selected Industries	27
Figure II.4—Comparison of Canadian and US Industrial Structures Based on Value Added and Employment	29
Figure II.5—Comparison of Canadian and Western European Industrial Structures Based on Value Added and Employment	30
Figure II.6—Duty-Free Imports of Industrial Commodities	36
Figure II.7—Degree of US Economic Control Over Some Countries	38

Preface

The Science Council of Canada last addressed the condition of Canadian manufacturing industry in 1971 when it published Report No. 15, *Innovation in a Cold Climate*. Since then, the precipitous decline in Canadian manufacturing has continued. For this reason, Council again turns to the problems of our manufacturing industry in order to analyse the causes of its decline and to suggest a broad framework of policy remedies.

Given the serious and wide ranging crisis facing Canadian manufacturing, Council focusses the recommendations in this Report, *Forging the Links: A Technology Policy for Canada*, upon those problems of Canadian industry linked to its use of technology. Increasingly in the future, opportunities for Canadian industry will lie in its ability to utilize advances in science and technology effectively. However, Council also appreciates that many of the problems of Canadian industry are connected with the general absence of a healthy business climate and economic environment. It is important, therefore, that these issues be taken up as rapidly as possible by the responsible public agencies if the problems facing Canadian industry are to be tackled in a realistic manner.

Many of the recommendations in this Report imply the need for government action. While this may seem unfashionable in a period when many are calling for a withdrawal of government from the marketplace, we feel that such recommendations recognize the realities of a situation which exists in most industrial economies. Government spending in Canada now accounts for over 40 per cent of GNP. Much of this expenditure is essential to the functioning of an advanced industrial economy. Thus, regardless of further reductions in public spending, it seems likely that governments will continue to have a substantial impact on the nature of economic activity in Canada for the foreseeable future.

The issue is not, therefore, whether to expand the role of government, but rather how to ensure that government influences on the economy are used constructively to assist in economic growth and development. Every tool at our disposal must be used to ensure the regeneration of Canada's industrial base. This implies a constructive role for governments in the regeneration process: a role which becomes even more important in light of the fact that governments in other countries are harnessing their industrial capacities to meet their own economic problems. If Canada does not emulate them, Canadians will find themselves at a serious trade disadvantage, both in terms of meeting competition from imports and expanding our exports.

I. Introduction

The Canadian economy is exhibiting signs of serious structural weakness. Current economic problems such as high unemployment and persistent current account deficits highlight the importance of a strong industrial base to provide Canada with the quantity and quality of jobs and the level of exports needed to maintain a high standard of living in an increasingly competitive world climate.

The Science Council has long been concerned with the health of the Canadian industrial system because the wise utilization of science and technology is intimately linked to the prosperity of the industrial system which must use and support it. For this reason, *Forging the Links* stresses the need for close linkages between *industrial* policies designed to create a strong economy capable of adapting to rapidly changing international economic conditions and the articulation of a coherent *technology* policy for Canadian industry. The Science Council believes that the maintenance of Canada's high standard of living lies, in large measure, on the ability to restructure the economy using the fruits of both indigenous and foreign technology. Failure to accomplish this objective under changing international economic conditions will progressively reduce the quantity and scope of employment opportunities in Canada to such an extent that Canadians will return to their traditional role of "hewers of wood and drawers of water". Thus, Council advocates an industrial strategy which stresses a technology policy based on *technological sovereignty**: a policy which seeks to influence the selective development and use of technology in the industrial system so that the maximum benefits of economic activity in Canada are realized for Canadians. Only by increasing our ability to influence the direction and use of technological change in the economy can Canadians ensure that the adaptation to shifting international economic circumstances is accomplished in a manner consistent with maximizing the advantages to our domestic economy.

The symptoms and causes of Canada's industrial decline are outlined in this Report.** In order to meet the challenge posed by the decline of Canadian industry, Council suggests a series of policies based on technological sovereignty. These policies are *illustrative* of the types of initiatives which can be taken by decision-makers in the articulation of an industrial strategy. Council commends them to federal and provincial governments, and to the private sector as a first step in the long process of reversing Canada's decline as an industrial economy.

Symptoms of Industrial Decline

Canada's present economic problems are not short-term. Their origins *precede* the current recession in the western economic system. Indeed, while many other countries are suffering from the effects of international recession,

* A nation can be said to be technologically sovereign when it has the ability to *develop* and *control* the technological capability necessary to ensure its economic, and hence its political, self-determination. See, Science Council of Canada, "Technological Sovereignty: A Strategy for Canada", *Eleventh Annual Report, 1976-77*, p. 26.

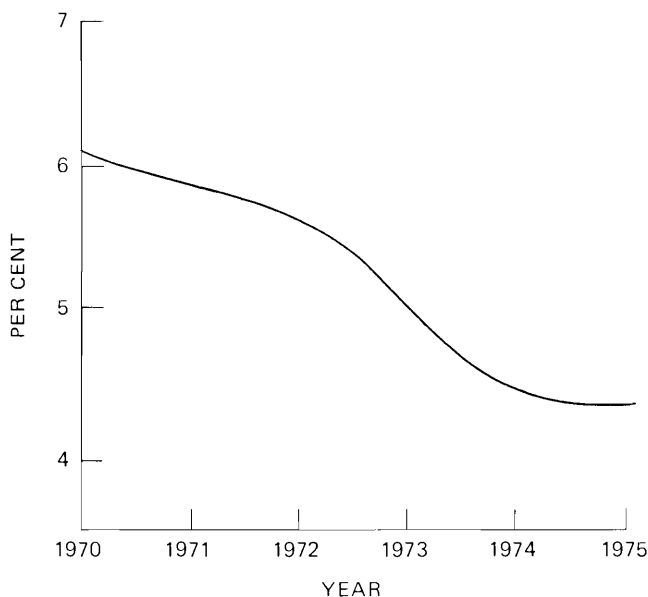
** For a more detailed study of the issues, see John N. H. Britton and James M. Gilmore, Background Study No. 43, *The Weakest Link: A Technological Perspective on Canadian Industrial Underdevelopment*, Science Council of Canada, Supply and Services Canada, Ottawa, 1978.

Canada seems unique in the degree to which the long-term causes of structural weakness *are the result of policies of its own making* – policies which have guided Canadian industrial development since well before World War II.

An examination of some of the key economic indicators show quite clearly that the trend to industrial failure goes back to the early part of the 1950s and, indeed, in terms of its causes, even further. Canada's international trade has reflected this pattern for a considerable period of time. For example, since 1950 Canada has had a surplus on current account in only four years. In addition, the long-term decline of the Canadian economy has also begun to manifest itself in other, more dramatic ways. Nowhere has its competitive weakness become more obvious than in Canada's declining share of world exports.

In 1970 Canada's share of world exports stood at 6.1 per cent.¹ As shown in Figure I.1, our share of world trade had slipped to 4.4 per cent by 1975. (The most recent year for which statistics are available.) This drop was particularly significant in light of the fact that during this period most industrialized countries managed to hold their share constant or increase it.² While a loss of 1.7 per cent of world trade over five years may not seem significant, its impact on the Canadian economy in terms of the value of lost exports is catastrophic. If Canada had managed to hold its share of world trade from 1970 to 1975, domestic exports in 1975 would have been \$13.0 billion more than they actually were. This figure represents almost 40 per cent of the value of Canada's exports in 1975! It is difficult to estimate what effect this failure has had on domestic employment, but the influence on the recent high levels of unemployment must have been substantial.

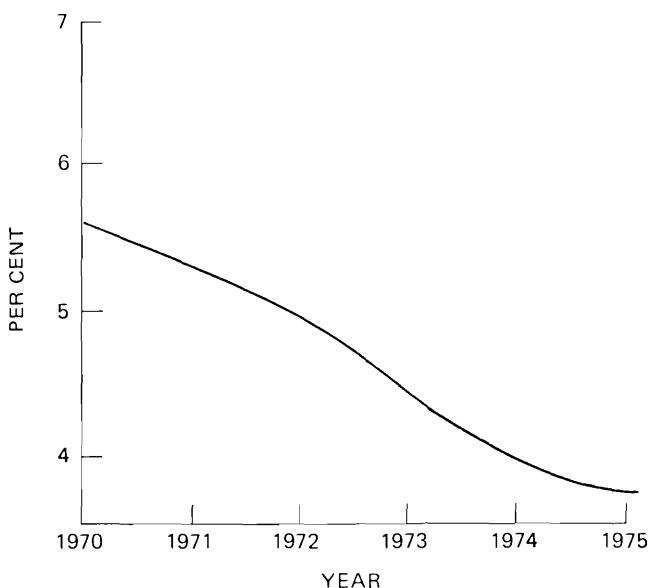
Figure I.1 – Canada's Share of World Exports, 1970–1975



Sources: United Nations, *Statistical Yearbook*, United Nations, New York; United Nations, *Yearbook of International Trade Statistics*. New York: United Nations, various years.

Significantly, Canada's declining share of world trade was also matched by a sharp fall in its share of world exports of manufactured goods. Canada is, in effect, being pushed out of the market by stronger trading partners. For example during the period 1970 to 1975, Canada's share of world trade in manufactures *dropped* from 5.6 to 3.8 per cent (see Figure I.2). During the same period, Japan's share of world trade in manufactures *grew* from 10.4 to 12.1 per cent, France's share *increased* from 7.7 to 9 per cent, Germany's share *increased* from 17.6 per cent to 18.1 per cent, and Sweden's share *increased* from 3.0 to 3.1 per cent.³ If Canada had been able to maintain its 1970 level, let alone increase it, an additional \$8 billion worth of exports would have been gained in 1975 alone.

Figure I.2—Canada's Share of World Manufactured Exports, 1970–1975



Source: United Nations, *Statistical Yearbook*, United Nations, New York; United Nations, *Yearbook of International Trade Statistics*, New York, various years.

Some observers of Canada's economic performance have viewed with a certain indifference the decline in Canada's industrial and manufacturing capability. They claim it only indicates that, like the United States, Canada is moving into a post-industrial economy with the bulk of employment concentrated in the service sector. (While the concept of post-industrialism may appeal to some since there are many people working in service occupations today, it is inappropriate to the present Canadian economic context.) Much of our service employment in Canada is directly related to the health of manufacturing industry. A recent study completed for the Science Council demonstrated that about a fifth of all service employment in Canada is directly linked to manufacturing and resource extraction activities.⁴ For every 100 jobs in manufacturing, for example, 33 jobs are directly generated in services.

The dependence of service employment upon industrial employment has been *growing* steadily over the past decade. Thus, Canada's industrial decline has implications not only for jobs in industry, but for service employment as well. Indeed, many experts⁵ predict that because of technological change the

production of goods will likely decrease the demand for non-industrially related services. Further, there is a growing tendency for manufacturing operations to require inputs from outside sources that are traditionally classed as services but nonetheless essential to the production process (e.g., consulting engineers, design services, advertising and marketing, and various types of sophisticated financial services).

Figure I.3—Imports as a Percentage of Total Spending on Goods in Canada



Source: Statistics Canada; *National Income and Expenditure Accounts*, Cat. No. 13-201 Supply and Services Canada, Ottawa; *The Canadian Balance of International Payments* Cat. No. 67-201, Supply and Services Canada, Ottawa, various years.

Equally disturbing has been the tendency for imports to capture an increasingly large share of Canada's domestic markets. From 1970 to 1977 the proportion of the Canadian market served by imports grew from about 26 per cent to just over 31 per cent (see Figure II.3). Although Canada's *volume* of exports has grown as the world economy expanded, it is steadily losing its place in the world trading hierarchy and, at the same time, is surrendering domestic markets to foreign competitors. *This situation can only be described as a massive failure of the country's industrial system.*⁶

These large scale indicators of failure mask even more serious structural changes in the Canadian economy which show an increasing weakness in advanced industrial sectors. Indeed, these changes indicate that Canada is moving away from an industrialized economy back to one based on the export of raw materials.

The Science Council and an Industrial Strategy

The relationship between the health of science and the health of the industrial system was recognized in early Science Council reports and made explicit in 1971 with the publication of Report No. 15, *Innovation in a Cold Climate*, which addressed the problems of the Canadian manufacturing industry.

In that Report, Council summarized the reasons for its advocacy of a national industrial strategy. The rationale centred on two issues; first, the need to overcome the structural problems facing Canadian industry due to its poor innovative capacity and the constraints placed upon it by the size and nature of the Canadian market; and second, the implications for Canada's standard of living and for the opportunities for meaningful and substantial levels of employment, if manufacturing activity were to decline further. In Council's view the only way to surmount these problems would be to develop a coherent industrial strategy. The Report stressed the necessity of involving both government (federal and provincial) *and* industry in the process of developing and implementing such a strategy.

Since 1971 two other Council Reports have addressed aspects of a potential industrial strategy. In 1975, Report No. 24 focussed on the problem of the transfer of technology from government laboratories to industry.⁷ In this Report, Council introduced the principle of *technological sovereignty* which is based on the recognition that if Canadian industry is to develop successfully, it must have a sufficient indigenous and independent technological base from which to exploit national strengths effectively. The Report stressed the importance of this principle in an economy that was substantially foreign-owned and where industry would suffer in international markets without the capacity to develop an indigenous technology and offer distinctive products to the global marketplace.

Two years later, in Report No. 26, *Looking Northward*, Council drew attention once again to the need for technological sovereignty. The Report stated that unless Canada evolves an indigenous technology to develop the North, Canadians would lose the ability to shape a northern development strategy which is harmonious with national needs and with the special problems and opportunities of the natural and human resources of that region.

With this Report, *Forging the Links*, Council once again addresses the problems outlined in *Innovation in a Cold Climate*. Canadian industry has deteriorated further and the urgency for an industrial strategy has become more pressing. Many of Canada's manufacturing industries are in serious decline. Over the past seven years foreign ownership and control over the economy has remained at levels without parallel in any other developed country and has resulted in a greater level of truncation* of the Canadian industrial system. This truncation has weakened the economy's competitive position in world markets and undermined our indigenous technological

* Truncation occurs in a foreign-owned firm when many of the functions necessary for it to pursue independent commercial objectives are absent, and located in a parent company abroad. These functions can include any aspect of the productive process, from R and D to marketing, but are generally those which have an impact on important aspects of the firm's operations – the goods it produces, the markets it serves, etc. If many firms in an economy are truncated, the economy itself takes on the characteristics of the individual firm, and becomes dependent, and technically and commercially backward. For a fuller discussion of truncation and its implications, see pp. 37-39 of this Report.

capabilities still further. In addition, changes in the structure of the world economy threaten our already feeble international position.

Past Industrial Policies

Canada has had an industrial policy if one accepts the definition of such a policy as simply a collection of measures directed at industry; however, if the more rigorous definition of industrial policy as an integrated set of complementary measures embodying both strategic economic and industrial objectives is taken, then clearly Canada has *not* had a coherent industrial strategy.⁸

The first recent attempt to establish an industrial policy occurred in 1963 when the new Liberal government of Lester B. Pearson established a federal Department of Industry. Designed to operate initially in tandem with the Department of Defence Production and, like it, organized along sectoral lines, the mandate of new department was to look after the growth, productivity and employment opportunities of the manufacturing and processing industries. It was staffed by experienced public servants and former industry executives. Unfortunately, much of the department's work was concerned with the administration of aspects of a regional development policy, a fact which deflected attention from industrial restructuring and resulted in some confusion about the objectives of industrial development policy.⁹

Because of a desire on the part of the government to rationalize industrial policy and prevent an overlapping of departmental responsibilities, the Department of Industry was merged with the Department of Trade and Commerce in 1969.¹⁰ The new department, the Department of Industry, Trade and Commerce (ITC), was given a mandate to "further growth, productivity, employment opportunities, and the prosperity of the Canadian economy through the efficient development of Canada's manufacturing and processing industries, and the expansion of trade and tourism." However, while the overall objectives were ambitious, actual success in the development of an industrial policy was questionable despite the attempt to rationalize the process by creating a single department responsible for all industrial and trade affairs and the substantial investment in industrial assistance programs. The reasons for the lack of support within the federal government for industrial policy over the past 10 years can be attributed to a number of factors.

Institutional Problems

As a new department in the Ottawa hierarchy, the Department of Industry was ill equipped to sponsor a major push to industrial development and make it a primary element of federal government policy. In merging the Department of Industry and the Department of Trade and Commerce, the objective of industrial development was fused with the mandate to encourage the expansion of Canada's trade and exports, of the older, larger and more prestigious department. This resulted in the dilution of policy attention to specific industrial problems and shifted the emphasis of industrial policy into a broader trade policy framework. In addition, even the new larger department did not have full control of policy development or the delivery of support for industry.

