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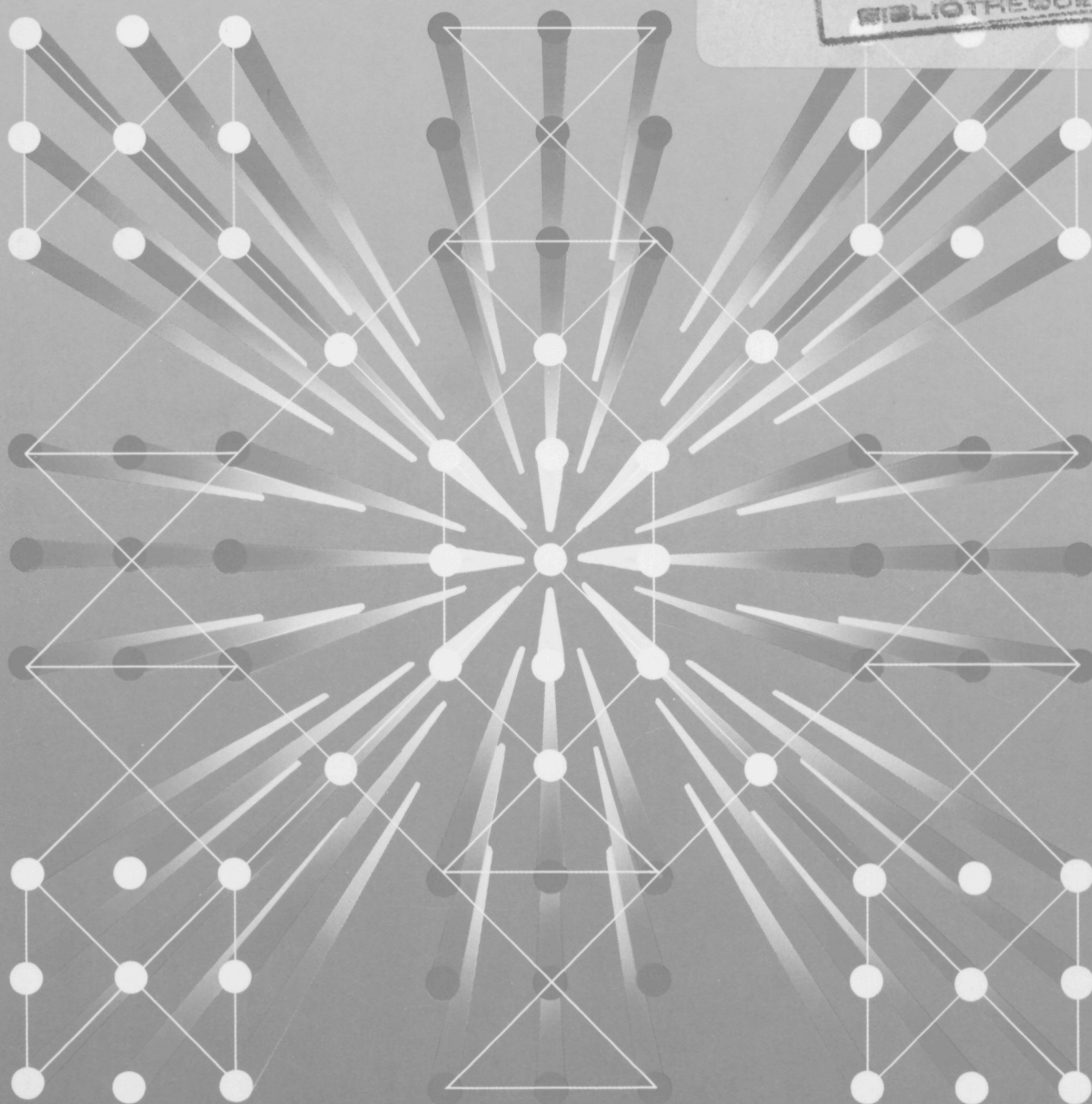
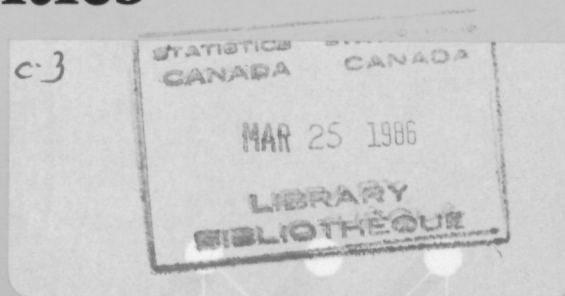
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Science, Technology and
Capital Stock Division

Division des sciences, de la technologie
et du stock de capital

Federal Scientific Activities 1985-86



Canada

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Statistics Canada

Science, Technology and
Capital Stock Division

Federal Scientific Activities 1985-86

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FOREWORD

Statistics on Canada's science effort have been systematically collected since 1963. At the present time Statistics Canada surveys the Federal Government, some provincial governments, the provincial research organizations, the business sector and private non-profit organizations. The results of these surveys plus estimates of science expenditures by universities provide a 22 year historical data base for science and technology. This information is available from the Science, Technology and Capital Stock Division of Statistics Canada in several forms, including formal reports such as this one and as computerized statistical tabulations.

The present report, one of a series issued by the Division, describes the Federal Government's involvement in science and technology. Federal expenditures data have been published by both Statistics Canada and the Ministry of State for Science and Technology (MOSSI). The MOSSI "Red Book", first issued in 1977, resulted from a recommendation of the Senate Special Committee on Science Policy chaired by Senator Lamontagne. Its purpose was to provide Parliamentarians with information on federal science expenditures for their use in reviewing the Government's spending plans. MOSSI issued six such reports, the last dealing with the Government's estimated 1982-83 spending.

During the summer of 1983, MOSSI underwent a major reorganization which resulted in a significant reduction in its size. Certain of its functions were transferred to other departments including its work on science statistics.

This report is the second issued by Statistics Canada describing federal S&T activities. It differs in several respects from the former MOSSI "Red Book". Unlike its predecessor it is not intended as a companion to the Government's Main Estimates report to Parliament, thus references to budgetary programs contained in that report are omitted. Narrative descriptions of ongoing departmental programs are replaced by an analysis of departmental expenditures.

The information presented in this report has been obtained with the cooperation of the Treasury Board Secretariat and the federal departments and agencies engaged in science activities. Their effort in ensuring accurate and complete information is gratefully acknowledged.

This publication was prepared by Elinor Bradley and Bert Plaus, under the direction of Peter Koumanakos, Director of the Science, Technology and Capital Stock Division.

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1.0 INTRODUCTION

This report presents information on the disposition of monies on science and technology by federal departments and agencies. The information is in an aggregated form to serve as a reference document for scientists and engineers, science managers, government officials, the media and the general public. Less aggregated data are available from the Science, Technology and Capital Stock Division of Statistics Canada.

By international convention science and technology (S&T) activities are divided into two fields; natural sciences and engineering (NSE) and social sciences and humanities (SSH). These fields of science are further divided into research and development (R&D) and related scientific activities (RSA). The Federal Government may choose to perform S&T in its own laboratories (intramural expenditures) or select another organization to perform S&T (extramural expenditures). Data are presented in this report on S&T activities funded wholly or in part by the Federal Government for R&D and RSA, distinguishing among the performers (that is intramurally by the Government itself or extramurally, by industry, universities, provincial and municipal governments, private non-profit corporations, other Canadian performers and foreign performers). Definitions of these terms are provided in the Technical Notes section.

Over 60 different departments and agencies either perform S&T activities or have a budgetary allocation to fund S&T. Those Crown Corporations, such as Petro Canada, which have an industrial function, are not included. Those agencies are treated as commercial enterprises and their expenditures are included in the Statistics Canada report **Industrial Research and Development Statistics**, Catalogue 88-202.

Management of government funded S&T activities is assigned to individual departments and agencies responsible either to a Cabinet Minister or through a designated Minister to Parliament. In some cases, a single department or agency may work towards a specific government objective while in other cases several departments may work towards an objective. When several departments are involved, an interdepartmental committee is formed to advise

and assist the lead department in coordination and/or management of resources. There are also in place many advisory bodies which include representatives of the public and the private sector. Their advice and comment assist the Government to assess its spending in particular areas vis-a-vis spending by other sectors such as industry and provincial governments.

The Overview section which follows this introduction provides an aggregate of government expenditures by field of science (NSE and SSH) and by activity (R&D and RSA). The performers of S&T are also identified for the period 1979-80 to 1985-86. In the Overview and subsequent sections, data are presented on federal expenditures in the 10 provinces and in the National Capital Region (NCR). Since no attempt is made to forecast or estimate regional expenditures, only actual expenditures after the close of the fiscal year are obtained. Thus regional data are available only from 1979-80 through to 1983-84.

In the next section some highlights of the Government's proposed program for 1985-86 are outlined. The following section, Departmental Support for Science and Technology, provides a more detailed breakdown of the aggregate information presented in the Overview. Included in this section are the departmental objective, and organizational units engaged in S&T. Where applicable, an analysis of the regional distribution of the departments' intramural S&T expenditures is presented.

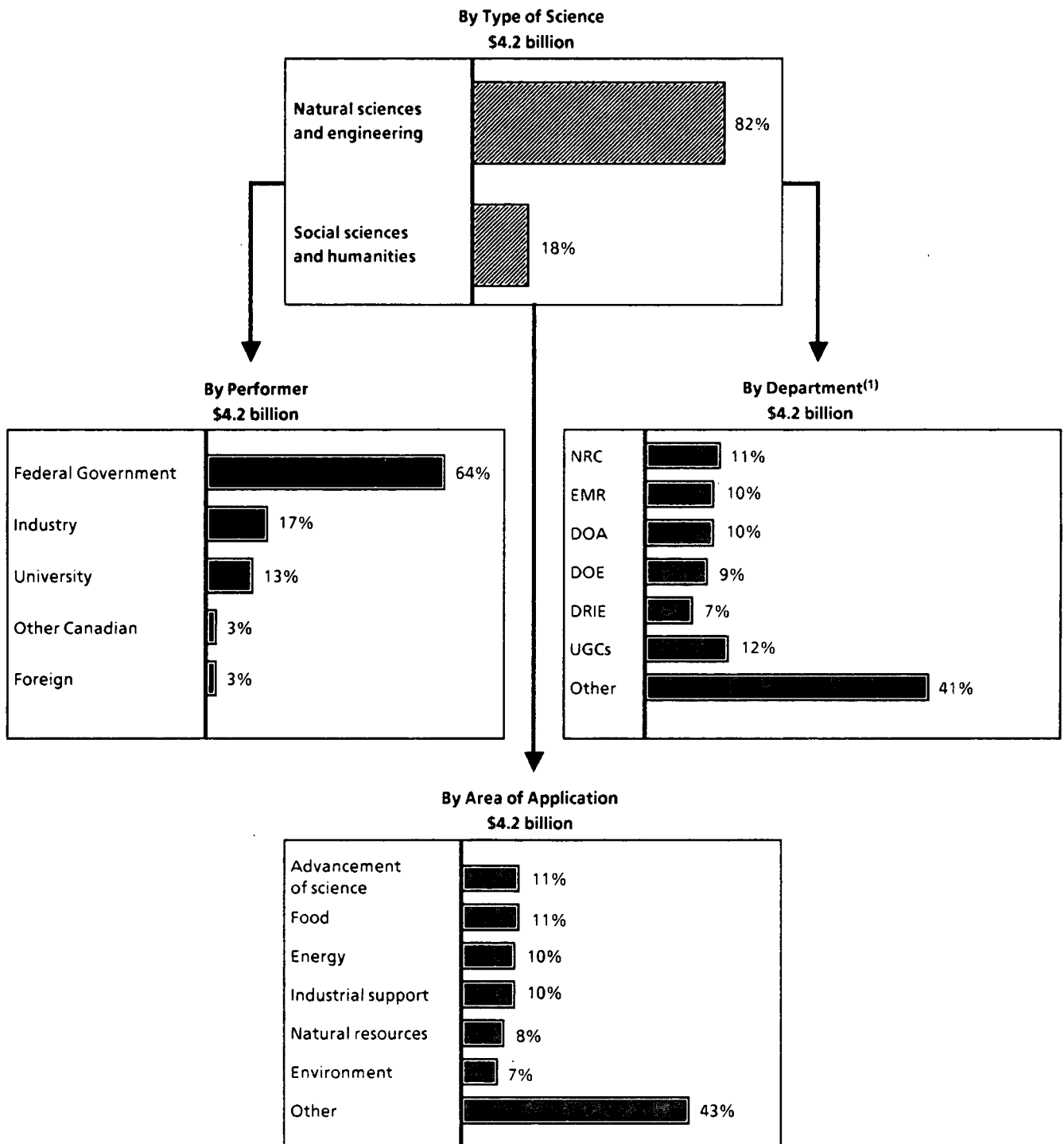
Further details on the payments to the major extramural performers are given in section 5.0 including regional distribution of industry and university expenditures. Section 6.0 presents data on areas of application which are of priority to the government such as energy and food.

In addition to spending monies on S&T, the government has in place other measures such as tax incentives for R&D. These are described briefly in section 7.0.

The nation's gross expenditures on R&D (GERD) are summarized in section 8.0. The progress towards the government's objective of GERD as 1.5% of the Gross National Product (GNP) by 1985 is reviewed. The final section compares Canada's R&D effort with that of other countries.

2.0 OVERVIEW

Chart - 1
Distribution of Federal Expenditures on Science and Technology, 1985-86



(1)

NRC = National Research Council

EMR = Energy, Mines and Resources

DOA = Agriculture

DOE = Environment

DRIE = Regional Industrial Expansion

UGCs = University Granting Councils (total for Medical Research Council, Natural Sciences and Engineering Research Council and Social Sciences and Humanities Research Council)

HIGHLIGHTS

- In 1985-86, the Federal Government will allocate about \$4.2 billion to its departments and agencies for scientific and technical (S&T) activities. This is 2% more than the 1984-85 total of \$4.1 billion. These expenditures represent 4% of the Government's total spending estimates, a decrease from 4.2% for 1984-85.
- A period of real growth in federal support for S&T activities began in the 1980s. This trend has been interrupted in 1985-86. The 2% increase in S&T funding indicates a real decrease after inflation of almost 1% below the 1984-85 expenditures.
- Federal S&T support related to the advancement of science, food, energy and industrial support will continue to receive special emphasis in 1985-86, each receiving a 10% share of the S&T expenditures. Funding for the advancement of science includes all research and development contributing to the general advancement of knowledge.
- Over 60 departments and agencies either perform S&T activities or have budgetary expenditures to fund S&T. Of these, the National Research Council, the departments of Energy, Mines and Resources, Agriculture, Environment, Regional Industrial Expansion, and the three university granting councils, together account for almost 60% of the total S&T expenditures.
- While federal S&T expenditures show an overall increase of about 2% from 1984-85 to 1985-86, the components of S&T support show varied rates of change:

Component activities	Percentage change 1985-86/ 1984-85	Per cent of S&T expenditures
TOTAL S&T	+1.6	100
NSE	+2.1	82
R&D	+0.7	61
RSA	+6.3	21
SSH	-0.3	18
R&D	-2.6	4
RSA	+0.3	14

- Research and Development (R&D) expenditures in the Natural Sciences and Engineering, at about \$2.6 billion, have increased by less than 1% over 1984-85.
- The largest increase in spending has been in Related Scientific Activities (RSA) in NSE, for activities such as scientific data collection and feasibility studies. These activities account for \$876 million, or 21% of the total S&T budget.
- Expenditures in the Social Sciences and Humanities (SSH), at \$739 million, have decreased slightly from 1984-85. The small increase in RSA did not offset the decrease in R&D.
- Capital expenditures for 1985-86 total \$395 million, which is a 7% decrease from 1984-85. Capital for R&D (NSE) at \$308 million is the largest component.
- Almost two thirds of the federal S&T expenditures are for activities to be performed within its own scientific establishments. The Federal Government will perform 55% of its own R&D and 81% of its own RSA.
- Industry will receive 17% and universities 13% of federal S&T expenditures in 1985-86.
- More federal funding will be allocated to business enterprises in 1985-86; an increase of 6% in R&D funding and a 32% increase in RSA funding.
- Federal R&D expenditures to the foreign sector, at \$124 million, is an increase of 19% over 1984-85.
- In 1985-86, almost 35,200 person-years (PYs) will be involved in federal S&T activities, a 1% decrease from 1984-85. Forty-nine per cent of these PYs will be involved in R&D.
- There has been no decrease in the number of PYs in the scientific and professional categories (10,817).
- Support of S&T activities by the technical category decreased by 1% and the other support categories by 2%.
- As in the past, more funds were spent in the National Capital Region (26%) than in any other. Ontario (less intramural expenditures in the NCR) is the second largest recipient of federal science funds (25%) and Quebec (less intramural expenditures in the NCR) the third largest (15%).
- Of the support for industrial performers, Ontario and Quebec receive the highest percentage of funds. In 1983-84, Quebec received 37% and Ontario 42% of the total funding to industry.

Chart - 2
Federal Expenditures on Science and Technology as a Percent of the Total Federal Budget