Over the intervening years, many other federal departments and agencies have come to play a role in the development of industrial policy. For example, the departments of Finance, Consumer and Corporate Affairs, Supply

and Services, Environment, Regional Economic Expansion, Communications, and Energy, Mines and Resources have all had significant inputs in the evolution of government policy toward industry. Further, other departments have not emphasized deliberate *encouragement* of industrial development. For example, the departments of Consumer and Corporate Affairs, and Environment have been primarily concerned with *regulating* industry — a factor which often inhibits industrial growth. The result has been the emergence of a number of diverse, and in many cases, inconsistent policies.

Policy Priorities

A second factor is the rather low priority which industrial policy as such has had in terms of the government's general economic policy concerns. While a number of the *symptoms* of industrial decline have been a matter of concern to government policy makers, there has been no attempt to develop policies to attack its underlying structural causes. Consequently, Canada has had policies during the 1960s to encourage full employment, high economic growth, stability of prices and a viable balance of payments, along with an emphasis on regional development policy. All such policies were based on the assumption that Canada was an industrially strong country which could expect high and continued rates of economic growth for the foreseeable future.

During the 1960s, some government policies placed emphasis on creating an R&D push, that is to say, concentration on supplying technology to industry through, for example, government laboratories, or in the form of financial assistance for R&D. The government's intention appeared to be that by offering R&D opportunities and facilities the technological capacity of Canadian industry would be improved. Unfortunately, such policies ignored an important structural problem of Canadian industry: its truncation (a result of high levels of foreign ownership) as well as the lack of sufficiently concentrated markets — factors responsible for the lack of a demand "pull" for technology in Canadian industry.

A much more pessimistic view of Canada's economic prospects is evident in the 1970s, and consequently governments have focussed on two major issues: inflation and unemployment. Unfortunately, these issues have been tackled as isolated phenomena and not as symptoms of larger structural difficulties. When the issue of the wider ranging causes of high inflation and unemployment has been addressed, blame has been placed principally on changing, short-term international conditions such as the recent recession in the global industrial system caused by the 1973 OPEC price increases.

Lack of Commitment

A third factor which has discouraged the emergence of an industrial strategy has been the official attitude of the federal government. There can be little doubt that many senior officials within the government are reluctant either to embark on an exercise involving a comprehensive review of industrial structure or to develop a coordinated industrial strategy to tackle Canada's economic problems. This reluctance reflects some of the real difficulties of developing such a coherent program in Canada. The difficulty of obtaining federal-provincial cooperation on an overall industrial strategy and the sheer enormity of the restructuring effort required, are two of the major stumbling blocks. It would seem that the government regards the situation as too complex and has decided instead to rely on a number of *ad hoc* policies of finan-

cial support to industry and the promise of freer trade emerging from the current GATT negotiations, to act as the major stimulus for Canadian industrial regeneration.

There would seem to be an ideological aversion on the part of federal officials to become involved in any policy which requires government cooperation with industry. As a result of official commitments to *laissez-faire*, government has failed to solve the serious problems now facing Canadian industry. In contrast, many foreign governments (particularly in Europe and the Far East) are not the least reluctant to intervene directly and comprehensively in their economies to achieve international trading advantages for their domestic industries. Canadians, on the other hand, formulate economic policy as if Canada were in a world of market economies. The reality is that many countries are moving progressively toward "political" economies in which market forces are manipulated for strategic national purposes.¹¹ Partial recognition of this fact is evident in the federal government's recent establishment with industry of 23 sector working parties to advise the government on industrial policy. However, this initiative has not been sufficient to fill the policy vacuum created by the reluctance of the federal government to formulate or to implement an industrial strategy. This is particularly worrying given that a number of provincial governments have moved to establish their own industrial strategies in an attempt to assure the future of industries within their jurisdictions. There is, therefore, the distinct possibility that the Canadian economy will become increasingly balkanized.

II. Increasing Vulnerability in a Changing World

Nature of Canada's Economic Decline

Trade Failure

While the symptoms of industrial decline in the Canadian economy are readily obvious in the trade figures presented at the beginning of this Report, these general figures mask the factors underlying that decline. If we disaggregate these data, it becomes possible to isolate some of the principal features of Canada's industrial failure.

On examining Canada's trade performance, two principal trends immediately become evident; first, a generally weak position on invisible trade, and second, an even more serious degeneration of trade in manufactured goods and high-technology items.

Invisible Trade

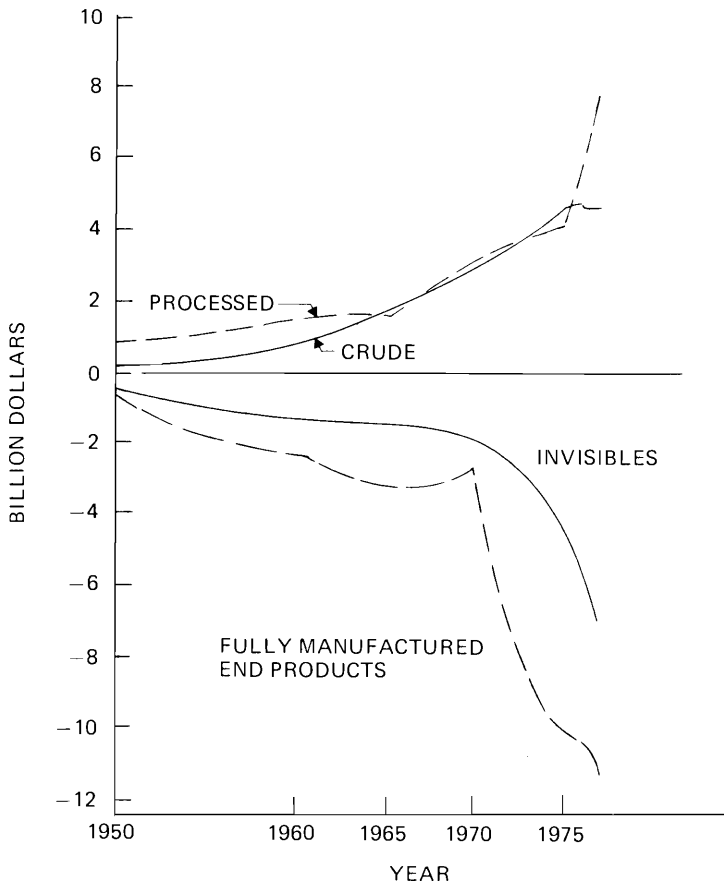
Invisible trade, generally, refers to payments between countries for such non-material items as transport services, tourism, investment income and payments for financial services. Most developed countries have a surplus on their invisible trading account largely attributable to earnings on items such as foreign investment, payments for financial services (banking and insurance), and the provision of licences and patents. As such, a positive balance of payments in invisible trade is usually a good indicator of the degree to which the country's industrial system is advanced. While not all industrial countries have a surplus, Canada is notable among industrialized countries in the relative magnitude of its deficit in invisibles and the relatively small size of its receipts on invisible trade. For example, in 1977, Canada's *deficit* in invisible trade was \$6984 million; a figure over *twice* as large as our surplus that year in merchandise trade (i.e., trade in raw and processed materials and manufactured goods). In terms of receipts earned on invisible trade, the true dependency of the Canadian economy becomes even more apparent. In 1971, of 25 industrial countries Canada ranked *last* in terms of the percentage contribution of invisibles to over-all trade receipts.¹ While in recent years the invisibles trade account has also been adversely affected by the large number of Canadians travelling abroad, this outflow still accounted for only one-quarter of the 1976 deficit.

A substantial part of the weakness on our invisible trade can be attributed to the degree of foreign ownership in Canada. For example, almost half of the deficit on invisible trade is due to the remission of profits, dividends and interest to foreign firms, and individuals. Furthermore, a large proportion of the payments for services from abroad, (over \$1.4 billion in 1976) were due to the import of services by subsidiaries of foreign-based multinational corporations.²

Trade in Manufactured Goods and High-Technology Items

While our trade in invisibles has been in a serious and consistent deficit, the immediate impression of Canada's merchandise trade is one of continuous balance of payments surpluses. For example, since 1960 Canada has generally had a surplus in merchandise trade. However, this surplus has been maintained only through substantial exports of crude and processed resource materials (e.g., oil and gas, minerals, pulp and paper, agricultural products, and fish). In contrast, as can be seen in Figure II.1, Canada has been running a consistent and growing deficit in our trade in manufactured goods, thus effectively cancelling any gains in the resource sector.

Figure II.1 –Major Components of Canada's Trade Balance, Selected Years



Sources: Statistics Canada, *Canada Year Book*, Cat. No. CS11-202, Supply and Services Canada, Ottawa; and, *The Canadian Balance of International Payments*, Cat. No. 67-201, Supply and Services Canada, Ottawa, selected years.

A more detailed examination of the nature of our balance of payments deficit in manufactured commodities gives further cause for concern. As shown in Figure II.2, Canada currently has a trade surplus only in those areas of manufacturing utilizing low to medium technology.* The greater part of this surplus is generated by resource-based industries. However, those sectors of manufacturing utilizing high technology have been in a serious deficit situation for some time. In fact, the deficit in high-technology manufactures has been so large it has effectively dragged our overall trade in manufactured goods into a sizeable deficit position. This trend is particularly disturbing because the greatest potential for industrial growth and improvement in job

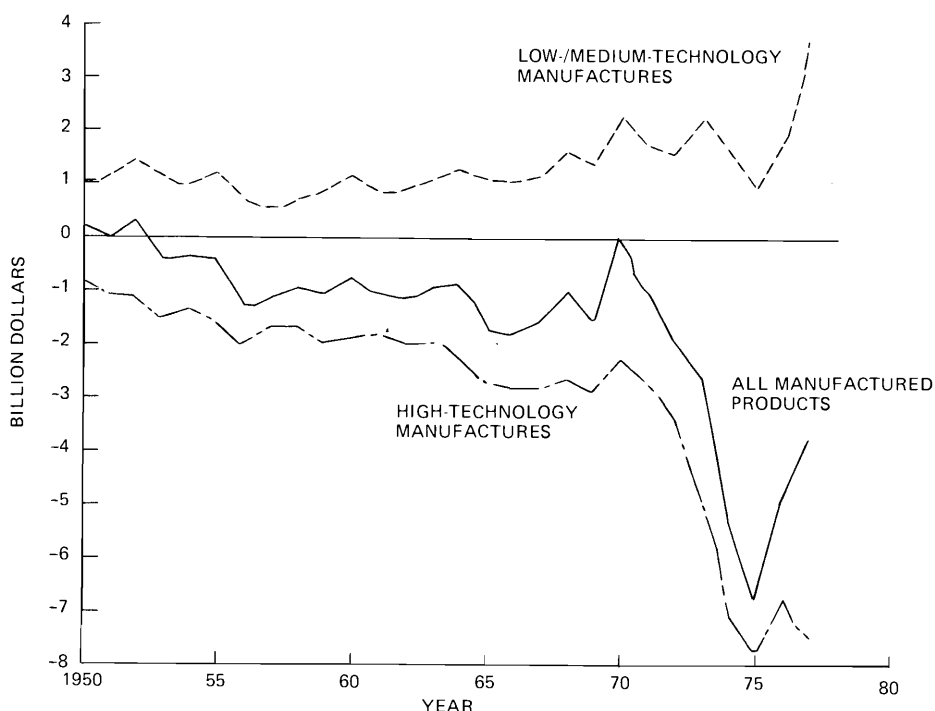
* Examples of low-technology industries include: furniture, most textiles, and wearing apparel.

Examples of medium-technology industries include: household appliances, smelting and refining, pulp and paper. Significantly, it is these medium-technology resource-based industries from which the bulk of our current balance of payments surplus is obtained.

Examples of high-technology industries include: electronics, aerospace, chemicals, etc.

quality lies in high-technology manufactures. Recent studies of high-technology industries in the United States indicate that technology-intensive industries grew 45 per cent faster in terms of output, and 88 per cent faster in terms of employment generation, than ordinary manufacturing industry. In addition, high-technology industries had a greater than average propensity for export growth.³

Figure II.2—Canada's Trade Balance in Manufactured Products

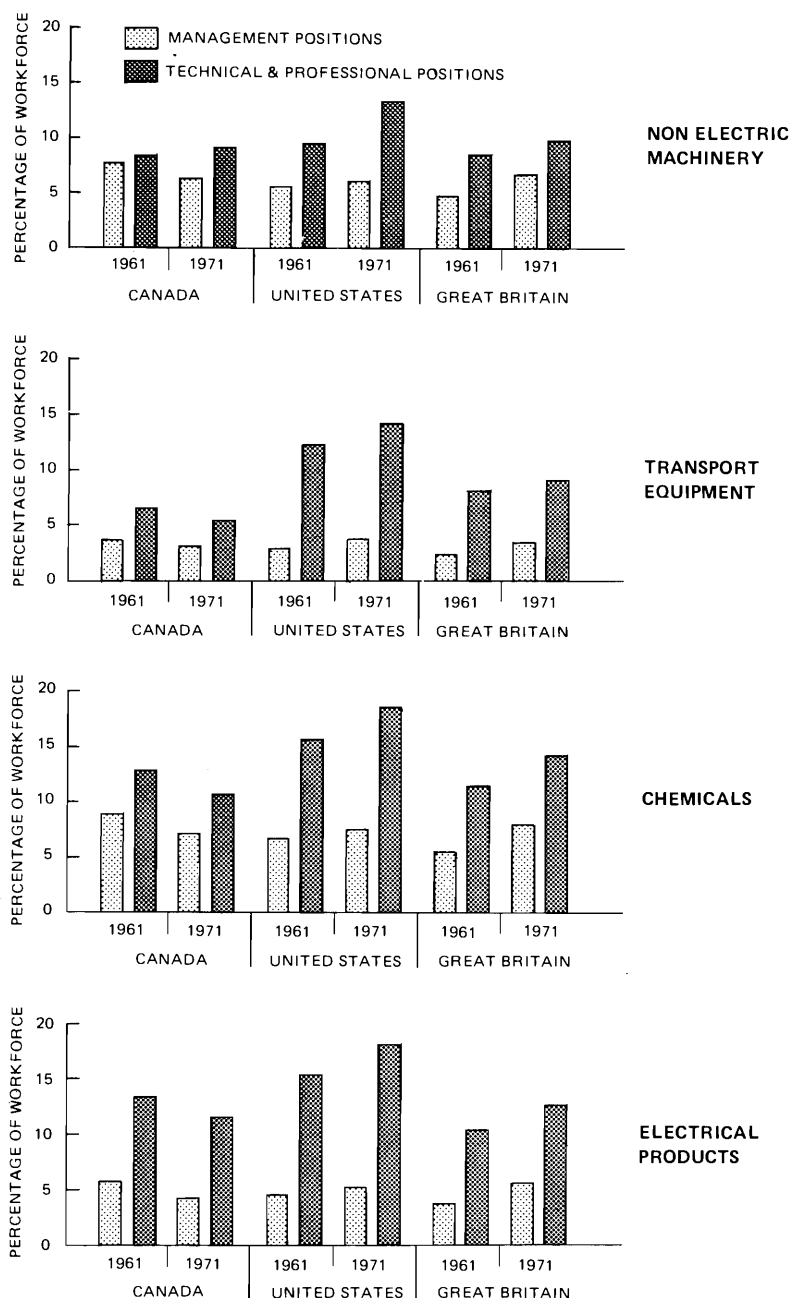


Source: Based on data available from Statistics Canada.

Unfortunately, our trade deficit in high-technology manufactures has also been paralleled by the growing dominance of high-technology imports in our domestic market. For example, the percentage of the domestic market served by high-technology foreign imports has increased from 32 per cent in 1960 to over 50 per cent in 1975. Not only are we failing to exploit growing export markets in an expanding form of industrial activity, but we also seem resigned to allow foreign suppliers to take advantage of the opportunities that exist within Canada.

This decline in industrial capability is clearly seen when comparing the growth of the proportion of finished manufactures in Canada's overall exports to that of other industrial countries. From 1965 to 1970, the proportion of Canada's exports categorized as finished manufactures rose by 3.2 per cent.⁴ In contrast, the increase was 11.3 per cent in Denmark; in France 5.5 per cent; in Mexico 16.8 per cent; in Sweden 10.8 per cent; in Ireland 7.9 per cent; and in Norway 6.6 per cent. By comparison with virtually *all* the West European countries and a number of non-European countries, Canada

Figure II.3—Occupational Composition: Selected Industries



Sources: Statistics Canada, 1971 *Census of Canada*, col. 111, part 5, Cat. No. 94-758, Supply and Services Canada, Ottawa, Table 7; United States, Bureau of the Census, *Census of Population: 1970—Detailed Characteristics*, Final Report, United States Summary, US Government Printing Office, Washington, D.C., 1973, Table 232; Worton, David S., "The Service Industries in Canada", in V. R. Fuchs (ed.) *Production and Productivity in the Service Industries*, National Bureau of Economic Research and Columbia University Press, 1969, pp. 237-ff; Office of Population Censuses and Surveys, 1971 *Census: Great Britain*, Economic Activity, Part 111, Her Majesty's Stationery Office, London, Table 19, p. 2. Data for 1961 obtained from a similar source.

fell behind through its abnormally slow rate of industrialization. This is particularly significant because the 1960s were generally regarded as a “golden era” for the expansion of Canadian manufacturing.⁵

Declining Employment Opportunities

The general weakness of the country's trade performance, particularly in the more advanced sectors, is also mirrored in employment trends and in the structure of Canadian industry.

Looking at employment changes in the Canadian economy, Canada, like many countries, has experienced a shift from blue-collar to white-collar occupations. However, in Canada this trend differs markedly from other countries in several important respects.

1. The shift from blue- to white-collar occupations has been more rapid and has proceeded from a smaller absolute base of blue-collar workers.

2. In most industrialized countries the shift to white-collar employment has involved a significant upgrading of the labour force. This has not occurred to the same extent in Canada where the shift into white-collar employment has a low scientific and technological component and a regrettably large increase in low skill occupations such as sales and clerical work.⁶

3. Further, any shift in the workforce into quaternary employment (i.e., professional, technical, managerial and administrative positions) has been disproportionately directed to education and other social service areas (health and welfare). In Canada, the transfer of management, scientific and professional workers into manufacturing industry has been proportionately low when compared with other sectors of the economy and has lagged significantly behind the shift of these workers into manufacturing in other countries.⁷ For example, between 1960 and 1970, professional and technical employment in manufacturing grew almost four times more rapidly in the United States than in Canada. This trend, as seen in Figure II.3, has been especially prevalent in the high-technology industries, where the growth of managerial, scientific and professional staff is significantly below levels in such industries in the United States and even in Britain. Indeed, the proportion of highly qualified manpower in the advanced technology industries in Canada has declined in comparison with most industrial countries.

These trends are disturbing not simply because they indicate that future generations of Canadians will face fewer and less rewarding employment opportunities, but in addition Canadians will have fewer and less fulfilling employment opportunities than their peers in other industrialized countries.

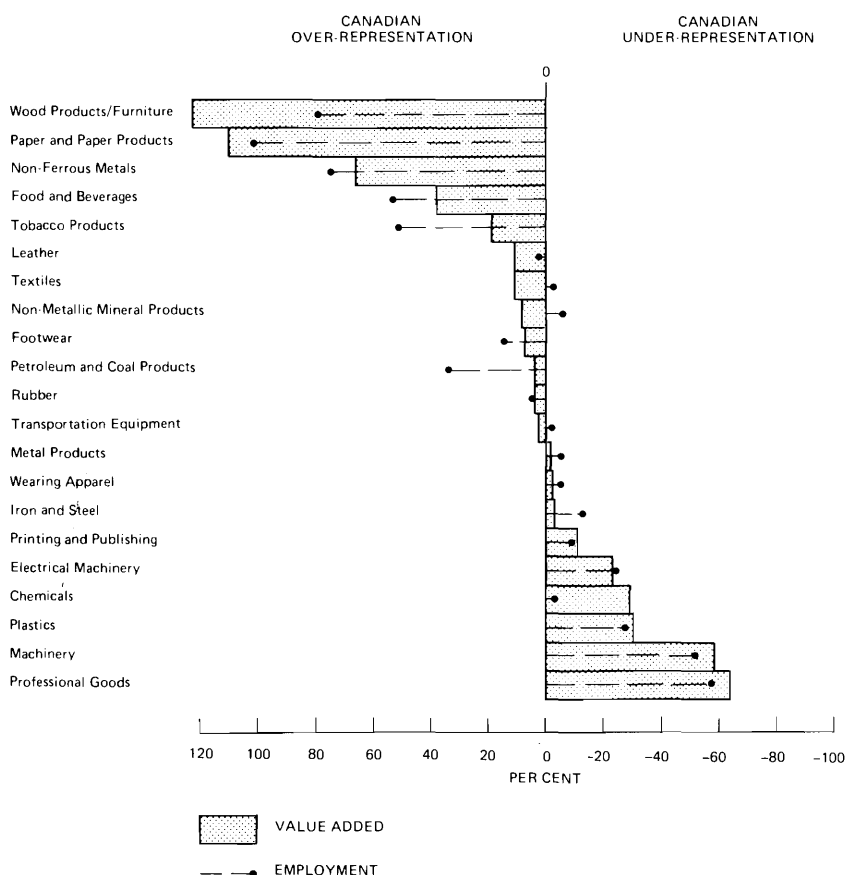
The declining rate of growth in high quality employment opportunities will make upgrading or even maintaining our workforce increasingly difficult as substantial numbers of industrially related blue-collar jobs are transferred to the industrializing Third World or made redundant by advances in production technology.

Deindustrialization

Increasing trade failure in the more advanced sectors of Canada's economy and the consequent distortion beginning to appear in the makeup of Canada's workforce, is reflected in the structure of Canadian industry. *Contrary to what many people believe, Canada does not have the economic structure of an industrialized country.* Figures II.4 and II.5, for example, compare the value added and employment structure of the Canadian economy with the

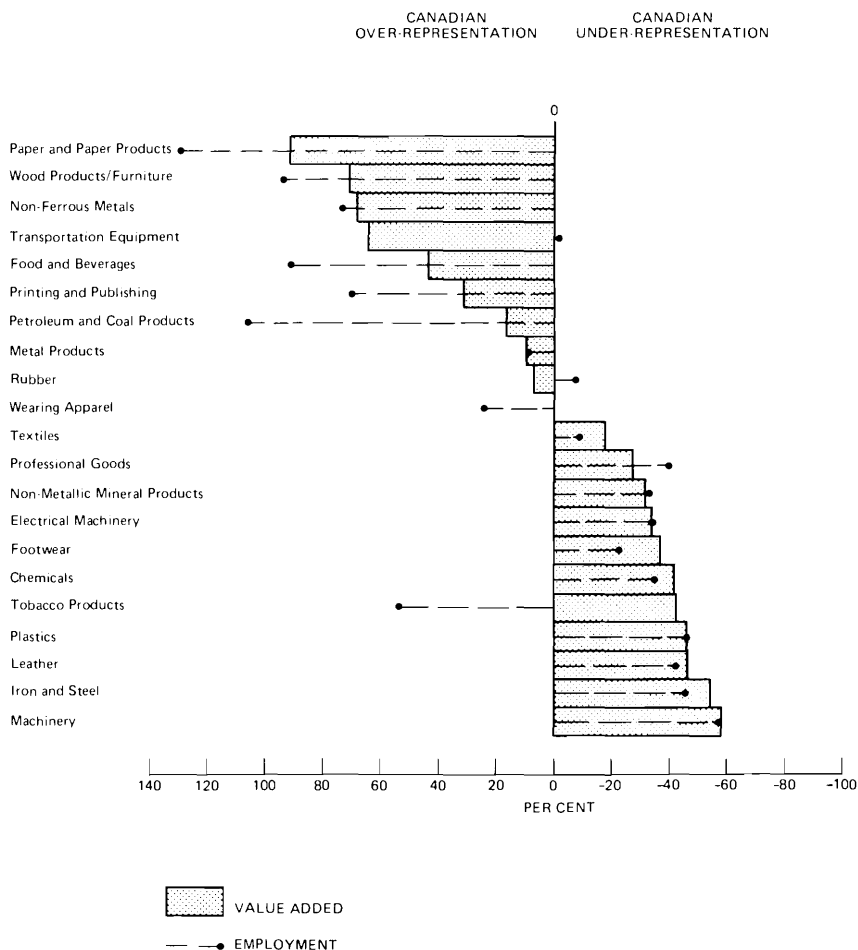
American and selected European economies — those economies most commonly accepted as the paradigm of industrialization. If these economies and Canada's were similar in structure there would be little deviation from the "0" per cent line in either diagram. However, the pattern apparent in Figures II.4 and II.5 reveals an economy which is still predominantly a resource hinterland for the world's industrialized economies. Compared with the industrialized US and European economies, Canadian economic activity is "over-represented" in resource processing and extractive industries (e.g., wood products, paper and pulp products and non-ferrous metals) where, relative to the US or Europe, Canada has a high degree of specialization due to resource endowments. In contrast, the Canadian economy is "under-represented" in advanced sectors such as chemicals, machinery and electrical products — the growth industries of the last two decades. Significantly, these very industries "have been entrenched in the industrial specializations of Western Europe and the US by virtue of technical excellence, massive investments in R & D, and innovations in product and production processes."⁸

Figure II.4—Comparison of Canadian and US Industrial Structures
Based on Value Added and Employment, 1973



Source: United Nations, *Yearbook of Industrial Statistics*, Vol I, 1974 Edition, United Nations, New York, 1976.

**Figure II.5—Comparison of Canadian and Western European Industrial Structures
Based on Value Added and Employment, 1973**



Source: United Nations, *Yearbook of Industrial Statistics*, Vol I, 1974 Edition, United Nations, New York, 1976.

The picture presented is one of a country that while industrialized is significantly underdeveloped in the new and expanding sectors that are likely to play a key role in the economic future of most advanced countries. *Indeed, in terms of trade and employment trends, Canada seems to be in a process of deindustrialization.*

Changing World Environment and Its Impact on Canada

Canadian economic trends are even more serious when viewed in the context of global economic change. Three changes are of particular significance to Canada: the emergence of a “new industrial revolution” in most of the devel-

oped industrial countries; a fundamental change in world commodity markets in oil and raw materials; a shift in the location of many technologically mature industrial activities from the industrial countries to the industrializing Third World (e.g., Brazil, South Korea, Taiwan, etc.) and a consequent concentration in technologically-intensive industry by the major industrial economies.

The “New” Industrial Revolution

One of the most significant changes in the world economy is the revolutionary impact of technological change on industrial performance and on the structure of industry itself. This new industrial revolution, the “third wave” of industrialization, is the result of the growing importance of scientific and technological research and development as agents of industrial change. A striking example of this process is the manner in which the application of recent advances in electronic technology are changing the nature of industrial production. The emergence of very large integrated circuits and microprocessors created a new industry involved in manufacturing a whole new range of electronic products such as mini-computers, calculators, and sophisticated forms of telecommunications equipment. These products in turn have a significant impact on other forms of industrial production. Recent advances in the application of microprocessor technology to textile design procedures, for example, are allowing a number of Japanese clothing manufacturers to maintain production activities within Japan which due to high labour requirements would have had to be located to low wage countries. Indeed, the application of this new technology will have a substantial impact on the global location of manufacturing capacity, on the importance of scale in manufacturing operations, and on the need for a substantial restructuring of industrial activity. It is little wonder, therefore, that many countries recognize the strategic importance of microprocessor technology and are seeking to establish a commercial presence in this new area of industrial activity.⁹

In many ways the revolution in electronics technology (a part of the new industrial revolution) could bring about substantial benefits to the Canadian economy. It could increase the demand for highly skilled labour and also allow Canada to customize production processes so that the cost of “one off” or short production run goods destined for its small domestic market would make economic sense. In addition, production costs could be reduced to the extent that some mass market consumer goods would be produced in Canada at prices competitive with low wage economies. One Canadian firm has already embarked on this process by using production-line automation to assemble low cost, home music centres which can compete in the mass market with comparable Japanese products. However, it is also important to stress that the new industrial revolution will place a premium on the ability of the Canadian industrial system to support a high level of entrepreneurial activity, and a substantial capacity for innovation.

As we have seen, Canada is ill-prepared to face many of the significant challenges necessary in a transfer to an industrial system based on high-technology innovation and adaptation. Canada has a highly trained workforce suitable for exploiting these new industrial opportunities; despite this Canada is gradually eroding its high-technology industries, and in many instances has lost vital connecting industries (i.e., those industries able to provide the ser-

vices and markets for advanced industrial products). The substantial benefits that the new industrial revolution would bring to the economy will slip away.

The increasing application of science and technology to industrial processes should be visualized in terms of an expanding emphasis on conservation as outlined in the Science Council Report No. 27, *Canada as a Conserver Society*.¹⁰ Many of the world's industrialized countries are becoming resource deficient. Consequently a greater emphasis will be placed in these countries on making their industrial processes more efficient and less wasteful, both in an economic and an environmental sense. This, in turn, will require a heightened capability in the sophisticated technologies and the industrial processes needed to conserve resources and reduce environmental degradation. A move to more efficient production processes and an emphasis, for example, on renewable energy resources, will also require an innovative capability on the part of Canadian firms both in a technical and an organizational sense. The education system has produced a large number of highly skilled and trained people capable of meeting these challenges. Yet Canada may not be able to employ these people as it has allowed its technological capabilities to atrophy, and seems to be increasingly adopting, through high levels of foreign ownership, an imposed pattern of industrial organization.

Growing Pressure On Canada's Resource Exports

Current world economic trends which are having a direct and immediate impact upon the Canadian economy are of particular concern. One major change is occurring in a field of traditional Canadian strength — natural resources. Since the end of World War II, Canada has experienced a relative decline as a major world supplier of minerals and raw materials. This decline has occurred as a result of the opening of new sources of supply for minerals and raw materials in the developing countries and in the Soviet Union, and of the ability of these countries, particularly within the last decade, to export their resources in substantial quantities.

The impact of these changes has been typified by our decline as a major exporter of both nickel and newsprint. For example in 1950, Canada accounted for about 75 per cent of world exports of nickel, but by 1976 this share had declined to about 30 per cent; over the same period of time, Canada's share of world newsprint production fell from 55 per cent to 38 per cent.¹¹ The absolute level of Canada's exports of raw materials has been growing during the past 25 years, but growth has been slowing down significantly. For example, the 10 per cent per annum growth in mineral production common during the early 1950s has fallen to a figure of about 3 per cent in 1975. Reliable estimates place the likely growth rate over the coming 25 years to be around 2 per cent.¹²

The decline in Canada's growth rate in mineral production is due to a number of factors. Most significant perhaps is the increasing competition which Canadian mineral and newsprint exports have to face in the world market. Many of the newer sources of raw materials in the world, particularly in the developing countries, are easy and cheap to exploit in relation to corresponding sources in Canada. In addition, as a result of the importance of mineral production to the economies of Third World countries, government control and ownership of production is often used to maintain output despite cost changes. Such trends have tended to keep the long-term price of commodity

exports low (despite the world commodity boom in the early 1970s), especially as developing countries try to use resource exports as a device to alleviate their balance of payments deficits with the Western industrialized countries.

A final trend in world trade in resources concerns energy. Ironically, the only raw material in which a producer cartel has been able to maintain a high, world commodity price is the very raw material in which Canada already has, and will likely have, a domestic resource shortage for several years to come — oil. By 1985 Canada, a net importer of crude oil, will require quantities of oil of such a magnitude that our balance of trade in crude oil will reach a deficit of over \$3 billion.¹³ Even if our exports of coal, uranium and natural gas are increased substantially by the mid-1980s, thus preventing an overall balance of payments deficit in energy resources, it is clear Canadians cannot simply rely on energy resources for foreign exchange earnings in the future.¹⁴

All of these trends indicate that Canada's traditional reliance on resource exports to finance its expanding dependence on foreign manufactured goods will no longer be possible. Because of the decline in our ability to earn substantial surpluses from our energy trade, combined with very slow growth in mineral and raw materials exports and their likely low prices, little can be expected from these sectors as possible counterweights to the growth in manufactured imports. Because of the growing propensity of the Canadian economy to import manufactured goods with a high component of technology, and hence a high value added, Canadians will need to export larger and larger quantities of raw materials to pay for these imported goods. In light of Canada's declining competitiveness in many resources and the gradual running down of resource reserves, this strategy can have only a very limited life span.

Transformation Of World Trading Conditions

The most significant change in the structure of the world economy with a short- and medium-term impact for Canada is the shifting pattern of world industrial trade. Two major changes are emerging: first, a shift in activity in mature products from the industrialized countries to the industrializing Third World; second, a move by the developed industrial countries into more advanced forms of technology-intensive industrial production.

A major trend in the world economy over the past few years has been the growth of the semi-industrialized countries in the Third World. Countries such as South Korea, Taiwan, Singapore, Brazil, Mexico, and Venezuela are rapidly expanding their industrial bases, taking advantage of a relatively skilled but inexpensive labour force and the opportunity to establish highly efficient and modern world-scale manufacturing facilities. These countries are rapidly increasing their share of world trade in those industries characterized by relatively large inputs of labour, assembly manufacturing operations, and mature technological processes. Examples of this phenomenon are seen increasingly every day in Canadian shops. The Third World is now manufacturing many of our mass-produced consumer goods (e.g., radios, televisions, household appliances, toys) and is increasingly involved in the manufacture of automobiles, commercial vehicles and machinery.