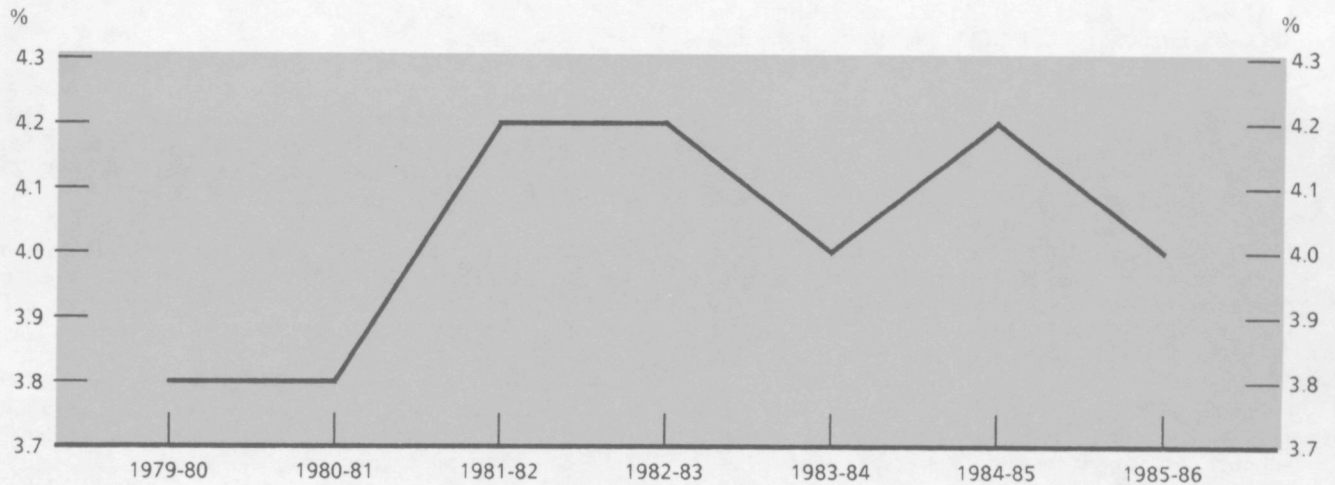


Chart - 3
Federal Expenditures on Science and Technology, 1963 to 1985

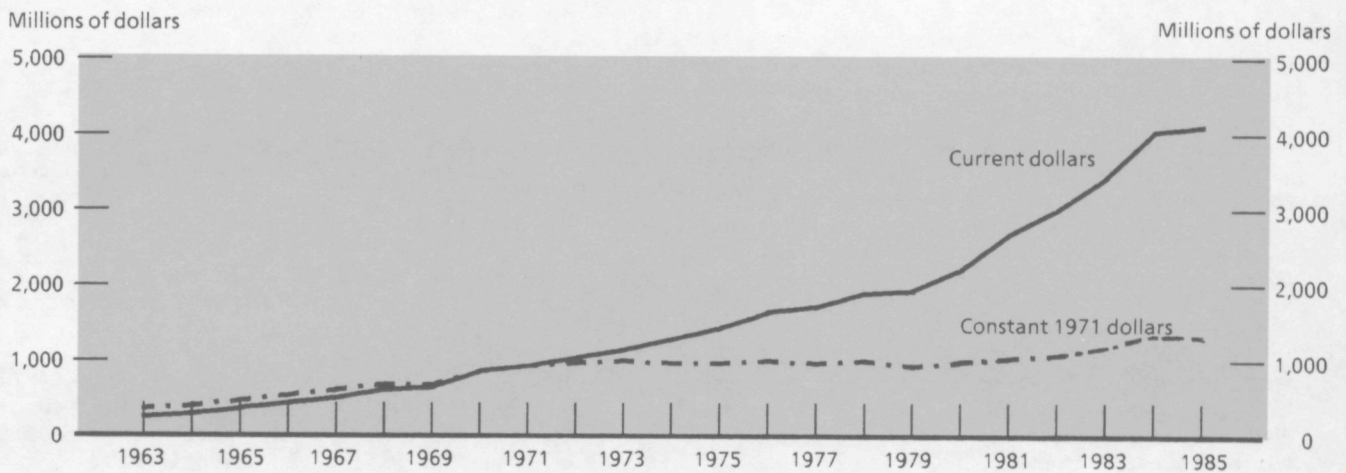


Chart - 4
Science and Technology Expenditures by Field of Science

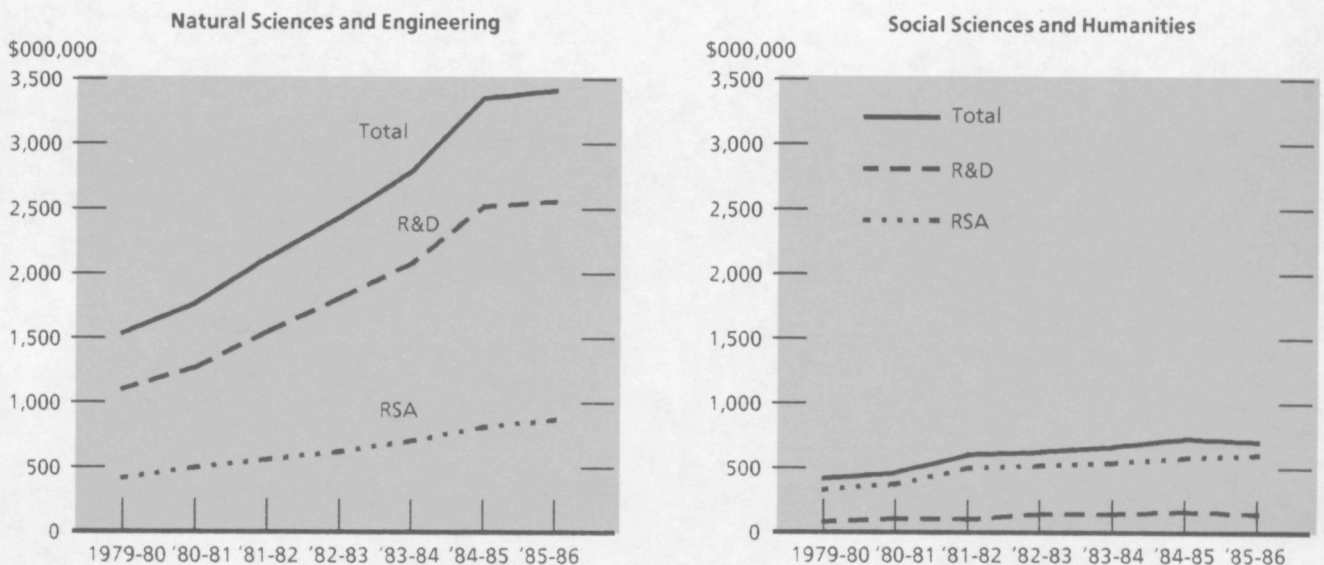


Chart - 5
Science and Technology Expenditures by Performer

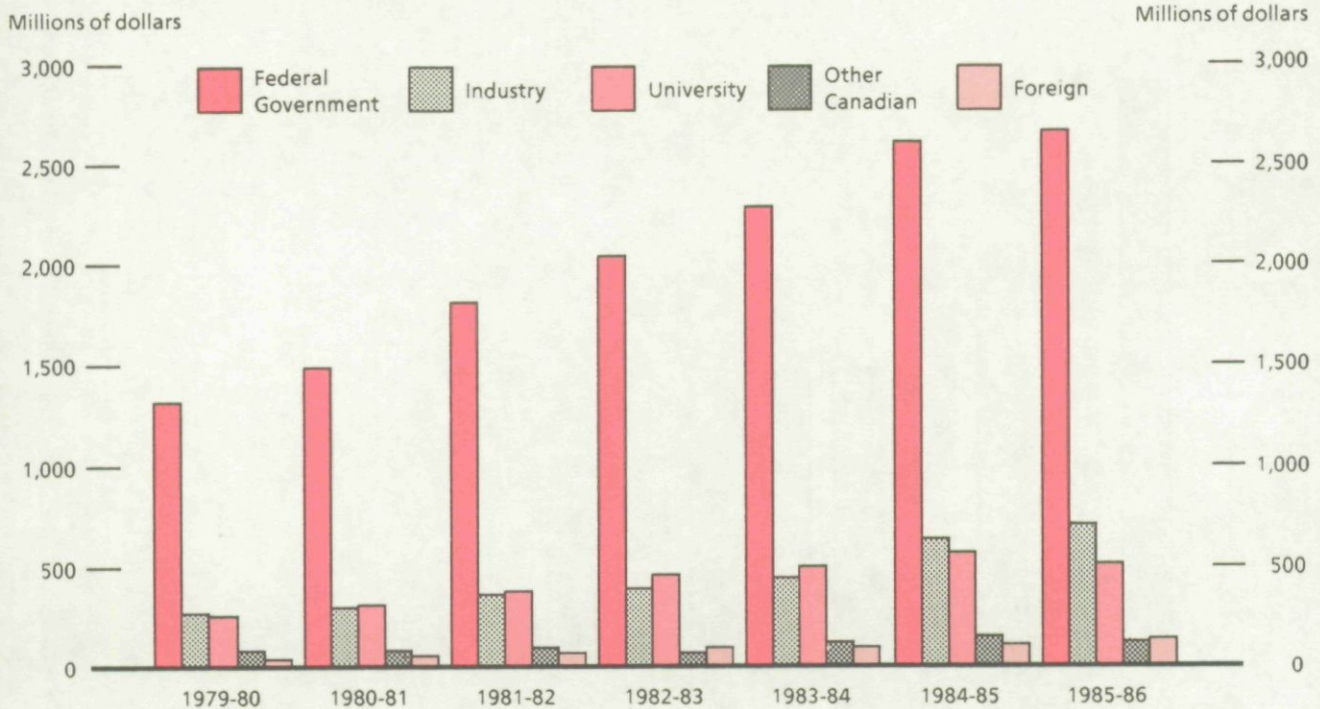


Chart - 6
Federal Personnel Engaged in Science and Technology Activities, 1985-86

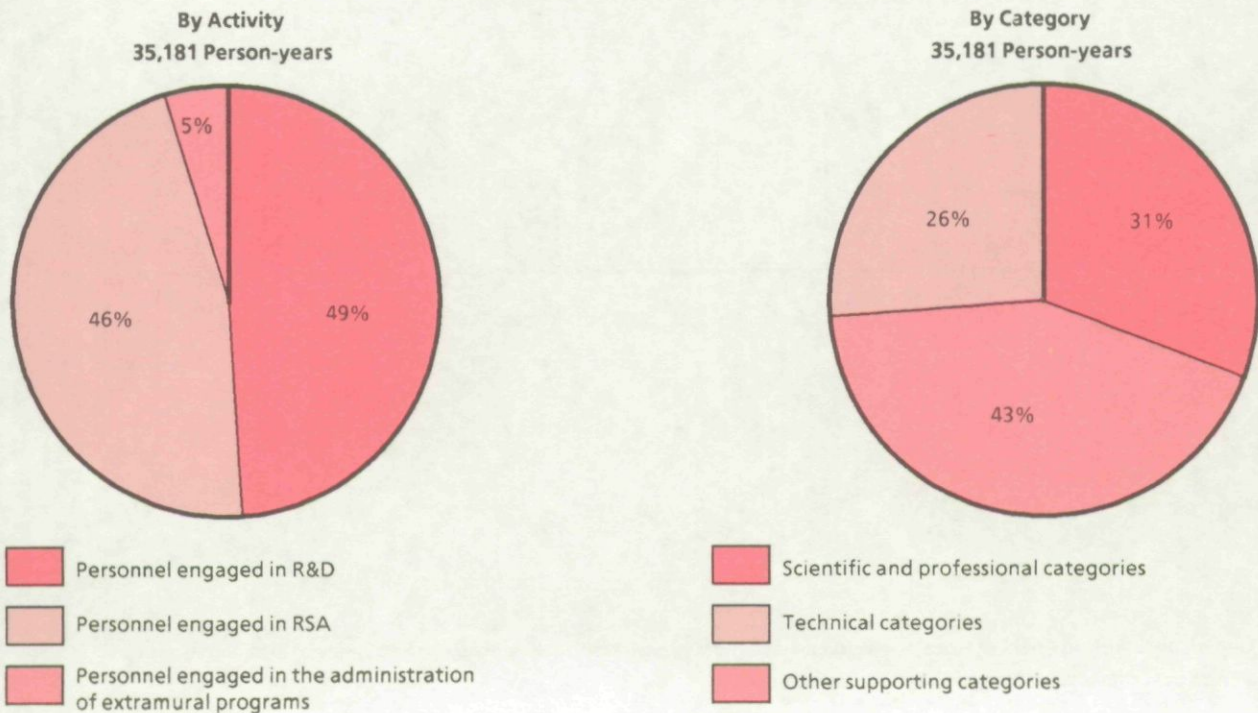


Chart - 7
Federal Personnel Engaged in Science and Technology Activities by Department, 1985-86

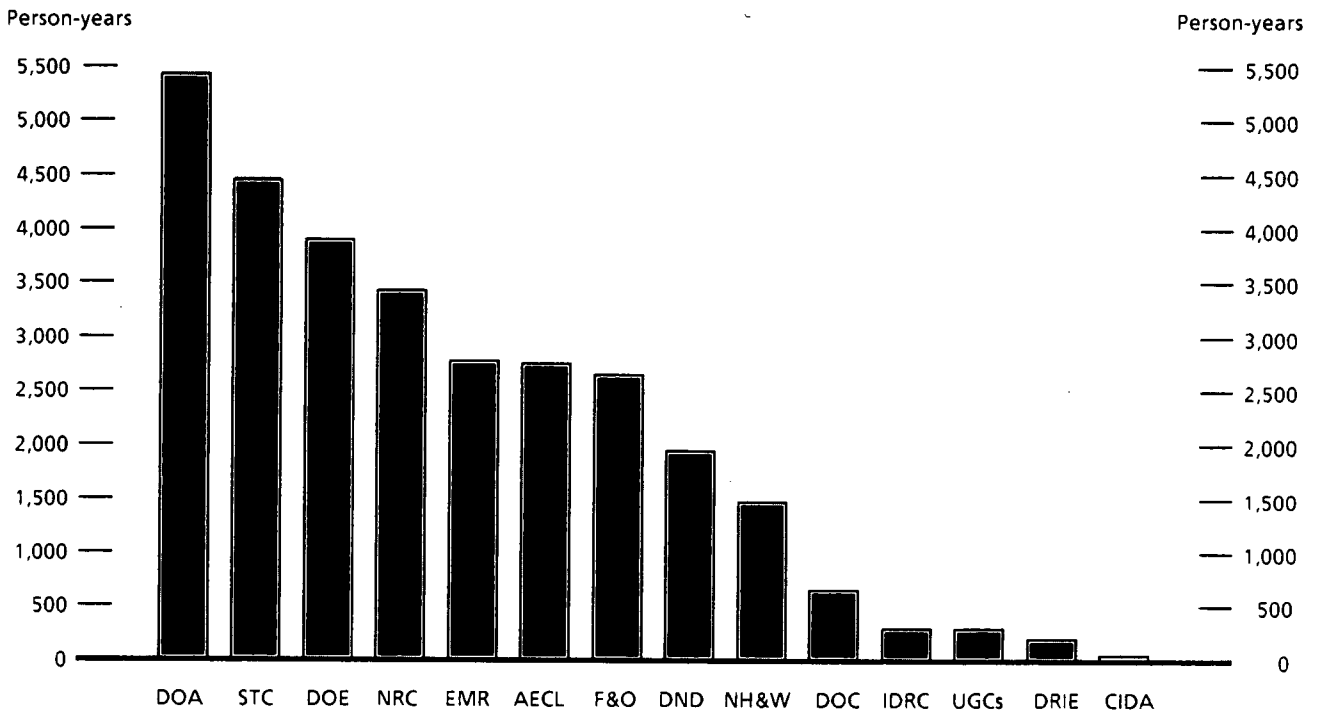
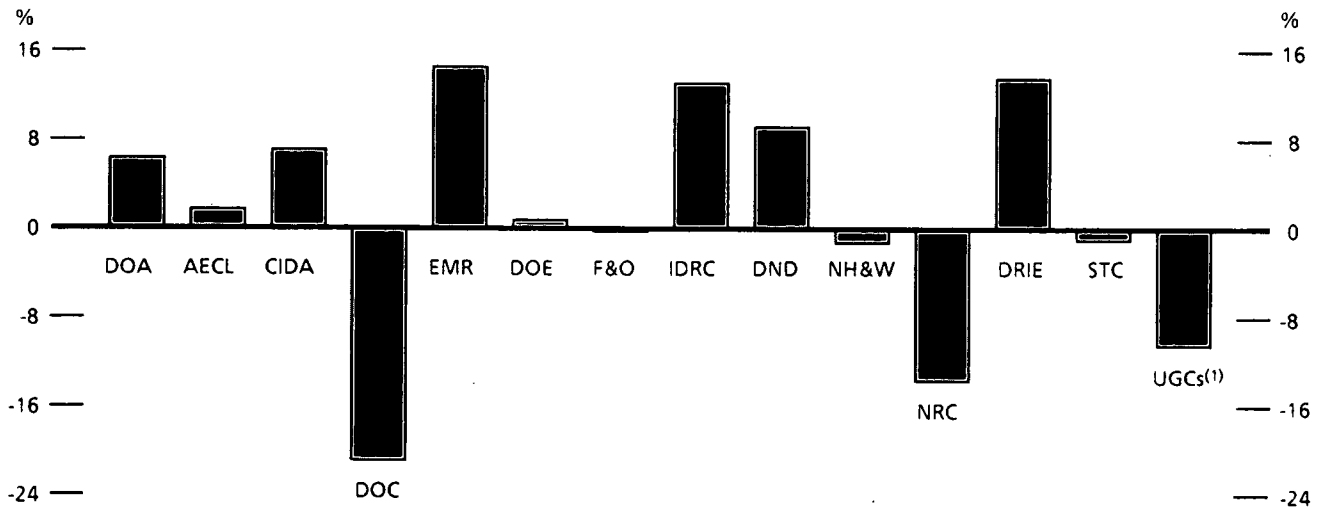


Chart - 8
Federal Science and Technology Expenditures by Department, 1985-86
 (Percent change from previous year, in constant dollars)



(1) University Granting Councils (total for Medical Research Council, Natural Sciences and Engineering Research Council and Social Sciences and Humanities Research Council).

TABLE 2.1 Science and Technology Expenditures by Activity

	1979-80	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86	Percentage change 1985-86/ 1984-85
	\$000,000							
Total S&T	1,992	2,268	2,745	3,084	3,491	4,104	4,172	+2
Natural sciences and engineering	1,561	1,791	2,132	2,455	2,805	3,363	3,433	+2
Research and development	1,125	1,290	1,568	1,815	2,091	2,539	2,557	+1
Related scientific activities	437	501	564	640	714	824	876	+6
Data collection	222	250	278	315	353	380	395	+4
Information services	68	77	93	108	122	136	145	+7
Testing and standardization	40	43	52	51	47	55	57	+4
Feasibility studies	42	60	63	64	72	88	106	+20
Education support	17	21	25	33	44	57	52	-9
Museum services	18	18	20	21	25	26	26	-
Total operational	1,433	1,645	1,961	2,198	2,508	2,877	2,968	+3
Total capital	99	114	132	213	241	417	389	-7
Total AEP(1)	29	32	39	44	56	69	76	+10
Social sciences and humanities	431	477	613	629	686	741	739	--
Research and development	92	97	110	124	131	156	152	-3
Related scientific activities	338	380	503	504	555	585	587	--
Data collection	135	138	242	202	218	231	234	+1
Information services	59	75	84	96	116	125	126	+1
Economic and feasibility studies	24	35	27	35	30	37	38	+3
Operations and policy	55	61	76	96	108	103	101	-2
Education support	15	16	15	17	18	22	22	-
Museum services	37	40	42	43	47	49	48	-2
Total operational	410	453	586	599	653	706	702	-1
Total capital	7	9	10	8	9	7	6	-14
Total AEP	14	15	17	22	24	28	31	+11

(1) AEP are the costs of administering extramural programs.

TABLE 2.2 Science and Technology Expenditures by Type of Science and Performer

	1979-80	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86	Percentage change 1985-86/ 1984-85
	\$000,000							
Total S&T expenditures	1,992	2,268	2,746	3,083	3,491	4,104	4,172	+2
Natural sciences and engineering	1,561	1,792	2,132	2,455	2,805	3,363	3,433	+2
Intramural	990	1,119	1,310	1,548	1,732	2,034	2,086	+3
Extramural (total)	570	673	822	907	1,073	1,329	1,347	+1
Industry	260	294	356	385	437	629	697	+11
University	216	275	339	400	449	495	453	-8
Private non-profit	12	12	9	10	44	38	33	-13
Provincial and municipal governments	37	39	39	20	34	38	23	-39
Other Canada	11	10	20	18	24	32	26	-19
Foreign	35	42	60	74	85	97	115	+19
Social sciences and humanities	431	477	613	628	686	741	739	--
Intramural	335	378	503	500	552	577	583	+1
Extramural (total)	96	100	110	129	134	164	155	-5
Industry	15	13	14	18	15	18	18	-
University	41	45	50	61	64	80	72	-10
Private non-profit	14	11	11	13	15	19	18	-5
Provincial and municipal governments	7	7	10	8	8	9	10	+11
Other Canada	4	7	9	8	10	15	14	-7
Foreign	15	15	17	21	22	23	24	+4

TABLE 2.3 Science and Technology Expenditures by Activity and Performer

	1979-80	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86	Percentage change 1985-86/ 1984-85
	\$000,000							
Total S&T expenditures	1,992	2,268	2,746	3,083	3,491	4,104	4,172	+2
Total R&D expenditures	1,217	1,388	1,679	1,939	2,222	2,695	2,709	+1
Intramural	685	780	912	1,094	1,224	1,462	1,480	+1
Extramural (total)	532	609	766	845	1 998	1,233	1,229	--
Industry	208	218	287	320	380	544	579	+6
University	228	285	347	411	454	505	456	-10
Private non-profit	17	15	11	11	43	39	34	-13
Provincial and municipal governments	32	34	37	4	4	8	9	+13
Other Canada	6	7	18	17	23	33	27	-18
Foreign	42	49	67	83	94	104	124	+19
Total RSA expenditures	775	881	1,067	1,144	1,269	1,409	1,463	+4
Intramural	640	717	901	954	1,060	1,149	1,189	+3
Extramural (total)	134	164	166	191	209	260	273	+5
Industry	67	89	83	83	72	103	136	+32
University	29	35	42	50	59	70	69	-1
Private non-profit	9	8	9	12	16	18	17	-6
Provincial and municipal governments	12	12	12	24	38	39	24	-38
Other Canada	9	10	11	9	11	14	13	-7
Foreign	8	8	10	12	13	16	15	-6

TABLE 2.4 Regional Distribution by Performer in the Natural Sciences and Engineering, 1983-84

	Total	Intramural	Industry	University	Other
	\$000,000				
		%			
All regions	2,518	100	100	100	100
Atlantic	277	13	6	7	12
Quebec(1)	372	8	37	21	20
Ontario(1)	625	15	42	40	45
Manitoba	152	7	3	4	4
Saskatchewan	67	3	1	4	6
Alberta	129	8	4	8	2
British Columbia	235	8	7	16	12
NCR(2)	661	41	-	-	-

(1) Less Intramural Expenditures in the NCR.

(2) Intramural Expenditures only.

3.0 RECENT DEVELOPMENTS

The Economic and Fiscal Statement delivered in the House of Commons on November 8, 1984 had a significant impact on Canada's S&T activities. In an effort to reduce financial requirements, an intensive ministerial review of all programs was undertaken. A number of programs and projects were either discontinued or reduced in scope. The effectiveness of R&D tax incentives to industry was also reviewed.

The budget cuts reflect the Government's emphasis on increased market relevance of technology funding, and public sector R&D activities more in tune with small firms' needs. The Government is also encouraging the industrial sector to do more R&D, independent of government funding.

The following is a list of major S&T programs or projects affected by these budgetary reductions.