The advance of these countries has been so rapid in terms of the international competitiveness of their industries that some analysts, in Japan for example, believe that the Japanese car industry may have to move the bulk of

its volume car assembly plants to countries such as South Korea by the late 1980s in order to stay internationally competitive.¹⁵ In addition, the International Iron and Steel Institute forecasts that between 1978 and 1985 the Far East's steel making capacity will grow by 27 per cent and Latin America's by 17 per cent, compared with a growth rate of less than 10 per cent in Western Europe and the United States. Steel from these new Third World producing countries is expected to be cheaper than Japanese steel which is already being produced at costs 15 to 20 per cent less than comparable American products.¹⁶

The implications of these changes in world patterns of manufacturing production are hardly pleasant for Canadian industry. Most of Canada's industrial capacity is located in industries typified by low- to medium-technology assembly operations serving the domestic market. (Many of these operations are, in fact, branch plants.) Unfortunately, these are the very industries which are expanding in the new industrializing countries. Despite tariff protection some Canadian industries are already being effectively destroyed by foreign competition — the two most notable examples are textiles and consumer electronics. Unable to compete either in terms of cheap labour or modern production facilities, Canadian firms are incapable of maintaining their domestic, let alone export, markets. The same destructive trend is already taking place in a large number of other industries in Canada. In fact, in order to survive, a few Canadian-based multinationals and some domestic firms have responded by closing their assembly operations in Canada and moving them to industrializing countries such as Taiwan or South Korea.

Most advanced industrialized countries have attempted to counter the challenge from the industrializing Third World by moving their export base into the more technologically intensive areas of industrial activity. Sweden, for example, has expanded steadily into the area of industrial electronics; Japan is emphasizing its innovative capacity as it realizes that its traditional industrial strengths of cheap labour and advanced production techniques are being worn away. In consequence, Canadians can expect Japanese exports to concentrate increasingly in the early and growth phases of the advanced technology product cycle; this trend can already be seen in their move from simple electronic and radio equipment into sophisticated microcomputers and various other forms of advanced electronic and optical equipment.¹⁷

Realizing the importance of high technology to the United States' future place in the world economic system, many senior American planners are considering limiting the export of US technological expertise abroad in order to maintain the lead of those US industries at the technological forefront of their respective fields.¹⁸

Unfortunately, the weakness of our advanced technology industries makes such a strategy difficult for Canada at present. This weakness is evidenced in the growing level of import penetration by high-technology products into our domestic market, the declining ability of Canadian industry to absorb scientific and technical manpower, and the small amount spent by Canadian industry on research and development.

Canadian industry is threatened on two fronts: by the danger that much of its traditional manufacturing activity will become non-competitive through pressures from the industrializing Third World, and by its inability to exploit new avenues of industrialization made possible by advanced technology. In this sense, Canadian industry is uniquely threatened.

Reasons for Canada's Industrial Weakness

In recent years, much attention has been given to the competitive weakness of Canadian industry, and in particular Canadian manufacturing.¹⁹ The factors which have been isolated most frequently as the cause of this weakness are: an artificially high exchange rate, high labour costs, and the inefficient nature of most industrial plants and organizations in Canada. However, while the first two factors have compounded the problems of the lack of competitiveness of Canadian industry abroad, they have not been long-term features of the Canadian economy and are likely to be corrected within the next few years by international market forces. For example, until June 1970 the Canadian dollar traded well below its US counterpart: only during the first half of this decade did the dollar rise sharply compared to the American currency. In addition, during this period labour costs rose significantly due, in part, to the achievement of wage parity with the US in many industries.²⁰

In the case of the exchange rate, international market forces already seem to be correcting the overvaluation of the Canadian dollar with the result that it is now well below its US counterpart. This recent dramatic depreciation of the Canadian dollar will, in turn, have an impact on Canadian wage costs, effectively lowering them relative to our principal trading partners.

However, the third factor, the inefficient nature of plants and organizations in Canada, has been a long-term feature of the Canadian economy and seems unlikely to disappear within the immediate future. In addition, because industrial inefficiency is primarily a problem of the structure of the economy, it is less likely to be corrected by market forces, except over the long term and with considerable industrial dislocation.

The inefficiency of Canadian industry has, in turn, been attributed to a number of weaknesses in the structure of the economy. These include: the small size of the Canadian market, manufacturing plants of a sub-optimum size to utilize economies of scale needed to be competitive in world markets; and production runs often shorter than necessary to obtain maximum efficiencies.²¹ Apart from problems relating to the scale of manufacturing operations, Canadian industry also suffers from other weaknesses. These include the inability of some firms to garner, or absorb, changes in technology; the failure of other firms to organize flexibly to meet differing production requirements, and in a high wage economy such as Canada, a reluctance on the part of many firms to concentrate on products which stress quality or unique performance capabilities (the demand for such products being less sensitive to price fluctuations).²²

The great variety of problems contributing to Canada's industrial inefficiency are a consequence of the particular character of Canada's industrial structure. However the question remains: what underlying factors have allowed industrial inefficiency to develop? It would seem that two principal factors have been identified as the major contributors: tariff protection and foreign ownership.

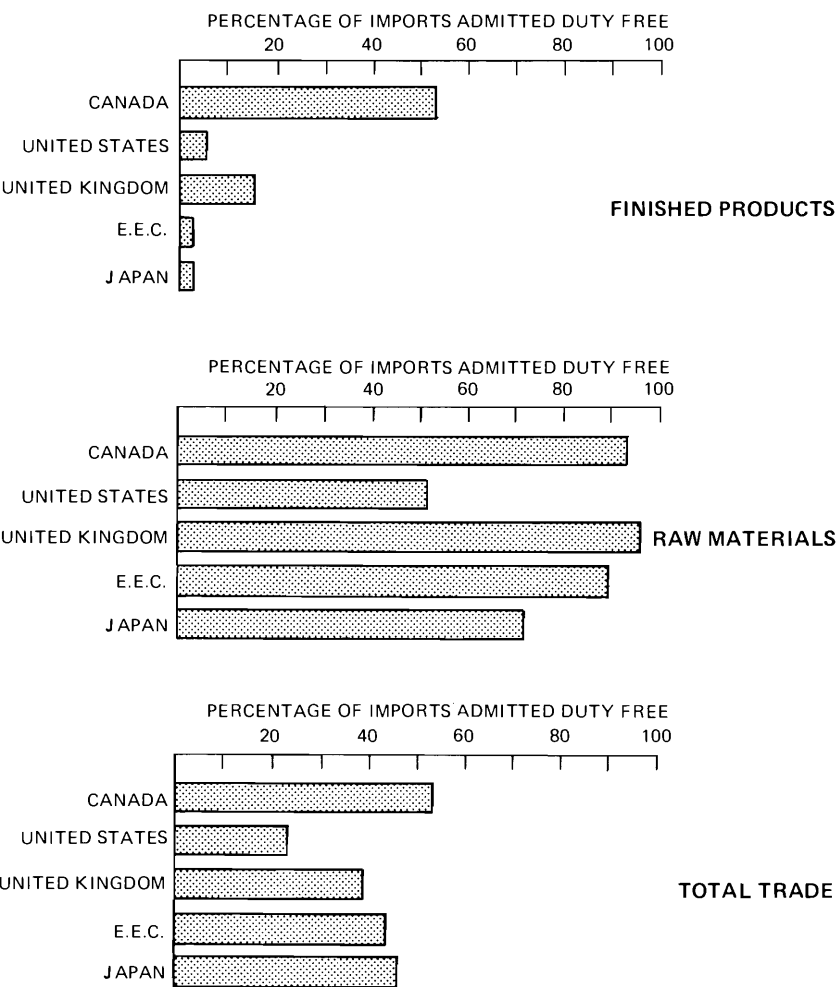
Tariff Protection

A number of authors have pointed to tariff protection as the cause for the poor competitive structure of Canadian industry.²³ They see the eventual elimination of tariff barriers and the exposure of Canadian industry to the

full force of international competition as the only effective device to restructure and to make Canadian industry competitive on world markets. While it is doubtless true that tariff protection may provide a shelter for some inefficient firms and has allowed some technologically obsolescent industries to survive, the elimination of tariff protection for Canadian manufacturing does not seem to provide a suitable antidote.²⁴ A recent review of the impact of tariff exemptions on Canadian industry commissioned by the Science Council,²⁵ shows that the Canadian practice of having high *nominal* tariffs, but providing substantial exemptions to particular products, and thus effectively reducing tariff rates by large amounts, has resulted in *increased* balance of payments deficits and import penetration in those products.

Indeed, the above study revealed that in terms of the percentage of imports allowed into the country duty-free, Canada *already* leads the industrialized world as a practitioner of free trade. As shown in Figure II.6, Canada ad-

Figure II.6—Duty-Free Imports of Industrial Commodities, 1970



Source: US Tariff Commission, *Trade Barriers*, TC Publication No. 665, Washington, DC, April 1974.

mitted about 53 per cent of its finished manufactured imports duty free in 1970, compared to about 6 per cent in the United States, and just over 3 per cent in the EEC (European Economic Community) and Japan. By 1976 it was estimated that Canada admitted about 63 per cent of finished manufactured imports duty free. As noted earlier, it is precisely in manufactured goods that Canada has the most substantial trade deficit. More specifically there are significant trade deficits in the four industrial sectors in which Canada effectively practises a policy of free trade (i.e., automobiles, farm machinery, industrial machinery, and defence production). Beginning with the signing of the Auto Pact in 1965 and until 1977, our accumulated trade deficit in automobiles with the United States has reached a total of \$7.4 billion. In addition, our deficit in trade in farm machinery *in 1977 alone* was \$775 million. Clearly, tariff reductions and free trade are not a sufficient answer to the problems of Canadian industry.²⁶

Evidence would seem to suggest Canada needs not wider free trade, but a strategy designed to accomplish more than the protection of inefficient firms. In short, Canada should link tariff policy to an industrial strategy, so that tariff protection is only one of a wide variety of policy instruments designed to assist domestic industry to rebuild and face international competition effectively.

Foreign Ownership and Truncation

Foreign ownership makes a greater contribution to Canada's overall industrial problems than the substantial tariff protection purportedly enjoyed by Canadian industry. High levels of foreign ownership have an impact not only on the optimal size of plants and production runs, but also on the ability of Canadian firms to export, on the accessibility of advanced technology to Canadian firms, and on many other important elements of the production process essential for the success of a developed industrial economy.

Most of these problems are attributable to "truncation" which arises when high levels of foreign ownership are present in an economy. Most importantly, it is particularly prevalent in foreign-owned subsidiaries in the medium- and high-technology industries (already underrepresented in Canada). Put simply, truncation occurs when a subsidiary does not carry out all the functions — from original research to marketing — necessary for developing, producing and selling its goods. One or more of these functions is usually carried out by the foreign parent firm.²⁷ However, the term also describes a more general tendency in the business behaviour of foreign firms to allocate roles to their subsidiaries in light of the world-wide strategic interests of the parent. Consequently, subsidiaries in Canada are frequently restricted to simply supplying the domestic market, or if they are given an export role it is often to an assigned market. Such an assigned market relies not so much on the distinctive capacities of the subsidiary as on the particular commercial objectives of the parent corporation.

The consequences of truncation are twofold. First, the factors which would make a subsidiary innovative, flexible and capable of developing new products for both domestic and world markets (e.g., R&D, marketing capacity, etc.) are usually entirely, or substantially, located elsewhere. Hence the local subsidiary is unable to initiate new products or to develop new markets, and becomes highly dependent on services (R&D or marketing) derived from its parent. This trend weakens the ability of the subsidiary to compete in

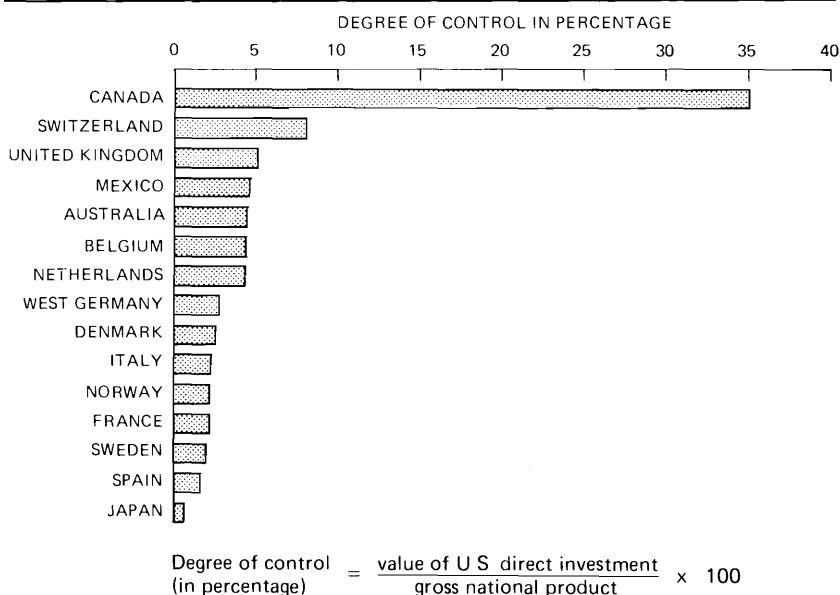
international industrial markets, especially as they become increasingly technologically oriented. Indeed, as Canadian subsidiaries often only manufacture those products at the more mature end of the product life cycle, the most technologically advanced levels of industrial production (the levels most likely to provide Canada with a trading advantage) are denied to them.

Secondly, much of the employment generation one would expect from the range of industrial activities present in Canada, simply does not arise. The professional, scientific and managerial functions normally required are supplied from abroad.

Of course, not all multinationals cause their subsidiaries to become increasingly dependent on the parent firm. Some multinationals in Canada have given their subsidiaries "world product mandates" to design, develop, manufacture and market world-wide certain categories of products: a policy which helps to overcome some of the problems of truncation. However, foreign subsidiaries with a world product mandate are still a minority in Canada and on balance foreign ownership is not assisting Canadian industrial development.

Further, the foreign ownership problem is all the more difficult because of its pervasiveness. Since the question of foreign ownership has been discussed at length elsewhere,²⁸ it is not necessary to review the large number of firms, and indeed, whole industrial sectors that are effectively controlled from abroad. Not surprisingly, Canada's dependence on foreign technology and capital (particularly American capital and technology) is on a scale unmatched by any other advanced economy. As can be seen quite clearly in Figure II.7, Canada's dependence on US capital in 1970 was *ten times higher* than the average of a group of 13 member countries of the OECD. Even Mexico, a developing country, has a significantly lower level of dependence on US capital.

Figure II.7—Degree of US Economic Control over Some Countries, 1970



Source: Adapted from, Office de planification et du développement du Québec, *Valeurs et idéologies post-industrielles au Québec*, (dossier technique) tome 1, l'Editeur officiel du Québec, Québec, 1978, p. 99.

Foreign direct investment provided Canada with a fast and relatively painless way to achieve rapid economic growth. Unfortunately this growth was not accompanied by an adequate level of economic development. For the reasons outlined above, the problem in Canada is that the costs of relying on an industrial structure and technology, determined in large measure from abroad, are becoming greater than the benefits. Changing world circumstances and such extensive levels of foreign ownership have seriously undermined the competitive position of Canadian industry.

The Weakness of Canada's Decision-Making Mechanisms

Unlike many industrialized countries faced with the challenges of a changing world economic climate, Canada confronts additional institutional and political problems posed by industry-government relations and a federal system of government. Canada has an underdeveloped social system with respect to linkages between government and industry and a highly complex federal system with effective regional centres of power.

The government-business relationship in Canada is improving, but is as yet still intermittent, fractured, and at times hostile. Compared with other countries, Canada has a decentralized trade association structure, which reflects in part the highly fragmented character of Canadian industry. For example, Canada has *both* a sizeable manufacturing industry and a substantial resource extraction sector. This situation is not found in most industrial countries. It creates tensions between the two sectors in regard to economic and industrial policy. In addition, apart from the differing perspectives of large and small business, the interests of a large proportion of foreign-owned firms in Canada diverge substantially from their domestic counterparts on many issues. Thus compared to other countries, it is more difficult to articulate coherent and consistent industry opinions on many issues of public concern, particularly with respect to industrial policy. In turn, this has made the integration of industry opinion into the policy-making process difficult.

In addition, other factors relating to the nature of Canadian society have impinged on the relationship between government and industry. For example, the weak linkages among elites in government, industry and the universities, have frustrated the effective interchange of ideas and individuals among these groups. While some attempts have been made to correct this problem (eg., the federal government's Executive Exchange Program which encourages an exchange of personnel between the private and public sectors) the country seems to lack both the social and institutional mechanisms capable of overcoming the very real barriers existing between these various sectors of Canadian society. Clearly, such difficulties must be overcome if we are to ensure the continuous dialogue between government and industry essential to the effective implementation of an industrial strategy.²⁹

Equally important is the need to ensure cooperation between federal and provincial governments. This is a particular problem in Canada due to the sizeable regional, economic and social differences represented by ten provincial governments. Because of the regional distribution of economic activity in Canada, provincial governments have come to represent coherent local economic interests and have been anxious to promote those interests. There is growing evidence that the expansion of the economic power of Western Canada is making it unwilling to accept the traditional distribution of econom-

ic activity within the country. The increasing political sophistication of many provincial governments and the desire for greater political autonomy in Quebec are creating intense conflicts between federal and provincial governments over the nature of economic and industrial policy. Such conflicts can be seen in the attempt by many provincial governments to establish, in the absence of a national strategy, provincially-based industrial strategies. Saskatchewan, Alberta, and Quebec have already started this process, and there are indications that other provinces may follow suit. Further, the growing conflict between, for example, Ontario and Alberta over energy pricing and the location of petrochemical plants is perhaps a harbinger of future interprovincial disputes. With the expansion of locally-oriented industrial policies, it is conceivable that Canada could have ten uncoordinated and, at times, antagonistic industrial policies within one country.

This is not to endorse a return to a national policy which effectively bolstered the existing pattern of economic activity within the country: a situation which favoured an industrialized core in Ontario and parts of Quebec and maintained a relatively poor resource-producing periphery in Western Canada and the Maritimes. The political realities of the times and the awareness of economic disparities in the traditional "have not" regions prevent such a retrograde course. Rather, the situation points out the necessity of developing new mechanisms to ensure the implementation of an industrial strategy which takes into account both regional aspirations and Canada's position in the international trading community.

III. The Need for Innovative Industry in Canada

The current state of the Canadian economy and the changes in world trading conditions underscore the need for a significant transformation in the structure of Canadian industry. With a lack of innovative firms and the present emphasis on mature technology manufacturing* and resource exports, Canada is inadequately equipped to ensure its future prosperity.

If Canada wishes to maintain a high wage economy with good and varied opportunities for employment, greater emphasis will have to be placed on those firms and industries most capable of providing such benefits. Because of changes in the distribution of economic activity in other parts of the world, benefits will occur predominantly through (1) selective development of industrial activities emphasizing high technology, and (2) encouragement of the emergence and growth of firms with innovative capability (*regardless* of their degree of technological intensity).

Selective Development in High Technology

Our technology development strategy must be selective, based on existing technology strengths and on sectors in which the country has some particular international comparative advantage. Hence, Council does not advocate a shift of industrial activity into the whole gamut of high-technology industries, but rather an emphasis on three types of existing or potential technological strengths. First, Canada already has a strong technological capacity in a number of areas. Atomic energy, electricity generation, and aspects of aerospace are notable examples which should be developed and expanded. Second, Canada's resource endowment provides an opportunity to promote additional technical specializations. The development of natural resource extraction and processing technology to take advantage of Canada's wealth of minerals, and forest and agricultural products should be of particular concern. This would include the development of oceans technology to take advantage of marine and mineral resources in Canada's newly expanded offshore regions. Further, as a major northern country, Canada needs to develop technologies to utilize the natural resources in its northern areas.

Third, environmental factors affect industry in Canada. The cold northern climate and size of the country oblige Canadians, for example, to develop technologies to deal with living and working in winter conditions, and to move goods and services around a large, sparsely populated environment efficiently. Logically therefore, Canada should concentrate resources for R&D and industrial organization in activities such as transportation and telecommunications where it can expect to develop a distinct competitive advantage by meeting domestic conditions.

The "new industrial revolution" will also create unprecedented demands for high-technology industry embracing industrial, institutional and consumer markets. The immense opportunities offered affect all sectors of activity from resources, to secondary manufacturing, to the service sector. They not

* Technology which is already well integrated into the industrial system and consequently is readily obtainable by any producer wishing to enter the market. Concentration on mature technology by Canadian firms leaves them with few *distinctive* advantages in international markets as they are frequently competing against lower cost foreign producers with similar access to such technology.

only create the potential for a revitalisation of our industrial base, but also require that Canadians choose judiciously those areas of industrial activity in which to become engaged. The entry cost of developing new technology will be very high and careful investment decisions will have to be taken by industry and government acting in concert.

Excessive reliance on foreign technology is likely to produce two undesirable results. To begin with, it will deny Canadian industry the capability of competing internationally using the most advanced technology. Second, and most importantly, excessive reliance on foreign technology usually stunts the growth and development of an indigenous technological capability.¹ It is vital that Canadian industry be structured and stimulated to develop technology suited to national needs and at the same time to produce distinctive goods and processes. These products and processes will provide the country with a set of independent niches in the international marketplace.

Encouraging the Emergence and Growth of Firms with Innovative Capability

As in all industrial countries, the vast majority of manufacturing firms in Canada undertake little or no R & D. Yet, most Canadian manufacturing workers are employed in these firms which provide the bulk of Canada's manufacturing output. These companies cannot be abandoned for they are the foundation of our industry. Positive measures must be taken to improve their commercial performance rather than merely protect them.

For these firms, effective competitive strength will hinge not so much on their capacity to develop new technology as on their capability to innovate in the design and engineering of new products or production processes oriented to specialized markets. Innovative capability in this sense will often involve making commercial use of available technology (new and not so new). The critical factor is the ability to "assess and exploit" known technology in terms of a specific market (in other words, to assess consumer needs, tastes and, hence, potential sales) and to exploit such knowledge using good product design, price and marketing. In this way innovative capability is concerned with the technical utility of products and production processes and also with the efficiency, reliability and aesthetic appeal of products — characteristics essential to their best market performance.

The "assess and exploit" function of innovative capability will be of even greater significance in all industrial countries in the near future. On a world scale, there is already an enormous volume of raw scientific knowledge available for use in industrial products. Substantial industrial development work has already produced a great variety of industrial components, for example electronic microprocessors, that could be used in new products and in redesigns of existing ones (e.g., the solid state telephone). Given this situation, the capability to identify a market, use relevant but existing technology, and produce goods of superior design will be important preconditions for the development of manufacturing in Canada. This does not mean that the search for scientific or industrial "breakthrough" technology should be viewed as unimportant, but that *innovative expertise*, including marketing capability, will be a *sine qua non* of industrial success. These factors are particularly important due to the weakness of the design and engineering capacity of many

small- to medium-sized Canadian firms. For example, a recent internal report for the Design Council of Canada showed that design and engineering, essential to utilizing new technology (from whatever source) and improving existing processes or products, is even less developed than industrial R&D in Canada,² an area in which Canada spends the least of any advanced industrial country. Without the ability to adapt technology independently and to develop new products and processes, firms are condemned to rapid technical and productive obsolescence.

It is essential to encourage both the selective development of technology appropriate to Canadian needs and to encourage the use of that technology by all types of firms, if Canadians are to meet the challenges of the coming decades. These objectives are best met if the principle of technological sovereignty is adopted, for it stresses the importance of developing an indigenous technological capability which can be readily incorporated by a great variety of industrial enterprises in Canada. Only by adopting such a technological capability can a high wage economy such as Canada ensure itself a place in a world market demanding technological and economic sophistication as the price of survival.

IV. The Goal: Technological Sovereignty

Background for an Industrial Strategy

In discussing industrial and economic policies it is important to make a distinction between the purpose of such policies and the means of attaining them. The purpose of advocating an industrial strategy is to ensure that Canadian industry will be capable of providing the *number, quality, and variety* of employment opportunities Canadians have come to expect, and the consequent high standard of living and job satisfaction which such opportunities provide. In this sense, the advocacy of an industrial strategy has a fundamental social purpose — ensuring the future prosperity of Canadians. However, as made clear in our analysis, the provision of meaningful levels of employment opportunities and the health of Canadian industry are inextricably linked. It is only through the development of an independent, strong, and technologically-advanced industrial structure that the employment and living standards to which Canadians have become accustomed can be maintained. Technological sovereignty offers a focus for such a strategy. It directs attention to the importance of technology in the modern industrial process and to the manner in which that technology is integrated into the industrial system.

Embarking on an industrial strategy for Canada involves not only the adoption of advanced technology by specific industries, but also a restructuring of those industries to use that technology effectively. It also implies the selective concentration of efforts in certain sectors. Such a process will not be easy or short term. It will require a sense of determination and courage on the part of governments, labour, and industry.

While the cooperative implementation of an industrial strategy will be a difficult task, it is important to keep the alternative in mind. If Canada does not gain control over its own industrial and technological development and rebuild its industries, a rather unpleasant form of restructuring (i.e., deindustrialization) will be imposed upon it by virtue of excessive vulnerability to external conditions. This latter alternative will be far more costly in terms of the decline in our standard of living and employment opportunities than taking the initiative to make structural changes in the economy ourselves — changes designed for the maximum benefit of all Canadians.

A Developing Consensus

Fortunately, a consensus is gradually emerging within industry that Canada faces a major discontinuity in its industrial system and that, in response to this crisis, it is necessary for government, labour, and industry to have a clear idea of the direction in which they wish industrial policies to develop. A typical industry reaction is contained in a Canadian Manufacturers Association document entitled *Agenda for Action* which concluded:

“Canadians must come to grips with the fact that we have developed, relative to other countries, an environment of high production costs . . . a high level of personal and government services and high ideals in terms of equality of regional development . . . In the face of these pressures, Canada must urgently develop a clearly articulated vision of what industrial development it wants to maintain and develop”¹

Another major business association, the Canadian Federation of Independent Business, has come to a similar conclusion about the seriousness of Canada's problems and the necessity for a comprehensive industrial strategy to halt our economic decline. While the Federation is optimistic about Canada's future, it draws the following qualification:

"There is, however, one important qualification to the Federation's position: the Federation's faith is based on the expectation that Canada will adopt a dramatic new economic awareness that includes both a new set of economic goals and a new set of economic strategies. In short, Canada's future depends on the adoption of a new National Industrial Policy. With such a policy, it is possible — indeed, probable — that Canada can ride comfortably through the coming decades. Without such a policy, the economic forecast is far from pleasant."²

The Federation points out the importance of technology to a strategy of survival in a changing world:

"There is only one way out for Western nations like Canada; relying on impressive new technological innovation. For the most adept of the industrial nations — such as the United States — this will be a painful process involving enormous investments and considerable adjustments in the capital and labour market. For second-rate industrial nations like Canada, however, the transition will be immensely more difficult."³

As recognized by many of Canada's business associations, the major structural problems of Canada's industrial system will require concerted effort on the part of government, industry, and labour, working separately and together, to face the challenges of the coming years. Recent calls by the Canadian Manufacturers Association, the Canadian Federation of Independent Business, and many other business associations for a closer relationship with government to tackle these problems reveal a will to obtain cooperation between government and industry. Obviously, there is disagreement on procedure, but it would seem that the following points are clear:

1. Structural Change

In order to face the challenges of the coming years, Canada must embark on a lengthy process to change the structure of the economy — a process which may take one or more decades to complete. However, given our current problems and the changing international market, Canadians cannot afford to wait for the effect of long-term measures alone. Action on a combination of short- and long-term measures must begin now.

2. Industry-Government and Intergovernment Cooperation

In the future, there will be increased emphasis upon industry-government interaction. The emphasis must be placed on fostering increasingly sophisticated patterns of decision-making amongst labour, industry, provincial governments and the federal government: a trend which will place new strains on political institutions and on the will of the various parties to work closely together. The decision-making process will involve labour as well as government and industry, since many of the decisions will ultimately involve not only the form and location of industry, but also the form, location, and number of future jobs. Significantly, other countries such as France, Japan and the United States have recognized the importance of such linkages and have either formal or informal networks which involve government, labour, and industry in industrial policy making. While such cooperation will be more difficult in Canada, the recent final report of the industry-labour Second Tier Committee⁴ on industrial policies, established by the federal government, is a vivid demonstration that similar collaborative processes can work in Canada as well.⁵

3. *Building on Indigenous Strength*

A major component in the restructuring operation will be the attention devoted to the development of an indigenous technological capacity within Canadian industry. Canada's future as a developed industrial nation depends principally upon the intelligent use of existing and new technology. Consequently, many of the policy instruments needed in the restructuring process will have to concentrate on this important principle.

4. *Specialization*

An industrial strategy which attempts to do everything and produce every product cannot succeed. Technological sovereignty is not designed to develop autarky or to encourage a system of "top down" central planning. Rather it emphasizes the need for industry to specialize in those areas in which Canada clearly has natural potential or existing strength. It highlights the need to create an environment to facilitate the growth of innovative capability at the firm level regardless of the industry in which it is located.

Recommendations for a Technology Policy

Four policy objectives that could form the basis of a technology development strategy for Canadian industry should be implemented to overcome the problems of industrial and technological underdevelopment and truncation. They are:

1. Increasing the demand for indigenous Canadian technology.
2. Expanding the country's potential to produce technology.
3. Strengthening the capacity of Canadian firms to absorb technology.
4. Increasing the ability of Canadian firms to import technology under conditions favourable to Canadian industrial development.

Each objective will require policies and instruments designed both for immediate impact and for longer term structural changes. Some will be easier to implement than others and some will require more time to take effect. The proposed recommendations are listed in order of the speed with which they can be implemented and the time they will take to have an impact on the economy. *All* are regarded as essential.

We are proposing *policy objectives and instruments*, and *not* a detailed plan for implementation. Such a plan must be developed by the agencies responsible for implementing an industrial strategy. While many of the recommendations which follow involve a substantial role for government, Council does not advocate an extension of the role of the state in the affairs of industry. Rather, we are arguing for a sensible and more constructive re-ordering of the already substantial government presence in the economy to more effectively assist Canadian industry in meeting the challenges of a changing world economy — an economy increasingly dominated by state involvement in economic affairs.

Increasing the Demand for Canadian Technology

Government Procurement

Canadian industry is underdeveloped and truncated. Therefore, much of the demand for technology that would be expected in a normal industrial economy is not present. A demand for technology must be created in order to encourage firms to move into technology-intensive areas. In the short term,

this objective is probably best achieved through the use of government purchasing policy. Governments in Canada spend substantial sums procuring goods and services (some \$26.7 billion in 1974-75).⁶ A change in government policy designed to direct purchases to Canadian sources will have a considerable impact upon the demand for Canadian goods and services. Indeed, a recent study conducted for several federal government departments has shown that substantial benefits, both economic and social, accrue to Canadians through a procurement policy based on a preference for Canadian goods and services. The study showed that in many cases, a Canadian product, up to 76 per cent more expensive than a foreign product, can still provide significant public benefits which outweigh the additional short-term costs to the taxpayer.⁷ Several provincial governments have already moved in this direction as seen, for example, in the recent Ontario government policy to give a purchase premium to Canadian goods and services in placing its supply contracts.⁸

Of course, simply spending large sums of money on Canadian goods and services will not in and of itself promote the kind of development required from purchasing policies. Purchasing policies, and indeed subsidies and other assistance given to firms by government, should be guided by a number of objectives:

1. Conduct, in cooperation with industry, an internal review of suppliers to pinpoint firms with a high innovative capacity so that policies can be targeted to specific firms or industries;
2. Actively solicit from such firms industrial proposals with a high degree of innovative content and be ready to provide special support for such innovation;
3. Develop specific programs that help the innovative Canadian supplier expand the department's or government's own base requirements to the larger similar needs of wider markets;
4. Train government officials to recognize innovative capability and provide them with incentives to develop flexible procedures to facilitate positive interaction with the private sector.⁹

The federal government's recently announced procurement policy indicates a willingness to use its financial resources to encourage the development of Canadian industries based on science and technology.¹⁰ This is a helpful first step. Using some of the above criteria, this initiative should be pursued further to ensure a healthy and developing high-technology sector in Canadian industry.

As there are greater opportunities for developing Canadian industries geared to serving concentrated industrial and institutional markets than the consumer market, the use of government purchasing policies (aimed as they are at institutional markets) will form a useful and appropriate device to strengthen Canadian industry.

Major Programs

While government purchasing policies will have an immediate impact on the demand for Canadian products and technology, in the medium term the general preference for Canadian technology will have to be directed to specific sectors reflecting national needs and strengths. This is particularly important because only by specializing in specific areas will Canada be able to develop strong companies which will: a) be able to satisfy the government's require-

ments; b) be capable of meeting foreign competition within Canada; and c) be able eventually to compete on world markets. These objectives are probably best achieved through the implementation of major government programs specifically directed to particular projects.