Reductions in Program Spending

Energy Research and Development

This interdepartmental program is intended to increase energy self-sufficiency and to diversify sources of energy in Canada. Future work will concentrate on developing areas of partial knowledge, such as fusion, or on areas of immediate need or application, such as tar sands and coal. Longer term or lower priority research work will be curtailed in the departments and agencies listed below. The expected savings for 1985-86 are:

Department	Millions of dollars
Agriculture (DOA)	2.7
Canada Mortgage and Housing Corporation	0.2
Consumer and Corporate Affairs	0.7
Energy, Mines and Resources (EMR)	14.4
Environment (DOE)	2.8
Forestry	1.4
Fisheries and Oceans	1.5
National Research Council (NRC)	34.6
Public Works	0.6
Transport	1.9
Total	60.8

Northern Oil and Gas Action Plan

This plan provides funding to a number of federal departments to accelerate studies in connection with Northern oil and gas production. Expenditures for 1985-86 have been reduced by \$8 million.

Reduction/Elimination of Programs

Maritime Engineering (EMR)

The program is designed to do engineering work for the Maritime leg of the Trans-Quebec and Maritime pipeline. Funding has been cancelled because the extension of the TQ&M project has been deferred. Savings in 1985-86 amount to \$8.0 million.

Research Programs (NRC)

The areas of X-rays, nuclear radiation and high pressure chemistry have been exhaustively studied. These programs will therefore be discontinued and other expenditures reduced at a saving of \$4.4 million in 1985-86.

Environmental Secretariat, Research Facilities (NRC)

The Rocket and Balloon Launching Facilities program supported studies of the upper atmosphere, and the Environmental Secretariat examined and analysed available information on the effects of contaminants. Since activity at the launching sites had fallen off in recent years and scientific interest in space science has shifted towards the use of earth satellites, the Rocket and Balloon facilities were eliminated. The work of the Environmental Secretariat was discontinued. Savings of \$5 million were realized for 1985-86.

Environment Services (DOE)

Environment Services encompass federal programs in the area of wildlife, water, environmental protection and atmospheric services. Steps are to be taken to concentrate activities regarding wildlife on migratory birds and endangered species; and to concentrate on activities concerned with obtaining climatological data and toxicological research information. Savings for 1985-86 amount to \$6.7 million.

Deferral/Cancellation of Capital Projects

Agriculture

Plans existed for the construction of a pharmaceutical testing laboratory in Trois Rivières, Quebec, and a plant health laboratory in Victoriaville, Quebec. These facilities will

be deferred, pending further review, saving \$4.9 million in 1985-86.

Forestry

Plans had been developed to relocate the Newfoundland Forest Research Centre from St. John's to Corner Brook. The move will be deferred, pending further review, saving \$3.5 million in 1985-86.

Environment

Facilities for a toxicology study centre were to be constructed in both Guelph and Toronto. Savings of \$5.4 million in 1985-86 result from cancelling the planned federal contribution towards this project.

National Research Council

The Government has decided not to proceed with the establishment of the Manufacturing Technology Institute in Winnipeg. The building will be completed at a cost of \$6.9 million in 1985-86, but will be put up for sale.

An Institute for Electrochemistry in Shawinigan and a Cold Regions Research Institute in Edmonton had been planned. The projects will not proceed, saving \$3.6 million in 1985-86.

Summary of 1985-86 Savings by Department

Department	Millions of dollars
Agriculture (DOA)	11.1
Canada Mortgage and Housing Corporation	0.2
Consumer and Corporate Affairs	0.7
Energy, Mines and Resources (EMR)	22.4
Environment (DOE)	14.9
Fisheries and Oceans	1.5
National Research Council (NRC)	47.6
Public Works	0.6
Transport	1.9
Total	100.9

New Initiatives

New initiatives and policies which have been put into place over the last year, will have a significant impact on Canada's S&I activities. These are summarized below.

Research and Development Tax Incentives

The May 1985 federal budget restructured the tax incentives relating to research and development and eliminated the scientific research tax credit (SRTC). The investment tax credit earned by small Canadian-controlled private corporations for current expenditures on R&D will be 100% refundable. At present, the refundable portion of the unused credit of such corporations (i.e., the portion which cannot be used because the corporation is not paying sufficient taxes) is limited to 40% of the credit earned - a provision scheduled to expire on April 30, 1986. The increased refund provision for R&D will not be subject to an expiry date, and will be effective for qualifying expenditures made after May 23, 1985. The new tax credit rate is 20% to 35% of the first \$2 million worth of R&D performed in a year by one company or an associated group of companies, with a maximum credit of \$700,000. Other budget changes will remove restrictions on the definition of R&D that qualifies for tax credits.

National Policy on Science and Technology

A federal-provincial meeting of Ministers responsible for science and technology took place in Calgary in February, 1985. Ministers committed themselves to providing a comprehensive national policy on science and technology. The following pledges were made in pursuit of this goal:

1. To work for more effective programs of grants, tax incentives and procurement targeted especially to small- and medium-sized technology intensive ventures.
2. To review and evaluate all existing agreements and programs to support provincial and territorial industrial development, with a view to increasing their effectiveness in promoting new technology, leading to more productive and internationally competitive industries.
3. To review the possibilities for more efficient coordination and use of all government research laboratories, in order to ensure better coupling with industrial opportunities and priorities.
4. To seek new ways of improving access to federal and provincial programs of support for industrial R&D, and access to information. Ministers will, in particular, investigate the possibility of creating single-desk access to such assistance on a decentralized basis.

The Canadian Space Program

The Canadian space program consists of four program areas conducted by several government departments and agencies. These activities are

co-ordinated by the Interdepartmental Committee on Space (ICS) which reports to the Minister of State for Science and Technology.

Program area	1981-82	1982-83	1983-84	1984-85	1985-86	Total
	\$000,000					
Technology development	38.8	45.0	50.9	44.1	60.3	239.1
Remote sensing	26.3	39.1	37.4	48.3	73.5	224.6
Communications	19.8	25.8	25.5	35.7	38.1	144.9
Space science	11.8	12.8	17.4	23.1	22.2	87.3
Total	96.7	122.7	131.2	151.2	194.2	695.9

An Interim Space Plan for Canada was announced in March, 1985, providing an early statement of the Government's commitment to maintain and develop Canadian capabilities in space. The next step will be the adoption of a long-term Strategic Space Plan at the end of 1985. This plan will identify strategic thrusts for the Canadian Space Program, propose strategies for increasing industrial competitiveness and recommend program priorities.

MSAT system is intended to meet a demonstrated need for improved voice and data communications to vehicles, aircraft, ships and other portable stations for a wide variety of business applications in rural and remote areas of Canada. The Department of Communications will be providing support to Canadian industry for the further development of the required satellite and ground terminal techniques.

Participation in Space Station

The Government has accepted the invitation of the United States government to participate in the definition stage of the Space Station Program (Phase B). The National Research Council will carry out project design and preliminary definition studies to develop specific proposals for Canadian participation which can be presented to NASA. The Government has allocated \$8.8 million from the NRC 1985-86 estimates for "Phase B" activities. Canada is developing several options for participation. First is a robotic servicer and an integrated servicing and test facility for space assembly, test, servicing and maintenance functions. This facility would be used to service satellites and other earth orbitary spacecraft, a key function in outer space. Second are the solar arrays which could provide primary power to the man-tended platforms or auxiliary power for the Station. Third is a remote sensing facility based on RADARSAT.

Continuation of the RADARSAT program

The Government had decided to continue the development of a proposal for implementing RADARSAT, a program to place a radar-equipped Canadian remote sensing satellite in polar orbit. The proposal is to include an in-orbit servicing option as a possible contribution to the Space Station.

The RADARSAT program is managed by the Department of Energy, Mines and Resources' Canada Centre for Remote Sensing. EMR has a major technical partner in the Department of Communications. Staff from DUC's Communications Research Centre, with their expertise in space technology and advanced radar, have formed the RADARSAT Project Technical Office, with responsibility for managing the "Phase B" industrial contracts.

Support for MSAT

The Government supports the implementation for a commercial mobile communications satellite (MSAT) systems for Canada by 1990. The

The departments of Environment, Agriculture, Transport and Fisheries and Oceans are also participating in the program by assessing uses of the satellite data and planning the facilities in order to meet a variety of departmental objectives.

4.0 DEPARTMENTAL SUPPORT FOR SCIENCE AND TECHNOLOGY

This section provides information on the scientific programs and activities carried out by departments in support of their mandates. Departments and agencies that are major

performers or funders are reviewed separately. For comparison purposes the three university granting councils, NSERC, MRC and SSHRC, are grouped together.

Federal Expenditures on S&T by Major Departments

Department/agency	1979-80	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86	Percentage change 1985-86/ 1984-85
	\$000,000							
Agriculture (DOA)	160.5	183.8	210.8	236.2	354.1	390.4	425.9	+9
Atomic Energy of Canada (AECL)	93.2	100.9	103.4	129.6	138.0	146.4	152.5	+4
Canadian International Development Agency (CIDA)	37.6	36.7	41.9	48.6	48.0	52.1	57.1	+10
Communications (DOC)	59.6	67.6	89.9	103.3	89.3	121.3	98.1	-19
Energy, Mines and Resources (EMR)	152.7	194.2	232.2	256.6	288.7	368.9	433.2	+17
Environment (DOE)	241.6	274.3	309.3	345.3	315.8	352.0	363.4	+3
Fisheries and Oceans (F&O)	133.8	143.4	156.7	192.6	219.1	272.4	277.9	+2
International Development Research Centre (IDRC)	36.5	39.8	45.9	53.6	63.7	73.7	85.4	+16
National Defence (DND)	88.1	103.5	118.9	145.4	162.3	209.1	234.3	+12
National Health and Welfare (NH&W)	66.1	72.5	86.5	94.1	109.9	118.6	119.7	+1
National Research Council (NRC)	205.2	230.0	285.5	352.4	411.5	527.6	466.2	-12
Regional Industrial Expansion (DRIE)	87.6	100.8	138.0	129.9	163.9	239.8	279.4	+16
Statistics Canada (SC)	134.6	157.7	246.9	208.2	229.7	241.8	244.5	+1
University granting councils - Total	228.4	288.2	349.4	415.6	483.3	532.8	488.3	-8
Natural Sciences and Engineering Research Council (NSERC)	121.4	163.2	202.1	245.3	282.1	312.4	296.2	-5
Medical Research Council (MRC)	70.2	82.2	100.4	113.5	140.7	157.2	130.8	-17
Social Sciences and Humanities Research Council (SSHRC)	36.8	42.8	46.9	56.8	60.5	63.2	61.3	-3
Other	266.4	275.0	330.3	372.2	414.1	456.8	446.5	-2
Total	1,991.9	2,268.3	2,745.5	3,083.7	3,491.4	4,103.7	4,172.4	+2

Federal Personnel Engaged in S&T Activities

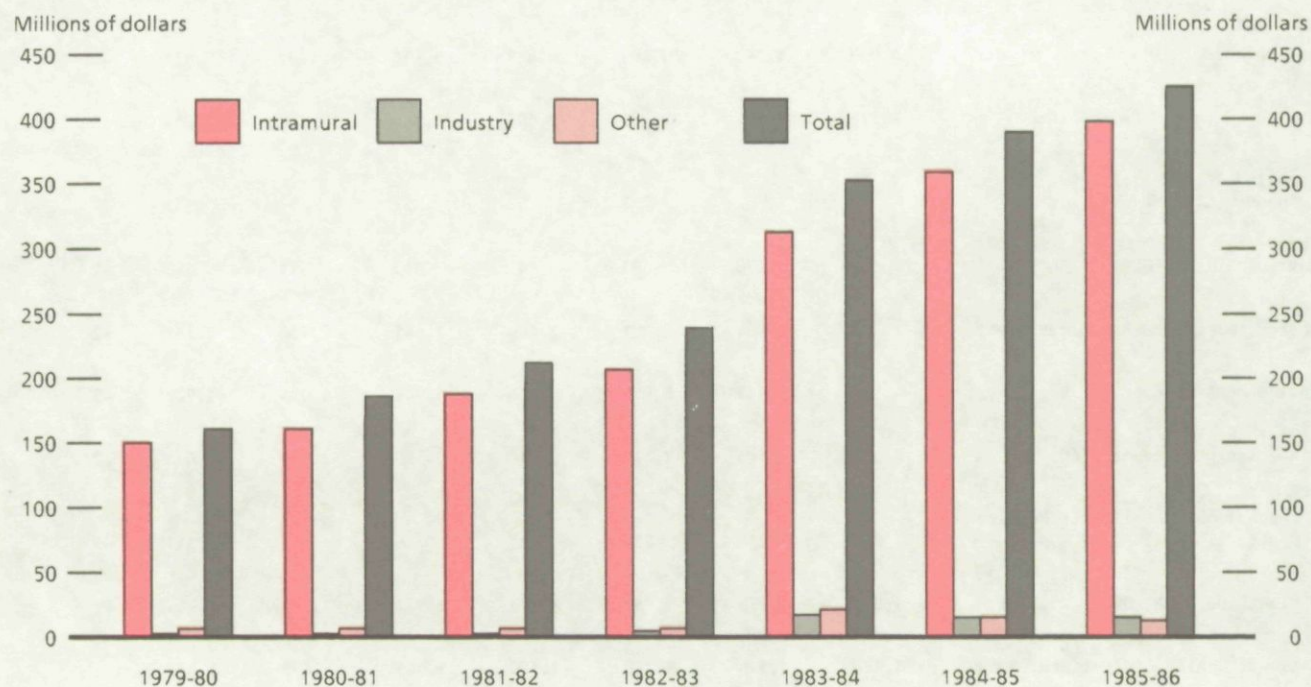
Department/agency	1979-80	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86	Percentage change 1985-86/ 1984-85
person-years								
Agriculture (DOA)	4,057	4,263	4,407	4,488	5,636	5,682	5,434	-4
Atomic Energy of Canada (AECL)	2,322	2,394	2,486	2,607	2,665	2,700	2,751	+2
Canadian International Development Agency (CIDA)	56	57	57	57	57	57	57	-
Communications (DOC)	649	670	683	743	613	651	658	+1
Energy, Mines and Resources (EMR)	2,403	2,484	2,401	2,549	2,661	2,734	2,781	+2
Environment (DOE)	4,921	4,915	4,894	4,866	3,942	4,034	3,922	-3
Fisheries and Oceans (F&O)	2,122	2,143	2,516	2,618	2,595	2,614	2,664	+2
International Development Research Centre (IDRC)	217	218	225	245	266	301	311	+3
National Defence (DND)	1,895	1,870	1,932	1,913	1,947	1,919	1,954	+2
National Health and Welfare (NH&W)	1,186	1,334	1,260	1,360	1,445	1,499	1,495	-
National Research Council (NRC)	3,160	3,158	3,197	3,366	3,424	3,515	3,442	-2
Regional Industrial Expansion (DRIE)	298	191	193	190	171	171	208	+22
Statistics Canada (SC)	4,534	4,619	5,489	4,470	4,651	4,600	4,472	-3
University granting councils - Total	206	219	205	248	266	296	309	+4
Natural Sciences and Engineering Research Council (NSERC)	61	75	81	98	111	138	148	+7
Medical Research Council (MRC)	40	39	39	45	51	54	54	-
Social Sciences and Humanities Research Council (SSHRC)	105	105	85	105	104	104	107	+3
Other	5,088	4,752	5,152	4,980	4,974	4,844	4,723	-2
Total	33,114	33,287	35,097	34,970	35,313	35,617	35,181	-1

4.1 MAJOR DEPARTMENTS

Agriculture (DOA)

Chart - 9

Department of Agriculture Expenditures on Science and Technology



Expenditures on S&T	1979-80	1980-81	1981-82	1982-83	1983-84(1)	1984-85(1)	1985-86(1)
	\$'000,000						
Total S&T	160.5	183.8	210.8	236.2	354.1	390.4	425.9
R&D (NSE)	149.6	162.1	186.5	209.0	312.7	348.5	372.3
RSA (NSE)	9.3	20.3	23.0	25.5	38.8	37.6	49.5
SSH	1.7	1.4	1.3	1.7	2.6	4.3	4.1
Per cent of S&T	%						
R&D (NSE)	93	88	88	88	88	89	87
RSA (NSE)	7	11	11	11	11	10	12
SSH	1	1	1	1	1	1	1
By performer	%						
Intramural	94	88	90	88	89	92	93
Industry	2	2	1	2	5	4	4
University	2	2	2	2	2	3	2
Other	3	8	7	7	4	1	1

(1) Includes the Canadian Forestry Service.

DOA - Continued**Objective**

To contribute to the development of optimum agricultural and food production; to ensure the continual supply of safe, wholesome, high quality and nutritious food for domestic and export trade; and to promote and enhance the sustained economic utilization of Canada's forest resource through environmentally sound forest management.

Organization

Recent organizational changes have resulted in the movement of the Canadian Forestry Service (CFS) from Environment Canada to Agriculture Canada under the new Minister of State (Forestry). This movement reflects the increased emphasis being placed on the forest resource within the Canadian economy.

The bulk of the department's research is in the Research Branch which operates 52 research units from coast to coast and the following six national research institutes located in the NCR:

- Animal Research Centre
- Biosystematics Research Institute
- Chemistry and Biology Research Institute
- Food Research Institute
- Land Resource Research Institute

- Engineering and Statistical Research Institute

Expenditures

- The department's expenditures on S&T represent 24% of its total budgetary expenditures.
- In 1985-86 the department's expenditures for S&T total \$426 million, 87% of which is for R&D in NSE. This represents a 7% increase over 1984-85.
- The department performs nearly all of its own S&T; however, payments to industry have increased slowly from 2% in 1979-80 to a high of 5% in 1983-84. This increase in the industrial performance of S&T is largely due to the transfer of the Canadian Forestry Service to Agriculture Canada.

Capital Expenditures

The department plans to spend close to \$104 million on capital in 1985-86, a 45% increase over 1984-85.

Major capital projects are listed below:

Capital expenditures	Total cost	1985-86 expenditures
	\$000,000	
Food Research Centre, St.-Hyacinthe, P.Q.	35.7	14.2
Laboratory, St.-Hyacinthe, P.Q.	17.0	10.7
Office/Laboratory extension, Lennoxville, P.Q.	11.4	7.2
Office/Laboratory addition, London, Ont.	11.4	1.3
Laboratory and Isolation Barn, Lethbridge, Alta.	22.3	12.2
Laboratory, Calgary, Alta.	16.8	2.8
Office/Laboratory, Summerland, B.C.	32.2	13.1
Maritime Forest Research Centre, Fredericton, N.B.	22.5	11.4
Laurentian Forest Research Centre, expansion, Ste.-Foy, P.Q.	18.1	5.0
Great Lakes Forest Research Centre, addition, Sault Ste. Marie, Ont.	17.4	6.9
Pacific Forest Research Centre, expansion, Victoria, B.C.	14.0	2.4

DOA - Continued

Grants and contributions	1985-86 expenditures
	\$000,000
ERDAs and assistance plan for Innovation and Technology Transfer in Quebec	11.8
Grants to universities for specific forest research projects	2.3
Contribution for the Maritime Forest Ranger School	6.7
Forest Engineering Research Institute of Canada	1.4
Contribution to FORINTEK Canada Corporation	4.4

Person-years

Five thousand, four hundred and thirty-four person-years are engaged in S&T activities, a reduction of 248 from 1984-85. Scientists and professionals total 1,468, the largest number since 1979-80.

Regional Distribution

The 1983-84 distribution of intramural expenditures showed the bulk (32%) of the expenditures occurring in the NCR. The distribution was as follows:

	Per cent
Atlantic provinces	11
Quebec (excluding Hull)	14
Ontario (excluding Ottawa)	9
Manitoba	7
Saskatchewan	8
Alberta	12
British Columbia	7
NCR	32

S&T Activities

Expenditures are mainly for S&T related to food, which accounts for about 60% of its total expenditures. The remainder of its expenditures are for S&T in forestry and other natural resources..

Research on natural resources. Research on the properties that limit the productivity of soils; soil survey and classification including procedures for evaluating the capability of soils for agricultural production; research on water use and water management to improve production potential; development of superior methods of irrigation, drainage, and desalination; research on use of climatic resource information; research on energy utilization and conservation in the agri-food system; environmental quality research for controlling pollution from plant nutrients, residue components and pesticide management.

Research on production development. Research, technology transfer and support services on animal selection and crossbreeding; cow-calf systems; feedlot systems; breeding, genetics,

feeding and management for improving milk production; breeding, reproductive physiology and improved feeding and management systems for swine, poultry and sheep; research on improving productivity of honey bees and fur-bearing animals.

Research, technology transfer and support services on increasing crop yields and improving quality by developing superior varieties and improving management practices; plant breeding; physiology; crop management; and the effective control of pests by improved methods and integrated pest control systems.