By tackling a single project or problem, major programs create a focal point. The best example is the Canadian nuclear power program which grew as a result of a government effort to develop Canadian capability in nuclear engineering (AECL), which in turn led to a domestically-designed reactor system (CANDU). The project induced the development of Canadian suppliers for many of the sub-systems involved with the CANDU reactor by providing Canadian suppliers with government-initiated technology and the market necessary to justify the establishment of production facilities. While there have been difficulties in the linkages between private industry and AECL and with the "lumpiness" of the market for atomic power plants, much can be learned from our nuclear power program.

One of the principal lessons, of course, is that the program has allowed growth of an advanced technology industry in Canada capable of designing and building nuclear generating systems. This industry has been able to provide a large number of high quality employment opportunities for Canadians. Further, it has contributed to our balance of payments by providing an indigenous capacity to build nuclear plants without resorting to paying either licence fees to foreign firms or to importing highly sophisticated components to build reactors and nuclear power systems.¹¹ Further Canada is able to compete on a world-wide basis in the design and supply of nuclear reactor systems. Other examples of potential major programs which fit both Canadian national needs and possible strengths in world markets include the Maritime fishing industry, telecommunications systems, resource processing technology, transport systems, and health care supplies and services.

Trade Agreements

In terms of increasing the demand for Canadian technology and industrial capacity in general, the potential of trade agreements should be noted. Negotiated trade agreements offer a tremendous opportunity to expand markets, but such agreements have to be approached with considerable care and in full recognition of the strengths and weaknesses of Canadian industry. The Canada-US Auto Pact, for example, shows that while benefits to Canadian industry (particularly the vehicle assemblers) have emerged, the Pact has had a deleterious effect on the Canadian parts manufacturers. In fact, while Canada traditionally runs a trade surplus in assembled vehicles, our overall automobile trade account is in deficit due to massive imports of auto parts. The agreement has turned the Canadian automobile industry largely into an assembler of imported parts, rather than an industry with an indigenous design and manufacturing capability. The Auto Pact illustrates that trade agreements must be negotiated from the perspective of strengthening indigenous Canadian industry if they are to be of long-term benefit. For example, if the Auto Pact had included safeguards for auto parts production as well as for the assembly of cars, Canada might be encountering a substantially smaller balance of trade deficit in automobile trade. It might also be argued that a clearer recognition of the pace and impact of technological change on the Canadian industry would have led to an agreement providing for Canadian

participation in new automobile technology, hence a more viable long-term role for the Canadian industry.

Expanding Canada's Potential to Develop Technology

The Canadian industrial system will develop technologically advanced firms only if it is healthy. Policies structured on the assumption that R & D alone creates industrial strength are bound to be insufficient. In fact, the reverse is true: industrial strength creates the fertile ground necessary to promote excellence in research and development. For this reason, any policy seeking to increase Canada's capacity to develop technology will have to concentrate on creating a healthy business climate. This policy stance relies heavily on a sympathetic attitude to investment and corporate profits on the part of government. Short- and medium-term measures of specific benefit to the development of technology in industry (eg., the provision of financial support for research and development activities, and measures to enhance design and marketing capability) should also be considered.

In the long term however, emphasis must be placed on creating a healthy business environment from a *strategic* point of view — in other words concentrating on selected sectors and even specific firms. Examples of policies which could be followed under a longer term strategy are:

Core Companies

The sponsoring of core companies in specific sectors each with the basic industrial and technological strength to act as the lead firm for a whole sub-industry of smaller companies. A good example of this strategy is the role played by some of Canada's large aerospace and telecommunication companies in creating a market for high-technology electronic and engineering components in the production of satellites, aircraft and telecommunications switching equipment, etc. This, in turn, has led to the development of a number of technologically sophisticated subcontractors supplying the companies with highly specialized components.¹² The stimulus provided by the presence of such major companies has assisted the establishment of strong and highly specialized aerospace and telecommunications sectors in Canadian industry.

Consortia and Joint Ventures

The encouragement and sponsoring of mergers between firms, joint ventures between government and industry (where private industry wishes to share the risk), and consortia between various groups of firms to provide the scale of enterprise needed to allow research and development to flourish. Naturally, sectors in which such activity is to be encouraged must relate to Canada's indigenous strengths. In general, the growth of larger companies with demonstrated innovation potential should be encouraged. Not only would their capacity to conduct research and development increase, but also these larger firms would generate greater "spin-off" business for many small, highly specialized suppliers.

Aid to Small Firms

As small firms can be highly innovative, particular attention needs to be devoted to their problems, especially in the technologically advanced industries. Strong emphasis should be placed on financial and marketing aid to such firms, particularly in terms of encouraging them to seek membership in larger

consortia within Canada in order to build up their marketing capability. Frequently the innovations marketed by such companies are the product of the efforts of a single entrepreneur, struggling in a harsh competitive environment. To such individuals, government financial assistance or services can be of great help. However, these people work in frequently uncertain and constantly changing situations. Therefore government assistance to the small entrepreneur must be flexibly structured and must be delivered as expeditiously as possible. Without government attention to the structuring of its assistance to the small entrepreneur, many opportunities to maintain and expand the small technologically innovative firms so necessary to a viable high-technology industry, will be lost.

Innovation is primarily the product of individuals. Special attention must be paid to the business environment which enables such individuals to prosper, and also to the training process of new generations of innovators and entrepreneurs. Young people entering careers in industry need a better understanding of the importance of technology and engineering in the productive process (particularly how this process functions in the Canadian context) and the important role of innovation in developing strong companies.

To this end, strong links should be encouraged between the universities and community colleges and small- and medium-sized firms. This would give students in scientific and technical disciplines, as well as those in commerce and business administration, a greater understanding of industrial problems and how their newly acquired skills can be applied to industrial needs. Greater use of cooperative work/study programs to give students practical experience while pursuing their studies should be encouraged. In addition, the universities and community colleges should become more involved in providing research services for specific industrial sectors; thus enabling both students and staff to have a practical opportunity to apply their skills while at the same time increasing the technical capability of small- and medium-sized firms.¹³

In this regard, the Science Council strongly supports the recently announced plans by the federal government to establish industrial innovation centres on a regional basis at selected universities.¹⁴ The centres will provide advice on, and assistance with, the technical development and commercialization of new technologies and industrial processes for small- and medium-sized firms. They will provide facilities for teaching and research on the technical innovation/entrepreneurship process in industry. These centres would provide an excellent opportunity to furnish badly needed technical development assistance to small- and medium-sized firms. At the same time they would also give future engineers, scientists and businessmen a realistic appreciation of the process of innovation and entrepreneurship in the business world.

Encouraging core companies, mergers, small innovative firms and entrepreneurs is the positive side of improving the technological and innovative capacity of Canadian industry. However, there will also be unpleasant side-effects such as the phasing out of some industries and firms, the moving of plants, and changes in product lines and processes, resulting from the need to encourage rationalization and specialization. Such a situation will naturally cause hardship in terms of the location of industrial activity and jobs. These effects can be kept to a minimum by a longer term and broader approach to adjustment policies, which is preferable to short-term reaction to crises and to rationalization imposed by external influences.

Strengthening the Capacity for Technology Absorption at the Enterprise Level

Fortunately, Canada has had a small, but important, number of dynamic domestically-owned companies that have been able to overcome some of the significant problems of the country's business environment and develop important new products utilizing advanced technology or superior design and engineering capacity. The member firms of the Canadian Advanced Technology Association are a good example of such companies. They demonstrate how individual firms and entrepreneurs are capable of overcoming the disadvantages of working in difficult technical and economic conditions.

However, many Canadian firms which are not foreign controlled are technologically isolated, backward, and lack design and marketing capability. Indeed, management in Canadian firms is often reluctant to adopt or develop innovations. In part, this problem is due to the fact that many Canadian-owned firms are small, with little or no financial ability to assume the risks associated with developing or implementing a new technology or product. However, part of the problem also lies in the attitude of the managers themselves who are often reluctant to become involved with unfamiliar new technologies. This attitude is also paralleled in some foreign-owned subsidiaries in which executive incentives stress qualities associated with line management and good administration, rather than to risk taking and innovation.

In addition, much of the technical information flowing from universities, government laboratories, research institutes and sources abroad is channeled into larger firms. Canadian firms, mostly small, lack access to these information "pipe-lines" and are often woefully ignorant of technological changes and design and marketing possibilities which would enable them to improve their sales and productivity performance.

Thus there is a real need to increase the ability and willingness of smaller domestic firms to absorb existing and new technology and to combine it with intelligent design and effective marketing. Only if these attitudes are encouraged can such firms survive to play a meaningful role in helping to develop Canada's industrial potential.

As a group, therefore, small- and medium-sized manufacturing firms in Canada need to increase their innovative capability and become more productive through access to a continuous systematic flow of information and by encouragement and advice about product and production technology and its exploitation. Unfortunately it is not sufficiently well known in policy circles that, compared with other industrial countries, these firms suffer from relative neglect with respect to the publicly funded technological assistance.

Sectorally oriented technical centres, knowledgeable of the problems faced by small firms, are needed to help alleviate this situation. Prototypes of these centres already exist in Canada. For example, federal government and industry cooperation have been instrumental in establishing the Sulphur Development Institute of Canada, the Canadian Welding Development Institute and the Canadian Gas Research Institute to help firms to develop technology appropriate for their industrial needs. An extension and modification of these industrial research centres to suit the needs of small- to medium-sized firms would help to increase the interface between the many sources of technology and information and the many small- and medium-sized companies.

Such centres could also serve to link firms with new product ideas with product design and marketing specialists, as well as strengthen and foster

Canadian capability in these two critical areas. Various forms of assistance (e.g., loans) and incentives to promote such linkages can be envisaged. Ideally, centres should be established by the user industries and should be financially supported, at least in part, by these industries. While government should assist the establishment of technical centres by providing encouragement, grants, tax incentives, etc., the full value of such centres will only be realized if they are actively supported by the user firms.

With domestic firms able to use technology effectively, Canadian-owned firms would develop into the core companies of the economy: core companies playing a leading role within Canada, and eventually abroad, in developing areas of specialization.

Increasing the Ability of Canadian Firms to Import Technology Under Conditions Favourable to Canadian Industry

Canada always has been, and always will be, a major user of foreign technology. The problem is not the use of foreign technology, but the conditions placed on the manner in which that technology is used. "Tied" technology is technology that comes into Canada through branch plants of foreign multinationals and is used only for the domestic purposes of the firms concerned. Possibilities for using imported technology to develop distinctive products within Canada for domestic use and to exploit export markets are therefore lost. Such technology can only be used in the manner deemed appropriate by the subsidiary's parent firm. Further, because many indigenous Canadian firms are small and weak they are often not in a position to negotiate effectively with foreign firms to obtain technology on favourable terms. Consequently, Canada has generally been unable to capitalize on many of the opportunities afforded by purchased foreign technology for the creation of an indigenous technological capability. Thus Canada has relinquished many industrial growth possibilities: the result is loss of income and employment opportunities which can flow from the use of foreign technology. Coherence between the importation of foreign technology and Canada's industrial and technological priorities and objectives, as defined by an industrial strategy, is required.

Since foreign technology in Canada is imported through multinational corporations (MNCs), the federal government should consider policies designed to encourage MNCs to become sensitive to the impact of their technology imports on the Canadian economy. Such policies should aim at achieving the following objectives:

1. To secure the maximum advantage for Canada from imported technology.
2. To coordinate the import of technology by foreign firms and to harmonize such imports with the objective of the selective development of Canadian technological capability, as outlined by an industrial development strategy.

Several methods are available to accomplish these objectives. For example, the federal government could insist that when MNCs invest in Canada, they locate as many of their new technology purchases here as possible to assist the development of domestic suppliers. Or it could insist that in return for investment opportunities in Canada, multinationals make certain types of advanced technology available to Canadian firms on a licensed basis. In cases in which the multinational is intimately linked with a specific technology — a

computer company, for example — various ways (e.g., joint ventures) of requiring Canadian equity participation and/or collaborative arrangements with Canadian firms in the area, should be considered. The fact that these conditions are imposed by foreign countries on *Canadian* firms operating within their jurisdictions should serve as a salutary lesson to Canadian policy makers that Canada's uncritical attitude to foreign investment, especially in sensitive high-technology areas, is unlikely to be reciprocated abroad.¹⁵

Indeed, policy makers should be encouraged by the positive contribution some foreign multinationals are making to the Canada's industrial development by providing their local subsidiary with a "world product mandate". In such instances, the subsidiary is charged with developing a new product, or products, by the parent firm for the world market. Once the subsidiary has conducted the necessary product research and development work, it is then charged with producing the product or products and marketing them on a world-wide basis. This trend should be encouraged, since it helps to overcome some of the problems (e.g., truncation) caused by the high level of foreign investment in Canada. A world product mandate leads to specialization or a product niche which, in turn, leads to longer production runs, consequent economies of scale, and hence, greater competitiveness. Such an arrangement also allows many of the "spin-off" effects of industrial activity to have a greater impact in Canada than normal. When a particular product is developed, designed, marketed, and exported entirely from Canada, the use of Canadian R & D, marketing, design, and other industrial services is greatly increased with consequent employment benefits. By encouraging foreign multinationals to give their Canadian subsidiaries a world product mandate, greater benefits to the domestic economy from foreign-owned firms would be ensured. Thus, by building on a positive development emerging from some of the more progressive multinationals, a greater level of benefits could be obtained for Canada.

Additional strategies will have to be employed in order for Canadian firms to obtain foreign technology. Owing to the fact that most Canadian firms will buy their technology abroad from large multinationals or from large foreign based corporations, government help will likely be required to give small Canadian firms the negotiating power necessary to obtain favourable conditions in the exchange of technology. The tendency to negotiate on a government-to-government basis for trade in many items (e.g., strategic commodities like oil and technology) between both developed and developing countries will make this increasingly possible. The exchange of oil in return for industrial technology and plants which has typified much of OPEC's trade relationship with Western countries is one example.¹⁶ In addition, many Western governments are insisting that when they are required to place large government contracts for sophisticated high-technology items (e.g., defence equipment) from abroad that offsets in the form of orders to local business and the provision, under favourable conditions, of foreign technology to domestic firms be undertaken by the supplying government or firm.

The four objectives of a possible technology development strategy are just a beginning and are meant to be *illustrative* of possible ways in which Canada should proceed to develop a technology policy for industry. As the first steps toward an industrial strategy, they will not be sufficient in themselves. Much effort must go simultaneously into finding devices and mechanisms which will allow Canadians to restructure many mature technology industries effective-

ly. In addition as much attention will have to be paid to the political aspects of implementing an industrial policy (i.e., industry-government relations and federal-provincial relations) as is paid to the technical and economic aspects.

Postscript

Forging the Links has outlined an analysis of the problems facing the Canadian economy and some possible directions to follow in overcoming these problems. There can be no doubt that world economic conditions are changing and pose a significant challenge. The proposals put forward in this Report are only a partial answer. However, in conjunction with measures to strengthen the business climate in Canada, they should provide the opportunity to address our industrial problems. The significant structural problems facing Canadian industry and the forces reshaping the world economy must be confronted if the Canadian economy is to meet the challenge of the coming decades. It is essential if Canada wishes to follow a policy of freer trade that a reorientation of our industry be implemented, and in large measure achieved, before negotiating more open trade arrangements. Only by rebuilding the Canadian economy, in part, through an industrial strategy stressing technological sovereignty, will Canadians be able to meet international competition effectively.