Supportive research and development on winter-hardiness, nitrogen, fixation, cytogenetics, protection of crops from diseases, insects and weeds; protection of animals from insects; classification and identification of Canadian insects, plants and fungi; research on improving and better utilizing farm machinery and structures.

Research and information related to processing, distributing, retailing and consumer concerns. Research, technology transfer and support services on food processing technology; technology and equipment for extracting and utilizing components of selected plant and animal agricultural products; new product development having commercial potential; methods and processes for new food ingredients, post harvest physiology and pathology of fruits and vegetables; off-farm storage of fruits and vegetables; reduction of losses in stored grain and oilseeds by controlling insects.

Research and analysis on the composition and nutritive quality of foods; research on microbiological and chemical contaminants including potential hazards in feedstuffs; provision of information and technical advice to consumers on food quality, safety, buying, and handling in order to promote Canadian products.

Research and advisory services. Research into new or emergent animal disease and meat safety, provision of technical advisory services on biologics, pesticides, and food additives; analyses and advisory services on food additives, residues, bacteriology and food borne diseases.

DOA - Concluded

Forest research. Environment research is carried out to assess the impact of forestry practices on the environment, the impact of environmental problems on the forest resource and to further the knowledge of forest ecosystems. Products research is conducted to develop improvements in the genetic quality of major tree species, improved methods of reforestation, tree and stand growth and forest

stand systems. Protection research is directed toward increasing the knowledge of forest biology, improving methods of prediction, detection, prevention and control of forest fires, and pest control including biological and chemical agents. Utilization research is directed toward the utilization of forest resources and the development of new products.

Atomic Energy of Canada Ltd. (AECL)

Expenditures on S&T	1979-80	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86
	\$000,000						
Total S&T	93.2	100.9	103.4	129.6	138.0	146.4	152.5
R&D (NSE)	75.4	78.8	90.7	114.1	120.7	127.8	133.0
RSA (NSE)	17.7	22.1	12.7	15.5	17.3	18.6	19.5
Per cent of S&T	%						
R&D	81	78	88	88	88	87	87
RSA	19	22	12	12	12	13	13
By performer	%						
Intramural	72	74	85	87	88	88	89
Industry	26	24	13	11	10	10	9
Other	2	2	3	2	2	2	2

Objective

To carry out basic and applied R&D in the field of atomic energy for peaceful purposes.

Organization

In 1978 AECL was reorganized into a series of subsidiary companies. The bulk of the S&T activities are conducted by the Research Company. AECL operates two major research establishments:

- Chalk River Nuclear Laboratories (CRNL) whose work on basic physics, chemistry, materials science and biology provides fundamental support to all aspects of nuclear technology and serves a national laboratory role in the nuclear sciences.
- Whiteshell Nuclear Research Establishment (WNRE) whose programs are mainly focused on nuclear fuel waste management and on nuclear reactor safety research.

AECL's programs are divided into six major activities:

- Power Reactor Systems;
- Advanced Fuel Cycles;

- Environmental Protection and Radioactive Waste Management;
- Heavy Water Processes;
- Underlying and Advanced Systems Research; and
- New Applications.

As announced in the May 1985 budget, there will be a significant reduction in funding to AECL's R&D program. The reduction will be phased in gradually over a five-year-period.

Expenditures

- It is estimated that AECL will spend \$152.5 million on S&T (NSE) in 1985-86 of which 87% is for R&D.
- In 1981-82 the percentage distribution of expenditures on R&D (NSE) increased by 10%, with a corresponding decrease in RSA (NSE). The percentage distribution on R&D has remained at about 88% since that period.
- The major change in expenditures has been a significant reduction in industrial expenditures from 26% in 1979-80 to 9% in 1985-86. Intramural expenditures have increased accordingly.

Canadian International Development Agency (CIDA)

Objective

To support the efforts of developing countries in fostering their economic growth and social evolution.

Organization

CIDA's program consists of three major activities:

- The Country to Country Co-operation activity, which includes development assistance to selected governments and regional institutions of developing countries.
- The International Initiatives activity which provides support in the form of funding, food transfers, and policy input for the development efforts of international organizations, both governmental and private. Its five sub-activities are:

International Financial Institutions;
Multinational Food Aid;
Multilateral Technical Co-operation;
International Humanitarian Assistance; and
International Non-governmental Organizations.

- The Corporate Services activity, which includes policy formation and evaluation services.

Expenditures

CIDA's S&T expenditures will be \$57 million in 1985-86, a 10% increase over 1984-85.

In 1985-86:

- The bulk (63%) of its S&T expenditures will be for feasibility studies (RSA) in the NSE performed by Canadian industry.
- Activities in the Social Sciences are small, less than 11% of its total S&T.
- Industry performs the bulk (63%) of CIDA's S&T activities. Foreign performers account for 25% of its activities.

Since 1979-80:

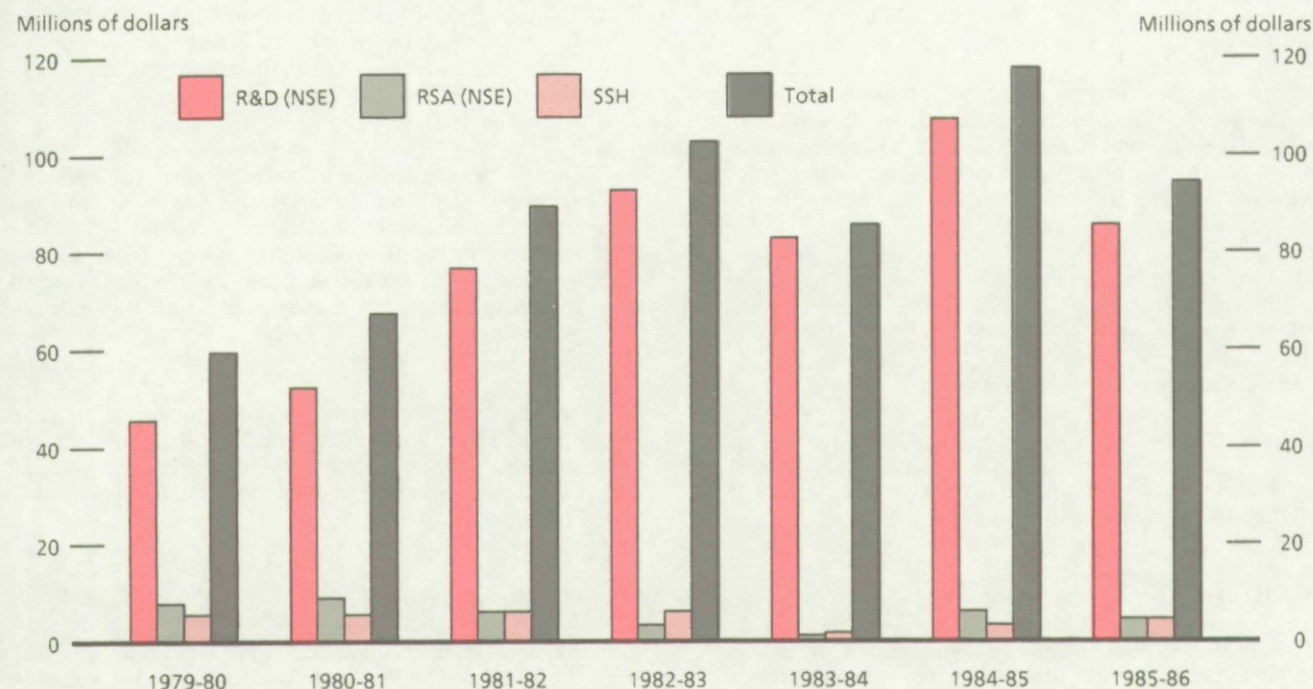
- CIDA has decreased its expenditures in the SSH from about 14% to 11%, with a corresponding increase in RSA (NSE) expenditures.
- Canadian industry has been performing a greater percentage of CIDA's RSA activities, increasing from about 59% to 63% in 1985-86, with a corresponding decrease in foreign expenditure.

Expenditures on S&T	1979-80	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86
	\$000,000						
Total S&T	37.6	36.7	41.9	48.6	48.0	52.1	57.2
R&D (NSE)	8.5	8.6	9.7	12.3	13.3	12.7	13.2
RSA (NSE)	23.7	23.7	27.3	30.9	28.7	33.6	37.8
SSH	5.4	4.4	4.9	5.4	6.0	5.8	6.2
Per cent of S&T	%						
R&D (NSE)	23	23	23	25	28	24	23
RSA (NSE)	63	65	65	64	60	65	66
SSH	14	12	12	11	12	11	11
By performer	%						
Intramural	6	7	7	6	8	7	6
Industry	59	61	62	61	57	61	63
University	6	6	6	5	5	6	6
Foreign	28	26	25	28	30	26	25

Communications (DOC)

Chart - 10

Department of Communications Expenditures on Science and Technology



Expenditures on S&T	1979-80	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86
\$000,000							
Total S&T	59.6	67.6	89.9	103.3	86.1	117.8	94.7
R&D (NSE)	45.6	52.5	77.2	93.3	82.9	107.6	85.7
RSA (NSE)	8.1	9.3	6.2	3.4	1.3	6.5	4.5
SSH	6.0	5.7	6.5	6.6	1.9	3.7	4.5
Per cent of S&T	%						
R&D (NSE)	77	78	86	90	96	91	90
RSA (NSE)	13	14	7	3	2	6	5
SSH	10	8	7	6	2	3	5
By performer	%						
Intramural	73	70	64	64	65	65	59
Industry	23	26	21	19	16	22	19
University	1	2	4	1	-	1	1
Foreign	2	2	11	16	17	12	20

DOC - Continued**Objective**

To foster the orderly development and operation of communications for Canada in the domestic and international spheres.

Organization

DOC has two major program components with the bulk of its S&T activities in Communications. In Arts and Culture about \$1 million is spent in the social sciences. The Communications activities are structured as follows:

- Policy Branch;
- Spectrum Management Branch;
- Technology and Industry Branch;
- Research Branch;
- Communications Research Centre (CRC), David Florida Laboratory.

Expenditures

- In 1985-86, DOC's S&T expenditures will be \$95 million, a 20% decrease from 1984-85 expenditures.

- R&D expenditures at \$86 million have also decreased 20% from 1984-85.

- DOC's expenditures in Canadian industry have varied in percentage terms from a high of 26% in 1980-81, to a low of 16% in 1983-84. In 1985-86, payments to Canadian industry are expected to total approximately \$18 million or 19% of S&T expenditures.

- These decreases are mainly due to reduced spending in the Technology Application and Industry Support activity. Funding of DOC's applications programs may vary from \$2 to \$20 million, from one year to the next, with the completion or commencement of major projects.

- Foreign performers have increased their share from about 2% in 1979-80 to 20% in 1985-86, this is due to the increased participation in the European Space Agency (ESA) Program.

Capital Expenditures

DOC will spend about \$12 million on S&T capital in 1985-86, a 66% decrease from 1984-85. Major items are as follows:

Capital expenditures	Total cost	1985-86 expenditures
	\$000,000	
Office Automation Research Centre	1.5	1.5
M-Sat Bridging	3.9	1.0
David Florida Laboratory expansion	5.5	3.9

Contributions

Contributions to the European Space Agency for the Large Satellite (now known as Olympus) Program are estimated at \$19 million, a 29% increase over 1984-85.

Person-years

Six hundred and fifty eight person-years will be devoted to S&T activities in 1985-86 of which 35% are in the scientific and professional category. Except for a one year increase in 1982-83, PY's have remained relatively constant.

S&T Activities

Research. Technological forecasting; planning and conducting of exploratory and applied research and development directed towards the solution of problems and the advancement of communications, information, and space telecommunications sciences.

Technology applications and industry support. Development and implementation of new communications and information services and technologies and the promulgation and management of programs to assist Canadian industry in the design, development, manufacture and marketing of these products and services.

DOC - Concluded**Management of the radio frequency spectrum.**

Development and implementation of radio frequency plans and frequency assignment criteria; administration and enforcement of the provisions of the Radio Act and Regulations and the Telegraph Act which includes development and application of technical standards for radio equipment and systems, the development and application of licensing and certification procedures and regulations. This activity includes technical certification for the granting of licenses for broadcasting undertakings by the Canadian Radio-television and Telecommunications Commission as defined in the

Broadcasting Act.

Policy development and coordination. Formulation of strategies for the development, promotion and monitoring of broadcasting and telecommunications services; responsibility for coordination of federal-provincial activities in communications and culture; development of Canada's policy on international aspects of communications and culture; and for development and dissemination of information regarding policies, programs and regulations to the departmental constituency and the general public.

Energy Mines and Resources (EMR)

Chart - 11

Energy, Mines and Resources Expenditures on Science and Technology

EMR - Continued

Expenditures on S&T	1979-80	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86
	\$000,000						
Total S&T	152.7	194.2	232.2	256.6	288.7	368.8	433.2
R&D (NSE)	107.3	124.7	153.5	170.4	193.2	254.1	286.1
RSA (NSE)	38.9	60.0	69.8	75.0	83.6	100.0	129.1
SSH	6.5	9.6	8.9	11.2	11.9	14.7	18.0
Per cent of S&T	%						
R&D (NSE)	70	64	66	66	67	69	66
RSA (NSE)	26	31	30	29	29	27	30
SSH	4	5	4	4	4	4	4
By performer	%						
Intramural	68	67	70	78	73	70	66
Industry	9	14	13	13	16	19	24
University	1	2	1	2	3	2	2
Provincial government	20	15	14	3	6	5	2
Other	2	2	2	4	3	4	6

Objective

To stimulate the discovery, development, use and conservation of Canadian mineral and energy resources; and to provide the earth sciences information needed for effective use and demarcation of the country's land mass.

Organization

The bulk of EMR's S&T activities are conducted in:

- Canada Centre for Mineral and Energy Technology (CANMET);
- Earth Physics Branch;
- Surveys and Mapping Branch;
- Geological Survey of Canada;
- Canada Centre for Remote Sensing;
- Atlantic Geoscience Centre, Bedford, N.S.;

- Institute of Sedimentary and Petroleum Geology, Calgary, Alberta;
- Coal Research Laboratories in Edmonton, Calgary, Alberta and Sydney, N.S.;
- Cordilleran Geology Division, Vancouver, B.C.;
- Pacific Geoscience Centre, Sydney, B.C.

The Government's energy S&T activities are coordinated by EMR through its Office of Energy, Research and Development (OERD).

Expenditures

- EMR's S&T expenditures are contained in two budgetary programs; the Mineral and Earth Sciences Program and the Energy Program. The Mineral and Earth Sciences Program is the largest in terms of S&T, accounting for about 78% of the department's S&T expenditures.

EMR - Continued**Expenditures -Continued**

- In 1985-86, EMR's expenditures on S&T will be \$433 million representing about a 17% increase over 1984-85. This increase results from a 13% increase in R&D (NSE) expenditures and a 29% increase in RSA (NSE). The Mineral and Earth Sciences program has increased its expenditures on supporting contracts, for the outfitting of the recently implemented Frontier Energy Geoscience Program. The Energy program has increased its spending on feasibility studies and R&D grants to industry, in relation to the Canada Oil and Gas Lands Administration Program (COGLA).
- Because of its mandate for earth science information, EMR spends about 30% on RSA (NSE), mainly on data collection.
- Payments for S&T in industry have been steadily increasing over the past few years,

representing about 24% of EMR's total expenditures for S&T in 1985-86. The big increase in payments began in 1983-84 with an increase in R&D grants and contributions in support of energy research. In 1985-86, about \$38 million in R&D grants are to be awarded to industry.

- EMR's payments to provincial governments dropped significantly in 1982-83, primarily resulting from the termination of the original Alberta/Canada energy agreement which included a \$96 million payment spread over five years ending in 1981-82.

Capital Expenditures

EMR will spend about \$44 million on capital in 1985-86. These include the expenditures listed below:

Capital expenditures	Total cost	1985-86 expenditures
		\$000,000
RADARSAT Phase B, P.Q.	7.5	4.4
MOSAICS Phase B, B.C.	3.5	3.5
Elliot Lake Research Laboratory, Ont.	6.3	2.6
Canadian Ground System, Ont.	16.7	7.0
Institute of Cartography, P.Q.	42.7	1.6

Grants and Contributions

- Joint Canada/Saskatchewan program for the development of heavy oil recovery technology, \$.65 million.
- Canada/Saskatchewan Heavy Oil and Fossil Fuel R&D Program, \$3.9 million.
- Contribution to the Canadian Electrical Association R&D program, \$3.0 million.
- Contributions in support of the development and demonstration of new technologies related to renewable and non-conventional sources of energy and energy conservation, \$16.3 million.
- Industry Energy Research and Development Program (IERD), \$3.7 million.
- Remote sensing contribution to the European Space Agency (ESA), \$13.3 million.
- Grant in aid of earth sciences, energy and minerals research, \$1.4 million.

Person-years

Two thousand seven hundred and eighty-one person-years are devoted to S&T activities of which 42% are in the scientific and professional category. Total PY's have increased slightly since 1979-80 with the largest increase occurring in the scientific and professional category.

EMR - Continued**Regional Distribution**

The bulk of EMR's activities are in the National Capital Region with small amounts in other areas of Canada. The 1983-84 distribution of intramural expenditures was:

	Per cent
Nova Scotia	6
Ontario (excluding Ottawa)	1
Saskatchewan	-
Alberta	8
British Columbia	3
NCR	82

S&T Activities

The department's S&T activities can be grouped as follows:

Mineral development. The assessment of Canadian and world supply and demand in minerals; analysis of the development and production of domestic and foreign mineral resources and products; and the availability of minerals for export; analyses of economic, social, regional and environmental effects of mineral policies and programs; and the promulgation of mineral policies, together with their co-ordination in both an international and domestic context.

Minerals technology. Co-ordination of the federal research effort in mining, and mineral extraction and processing; promotion and support of Research and Development by industry and universities in the mineral field; performance of applied research and engineering development in mining technology, mineral extraction, metallurgy, processing and use of metals and alloys; identifying technological opportunities in mining and metallurgy and transferring technology to the private sector.

Energy technology. Conduct of applied research and engineering development in selected areas including energy conservation, heavy oils and oil sands development, coal development and conversion, uranium recovery and energy transportation, identifying technological opportunities in energy and transferring technology to the private sector.

Geological surveys. The conduct of geological, geophysical and geochemical research and surveys; estimation of mineral and non-renewable energy resources; investigation of geological phenomena affecting engineering works and the environment; development of geophysical and other technologies; development of national

geoscience standards; fostering Canadian geoscience and Canadian international geoscience activities; cooperation with the provinces, provision of advice to government; and production and dissemination of maps and reports.

Earth physics. The provision of a comprehensive geophysical knowledge base on the framework, dynamic processes and hazards of the Canadian landmass and offshore areas; the operation of the national networks of geophysical observatories and the provision of geophysical standards.

Polar continental shelf. The study of scientific problems unique to Arctic Canada and the provision of co-ordinated logistic support to public and private sector groups conducting scientific studies in the Arctic; the provision of information about scientific operations in the Arctic to the scientific community and to the local inhabitants.

Remote sensing. The development and the demonstration of systems, methods and instruments to acquire, disseminate and analyze remote sensing data from aircraft and satellites, as a contribution to the development of effective information and management systems for Canada's land and ocean resources and the environment.

Surveying and mapping. The establishment and maintenance of a national network of accurately located horizontal and vertical positional reference monuments; the acquisition and maintenance of topographical and geographical information on the Canadian landmass; the preparation, publication and distribution of topographical and electoral maps, aeronautical charts and publications, aerial photographs, gazetteers and the National Atlas of Canada; the regulation and management of boundary and property surveys on federal lands; the maintenance of international boundaries.

Energy research and development. Development of federal R&D policies to support national energy strategy options; collection of information on research, development and demonstration activities in federal and provincial departments and agencies, in industry, in universities, and internationally; provision of advice on allocation of federal R&D resources; technical evaluation of federal energy R&D programs; management of energy R&D programs through contracts and co-operative agreements; and provision of information on Canadian Energy R&D.

EMR - Concluded

Energy public information. Analyses of the needs for public information in the area of energy policy and activities; analyses of public attitudes towards these policies and activities and determination of impact on the socio-economic system in Canada; preparation and co-ordination of plans for the communication of energy policies and activities; and evaluation of the impact on the Canadian public.

Environment (DOE)

Objectives

To conserve and enhance Canada's renewable resources for sustained economic and social benefit.

To protect the environment from the adverse impact of human activities.

To facilitate the adaption of human activities to the environment.

To safeguard and foster public understanding and enjoyment of Canada's natural and historic heritage.

Organization

DOE's S&T activities occur in its four services:

Atmospheric Environment Service;
Environment Conservation Service;
Environmental Protection Service; and
Parks Canada.

The Canadian Forestry Service (CFS), formerly with DOE, was transferred to Agriculture Canada on September 17, 1984. Thus, aggregate data on Environment Canada include information on CFS through to 1982-83 only.

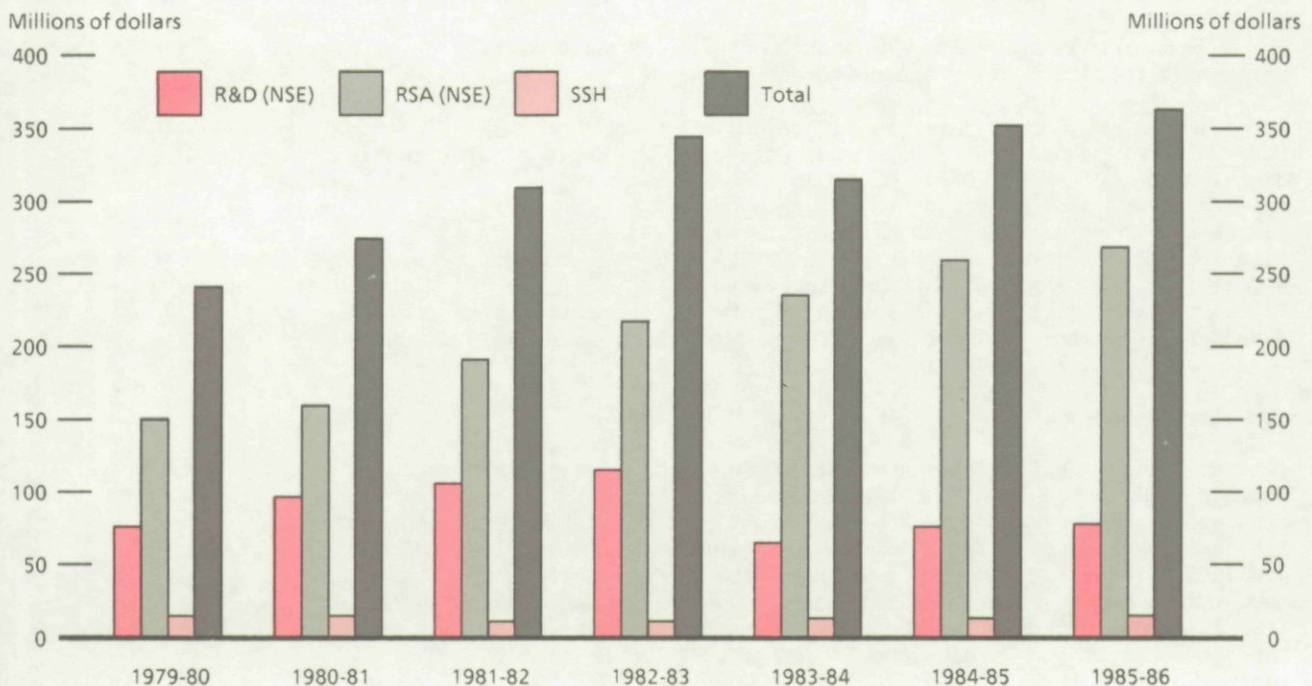
DOE's organization is highly decentralized in order to respond to the varying needs of clientel in, and environmental issues affecting, specific geographical areas.

Activities are managed by six regional offices:

Pacific Region in Vancouver;
Western Region in Edmonton;
Central Region in Winnipeg;
Ontario Region in Toronto;
Quebec Region in St Laurent;
Atlantic Region in Bedford.

Chart - 12

Department of Environment Expenditures on Science and Technology



DOE - Continued

Expenditures on S&T	1979-80	1980-81	1981-82	1982-83	1983-84(1)	1984-85(1)	1985-86(1)
	\$000,000						
Total S&T	241.6	274.3	309.3	345.3	315.8	352.0	363.4
R&D (NSE)	76.4	96.7	106.0	115.6	66.0	76.4	78.7
RSA (NSE)	150.0	161.0	191.1	217.3	236.1	260.9	269.3
SSH	15.2	16.5	12.1	12.4	13.7	14.7	15.4
Per cent of S&T	%						
R&D (NSE)	32	35	34	33	21	22	22
RSA (NSE)	62	59	62	63	75	74	74
SSH	6	6	4	4	4	4	4
By performer	%						
Intramural	90	89	90	91	93	94	94
Industry	5	6	6	5	3	2	2
University	1	1	1	1	1	1	1
Other	4	4	3	3	3	3	3

(1) Excludes the Canadian Forestry Service.

Expenditures

- DOE will spend an estimated \$363 million in 1985-86, a 3% increase over 1984-85. The bulk (74%) will be spent on RSA (NSE), mainly for data collection.
- DOE's S&T expenditures are 45% of the department's total budgetary expenditures.
- The transfer of forest research to Agriculture Canada decreased DOE's percentage distribution of R&D (NSE) spending. The department now places more of an emphasis on RSA (NSE), which increased from 63% of total S&T expenditures in 1982-83 to 75% in 1983-84. This also resulted in the increased intramural performance of S&T, with a corresponding decrease in industry.

Person-years

- In 1983-84, because of the transfer of the Canadian Forestry Service, person-years devoted to S&T decreased by 925, to approximately 3,940. While total PYs increased to 4,034 in 1984-85, those in the scientific and professional category decreased. In 1985-86, total PYs fell to 3,920. However, the scientific and professional category increased slightly.

Capital Expenditure

DOE will spend an estimated \$30 million on capital in 1985-86. Its major expenditure will be for the completion of the new National Hydrology Research Centre in Saskatoon. The estimated total capital cost is \$16.1 million, \$8.4 million of which will be spent in 1985-86.

Regional Distribution

Ontario (excluding Ottawa) receives the bulk of DOE's intramural expenditures. The distribution in 1983-84 was:

	Per cent
Newfoundland	1
Nova Scotia	5
New Brunswick	2
Quebec (excluding Hull)	9
Ontario (excluding Ottawa)	42
Manitoba	6
Saskatchewan	5
Alberta	9
British Columbia	11
NCR	10

DOE - Concluded

S&T Activities

The S&T activities of DOE can be grouped as follows: (percentage of 1985-86 S&T expenditures are given in brackets).

Environmental protection (4%). Technological development and demonstration of pollution control techniques; technical assessment and approval or rejection techniques concerning applications for pollution abatement incentives; co-ordination of national response to environmental crises; initiation, development and implementation of research and control measures for solid waste management and hazardous material disposal; abatement of pollution from federal facilities; management of a regional structure for the operation of environmental protection programs.

Atmospheric environment (66%). Provides historical, current and predictive meteorological, sea state and ice information for all areas of Canada, and contiguous waters; provides advice and consultation on the impact of meteorological, sea state and ice conditions on human activities and on the applications of meteorological knowledge to weather sensitive operations; provides assessments of the impact of human activities on the atmospheric environment; conducts research in the behaviour of the atmosphere and its inter-environmental reactions, in windwave mechanisms and in the dynamics of ice in navigable waters; develops, tests and calibrates standard meteorological instruments; formulates national ambient air quality objectives; conducts research and provides information, advice and consultation on the meteorological aspects of air quality and of noise intensity and propagation; develops and conducts professional and technical meteorological training programs; provides meteorological library services; participates in international scientific and operational programs and undertakes special field surveys in support of Canadian programs to assist individual nations.

Environmental conservation (26%). Initiation of national programs for the planning and implementation of water resources development and water quantity and quality research; develop-

ment of policies and systems for hydrometric data collection and networks, water and ice inventories and forecasting; management and research and data collection to establish a national inventory and data bank of land capability and use, participation in federal-provincial planning for land capability and use; provision of a federal response to research and related service needs of provincial governments; migratory bird conservation and protection; wildlife advisory services and information to government and other agencies; wildlife research on toxic chemicals, wildlife pathology, interpretation, information and biometrics, wildlife research and management in co-operation with provincial and territorial governments; defence and encouragement of rare and endangered species; assessment of the effect of resource development and other operations on wildlife; and management of regional structures for wildlife operations.

Fisheries and Oceans (F&O)

Objective

To undertake, promote and co-ordinate policies and programs: for the conservation and management of the aquatic renewable resources of Canada and their habitats; for the sustained economic utilization of these resources, taking into account the dependence of Canadian communities on them; and for the conduct of surveys and research in support of Canada's economic and scientific interests in the oceans, including the safe use of Canada's navigable waters and environmentally acceptable utilization of other marine resources.

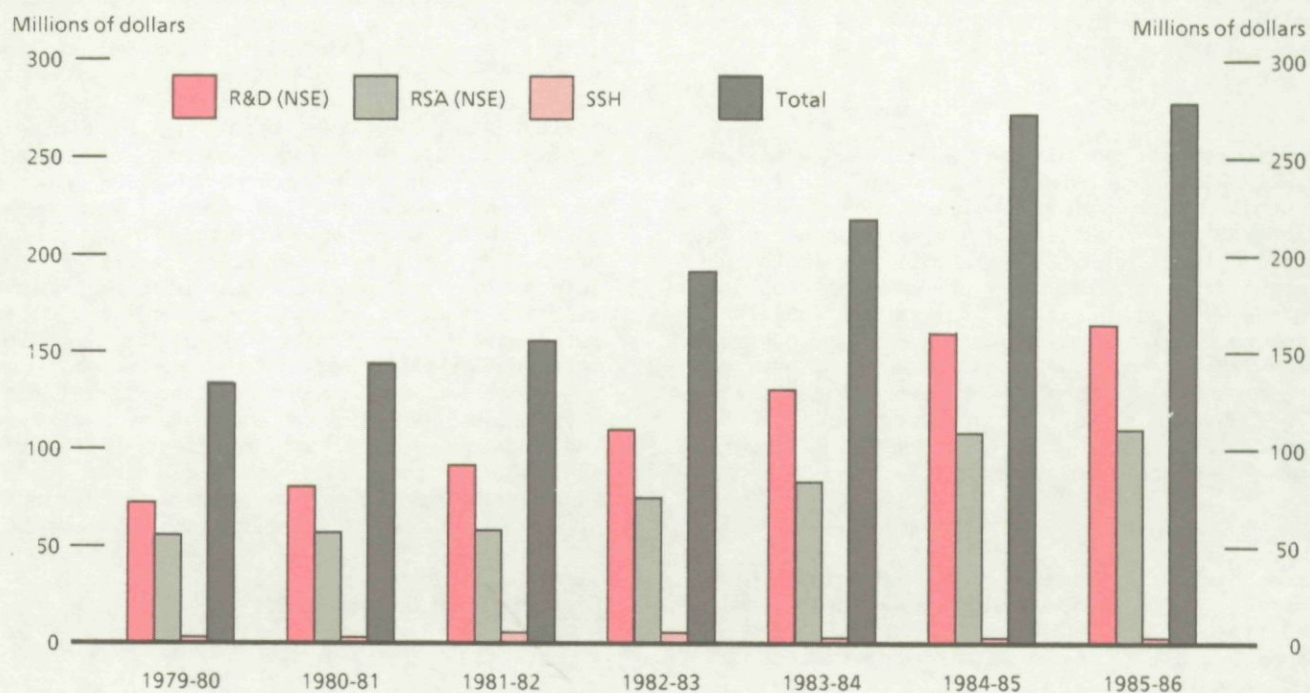
Organization

S&T activities are conducted in four program areas:

- Atlantic Fisheries Service;
- Pacific and Freshwater Fisheries;
- Ocean Science and Surveys;
- Marketing and International Fisheries.

F&O - Continued

Chart - 13
Fisheries and Oceans Expenditures on Science and Technology



Expenditures on S&T	1979-80	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86
	\$000,000						
Total S&T	133.8	143.4	156.7	192.6	219.1	272.4	277.9
R&D (NSE)	73.4	81.5	92.0	110.8	131.7	159.8	164.0
RSA (NSE)	56.9	58.2	58.8	75.4	84.3	108.4	109.9
SSH	3.5	3.7	5.9	6.4	3.0	4.1	3.9
Per cent of S&T	%						
R&D (NSE)	55	57	59	58	60	59	59
RSA (NSE)	42	41	37	39	39	40	40
SSH	3	2	4	3	1	1	1
By performer	%						
Intramural	93	93	91	94	93	94	94
Industry	4	4	7	5	4	4	4
University	1	1	1	1	2	1	1
Other	2	2	1	1	1	1	1

F&O - Continued**Expenditures**

- F&O will spend an estimated \$278 million on S&T activities in 1985-86, about 2% more than in 1984-85. S&T expenditures are about 43% of the department's total budgetary expenditures.
- Expenditures on R&D (NSE) will be 59% and on RSA (NSE) about 40%. The balance is spent on

SSH. Fifty five per cent of the RSA (NSE) expenditures are for data collection.

Capital Expenditures

F&O will spend about \$67 million on buildings, ships and equipment in 1985-86, the same as in 1984-85.

Capital expenditures	Total cost	1985-86 expenditures
	\$000,000	
Gulf Region Fisheries Centre, Moncton, N.B. (research component only)	9.2	2.6
Maurice Lamontagne Institute, Ste. Flavie, P.Q.	44.0	19.6
Freshwater Institute, Winnipeg, Man. (water treatment system)	2.5	0.5
M/V E.E. Prince (desing) (N.S.)	-	0.3
M/V Vessels A and B (design)	-	2.0
M/V Pandalus (replacement) (N.B.)	0.4	0.4
M/V W.E. Ricker (conversion and refit) (B.C.)	13.4	5.0
M/V F.C.G. Smith (Electronic Sweep Vessel) (N.S.)	5.6	2.1
M/V John P. Tully (B.C.)	26.5	5.0
M/V Hudson (mid-life refit) (N.S.)	7.3	3.3

Person-years

There will be about 2,660 person-years devoted to S&T in 1985-86, of which 31% will be in the scientific and professional category. The S&T PYs have increased about 2% over 1984-85.

Regional Distribution

The bulk of F&O's expenditures are spent on the east and west coasts. Its intramural expenditures for 1983-84 by province were:

	Per cent
Newfoundland	13
Nova Scotia	34
New Brunswick	5
Quebec (excluding Hull)	6
Ontario (excluding Ottawa)	5
Manitoba	6
British Columbia	26
NCR	5

S&T Activities

Fisheries management activities undertaken by the department include:

- The conduct of research on aquatic species and ecosystems, particularly to acquire the scientific knowledge needed for conservation, preservation, restoration, augmentation and culture of the aquatic renewable resources, for the wise use of the habitats upon which they depend, and for planning, evaluation and control of the commercial, recreational, and native fisheries;
- The provision of scientific professional services in those areas as well as in other specialized fields such as aquaculture, fish health, toxicology, limnology, systematics and the physiology of aquaculture organisms;
- The exploration and development of new fishery resources, and methods of harvesting, handling and processing of fish;

F&O - Concluded

Ocean Sciences and Surveys Activities include:

- The provision of hydrographic data, charts and associated publications in respect of all Canadian navigable waters and the production of natural resource maps for Canada's offshore areas in conjunction with EMR.
- The maintenance of an inventory of oceanographic data existing in Canada, data storage, processing and dissemination services, and the fulfillment of requests for marine scientific data.
- The conduct of research into ocean phenomena and processes, and the provision of scientific information, advice and assistance concerning marine science and technology;
- The provision of technological assistance to the Canadian ocean industry and the transfer of technology for use in the private sector.

About 49% of the S&T expenditures will be spent in the fisheries, 19% in the ocean and 21% in the transportation applications areas.

International Development Research Centre (IDRC)

Objective

To initiate, encourage, support and conduct research into the problems of the developing regions of the world and into the means of applying and adapting scientific, technical and other knowledge to the economic and social advancement of those regions.

Organization

S&T activities are conducted in four divisions:

- Agriculture, Food and Nutrition Sciences;
- Health Sciences;
- Information Sciences;
- Social Sciences.

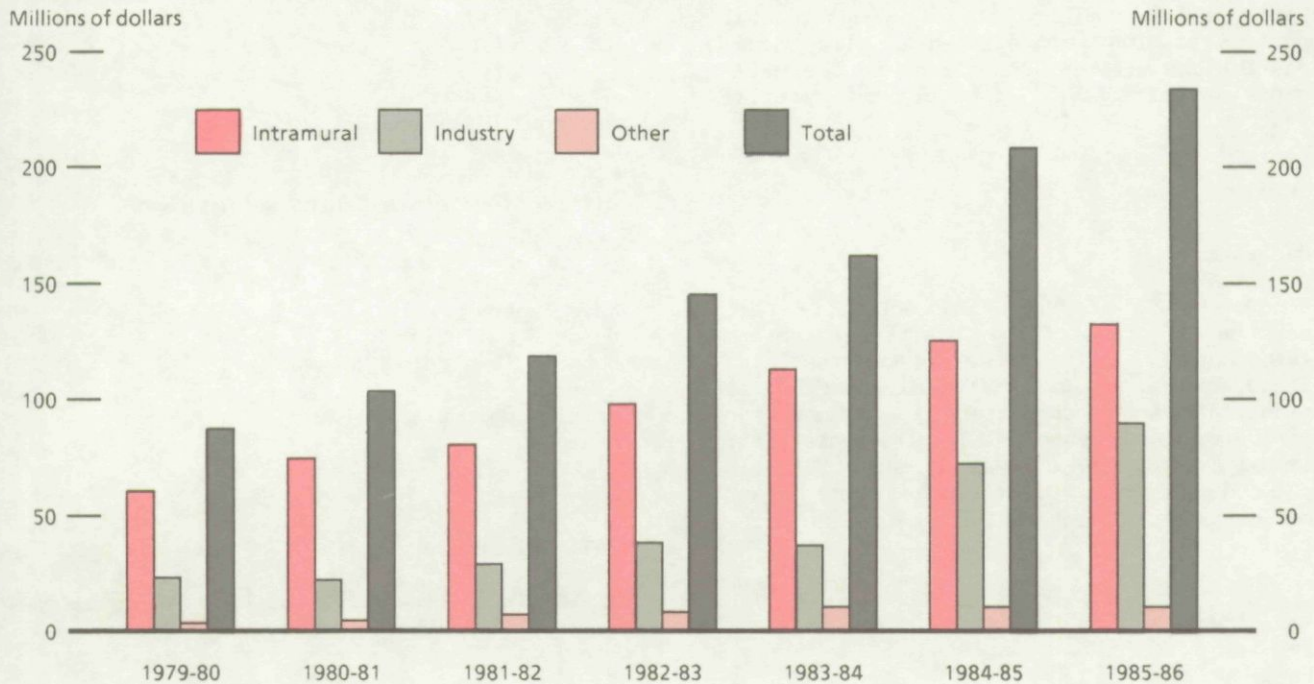
Expenditures

- IDRC's 1985-86 expenditures on S&T will be \$85 million, a 16% increase over 1984-85. S&T expenditures have doubled within the last five years.
- Next to the Social Science and Humanities Research Council, IDRC is the largest spender on R&D in SSH (\$27 million or 32% of its S&T budget in 1985-86).
- Because of its mandate, IDRC spends the bulk of its funds (53% in 1985-86) in the foreign sector.
- Spending patterns by IDRC have not changed significantly since 1979-80 although in 1985-86 it is spending a larger percentage on R&D.
- In 1983-84, performers of S&T changed significantly. Both the intramural and foreign sectors' shares decreased, resulting in a dramatic increase in S&T performed by the university and private-non-profit sectors (39% as compared to 3% in 1982-83). However, spending in both the intramural and foreign sectors has been increasing since that time.

Expenditures on S&T	1979-80	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86
	\$000,000						
Total S&T	36.5	39.8	45.9	53.6	63.7	73.7	85.4
R&D (NSE)	17.8	19.2	23.1	24.5	30.9	35.7	43.1
RSA (NSE)	0.8	0.9	1.5	2.0	1.8	2.5	2.6
SSH	17.9	19.7	21.3	27.1	31.0	35.5	39.7
Per cent of S&T	%						
R&D (NSE)	49	48	50	46	48	48	51
RSA (NSE)	2	2	3	4	3	3	3
SSH	49	50	46	51	49	48	47
R&D (SSH)	35	35	32	35	34	31	32
RSA (SSH)	14	14	14	16	15	17	15
By performer	%						
Intramural	30	30	30	33	20	24	28
Foreign	66	67	68	64	41	46	53
Other	4	3	2	3	39	30	20

National Defence (DND)

Chart - 14
National Defence Expenditures on Science and Technology



Expenditures on S&T	1979-80	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86
	\$'000,000						
Total S&T	88.1	103.5	118.9	145.4	162.3	209.0	234.3
R&D (NSE)	85.7	100.7	115.2	141.7	158.1	204.4	229.3
RSA (NSE)	0.8	0.6	1.2	1.2	1.4	1.7	1.8
SSH	1.7	2.1	2.5	2.5	2.8	3.0	3.2
Per cent of S&T	%						
R&D (NSE)	97	97	97	97	97	98	98
RSA (NSE)	1	1	1	1	1	1	1
SSH	2	2	2	2	2	1	1
By performer	%						
Intramural	70	72	68	67	70	60	57
Industry	26	22	25	27	23	34	38
University	2	3	3	3	4	3	2
Other	2	3	4	3	2	3	2

DND - Concluded**Objective**

To improve the operating capability of the armed forces by the effective application of science and technology to all departmental functions ranging from strategic policy decisions through military operations to the maintenance of effective personnel and material resources.