Notes

I. Introduction

1. Includes world trade between market economies, excluding trade between and with the command economies.
2. The only other industrialized country to lose a substantial share of world trade was the United States. The US share of total world exports slipped from 16.2 per cent in 1970 to 14.6 per cent in 1975. However, during this period the United States share of world manufactured exports declined by only 0.5 per cent (16.9–16.4).
3. Calculated using data from: United Nations, *Statistical Yearbook*, United Nations, New York, United Nations, *Yearbook of International Trade Statistics*, United Nations, New York, various years.
4. IBI Group, *The Orientation of Canadian Service Industry*, Toronto, March 1978 (mimeo).
5. See for example, J. I. Gershuny, "The Post-Industrial Society: The Myth of the Service Economy", *Futures*, Vol. 9, April 1977.
6. Finally, there has been much discussion over the past year of whether the impact of a falling exchange rate will increase our exports over the long term. While it is certain to have some short-term impact on our balance of trade, given that the existing pattern of Canadian imports and exports is in large measure determined by the structure of the Canadian economy, this is not likely to be long lasting. With a high propensity to import components and finished manufactured goods, devaluation will increase Canadian manufacturing costs and contribute to inflation. Devaluation will have an impact in increasing our exports of raw and semi-processed materials where Canada is a high cost producer, but this may only be a temporary phenomenon. Indeed, the analysis of recent trade figures indicates that export expansion which has occurred as a result of devaluation has been predominantly in raw materials rather than finished goods. In addition, inflationary pressures due to devaluation (e.g., winter vegetable prices, imported finished goods) have still to be fully felt in terms of their impact on wage demands and hence on the costs of production. Thus, while devaluation is a possible short-term expedient to our balance of payments problems, it will not overcome longer term weaknesses.
7. Science Council of Canada, Report No. 24, *Technology Transfer: Government Laboratories to Manufacturing Industry*, Information Canada, Ottawa, 1975.
8. It could be argued that the only occasion when Canada had an industrial strategy of any kind was during the latter part of the 19th century when the National Policy was implemented.
9. See A. Careless, *Initiative and Response: The Adaptation of Canadian Federalism to Regional Economic Development*, McGill-Queen's University Press, Montreal, 1977, Ch. 6.
10. See the Statement by the Minister of Industry, Trade and Commerce on the creation of the new department in, *House of Commons Debates*, 11 March, 1969, pp. 6491-6495.
11. For a review of some of the industrial policies among Canada's trading partners see, *Report on Selected Industrial Policy Instruments*, OECD, Paris, 1978; *Policies for Promoting Industrial Adaptation*, OECD, Paris, 1976; *The Aims and Instruments of Industrial Policy: A Comparative Study*, OECD, Paris, 1975; K. Pavitt and W. Walker, "Government Policies Toward Industrial Innovation: A Review", *Research Policy* Vol. 5, 1976; *Direction for Japan's Industrial Structure*, Ministry of International Trade and Industry, Tokyo, October 1974.

II. Increasing Vulnerability in a Changing World

1. J. N. Britton and J. M. Gilmour, Background Study No. 43, *The Weakest Link: A Technological Perspective on Canadian Industrial Underdevelopment*, Science Council of Canada, Supplies and Services Canada, Ottawa, 1978, pp. 28-30.
2. *Ibid.*, pp. 30 and 120-121.
3. Speech by L. D. Clarke, Chairman, Spar Aerospace Products Ltd., "The Challenge of Technology to Canadian Industry" Toronto, 27 May 1977. See also, National Science Board, *Science Indicators*, 1976, Washington, DC, US Government Printing Office, September 1977 pp. 33-41, 125-127; and M. Boretsky, *US Technology: Trends and Policy Issues*, Monograph 17, George Washington University, Washington, DC, 1973.
4. Excluding trade in automobiles. Trade in automobiles has been excluded as it is in large measure conducted under the aegis of the Canada-US Auto Pact and is, in general, made up of inter-corporate transfers between the four North American car manufacturers under conditions which do not apply to normal trade between countries in industrial commodities.
5. Science Council of Canada, *Uncertain Prospects: Canadian Manufacturing 1971-1977*, Ottawa, October 1977, pp. 17-19.
6. Britton and Gilmour, *op. cit.*, pp. 73-76.

7. *Ibid.*, pp. 73-82.
8. *Ibid.*, p. 55.
9. A major initiative in the field was taken when the UK government commissioned a series of studies on the impact of microprocessors on the UK economy. (The first of these was published recently by the Advisory Council for Applied Research and Development, *The Applications of Semiconductor Technology*, HMSO, London, 1978 and others are due in the near future.) In addition, the government-sponsored National Enterprise Board has made a major investment in microprocessor manufacturing capacity and the Department of Industry is sponsoring industrial projects related to the development and manufacture of microelectronic products to the amount of £70 million, and applications grants to assist industrial application of technology to new products to a total of £55 million. The French government is also considering significant action in this area and has already published one report recommending a wide range of government policies (*L'Informatisation de la société*, Documentation française, Paris, 1978).
10. Science Council of Canada, Report No. 27, *Canada as a Conserver Society: Resource Uncertainties and the Need for New Technologies*, Supply and Services Canada, Ottawa, 1977.
11. J. Kettle, "Direction Canada: Problems Ahead for Natural Resources", *Executive*, February, 1978.
12. *Ibid.*
13. Estimate based on revised oil import figures supplied by Energy, Mines and Resources, and the latest export projections for oil supplied by the National Energy Board in their publication, *Canadian Oil: Supply and Requirements*, Supply and Services Canada, Ottawa, 1978.
14. The future state of Canada's balance of trade in energy is indeed problematic. While it is certain that we will be running a sizeable crude oil deficit by 1985, the size of our exports of natural gas, coal and uranium are more uncertain. As a result of better conservation measures and slower growth, it would seem that we may escape the \$800 million balance of payment deficit in energy trade predicted by Energy, Mines, and Resources (EMR) in their 1976 report, *An Energy Strategy for Canada*. However, the degree to which increased exports of other energy resources, such as natural gas, will be able to provide a positive balance of trade in energy is uncertain and will depend on a number of factors such as rates of discovery, world prices, competing export sources and the growth of Canadian demand.
15. Britton and Gilmour, *op. cit.*, p. 148.
16. *Ibid.*, p. 149.
17. See, "Japans New Electronic Goodies", *The Economist*, 22-28 April 1978, pp. 84-85.
18. J. L. Orr, *US Proposals for a "National Technology Policy" and their Impact on Canada*. Report prepared for the Science Council of Canada, August 1977. See also, M. Boretsky, *op. cit.*, and, M. Boretsky "Trends in US Technology: A Political Economist's View", *American Scientist*, January 1975.
19. A recent example is, J. G. Frank, *Assessing Trends in Canada's Competitive Position*, The Conference Board in Canada, Ottawa, 1977.
20. *Ibid.*, p. 8.
21. For a review of the economies of scale at the plant level see, F. M. Scherer, *et al*, *The Economies of Multi-Plant Operation: An International Comparisons Study*, Harvard University Press, Cambridge, Mass., 1975; and for a general review of the issue see, D. J. Daly, "Economies of Scale and Canadian Manufacturing", *Appropriate Scale for Canadian Industry*, Science Council of Canada, Ottawa, February 1978. For a differing perspective see, B. A. Stein and M. Hodax, *Competitive Scale in Manufacturing, The Case of Consumer Goods*, Centre for Community Economic Development, Cambridge, Mass., 1976; and Rein Peterson, *Small Business: Building a Balanced Economy*, Press Porcépic, Erin, 1977, esp. Ch. 6.
22. This has been one of the strengths of the Swiss industrial performance. By stressing product excellence, good industrial design, and an emphasis on products with unique and highly specialized performance characteristics, the Swiss economy has prospered. A concentration on such industrial activity has led to export products which are highly insensitive to price fluctuations and have allowed the Swiss to have a high wage economy, a highly valued and a stable currency, a positive balance of payments and a low inflation rate. See, R. S. Collins and J. K. Owens, "Swiss Francs and Rising Exports: A Paradox", *The Business Quarterly*, Summer 1978.
23. See, D. J. Daly and S. Globerman, *Tariff and Science Policies: Applications of a Model of Nationalism*, University of Toronto Press, Toronto, 1976.
24. For a recent discussion of many of these issues see the following articles in the Spring 1978 issue of the *Journal of Canadian Studies*; D. A. Wolfe, "Economic Growth and Foreign Investment: A Perspective on Canadian Economic Policy 1945-1957"; C. J.

McMillan, "The Changing Competitive Environment of Canadian Business"; and W. T. Hunter, "Toward Free Trade? The Dilemma of Canadian Trade Policy". See also, Britton and Gilmour, *op. cit.*, pp. 50-51.

25. J. L. Orr and G. T. McColm, *The Significance of the "Duty Exemption" Factor in Canadian Imports of Manufactured Goods*, Technovation Consultants, Ottawa, 19 June 1978, (mimeo).

26. *Ibid.*

27. The issue of truncation in Canadian industry has received substantial attention. On R&D specifically see, A. J. Cordell, Background Study 22, *The Multinational Firm, Foreign Direct Investment, and Canadian Science Policy*, Science Council of Canada, Information Canada, Ottawa, 1971; on innovation P. L. Bourgault, Background Study 23, *Innovation and the Structure of Canadian Industry*, Science Council of Canada, Information Canada, Ottawa, 1972; and in general, Government of Canada, *Foreign Direct Investment in Canada*, Gray Report, Information Canada, Ottawa, 1972, esp. Part Four.

28. See, The Gray Report, *op. cit.*

29. For a discussion of some of the issues relating to improving the government-industry interface, see, *How to Improve Business-Government Relations in Canada*, MacLaren Report, Department of Industry, Trade and Commerce, Ottawa, September 1976.

III. The Need for Innovative Industry in Canada

1. See, Britton and Gilmour, *op. cit.*, esp. Chapters 5 and 6.

2. Innovation Committee of the National Design Council, *Commercial Innovation in Secondary Industry* Ottawa, 1978, (mimeo). For more details on the report and its contents see, "Tax incentives urged to encourage innovation by manufacturers", *The Globe and Mail*, 14 November 1978, p. B.7.

IV. The Goal: Technological Sovereignty

1. Canadian Manufacturers Association, *Agenda for Action*, CMA, Toronto, September 1977, pp. 17-18.

2. Canadian Federation of Independent Business, *An Industrial Policy for Canada*, CFIB, Toronto, February 1978, p. 2.

3. *Ibid.*, p. 5.

4. See the Report of the Committee, *A Report by the Second Tier Committee on Policies to Increase Canadian Competitiveness*, Department of Industry, Trade and Commerce, Ottawa, October 1978.

5. In this connection, it is encouraging to note the federal government's initiative in creating an advisory committee to the Minister of State for Science and Technology. Chaired by the Science Council and composed of members drawn from industry and the universities. This committee is charged with recommending policies aimed at intensifying Canada's national innovative effort. Procurement policies, venture capital support, and taxation matters are some of the issues being reviewed in this pragmatic and cooperative framework.

6. Based on information provided by the Department of Supply and Services. Data are the most recent available and do not include government in-house expenditures on wages and salaries, etc.

7. Bureau of Management Consulting, *Economic Justification for Payment of a Procurement Premium*, Vol. 1. Supply and Services Canada, Ottawa, June 1978.

8. *The Globe and Mail*, 20 June 1978. Quebec and several of the Maritime provinces have a similar policy.

9. For a discussion on this issue with respect to government scientific agencies see, Science Council of Canada, Report No. 24, *Technology Transfer: Government Laboratories to Manufacturing Industry*, Supply and Services Canada, Ottawa, 1975, esp. pp. 21-22 and 28-41.

10. The measures announced by the Minister of State for Science and Technology included increased support for R&D. For full details of the policy see the Minister's Statement in *House of Commons Debates*, 1 June 1978; and, *Measures to Strengthen and Encourage Research and Development in Canada*, Press kit, MOSST, June 1978.

11. For a discussion on the CANDU system see, Science Council of Canada, Report No. 23, *Canada's Energy Opportunities*, Information Canada, Ottawa, 1975, esp. pp. 111-114.

12. See speech by L. D. Clarke, *op. cit.*

13. There are, of course, other issues involved in the role post-secondary institutions can play in an industrial development strategy. One of the most important is that they provide sufficient numbers of the appropriately trained, innovative graduates. However, as this study has been concerned with the problems of the lack of demand in the economy for technologically innovative graduates due to the difficulties of the Canadian industrial system, the important question of the need for an appropriate supply of graduates has been left for future studies.

14. See the announcement by the Minister of State for Science and Technology in, House of Commons, *Debates*, Vol. 121, 3rd Session, 30th Parliament, June 1978, p. 5965.

15. Even less wealthy countries, such as Turkey, are reluctant to see foreign investment in high-technology areas of their economies without significant local involvement – even when that investment comes from as small a country as Canada. For example, when Northern Telecom established a presence in Turkey to manufacture telecommunications equipment they were required by the Turkish government to allow a substantial equity stake to be taken in the subsidiary by the country's Post, Telegraph and Telephone Administration.

16. Saudi Arabia, Algeria and Iran have been particularly interested in large turnkey projects for whole industrial complexes.

Dissents

Professor D. J. Daly, Dr. G. Sinclair and Mr. R. D. Richmond, members of the Industrial Policies Committee, wish to record their dissent to passages in the Report. Professor Daly would like to express his reservations concerning the analyses presented on pages 24-30 and 37-30 in Chapter II, as well as the recommendations contained on pages 48-56 in Chapter IV. Dr. G. Sinclair, also expressed reservations concerning the recommendations on pages 48-56 in Chapter IV, although the nature of his dissent differed from that of Professor Daly's. While agreeing with the recommendations (summarized on page 48) Mr. R. D. Richmond disagreed with the emphasis placed in the Report on technological sovereignty as the solution, in view of the complexity of our economic and industrial problems.

Index

- AECL, 50
- Aerospace industry, 25n, 42, 51
- Aesthetic appeal of products, 43
- Agencies, federal, 19-20
- Alberta, 40
- Algeria, 63n
- Assembly manufacturing, 7, 33, 34, 50
- Atomic:
 - energy, 42
 - power plants, 50
- Automobile industry, 50-51, 60n
- Auto Pact, 37, 50, 60n
- Balance of payments, 50, 60n
 - deficit, 24, 25, 33, 36, 50, 61n
 - positive, 24
 - surplus, 24, 25n
 - viable, 20
- Balance of trade, 60n, 61n
- Balkanization of economy, 21
- Blue-collar occupations, 28
- Branch plants, 34, 54
- Brazil, 31, 33
- Britain, 28
- Business associations, 47
- Business environment, 52, 53, 57
 - healthy, 11, 51
 - improved, 7
- Canada as a Conserver Society*, 32
- Canadian Advanced Technology Association, 53
- Canadian dollar, 35
- Canadian Federation of Independent Business, 46-47
- Canadian Gas Research Institute, 53
- Canadian Manufacturers Association, 46, 47
- Canadian Welding Development Institute, 53
- CANDU 50
- Cartel, 33
- Community college, and business, 52
- Competitive:
 - in resources, 32
 - strength, effective, 43
 - structure, 35-36
 - weakness, 15, 35
 - world climate, 14
- Competitiveness, international, 33-34, 35, 36, 37, 42, 43, 50, 55, 57
- Conservation, 32, 61n
- Consortia, 51
- Core companies, 51, 52, 54
- Currency, falling, 7
- Current account:
 - deficits, 14
 - surplus, 15
- Decision-making mechanism, 47
 - weakness, 39-40
- Deficits:
 - current account, 14
 - invisible trade, 24
 - trade, 26
- Deindustrialization, 28-30, 46
- Denmark, 26
- Department of Communications, 20
- Department of Consumer and Corporate Affairs, 20
- Department of Defence Production, 19
- Department of Energy Mines and Resources, 20, 61n
- Department of the Environment, 20
- Department of Finance, 20
- Department of Industry, 19, 61n
- Department of Industry, Trade and Commerce, 19, 55
- Department of Regional Economic Expansion, 20
- Department of Supply and Services, 20
- Department of Trade and Commerce, 19
- Design:
 - indigenous, 50, 51, 53, 54n, 55
 - innovation in, 43
- Design Council of Canada, 44
- Devaluation, 60n
- Developing countries, 32, 33, 38, 55
- Development:
 - economic, 39
 - strategy, 42-43, 48, 56
- Domestically-owned companies, 53
- Economic:
 - activity, 11, 40
 - conditions, changing international, 14, 26, 31, 39, 57
 - decline, nature of, 24-30, 46
 - disparity, 39-40
 - environment, absence of, 11
 - goals, 47
 - growth and government, 11, 20, 39
 - indicators, 15
 - performance, 16
 - policy, 20, 39-40, 46
 - problems, present, 14, 20-21
 - trends, 30-31
 - western system, 14
- Economies:
 - industrial, 7, 11, 14, 37
 - industrialized, 17, 29
 - market, 21, 60n
 - "political," 21
 - world, 11, 17, 19, 31, 33-34, 39, 48, 57
- Economy:
 - advanced industrial, 11, 31
 - decline of, 14, 15
 - high-wage, 35, 42, 44
 - low-wage, 31
 - post-industrial, 16
 - structure of, 47
 - weakness of, 14, 15
- EEC, 37
- Efficiency of products, 43
- Electricity generation, 42
- Electronic technology, 25n, 31, 34, 43, 51

- Employment:
 - administrative, 28
 - declining, 28, 30
 - domestic, 15
 - full, 20
 - generation of, 26, 38
 - high, 7
 - high-quality, 34, 50
 - industrial, 16
 - levels of, 18, 46
 - managerial, 28, 38
 - opportunities, 42, 46, 54, 55
 - professional, 28, 38
 - quaternary, 28
 - service, 16, 17, 28
 - technical, 28
- Energy:
 - pricing, 40
 - resources, renewable, 32, 61n
 - and world trade, 33, 61n
- Engineering:
 - capacity, 53, 54n
 - innovation, 43, 51
- Entrepreneurial activity, 31
- Entrepreneurship, encouragement of, 52, 53
- Environmental:
 - degradation, 32
 - factors, 42
- Europe, 21, 26, 29, 34
- Exchange rate:
 - falling, 60n
 - high, 35
- Exports:
 - encouragement of, 19
 - of energy, 61n
 - expanding, 11, 17, 26, 60n
 - world, 15, 16, 32, 33, 34, 37, 60n
- Far East, 21, 34
- Financial services, as invisible trade, 24
- Finished goods, 26, 33, 60n
- Fishing industry, 50
- Flexibility of procedures, 35
- Foreign capital, 38
- Foreign exchange earnings, 33
- Foreign investment, 63n
 - direct, 39, 55
 - as invisible trade, 24
- Foreign investment review procedures, 54
- Foreign-owned firms, 39, 53, 55
 - and invisible trade, 24
 - and truncation, 18n
- Foreign-ownership, 18, 20, 24, 32, 35
 - and truncation, 37-39
- France, 47, 61n
 - and world trade, 16, 26
- Free trade, 36-37, 57
- GATT negotiations, 21
- Germany and world trade, 16
- GNP, 11
- Government:
 - action, need for, 11
 - assistance, 51-52
- federal, 14, 18, 19, 20, 21, 39, 40, 47, 55
 - and industrial policy, 19-21
 - and industry, 18, 21, 40, 47, 51, 53, 56, 62n
 - laboratories, 18, 20, 53
 - provincial, 14, 18, 20, 21, 39, 40, 47, 49
 - purchasing, 49
- Growth:
 - economic, 11, 20, 39
 - industrial, 25-26
 - rate of, 32
- Health care supplies and services, 50
- High-cost producer, 60n
- Imports:
 - competition from, 11
 - and domestic market, 17
 - duty-free, 36-37
 - manufactured, 33
 - high-technology foreign, 26
- Indigenous strength, 48, 50, 51
- Industrial:
 - base, 11, 14
 - capability, 16, 26
 - capacity, 34, 50
 - decline, 14, 16, 17, 20, 24
 - development, 15, 19, 38, 46, 54, 55, 62n
 - discontinuity, 46
 - dislocation, 35
 - growth, 25-26
 - inefficiency, 35, 36, 37
 - organization, 32, 42
 - system, health of, 14, 24
 - system, failure of, 17
 - weakness, 17, 24, 28, 35-39
- Industrial assistance programs, 19
- Industrial innovation centres, 52
- Industrial policy, 14, 39, 40, 46, 47, 56
 - past, 19-21
- Industrial research centres, 53-54
- Industrial strategy, 7, 14, 18-19, 20, 21, 37, 40, 54, 56, 57, 60n
 - background for, 46-48
 - purpose of, 46
- Industrial structure, 7, 20, 28, 35, 39
- Industrialized countries, 15, 24, 28, 29, 32, 33, 34, 39, 60n
- Industrializing countries, 31, 34
- Industry-government relations, 18, 21, 39, 46, 47, 51, 53, 56, 62n
- Inflation, 20, 60n, 61n
 - high, 20
- Innovation in a Cold Climate*, 18
- Innovative:
 - capability, 32, 42, 43-44, 48, 49, 51, 53
 - capacity, 7, 18, 31, 34, 49
 - efforts, 62n
 - expertise, 43
- Institutional problems, 19-20
- International:
 - changing economic conditions, 14, 20, 31, 39, 57

- comparative advantage, 42
- competition, 33-34, 35, 36, 37, 42, 43, 50, 55, 57
- trade, 15, 21, 40, 47
- International Iron and Steel Institute, 34
- Iran, 63n
- Ireland, 26
- Japan, 47
 - and new industrial revolution, 31, 33-34
 - and world trade, 16
- Joint ventures, 51, 55
- Korea, 31, 33, 34
- Labour:
 - cooperation with government and industry, 46, 47
 - costs, high, 31, 35
 - costs, lower, 7
 - force, inexpensive, 33, 34
- Laissez-faire, 21
- Latin America, 34
- Licences, 50
 - as invisible trade, 24
 - for technology, 54n, 55
- Looking Northward*, 18
- Manufacturing:
 - capability, 16
 - costs, 60n
 - crisis in, 11
 - decline in, 11, 18
 - problems in, 18
 - secondary, 42
 - traditional, 7, 34
 - weakness in, 35
- Manufactured products, 7
 - duty free, 37
 - export of, 16
 - trade in, 24, 25, 33
- Maritimes, 40
- Marketing:
 - capabilities, 43, 51, 53, 55
 - capacity, 37
- Markets:
 - concentrated, 20
 - consumer, 31, 42
 - domestic, 17, 31, 34, 37
 - forces, 35
 - institutional, 42, 49
 - international, 18, 19, 35, 37, 47, 56
 - specialized, 43
 - world commodity, 31, 32, 35, 44
- Mature products, 33
- Mexico, 26, 33, 38
- Microprocessors, 31, 61n
- Mineral production, 32, 33, 42
- Multinationals, foreign-based, 24, 34, 38, 54, 55
- National Energy Board, 61n
- National Enterprise Board, 61n
- National Industrial Policy, 47
- National Policy, 60n
- National strategy, absence of, 40
- New industrial revolution, 7, 30-32, 42
- Northern development strategy, 18, 42
- Northern Telecom, 63n
- Norway, 26
- Nuclear power program, 50
- Ocean technology, 42
- OECD, 38
- Oil, 20, 24, 31, 33, 55, 61n
- Ontario, 40, 49
- OPEC, and price increases, 20, 55
- Patents, as invisible trade, 24
- Pearson, Lester B., 19
- Policy:
 - economic, 20, 39-40, 46
 - industrial, 14, 39, 40, 46, 47, 56
 - objectives, 48
 - past industrial, 19-21
 - priorities, 20
 - remedies, 11
- Price stability, 20
- Procurement policy,
 - government, 48-49
- Production runs:
 - costs, high, 31, 46, 60n
 - longer, 55
 - optimal, 37
 - short, 35
- Profits:
 - corporate, 51
 - of foreign-owned firms, 24
- Purchasing policy, government, 49
- Quebec, 40
- Raw materials, 31, 32, 33
 - export of, 17, 33, 60n
- Recession, international, 14
- Regional:
 - aspirations, 40
 - centres of power, 39
 - development policy, 19, 46
 - differences, 39
 - disparity, 39-40
- Reliability of products, 43
- Research and development, 18n, 20, 29, 31, 34, 37, 42, 43, 44, 51, 54n, 55
- Research institutes, 53
- Resource:
 - based industries, 25
 - conservation, 32
 - exports, 24, 32, 33, 42
 - extraction, 16, 29, 39, 42
 - pressure on, 32-33
 - processing, 50
 - shortage, 33
- Saskatchewan, 40
- Satellites, 51
- Saudi Arabia, 63n
- Scale:
 - economies of, 55, 61n
 - of manufacturing, 31, 35
- Science:
 - and industrial system, 18

- and technology, 11, 14, 31, 32, 49
- Scientific knowledge, raw, 43
- Second Tier Committee, 47
- Selective development, in high technology, 42-43, 46
- Semi-industrialized countries, 33
- Service:
 - occupations, 16, 17, 28
 - sector, 42
- Size:
 - of Canadian market, 35, 42
 - optimal, 37
- Small firms:
 - aid to, 51-52, 54, 55
 - and marketing, 44
 - and new information, 53, 54
- Specialization, industrial, 48, 51, 52, 54, 55
- Standard of living, 18
 - high, 14, 46
- Structural:
 - change in economy, 47
 - problems in industry, 18, 20, 57
 - weakness in economy, 14, 15, 17, 28
- Subsidiaries, foreign-owned, 37, 38, 53, 54, 54n, 55
- Sulphur Development Institute of Canada, 53
- Sweden:
 - and technology, 34
 - and world trade, 16, 26
- Tariff:
 - exemptions, 36
 - high nominal, 36
 - protection, 34, 35-37
- Technical:
 - capability, 52
 - centres, 53-54
 - development, 52
 - excellence, 29
 - information, flow of, 53
 - obsolescence, 44
- Technological:
 - advanced production, 37, 38, 46
 - backwardness, 7
 - base, indigenous, 18, 19, 44
 - capability, 7, 14n, 32, 44, 54
 - capacity, 20, 42, 48, 52
 - change, 16-17, 31
 - development, 46, 48
 - expertise, export of, 34
 - innovation, 47
 - obsolescence, 36
 - sovereignty, 7, 14, 14n, 18, 44, 46, 48
- Technology:
 - absorption of, 7, 48, 53-54
 - accessibility of, 37
 - changes in, 35
 - demand for, 7, 48-49
 - foreign, 14, 38, 39, 43, 54-56
 - and government, 18, 20
 - high, 24, 25n, 25-26, 28, 31, 34, 37, 38, 42-43, 47, 49, 51, 55, 63n
 - import of, 7, 48, 54-56
 - low, 25, 25n, 34
 - mature, 42, 42n, 56
 - medium, 25, 25n, 34
 - potential to develop, 51-52
 - purchases of, 53, 54
 - tied, 54
 - use of, 11, 44, 46
- Technology-intensive:
 - areas, 48-49
 - industry, 26, 31
- Technology policy, 14, 56
 - recommendations for, 48-56
- Telecommunications equipment, 31, 42, 50, 51, 63n
- Textiles, 25n, 31, 34
- Third wave of industrialization, 31
- Third World, industrializing, 28, 31, 32, 33, 34
- Trade:
 - agreements, 50-51, 57
 - associations, 39
 - deficit, 26, 37
 - encouragement of, 19
 - failure of, 24-28, 30
 - imbalance, 7
 - international, 15, 21, 40, 47
 - invisible, 24
 - surplus, 50
 - world, 15, 16, 17, 32, 33-34, 60n
- Trading:
 - advantages, 21
 - conditions, 42
 - partners, 7, 16
- Truncation, 18n, 62n
 - and foreign-ownership, 37-39, 55
 - of industrial system, 18, 20
 - managerial, 7
 - technological, 7, 48
- Unemployment, 20
 - high, 7, 14, 15
- United States, 47
 - capital, 38
 - dollar, 35
 - employment in, 28, 29
 - and high technology, 26, 34, 38, 47
 - and post-industrial economy, 16, 34
 - and tariffs, 37
- Universities:
 - and government and industry, 39, 52, 62n
- Value added, 29, 33
- Wage parity, 35
- White-collar occupations, 28
- Work/study programs, 52
- World:
 - economic trends, 30-31, 32
 - economies, changing, 7, 11, 17, 19, 31, 33-34, 39, 48, 57
- World commodity price, 32, 33
- World product mandates, 38, 55

Science Council Industrial Policies Committee

Chairman

Mr. John A. Pollock*
President,
Electrohome Ltd.,
Kitchener, Ontario.

Members

Dr. Robert J. Allio
Boston, Mass.

Mr. Carl E. Beigie
Executive Director,
C.D. Howe Research Institute,
Montreal, Québec.

Dr. D. A. Chisholm*†
Chairman of the Board,
Bell Northern Research Ltd.,
Ottawa, Ontario.

Mr. Bernard G. Côté*
Chairman,
Celanese Canada Inc.,
Montreal, Québec.

Dr. L. A. Cox
Consultant,
Vancouver, B.C.

Professor Donald J. Daly
Faculty of Administrative Studies,
York University,
Downsview, Ontario.

Mr. Claude Descoteaux‡
Président,
Centre de recherche
industrielle du Québec,
Ste-Foy, Québec.

Dr. Mervyn Franklin §
President,
University of Windsor,
Windsor, Ontario.

M. J. J. Heffernan**
Vice-President,
M.M. Dillon Ltd.,
Toronto, Ontario.

Mr. John Houlding
President,
Polar Gas Project,
Toronto, Ontario.

Dr. Josef Kates††
Josef Kates Associates Inc.,
Toronto, Ontario.

Mr. R. D. Richmond
President,
Spar Aerospace Ltd.,
Toronto, Ontario.

Dr. George Sinclair
Chairman,
Sinclair Radio Laboratories Ltd.,
Concord, Ontario.

Mr. J.C.R. Warren
Director,
Research and Development,
Uniroyal Limited,
Guelph, Ontario.

Project Officers

Dr. James Gilmour‡‡
Science Adviser,
Science Council of Canada

Dr. Michael Jenkin
Science Adviser,
Science Council of Canada

*Member, Science Council of Canada.

†From August 1977.

‡Until August 1977.

§ Past Member, Science Council of Canada.

**From January 1978.

††Chairman, Science Council of Canada until September 1978.

‡‡Director of Research, Science Council of Canada as of 1 January 1979.

Members of the Science Council of Canada

Chairman

Claude Fortier
Chairman,
Department of Physiology,
Faculty of Medicine,
Laval University,
Quebec, Québec.

Vice-Chairman

John J. Shepherd
Science Council of Canada,
Ottawa, Ontario.

Members

David V. Bates
Department of Health Care and
Epidemiology,
University of British Columbia,
Vancouver, B.C.

Yvon De Guise
Principal Consultant in Energy,
Lavalin Inc.,
Montreal, Québec.

Roger A. Blais
Dean of Research,
École Polytechnique,
University of Montreal Campus,
Montreal, Québec.

Leon Dion
Department of Political Science,
Faculty of Social Studies,
Laval University,
Ste-Foy, Québec.

V. Elizabeth Candlish
Research Consultant,
Winnipeg Chamber of Commerce,
Winnipeg, Manitoba.

E. Lawson Drake
Associate Professor of Biology,
University of Prince Edward Island,
Charlottetown, P.E.I.

Donald A. Chisholm
Chairman of the Board,
Bell Northern Research Ltd.,
Ottawa, Ontario.

David J.I. Evans
Assistant Vice-President,
Technology,
Sherritt Gordon Mines Limited,
North Edmonton, Alberta.

Bernard G. Côté
Chairman,
Celanese Canada Inc.,
Montreal, Québec.

John P. Gallagher
Chairman and Chief Executive
Officer,
Dome Petroleum,
Calgary, Alberta.

J.V. Raymond Cyr
Executive Vice President
(Quebec Region),
Bell Canada,
Montreal, Québec.

Jean-Paul Gourdeau
President and Chief Operating
Officer,
SNC Enterprises Ltd.,
Montreal, Québec.

T. R. Ide
Chairman,
Ontario Educational
Communications Authority,
Toronto, Ontario.

W. O. Kupsch
Professor of Geology,
Department of Geological Sciences,
University of Saskatchewan,
Saskatoon, Saskatchewan.

Donald A.S. Lanskail
President,
Council of Forest Industries of B.C.,
Vancouver, B.C.

J. J. MacDonald
Executive Vice President,
St. Francis Xavier University,
Antigonish, Nova Scotia.

Arthur J. O'Connor
General Manager,
New Brunswick Electric Power
Commission,
Fredericton, N.B.

John A. Pollock
President,
Electrohome Limited,
Kitchener, Ontario

B. E. Robertson
Professor of Physics,
University of Regina,
Regina, Saskatchewan.

H. Rocke Robertson
Mountain, Ontario.

Michael Shaw
Vice-President,
University Development,
University of British Columbia,
Vancouver, B.C.

Louis Siminovitch
Department of Medical Genetics,
University of Toronto,
Toronto, Ontario.

Harold L. Snyder
Director of C-CORE,
Memorial University of
Newfoundland,
St. John's, Newfoundland.

David Suzuki
Professor of Zoology,
University of British Columbia;
Broadcaster, Host of "Quirks and
Quarks", and "Science Magazine",
CBC,
Toronto, Ontario

Clayton M. Switzer
Dean,
Ontario Agricultural College,
University of Guelph,
Guelph, Ontario.

M. Vogel-Sprott
Professor,
Department of Psychology,
University of Waterloo,
Waterloo, Ontario.

Blossom T. Wigdor
Director of Psychology Services,
Centre Hospitalier Cote des Neiges,
Montreal, Québec.

J. Tuzo Wilson
Director General,
Ontario Science Centre,
Toronto, Ontario.

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)

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, \$0.25)
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** (SS22-1970/12, \$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** (SS22-1971/16, \$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, Canada: \$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 (SS22-1977/26, 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)

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 Research 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**, 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**, 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**, G. Bruce Doern, October 1977, (SS21-1/41, Canada: \$5.50, other countries: \$6.60)
- 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**, 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)

Issues in Canadian Science Policy

Issues 1, September 1974 (SS21-2/1, \$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)