Organization

The majority of DND's S&T activities are under the direction of the Chief, Research and Development (CRAD). The major components of its S&T structure consist of five directorates at National Defence Headquarters in Ottawa, and six Defence Research Establishments at: Halifax; Valcartier; Ottawa; Toronto; Suffield and Esquimalt. The Directorates control and coordinate the S&T activities by five environments:

- Maritime;
- Land;
- Air;
- Communications and Space;
- Human Performance.

Expenditures

- DND's S&T expenditures will increase to \$234 million in 1985-86, a 12% increase over 1984-85.
- 98% of DND's expenditures are for R&D (NSE) essentially unchanged since 1979-80.
- In recent years, a major change in S&T performers has occurred. The intramural sector has decreased from 70% in 1983-84 to 57% in 1985-86. The industrial sector has correspondingly increased from 23% to 38%.

Person-years

In 1985-86 DND has 1,954 person-years devoted to S&T of which 32% are in the scien-

tific and professional category. This category is the only one in which there has been a slight growth.

Regional Distribution

The department's 1983-84 expenditures were distributed across Canada as follows:

	Per cent
Nova Scotia	11
Quebec (excluding Hull)	28
Ontario (excluding Ottawa)	10
Alberta	11
British Columbia	9
NCR	31

S&T Activities

The functions of S&T within the Department of National Defence include:

- Maintaining a defence technology base;
- Providing scientific and technological advice to the technical and operational staffs;
- Conducting an in-house R&D program where civilian industry cannot meet DND's requirements;
- Engaging in cooperative international R&D programs; and
- Collecting, disseminating and exchanging scientific information.

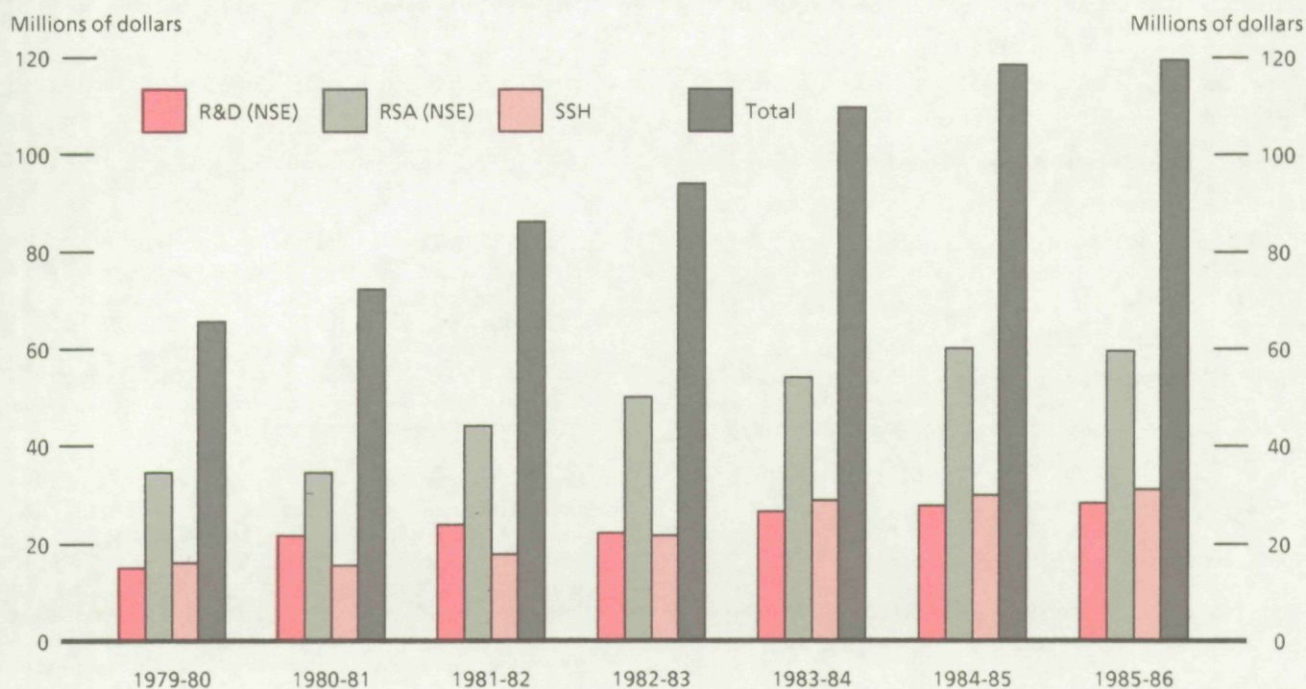
This effort includes such programs as:

- Development of components for ships to meet operational requirements;
- The study of explosives and ballistics;
- Research in underwater acoustics, electronic warfare, electro-optics, navigation, magnetism, command and control systems, radar and communications;
- Satellite systems, and
- Effectiveness of the man/machine interface involving studies of anthropometry, vision, hearing, vibration and human-engineering aspects of equipment design.

National Health and Welfare (NH&W)

Chart - 15

National Health and Welfare Expenditures on Science and Technology



Expenditures on S&T	1979-80	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86
\$'000,000							
Total S&T	66.1	72.5	86.5	94.1	109.9	118.6	119.7
R&D (NSE)	15.1	21.7	24.4	22.4	27.0	28.1	28.4
RSA (NSE)	34.8	34.9	44.2	50.0	54.0	60.3	59.8
SSH	16.3	15.9	17.9	21.7	28.9	30.2	31.5
Per cent of S&T	%						
R&D (NSE)	23	30	28	24	25	25	24
RSA (NSE)	53	48	51	53	49	51	50
SSH	25	22	21	23	26	25	26
R&D (SSH)	14	12	11	9	9	9	9
RSA (SSH)	11	10	10	14	17	17	17
By performer	%						
Intramural	74	74	75	74	73	74	74
University	16	15	13	13	12	13	13
Other	10	11	12	12	15	13	13

NH&W - Continued**Objectives**

The departmental mission is:

- To promote and preserve the health, social security and social welfare of the people of Canada.

Departmental responsibilities focus on the following objectives:

- Income security for individuals and families;
- Essential social services, particularly for socially and economically disadvantaged Canadians;
- Universal access for all Canadians to quality health services;
- Protection against disease and environmental hazards;
- Promotion of healthy lifestyles;
- Excellence in amateur sport; and
- Support of the planning and staging of the XV Olympic Winter Games.

The Department of National Health and Welfare is composed of eight program areas:

- Health Services and Promotion;
- Social Services;
- Medical Services;
- Health Protection;
- Income Security;
- Fitness and Amateur Sport;
- XV Olympic Winter Games;
- Departmental Administration.

Organization

Most of the S&T activities in the department are undertaken by the following units:

- Social Service Program Branch (the Social Development Directorate);
- Health Services and Promotion Branch (Extramural Research Programs Directorate);
- Health Protection Branch (the Drugs, Food, Field Operations, and Environmental Health Directorates, and the Laboratory Centre for Disease Control);

- Policy, Planning and Information Branch.

Expenditures

- NH&W's S&T expenditures will be about \$120 million in 1985-86 with 50% spent on RSA (NSE). Of this, \$23 million will be spent on testing and standardization and \$35 million on scientific data collection.
- 24% is to be spent on R&D (NSE) and 26% on SSH.
- Since 1979-80 the spending patterns have not changed significantly. Payments to universities have declined slightly from 16% in 1979-80 to 13% in 1985-86. Also R&D (SSH) has declined with a corresponding increase in RSA (SSH). However, the total devoted to SSH in 1985-86 has increased only slightly over the 1979-80 expenditures.
- Most of the payments to universities take the form of grants and are administered through the National Health R&D Program for the improvement of health services and in support of research and demonstrations in the field of public health. This program's expenditures will be close to \$23 million in 1985-86, a 6% increase over 1984-85 expenditures.

Person-years

NH&W has 1,495 person-years allocated to S&T activities, 48% of which are in the scientific and professional category. There has been a gradual increase in PY's in recent years, in all three categories. However, this trend has been halted in 1985-86.

S&T Activities

The department's S&T activities in 1985-86 include:

- The National Health Research and Development Program, where emphasis is currently being placed on research dealing with environmental health hazards, illness prevention and health promotion, accessibility and quality of health care, the health of Native peoples, and rehabilitation;
- The National Welfare Grants Program, which assists research, demonstration and human resource development and projects in support of the development of improved social services, particularly those aimed at disadvantaged Canadians;

NH&W - Concluded

- A wide range of health related research in the Health Protection Branch; current activities include a review of the science base of the Program by expert committees, the investigation of potential health hazards of contaminants in food, the review and update of standards for chemicals used in food, a review of the risk/benefit balance of marketed drugs, improved analytic services to assist those combatting drug abuse and illegal drug traffic, a revision to the guidelines for drinking water, a study of hospital infection rates, the development of methods for producing reagents for infectious-disease diagnosis and the development of diagnostic methods for Acquired

Immune deficiency Syndrome;

- The support in the Fitness and Amateur Sport Program, for the implementation of a drug testing and research program initiated by Sport Canada to detect and control the use of banned substances in the sports world;
- Ongoing social science research in the Departmental Administration Program; current activities include the comprehensive analysis of federal policies as they affect the social security of the family and the assessment of policy options for federal contributions to the provinces for health care services.

National Research Council (NRC)

Chart - 16

National Research Council Expenditures on Science and Technology

NRC - Continued

Expenditures on S&T	1979-80	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86
	\$000,000						
Total S&T	205.2	230.0	285.5	352.4	411.5	527.6	466.2
R&D (NSE)	173.8	193.2	239.8	306.0	361.1	472.0	406.6
RSA (NSE)	31.4	36.8	45.7	46.4	50.4	55.6	59.6
Per cent of S&T	%						
R&D	85	84	84	87	88	90	87
RSA	15	16	16	13	12	10	13
By performer	%						
Intramural	69	71	69	70	70	67	70
Industry	24	20	20	21	20	22	19
University	5	7	7	7	6	6	6
Foreign	1	1	1	1	2	2	3
Others	1	1	4	2	2	3	2
Capital expenditures (included in above figures)	\$ 12.8	18.2	25.8	49.8	68.4	120.6	80.3
As a percentage of S&T	% 6	8	9	14	17	23	17

Objective

To create, acquire and promote the application of scientific and engineering knowledge to meet Canadian needs for economic, regional and social development.

Organization

Within the National Capital Region, NRC's laboratory divisions are:

Canada Centre for Space Sciences
 Division of Biological Sciences
 Division of Building Research
 Division of Chemistry
 Division of Electrical Engineering
 Division of Mechanical Engineering
 Division of Microstructural Sciences
 Division of Physics
 Hertzberg Institute of Astrophysics
 National Aeronautical Establishment.

NRC also has a series of regional laboratories:

- Institute for Marine Dynamics at St John's, Nfld.;

- Atlantic Research Laboratory at Halifax, N.S.;
- Industrial Materials Research Institute at Boucherville, P.Q.;
- Plant Biotechnology Institute in Saskatoon, Sask.;
- Western Laboratory in Vancouver, B.C.;
- Biotechnology Research Institute at Montreal, P.Q.

The NRC also operates the Canada Institute for Scientific and Technical Information (CISTI) and the Industry Development Office, both located in the NCR. The Industry Development Office is responsible for the IRAP and PILP programs, for which further details are available in the Extramural Expenditures - Industry Section.

Expenditures

- NRC, with a budget of \$466 million in 1985-86, is the largest spender of S&T funds. It has experienced a rapid growth from 1979-80 through to 1984-85. However, NRC's 1985-86 expenditures are \$61 million lower than those in 1984-85.

NRC - Continued

- All NRC's expenditures are in NSE with 87% of its 1985-86 budget devoted to R&D.
- From 1979-80 to 1984-85, NRC had continually increased its R&D spending from 85% to 90% of its total budget. R&D expenditures for 1985-86 amount to \$407 million, a decrease of 14% from 1984-85.
- Performer shares of S&T expenditures have not varied greatly over the years. The foreign sector's share has increased slightly due to increases in R&D contracts abroad. In 1985-86, Canadian industry will

perform proportionately 3% less than in 1984-85, due to R&D contract reductions.

Capital Expenditures

- In the past few years NRC has been undergoing a significant laboratory expansion. NRC's capital expenditures had continually increased, from 6% of its budget in 1979-80 to 23% in 1984-85. Its 1985-86 capital budget is \$80 million, a 33% decrease from 1984-85. Major capital expenditures are listed below:

Capital expenditures	Total cost	1985-86 expenditures
	\$000,000	
Extension to Biological Sciences Laboratory (NCR)	6.5	4.1
Institute for Manufacturing Technology (Manitoba)	31.7	6.9
Biotechnology Research Institute (Quebec)	61.0	21.3
Institute for Marine Dynamics (Newfoundland)	55.6	3.8
Algonquin Radio Observatory (Ontario)	6.6	2.0
Institute for Research in Optics (Quebec)	16.0	7.8
Advanced Teleoperator System (Ontario)	118.2	2.8

Grants and contributions	Expenditures, 1985-86
	\$000,000
Institut de recherche d'Hydro-Québec - Magnetic confinement fusion research and development program	6.8
Contribution for research on materials for fusion	1.6
Assistance toward applied research and improvements in technology to Canadian industry	40.8
Contributions to provincial research organizations and research institutes to provide technical information and field services	6.4
Program for Industry-Laboratory Projects	21.9
Institut de recherche d'Hydro-Québec - Large capacity vertical axis wind turbine program	4.5
National manufacturing technology centre and network	0.5
Canada's share of the costs of the Canada-France-Hawaii Telescope Corporation	2.3
Universities of Alberta, British Columbia, Simon Fraser and Victoria in support of TRIUMF Project	26.7

NRC - Concluded**Person-years**

NRC's S&T personnel will be 3,442 in 1985-86 of which 36% are in the scientific and professional category. 1985-86 sees a reduction of 94 PYs in this category.

Regional Distribution

The bulk (over 70%) of NRC's intramural expenditures are in the NCR. The 1983-84 distribution of its expenditures was:

	Per cent
Newfoundland	9
Nova Scotia	3
Quebec (excluding Hull)	4
Ontario (excluding Ottawa)	1
Manitoba	4
Saskatchewan	4
British Columbia	3
NCR	72

The regional distribution of its industrial expenditures are discussed in the section on Extramural Expenditures - Industry.

S&T Activities

In a report such as this, it is not possible to fully describe the scope of NRC's research activities. For present purposes NRC's activities can be structured as follows: (percentage distribution of 1985-86 expenditures for each element is given in brackets).

National competence in the natural sciences and engineering (9%). Research undertaken to build and maintain national competence in the natural sciences and engineering, to acquire knowledge and to gain the understanding that is essential to future applications in science and technology.

Research on problems of economic and social importance (15%). Performance and promotion of research and development aimed at the solution of problems of economic and social importance including building and construction, energy, environmental quality, food, health, public safety and transportation.

Research in direct support of industrial innovation and development (43%). Performance and promotion of research, development and related activities for the advancement of technology required for industrial development, including technology transfer, financial assistance, co-operative projects and technical services aimed directly at strengthening the research, development and innovative capacity of industry in Canada.

National facilities (17%). Provision of national research and development facilities as a service to industry, governments and universities.

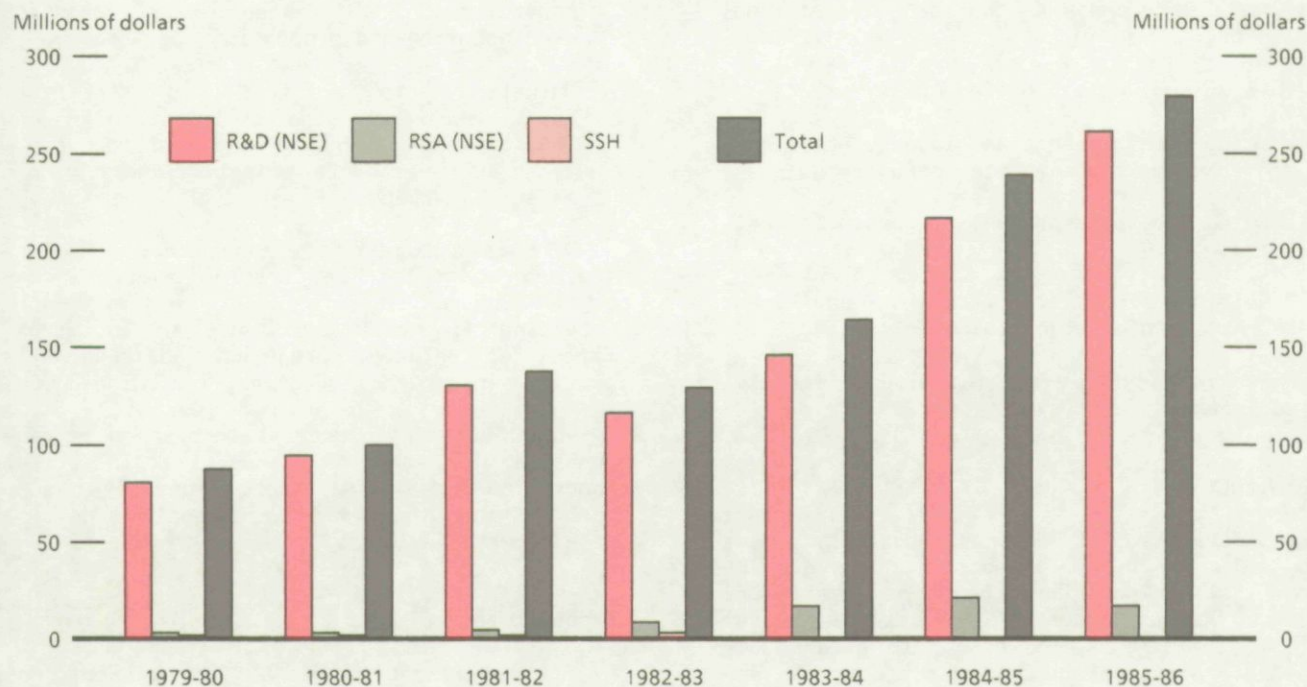
Research and services related to physical standards (2%). Research and services in the field of physical standards, including support of national and international activities.

Scientific and technical information (5%). Selection, acquisition, analysis, storage, retrieval and transfer of published and machine readable scientific and technical information; development of validated scientific numeric data; implementation and maintenance of a Canadian network of scientific and technical information services; development of procedures, processes and standards for inter-system exchanges with other national and international networks and services; enhancement of these processes by the application of technology to improve efficiency and productivity; publication of the Canadian Journals of Research.

Administrative and special support services (9%). Administrative support including financial and personnel services; special services including operation and maintenance of National Research Council buildings and facilities, central computer services; all services for programs of the Council; and grants in support of international scientific affiliations.

Regional Industrial Expansion (DRIE)

Chart - 17
Regional Industrial Expansion Expenditures on Science and Technology



Expenditures on S&T	1979-80	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86
	\$'000,000						
Total S&T	87.6	100.8	138.0	129.9	163.9	239.8	279.4
R&D (NSE)	81.6	94.6	130.7	117.9	146.0	217.3	261.7
RSA (NSE)	3.4	3.5	4.7	9.0	17.2	21.6	17.3
SSH	2.5	2.7	2.7	3.1	0.7	0.9	0.4
Per cent of S&T	%						
R&D (NSE)	93	94	95	91	89	91	94
RSA (NSE)	4	3	3	7	11	9	6
SSH	3	3	2	2	--	--	--
By performer	%						
Intramural	10	8	7	8	6	6	6
Industry	85	87	88	86	86	87	90
University	2	2	3	2	1	1	1
Other	3	3	2	4	7	5	3

DRIE - Concluded

Objective

DRIE's objective is to increase overall industrial, commercial and tourism activity in all parts of Canada by building on regional strengths.

This objective is achieved by:

- Working with business and labour, other governments and the academic community;
- Shaping the framework set by government policies;
- Providing financial, marketing and other technical information to business; and
- Where necessary, extending direct financial assistance.

Organization

The Department of Regional Industrial Expansion's two major R&D support programs are the Industrial Regional Development Program (IRDP) and the Defence Industry Productivity Program (DIPP). The IRDP, which came into effect July 15, 1983, provides support to projects at various stages of the innovation process and business development including support for R&D. IRDP funds are provided on a graduated scale; that is, maximum levels of support are provided to firms located in regions of the country in greatest economic need. The development index ranks needs of individual census divisions on the basis of levels of employment, income and fiscal capacity of the province. Further adjustments were announced November 9, 1984, reflecting the government's intention to reorient federal support towards the private sector. In this regard, federal-provincial agreements are to deal with requests in support of studies, courses and the establishment of non-profit centres or institutes.

The 1984 IRDP is a program that is streamlined and more responsive to the needs of business and the regions. The project elements have been trimmed down to those that will most effectively increase industrial productivity and international competitiveness:

- Innovation - to encourage the development of new products, new processes and to increase industrial productivity and international competitiveness through support of research and development projects which show promise of economic success or strategic importance to a region and which would not be undertaken without support;

- Establishment - to assist in the establishment of new production facilities;
- Modernization/Expansion - to increase industrial productivity through the improvement, modernization and expansion of existing manufacturing and processing operations;
- Marketing - to facilitate the identification, development and exploitation of new domestic and international market opportunities and to enhance competitiveness within existing markets.

DIPP is designed to enhance the technological competence of the Canadian defence industry in support of its export activities by providing financial assistance to individual firms for selected projects. Assistance is provided in a number of areas, including R&D.

The Office of Industrial Innovation is responsible for matters concerning industrial innovation and the application of S&T in support of the department's regional industrial development mission.

Expenditures

- The department's 1985-86 S&T expenditures are estimated as \$279 million, an increase of 16% over 1984-85. These S&T expenditures represent about 21% of the department's total budgetary spending.
- Because of DRIE's mandate, the bulk (94%) of its expenditures are for R&D (NSE) performed in the industrial sector.
- The department's distribution of spending across Canada is discussed in the section on Extramural Expenditures - Industry.

Statistics Canada (SC)

Objective

To collect and provide statistical information needed for understanding the Canadian economy and Canadian institutions and for the development of economic and social policies and programs; to collaborate with other departments and agencies of the Federal Government, provincial and municipal governments and with businesses and individuals on the development of methodology and its application and on the production of new and expanded statistical information to meet their particular requirements.

Organization

Statistics Canada's activities include the collection and analysis of international and

SC - Continued

domestic economic statistics; socio-economic statistics; census and social statistics; and institution statistics.

Its organization is comprised of six fields:

- National Accounts and Analytical Services;
- Business and Trade Statistics;
- Social, Institutions and Labour Statistics;
- Informatics and Methodology;
- Management Services; and
- Communications and Operations.

Of particular interest to the readers of this publication was the formation of a new division in 1985, integrating the Science and Technology Statistics Division with the Capital Stock statistics section.

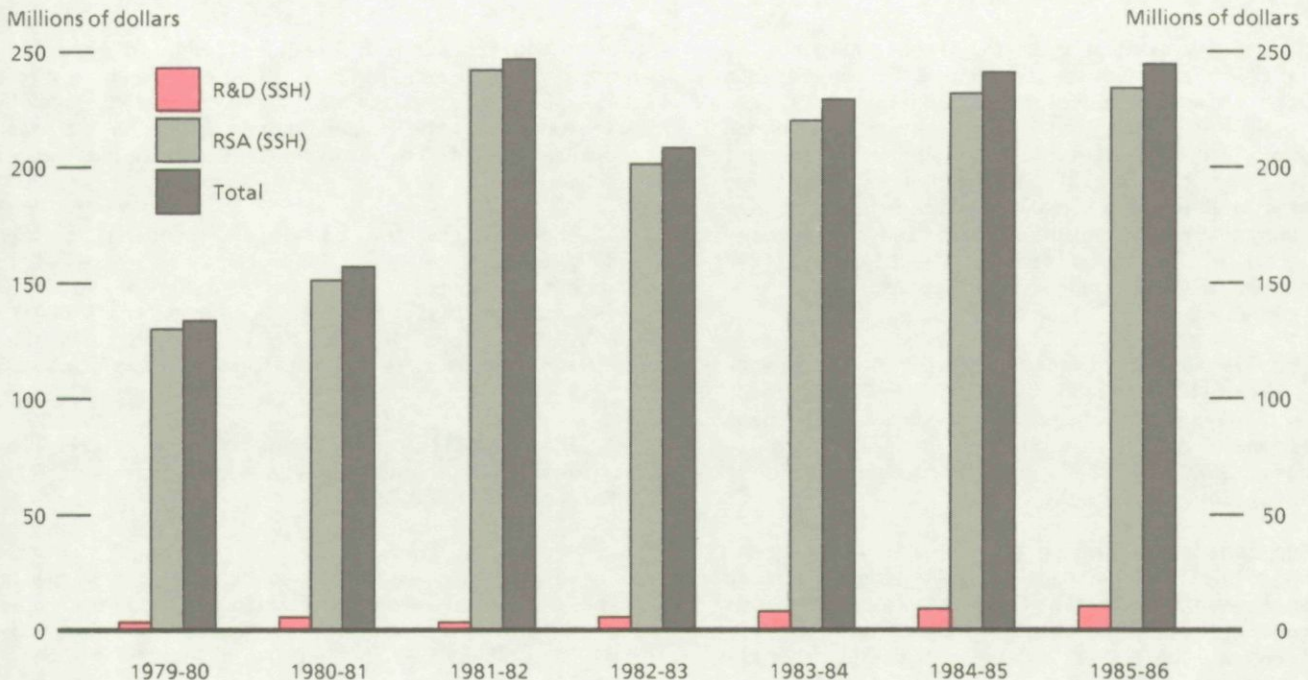
Expenditures

- SC's total budget is for S&T activities in the SSH field. Its budget for 1985-86 will be \$245 million, the bulk of which is spent on RSA (96%), performed intramurally.
- SC spends about 4% of its budget for R&D.
- Budgetary expenditures include those associated with the national census which caused the jump in expenditures in 1981-82.

Person-years

Four thousand four hundred and seventy-two person-years will be engaged in S&T activities in 1985-86, a decrease of 128 PYs from 1984-85. Nineteen per cent are in the scientific and professional category, an increase of 1% over the previous year.

Chart - 18
Statistics Canada Expenditures on Science and Technology



SC - Concluded

Expenditures on S&T	1979-80	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86
	\$000,000						
Total S&T	134.6	157.7	246.9	208.2	229.7	241.8	244.5
R&D (SSH)	3.8	6.4	4.0	6.0	9.2	10.3	10.7
RSA (SSH)	130.8	151.3	243.0	202.2	220.5	231.5	233.8
Per cent of S&T	%						
R&D (SSH)	3	4	2	3	4	4	4
RSA (SSH)	97	96	98	97	96	96	96
By performer	%						
Intramural	100	100	100	100	100	100	100

4.2 University Granting Councils

The Government's primary direct support for university research is contained in the budgets of the three university granting councils, the Natural Sciences and Engineering Research Council (NSERC), the Medical Research Council (MRC) and the Social Sciences and Humanities Research Council (SSHRC). Their objectives are to support research in universities and to contribute to the provision of highly qualified manpower in their respective fields.

The 1985-86 combined budget for these granting councils is \$488 million, an 8% decrease from 1984-85. MRC has experienced the largest decrease, at 17% below its 1984-85 expenditures. NSERC's 1985-86 budget has decreased by \$16 million.

Supplementary funding to the university granting councils, awarded at any time during a fiscal year, accounts for these apparent decreases. NSERC was allotted an additional \$20 million at the end of 1984-85. MRC was recently allotted an additional \$30 million for 1985-86,

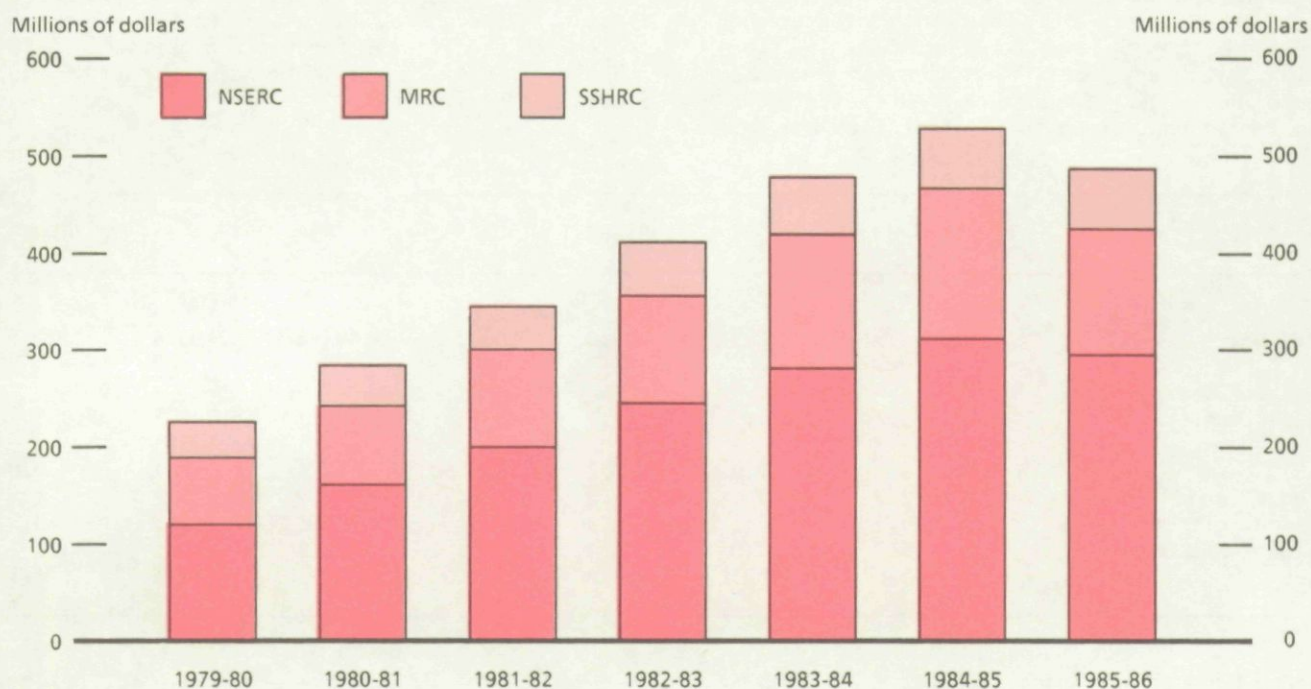
bringing its total S&T expenditures to approximately \$160 million, a slight increase over 1984-85. This additional funding to MRC is not included in the expenditure data, as it was awarded after the estimated expenditures were tabled.

The bulk of the councils' spending is for R&D, 86% in 1985-86. The balance is mainly for education support. NSERC and MRC spend 86% and 96% respectively on R&D compared to SSHRC's 64%. SSHRC has increased its expenditures on R&D in the past few years from a low of 58% in 1979-80.

The councils spend most of the monies in universities, about 90% for NSERC and about 80% for both MRC and SSHRC.

Very little is funded to other sectors, with the exception of MRC's funding to private non-profit organizations. Seventeen per cent of MRC's 1985-86 S&T budget is allocated to this sector.

Chart - 19
Science and Technology Expenditures of University Granting Councils



Expenditures on S&T	1979-80	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86
	\$000,000						
Total S&T	228.4	288.2	349.3	415.6	483.3	532.8	488.3
NSERC (NSE)	121.4	163.2	202.0	245.3	282.1	312.4	296.2
MRC (NSE)	70.2	82.2	100.4	113.5	140.7	157.2	130.8
SSHRC (SSH)	36.8	42.8	46.9	56.8	60.5	63.2	61.3
Per cent of expenditures for R&D	%						
	88	87	88	88	88	87	86
NSERC (NSE)	91	90	90	89	88	87	86
MRC (NSE)	97	97	97	96	97	96	96
SSHRC (SSH)	58	60	63	66	65	66	64
Per cent of expenditures in universities	%						
	91	91	92	91	88	87	87
NSERC (NSE)	93	93	94	93	93	92	91
MRC (NSE)	94	94	95	94	81	80	81
SSHRC (SSH)	77	77	79	80	79	80	78

4.3 OTHER DEPARTMENTS

The spending of the departments and agencies discussed so far, account for \$3,852 million or 92% of the Federal Government's total S&T spending. Of the other departments and agencies, four, the Ministry of State for Science and Technology, the Science Council of Canada, the National Library and the National Museums should be noted. Spending by the first two agencies is small, due to the fact that they

have no operational programs per se. However, these agencies advise the government on new science policy initiatives and thus have a significant input on science spending in the country as a whole. The other two federal agencies are significant for their contributions to S&T education, information dissemination and cultural activities.

Expenditures on S&T	1979-80	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86
	\$000,000						
Total S&T	1,991.9	2,268.3	2,745.5	3,083.7	3,491.4	4,103.6	4,172.3
Total S&T by major departments	1,772.2	2,075.6	2,511.1	2,818.5	3,193.1	3,769.2	3,851.7
MOSST	6.2	9.0	10.2	10.9	12.1	8.7	9.8
Science Council	2.7	3.1	3.8	4.3	4.9	5.2	5.4
National Library	18.5	21.3	28.8	34.0	36.8	39.5	40.9
National Museums	56.7	61.0	67.1	73.0	82.2	86.5	88.2
Other	135.6	98.3	124.5	143.0	162.3	162.3	176.3

Science Council of Canada (SCC)

Objective

The Science Council of Canada undertakes a wide range of activities in line with its mandate to carry out a program of science and technology policy research, to publish its findings, and, through communications activities, to increase awareness and discussion of science and technology policy issues in Canada.

Council's work is administered under five key policy areas:

- Technological and innovative capacity in industry;
- Education and employment in a technologically changing world;
- Biotechnology, information technologies and other new technologies;
- Science and technology infrastructure;
- The impact of science and technology on society and the environment.

S&T Activities

Major activities for 1985-86 include:

- A national consultative program identifying emerging science and technologies that promise to be critically important to Canada over the next decade;

- Increased discussions leading to policy advice which will assist to determine the balance of Canada's scientific effort;
- Increased activity to promote greater awareness, among a broader public, of the development and effects of science and technology.

Ministry of State for Science and Technology (MOSST)

Objective

MOSST is responsible for formulating policies and providing advice to the Federal Government on science and technology. Its mandate covers the science and technology activities of government departments and those of industry and universities insofar as they interact with the Federal Government. MOSST has, in effect, a single program objective, which is to encourage the development and use of science and technology in support of national goals.

S&T Activities

In 1985-86, MOSST will focus on the policy aspects of:

- Increasing Canada's level of research and development;
- Promoting the development, diffusion and application of technology in industry;
- Strengthening the management and relevance of government laboratories;

- Supporting research and research-training capabilities in the universities;
- Improving cooperation and coordination between the federal and provincial governments in S&T matters;
- Strengthening the international linkages which will enhance Canada's technological strengths;
- Increasing national efforts in technologies of strategic importance to Canada, with particular attention to:
 - The National Biotechnology Strategy;
 - The Canadian Space Program;
- Fostering increased understanding by the general public of the impact of science and technology.

National Library (NL)

Objective

To facilitate the use of the library resources of the country by the people and the Government of Canada.

Organization

NL has five separate units:

- Library Systems Centre;
- Public Services;

- Cataloguing;
- Collections Development;
- Conservation and Technical Services.

In addition, the NL operates an automated on-line library data base management system called DOBIS.

National Museums (NM)

Objective

To demonstrate the products of nature and the works of man with special but not exclusive reference to Canada so as to promote interest therein throughout Canada and to disseminate knowledge thereof.

Organization

NM operates the:

- National Gallery of Canada;
- National Museum of Man;
- National Museum of Natural Sciences;
- National Museum of Science and Technology.

In addition, NM operates a Museum Assistance program to provide financial assistance to non-profit organizations and a National program to provide museum services through related organizations.

5.0 EXTRAMURAL EXPENDITURES

This section focuses on federal government expenditures for S&T performed extramurally, that is for S&T performed outside of its own laboratories. Aggregate payments to industries, universities, provincial and municipal governments and to foreign performers are presented. Section 4.0 provides these data for individual departments and agencies. It is estimated that in 1985-86, the Government will spend \$1,502 million or 36% of its total S&T expenditures extramurally. The major recipients of these funds will be industry (\$715 million), and universities (\$525 million). In addition, provincial and municipal governments will receive \$33 million, foreign performers \$139 million and others including individuals and private non-profit organizations \$91 million.

Extramural payments take the form of a contract, a grant or a contribution. Contracts, normally awarded as a result of competitive bidding, provide a service or perform an activity required by a federal department or agency. The Government's policy (known as the Contracting-out Policy) stipulates that, wherever feasible, government S&T requirements should be contracted to the private sector. Almost all of these contracts are awarded to business enterprises. A grant or contribution is awarded by the Government to an organization to perform an activity deemed worthwhile and necessary to the well-being of the recipient organization. Payments for university and industry support programs are normally in the form of a grant or contribution.

In 1985-86, R&D contracts and grants are expected to be distributed as follows:

	Indus- try	Univer- sity	Other	Total
	\$000,000			
Contracts	206	54	105	365
Grants	373	402	141	916

In addition to direct payments for S&T activities, the Government endeavours to provide a favourable climate for the expansion of R&D activities within the private sector. Through tax, tariff, patent, competition, trade and special procurement policies, the Government assists the private sector in its R&D activities. Section 7.0 provides further details on its tax incentive initiatives.

The Government also assists the private sector in its R&D activities by providing, on a cost recovery basis, the use of specialized S&T testing facilities maintained in government laboratories (Contracting-in Policy).

5.1 INDUSTRY

TABLE 5.1 Federal S&T Expenditures in the Industrial Sector

	1979-80	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86	Percentage change 1985-86/ 1984-85
	\$000,000							
Total S&T payments	274.3	310.4	374.9	402.7	451.8	647.8	714.7	+10
R&D grants and contracts (total)	207.6	219.1	287.1	319.4	379.8	544.1	578.8	+6
R&D contracts (total)	101.1	103.0	130.2	151.0	158.9	218.6	205.9	-6
Communications	3.5	7.0	10.3	14.9	13.1	19.2	14.0	-27
Energy, Mines and Resources	7.0	4.9	6.8	14.6	19.5	17.2	18.7	+9
Atomic Energy of Canada Limited	9.8	7.7	6.4	6.4	5.4	6.8	6.7	-1
Environment	8.0	9.6	13.4	13.3	5.7	5.1	4.0	-22
Fisheries and Oceans	3.3	3.4	5.4	3.6	5.8	6.6	6.4	-3
National Defence	23.2	23.0	30.1	38.9	37.9	72.0	89.6	+24
National Research Council	22.8	23.9	28.2	25.3	21.8	38.6	13.9	-64
Supply and Services (unsolicited proposals)	10.3	10.9	12.2	10.1	10.2	10.3	10.4	-2
Transport	5.5	3.3	8.8	11.9	20.3	22.3	23.5	+5
Other	7.7	9.3	8.6	12.0	19.2	20.5	18.7	-9
R&D grants and contributions (total)	106.5	116.1	156.9	168.4	220.9	325.5	372.9	+15
Energy, Mines and Resources	2.9	3.7	2.6	7.3	16.1	32.0	38.2	+19
National Research Council	25.6	22.1	27.8	47.0	59.2	76.8	76.2	-1
Regional Industrial Expansion	72.6	84.2	116.3	105.9	136.4	203.1	244.6	+20
Other	5.4	6.1	10.2	8.2	9.2	13.6	13.9	+2
Other S&T payments (total)	66.7	91.3	87.8	83.3	72.0	103.7	135.9	+31
Energy, Mines and Resources	3.6	18.8	20.6	11.0	10.1	20.9	49.5	+137
Atomic Energy of Canada Limited	14.2	16.7	6.8	8.2	8.5	9.6	10.0	+4
Environment	4.5	5.4	5.5	5.2	2.0	2.2	2.3	+5
Fisheries and Oceans	1.9	1.9	6.0	5.7	3.4	4.1	3.6	-12
Canadian International Development Agency	22.3	22.4	25.9	29.6	27.3	31.9	36.0	+13
Transport	1.1	1.6	1.8	1.8	0.8	4.9	4.6	-6
Other	19.1	24.5	21.2	21.8	19.9	30.1	29.9	-1

HIGHLIGHTS

- S&T payments to the industrial sector have continually increased, especially over the last two years. In 1984-85, payments to industry were \$648 million, a 43% increase over 1983-84. Approximately \$715 million will be funded to industry in 1985-86, a 10% increase over 1984-85.
- R&D payments in 1984-85 amounted to \$544 million, an increase of 43% over 1983-84 expenditures. Approximately \$579 million will be funded to industry in 1985-86, a 6% increase over the previous year's payments.
- R&D contracts, totalling \$219 million in 1984-85, increased by 38% over 1983-84. In 1985-86, R&D contracts to industry will amount to \$206 million, a decrease of \$13 million.
- In 1984-85, the Department of National Defence almost doubled its payments for R&D contracts to Canadian industries. In 1985-86, DND will spend the largest amount for R&D in industry, accounting for about 44% of the total R&D contracts.
- The National Research Council has reduced its 1985-86 payments for R&D contracts by \$25 million; to an amount lower than its 1979-80 expenditures.
- The Department of Energy, Mines and Resources has significantly increased its funding to industry for scientific data collection and feasibility studies. Payments for 1985-86 will more than double the 1984-85 payments.
- R&D grants and contributions, totalling \$373 million in 1985-86, have increased 15% over 1984-85.
- DRIE provides the bulk (66%) of the grants and contributions to industry through two major programs.
 - DIPP - The Defence Industry Productivity Program is designed to enhance the technological competence of the Canadian defence industry in support of its export activities. Financial assistance is provided to individual firms for selected programs.
 - IRDP - The Industrial Regional Development Program provides support to projects at various stages of the innovation process and business development including support for R&D.
- In addition to these, DRIE also administers the Economic and Regional Development Agreements (ERDAs). These are long-term vehicles for federal-provincial planning and cooperation for economic development. New sets of ERDAs put a heavy emphasis on technology, research and development initiatives, in line with the economic and regional development of the individual province.
- Reductions in direct assistance to industrial development were announced in the May 1985 federal budget. These reductions will largely be accomplished by reduced planned spending in the Industrial and Regional Development Program and the Defence Industry Productivity Program.
- NRC will spend \$76 million in grants and contributions to industry through its two major industrial assistance programs:
 - IRAP - The Industrial Research Assistance Program consists of six sub-programs, namely:
 - IRAP-P provides assistance to firms having an in-house capability for R&D.
 - IRAP-M provides assistance to small firms with little or no technical staff.
 - IRAP-L provides assistance to small firms who wish to contract small R&D tasks to another organization.
 - IRAP-H pays salaries of students to work on technical problems in small firms.
 - IRAP-F provides technical advice to small and medium sized firms.
 - IRAP-C provides field advisory services to small and medium firms partly through contracts to Provincial Research Organizations.
 - PILP - The program of Industry/Laboratory Projects is designed to assist companies in technology transfer from government laboratories. In January 1984, PILP expanded its program to permit funding of Technology Transfer from university laboratories to industry.
- In addition to these departments, the Science and Professional Services Directorate of the Department of Supply and Services manages the Unsolicited Proposals Program. This was created as an adjunct to the Contracting - Out Policy. Institutions in the private sector, on their own initiative, submit innovative solutions to problems within the science missions of various departments. The aims of the program are to encourage industry to contribute to the accomplishment of the Government's goals and to increase the Government's appreciation of industrial capabilities.

Regional Distribution

- In Canada as a whole, 81% of the federally funded payments to industry are for R&D, and 19% for RSA. For R&D payments, 64% of expenditures are for grants to industry and 36% for contracts.
- Generally speaking, those provinces with a strong industrial base are awarded more R&D contracts and grants.
- As shown in Table 5.2, the departments with significant expenditures in the industrial sector for R&D in the NSE have different provincial spending patterns. For example, DRIE spends 57% of its funds in Quebec and 32% in Ontario; whereas, 14% and 36% of NRC's grants (IRAP and PILP mainly) go to Quebec and Ontario respectively. In terms of R&D contracts, the largest amounts are awarded to industries in Ontario.

TABLE 5.2 Percentage of R&D (NSE) Grants and Contracts to Industry by Region and by Department, 1983-84

Region	Total R&D	R&D grants			R&D contracts			
		DRIE	NRC	Other	DND	NRC	DSS	Other
	%							
Canada	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Newfoundland	1.4	0.1	1.2	1.6	0.4	3.2	1.0	2.7
Prince Edward Island	0.2	0.3	0.8	-	-	1.6	-	0.2
Nova Scotia	3.1	0.9	1.9	4.0	4.2	3.7	3.9	2.8
New Brunswick	1.5	0.2	1.4	2.2	0.2	0.7	2.2	2.0
Quebec	26.9	57.0	14.5	21.3	15.8	20.4	18.2	26.0
Ontario	39.4	32.4	35.9	38.3	63.5	56.9	55.5	37.2
Manitoba	3.1	2.6	0.7	4.2	1.1	1.6	-	2.8
Saskatchewan	2.6	1.4	2.2	3.7	0.3	0.8	0.1	2.0
Alberta	5.4	2.4	1.9	7.0	1.6	2.7	1.7	7.9
British Columbia (including Yukon)	10.1	2.7	35.4	9.0	3.4	7.5	17.3	13.8
Unallocated	5.7	-	4.1	8.7	9.4	0.9	0.2	2.6

5.2 UNIVERSITY

TABLE 5.3 Federal S&T Expenditures in the University Sector

	1979-80	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86	Percentage change 1985-86/ 1984-85
	\$000,000							
Total S&T payments	256.0	320.0	388.8	461.4	513.0	575.6	525.2	-9
R&D grants and contracts (total)	218.1	273.5	331.3	393.2	453.5	504.9	456.0	-10
R&D Grants (total)	203.4	255.7	312.0	366.1	402.9	445.8	401.8	-10
Medical Research Council	61.6	72.2	88.4	98.1	104.6	115.6	97.7	-15
National Health and Welfare	7.3	7.9	8.2	8.0	8.0	8.7	8.7	-
National Research Council	9.5	13.5	16.8	21.2	23.2	25.5	26.7	5
Natural Sciences and Engineering Research Council	104.1	136.8	167.0	199.8	227.0	245.6	226.2	-8
Social Sciences and Humanities Research Council	14.6	18.2	21.2	28.3	30.4	31.6	28.9	-9
Other	6.3	7.1	10.4	10.7	9.7	18.8	13.6	-28
R&D contracts (total)	14.7	17.8	19.3	27.1	30.9	36.0	31.0	-14
Research fellowships (total)	9.3	11.1	15.4	18.0	19.8	23.1	23.3	+1
Other S&T payments (total)	28.6	35.4	42.0	50.2	59.4	70.7	69.1	-2
Education support (total)	21.5	27.2	31.3	38.2	47.1	56.9	55.3	-3
Medical Research Council	1.7	2.0	2.6	3.4	3.7	4.2	3.8	-10
Natural Sciences and Engineering Research Council	8.2	13.4	16.9	21.5	27.6	33.9	33.3	-2
Social Sciences and Humanities Research Council	7.0	7.1	7.2	8.0	8.5	8.5	9.0	+6
Other	4.6	4.7	4.6	5.3	7.3	10.3	9.2	-11
Other (total)	7.1	8.2	10.7	12.0	12.3	13.8	13.8	-

HIGHLIGHTS

- Total S&T payments to universities are \$525 million in 1985-86, a 9% decrease from 1984-85. R&D payments total \$456 million, a 10% decrease from 1984-85.
- R&D grants and contributions represent 77% of the total R&D payments to universities. The major funders are the three granting councils; MRC, NSERC and SSHRC which together account for 88% of the total grants and contributions.
- The 1985-86 combined budget for the granting councils is \$488 million, an 8% decrease from 1984-85. Not reported in these estimates is a recent allotment to MRC. An additional \$20 million was allocated to NSERC in 1984-85 for equipment, thus inflating that agency's expenditures for that year. Taking this into account, the 1985-86 expenditures are roughly comparable to those for 1984-85.
- The Natural Science and Engineering Research Council (NSERC) is the largest of the granting councils. Its expenditures in universities total \$270 million in 1985-86.
- The Medical Research Council (MRC) will spend an estimated \$106 million to support S&T activities in universities. An additional \$30 million has recently been allotted to MRC for university funding, bringing its total funding expenditures to \$136 million, an 8% increase over 1984-85.

- The Social Sciences and Humanities Research Council (SSHRC) will spend an estimated \$48 million to support S&T activities in universities.

Regional Distribution

Table 5.4 presents the percentage distribution of funds in the regions for the three granting councils and for other federal departments and agencies. The bulk of the university funding is in Ontario and Quebec, followed by British Columbia. NSERC, SSHRC and the others fund much more S&T in Ontario than in Quebec. MRC, on the other hand has a more equal distribution between these two provinces. Universities in Nova Scotia receive a much higher percentage of funds than those in the other Atlantic provinces by all departments and agencies. Of the universities in the Prairie provinces, those in Alberta receive a higher percentage of funds and those in Saskatchewan the least.

As illustrated below, federal government funding is directly proportional to the number and size of universities within a province. The percentage distribution of total government funding (including S&T expenditures) follows the same pattern as total university expenditures. British Columbia receives a greater proportion of S&T funding because of the NRC grants for the TRIUMF facility, which involves the universities of Alberta, British Columbia, Simon Fraser and Victoria.

Percentage Distribution of University Expenditures by Province, 1983-84

	Nfld.	P.E.I.	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	B.C.
	%									
Total expenditures	1.9	0.3	4.6	2.6	22.9	38.5	4.6	4.1	11.3	9.2
Federal Government funding	2.2	0.3	4.0	2.4	25.0	35.7	4.8	4.1	12.0	9.5

Source: The Canadian Association of University Business Officers.

TABLE 5.4 Percentage Distribution of Federal Expenditures to Universities by Region and by Department/Agency, 1983-84

Region	R&D grants(1)				RSA grants			
	NSERC	MRC	SSHRC	Other	NSERC	MRC	SSHRC	Other
	%							
Canada	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Newfoundland	2.0	1.7	1.7	1.4	0.9	0.3	0.3	0.5
Prince Edward Island	-	-	0.5	0.1	0.1	-	-	-
Nova Scotia	3.7	4.3	3.2	2.9	3.6	1.8	0.9	7.9
New Brunswick	2.0	-	1.1	1.1	2.7	-	1.0	2.2
Quebec	19.2	28.1	26.6	9.9	25.4	35.9	26.2	21.4
Ontario	44.1	37.5	43.8	17.2	44.0	36.6	51.7	24.1
Manitoba	3.4	6.1	2.8	2.3	3.5	10.2	2.3	11.9
Saskatchewan	4.7	3.3	0.9	1.6	1.9	2.9	0.9	0.8
Alberta	8.9	9.0	4.3	2.5	6.7	4.2	3.8	2.7
British Columbia (including Yukon)	11.9	10.0	9.6	60.1(2)	11.2	8.1	8.4	7.1
Unallocated	-	-	5.5	0.9	-	-	4.5	21.4

(1) Includes R&D fellowships.

(2) Includes an NRC grant to UBC for operation of the TRIUMF facility.

5.3 Provincial and Municipal Governments

TABLE 5.5 Federal S&T Expenditures in the Provincial Government Sector

	1979-80	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86	Percentage change 1985-86/ 1984-85
	\$000,000							
Total	44.8	46.6	48.8	27.8	42.0	47.9	32.4	-32
Energy, Mines and Resources	30.7	29.8	32.6	7.7	16.8	17.7	8.3	-53
Environment	3.5	4.3	2.9	3.1	4.0	5.4	5.2	-4
National Health and Welfare	1.5	2.0	2.4	2.6	2.7	2.8	2.9	+4
Regional Industrial Expansion	-	1.2	-	4.1	8.4	10.3	4.8	-53
National Museums	6.4	5.9	6.3	6.5	7.4	7.7	8.2	+6
Other	2.7	3.4	4.6	3.8	2.8	4.0	3.0	-25

HIGHLIGHTS

- S&T payments to provincial governments for 1985-86 total \$32 million, a decrease of 32% from 1984-85.
- Payments by EMR have been partially distorted through the payment of \$96 million under the Alberta/Canada Energy Resources Research Fund. These payments, spread over a five-year period, ended in 1981-82. EMR's 1985-86 payments to provincial governments have been substantially reduced due to the cancellation of Conservation and Renewable Energy Demonstration Agreements. These agreements, between the federal and provincial governments, supported the development and demonstration of new technologies related to renewable and non-conventional sources of energy and energy conservation.
- The Government's restructuring of its regional delivery systems through the amalgamation of ITC and DREE, has had some impact on provincial payments. The DREE General Development Agreements for cost-sharing with provincial governments are being allowed to lapse as their terms expire. These agreements are being replaced by new agreements managed by DRIE. In future years, increasing amounts of federal monies will be spent under the Economic and Regional Development Agreements, many of which place a heavy emphasis on technology, research and development. Funding agreements have not as yet been made with the individual provinces, accounting for the apparent reduction in DRIE's 1985-86 S&T funding.

5.4 FOREIGN

TABLE 5.6 Federal S&T Expenditures in Foreign Sector

	1979-80	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86	Percentage change 1985-86/ 1984-85
	\$000,000							
Total	49.5	57.5	76.9	94.2	107.2	119.8	140.0	+17
Canadian International Development Agency	10.5	9.6	10.5	13.4	14.5	13.6	14.1	+4
Communications	1.4	1.6	9.7	16.6	14.9	14.7	19.0	+29
Energy, Mines and Resources	1.0	1.4	1.9	3.4	2.8	5.3	14.1	+166
International Development Research Centre (IDRC)	24.0	26.7	31.1	34.4	40.7	46.1	52.7	+14
Medical Research Council	2.6	2.8	3.1	3.3	4.7	5.2	3.5	-33
National Defence	1.2	2.8	3.9	2.9	3.9	5.3	5.2	-2
National Research Council	1.0	2.0	2.5	3.6	8.8	12.2	12.7	+4
Natural Sciences and Engineering Research Council	2.5	3.2	3.5	5.3	5.3	5.8	6.6	+14
Science and Technology	0.5	1.9	2.1	2.0	2.4	1.9	2.1	+11
Social Sciences and Humanities Research Council	2.6	2.6	2.8	3.1	3.6	3.7	3.9	+5
Other	2.2	2.9	5.8	6.2	5.6	6.0	6.1	+2

HIGHLIGHTS

- Total federal S&T payments to the foreign sector are estimated to be \$140 million in 1985-86, an increase of 17% over 1984-85 expenditures.
- Payments to organizations in foreign countries are dominated by those of IDRC, which accounts for 38% of the total foreign S&T expenditures.
- Other departments and agencies such as Communications, EMR and NRC use foreign performers when the needed capabilities are not available in Canada.
- Foreign expenditures include dues for affiliation with international science organizations such as:
 - The International Council of Scientific Unions;
 - The International Union of Pure and Applied Chemistry;
 - The International Bureau of Weights and Measures; and
 - The International Institute of Applied Systems Analysis.

6.0 APPLICATION AREAS

The Government's spending in pursuit of its socio-economic objectives is budgeted by various departments and agencies. Their budgets are given in Section 4.0 of this report. In the past, departments and agencies have been asked to aggregate their expenditures into a list of some 30 application areas. Although these data are consistent with departmental budgets, they have been criticized for not representing the totality of expenditures in a certain area. For example, expenditures on space as an application area, which includes satellite systems and space research, would not include S&T activities on remote sensing of Canada's mineral resources. These expenditures would be identified as S&T in support of natural resources; mineral exploration as the primary application area. Despite these limitations, the data have been useful in providing an overall impression of the government's spending in areas of national need.

Table 6.1 gives the percentage distribution of expenditures on S&T, for selected application areas. Of particular interest, is the increased funding for industrial support which jumped from 7% in 1983-84 to 10% in 1985-86. The policy development category fell from 7% in 1983-84 to 6% in 1985-86. This is largely due to the dissolution of the Ministry of State for Economic Development, whose mandate was the development of economic policy.

Trends in application areas are further highlighted in Table 6.2 which shows the percentage distributions for R&D in NSE. The advancement of science category has decreased from 14% of total funding in 1984-85 to 12% in 1985-86. Spending in this category usually takes the form of grants to extramural performers. Additional funding to the university granting councils, usually awarded at the end of a fiscal year, accounts for this apparent decrease.

One noticeably increased area of importance is the industrial support area, which jumped from 11% in 1983-84 to 15% in 1984-85. 1985-86 expenditures are further increased to 16%.

In reference to the caveat mentioned earlier, what may initially be reported in one area, may be transferred at a later stage to another. For example, space technology decreased from 4% of total R&D spending in 1982-83 to 2% in 1983-84. Conversely, the communications area reported increased spending over the same time period.

Spending on S&T in 1985-86 is highest for food followed by advancement of science, energy, and industrial support. Spending on R&D in NSE follows the same pattern.

TABLE 6.1 Areas of Application of S&T in NSE and SSH Expenditures

	1979-80	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86
	\$000,000						
Total expenditures(1)	1,892	2,121	2,589	2,897	3,299	3,904	3,974
	%						
Advancement of science	11	12	11	12	12	11	11
Communications	2	2	2	2	3	3	3
Energy	12	11	10	11	11	11	10
Environment (including meteorology)	7	7	7	8	8	7	7
Food (including agriculture and fisheries)	10	9	10	10	11	10	11
Health	7	8	7	7	8	7	7
Industrial support (including NRC and DRIE programs)	7	7	8	7	7	10	10
Natural resources (including minerals and forestry)	6	6	6	6	7	7	8
Oceans	3	3	3	2	2	3	2
Policy development	7	8	10	8	7	6	6
Security (defence)	5	5	5	5	5	5	6
Space technology (including satellite systems and space research)	3	3	3	3	1	1	1
Transportation	4	3	3	4	4	4	4
Other	17	16	16	15	14	14	15

(1) Excluding non-program costs.

TABLE 6.2 Areas of Applications of R&D in Natural Sciences and Engineering

	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86
	\$000,000					
Total expenditures(1)	1,240	1,507	1,746	2,019	2,460	2,480
	%					
Advancement of science	14	14	14	14	14	12
Communications	3	3	3	4	4	4
Energy	16	14	15	15	14	13
Environment	3	4	4	4	3	3
Food (including agriculture and fisheries)	13	14	14	14	13	13
Health	10	9	9	9	9	8
Industrial support (including NRC and DRIE programs)	11	13	11	11	15	16
Natural resources (including minerals and forestry)	7	7	7	7	8	9
Oceans	2	4	3	3	3	3
Security (Defence)	8	8	8	8	8	9
Space technology (including satellite systems and space research)	5	4	4	2	2	2
Transportation	3	3	3	4	3	3
Other	5	5	6	6	4	7

(1) Excluding non-program costs.

7.0 NON-BUDGETARY EXPENDITURES

The foregoing analysis of federal S&T expenditures are for those expenditures proposed by the Government to Parliament, in its annual estimates. In addition to these expenditures, the Government, through tax and tariff measures, foregoes certain income to assist the industrial sector to undertake R&D.

For many years, Canada has had in place measures that permit a company to treat R&D costs, either capital or operating, as a cost of doing business, thus permitting such costs to be deducted from the company's taxable income. This deduction sometimes called the "100% tax write-off" has been in place for over 20 years.

Other forms of incentives have been used over the years. Since April 1, 1977, the Government has offered an incentive, the Investment Tax Credit, which is claimed against federal taxes payable. Initially the credits were between 5% and 10% depending on the region where the allowable R&D expenditures were incurred. On November 17, 1978, the Government modified this incentive by increasing the credit to 10% and 25% of the allowable R&D expenditures, the rate being dependent not only on the region in which R&D was performed but also on the size of the firm. This credit was designed to help small firms undertake R&D and consequently to stimulate economic activity in the economically disadvantaged regions of the country.

In addition to the Investment Tax Credit, the government introduced, effective January 1, 1978, an Additional Allowance for Scientific Research. This allowance permitted companies to deduct from their taxable income an amount equal to 50% of any increase in qualifying operating and capital expenditures for R&D. The increase was defined as the difference between the firm's expenditures on the current year and the average of the three preceding years.

In the April 19, 1983 budget, the Government proposed further modifications to the tax incentive system which were subsequently approved

by Parliament. The Additional Allowance credit was cancelled. In order to compensate for this cancellation, the rates of credit for the Investment Tax Credit were increased by 10 percentage points. That is, the credits could be calculated at 20% to 35% of the eligible expenditures, depending on the location of the R&D and also on the size of the firm. Credits could be used to fully offset federal taxes and any balance of the credit could be carried back three years or carried forward five years. For expenditures on R&D made after April 19, 1983 and before May 1986, 40% of unused credits earned in the year could be refunded for small firms (20% for large corporations).

Included in the package of tax incentives for R&D was a new measure which permitted a corporation to renounce the tax credits and to transfer the Scientific Research Tax Credit (SRTC) to Investors. Investments could be made in the form of common or preferred shares, debt or royalty interests.

On October 10, 1984, the Minister of Finance announced a moratorium period, in order to review the tax incentive program. It was also announced that the qualifying activity for the SRTC would be investments in common shares only.

The May 1985 federal budget restructured the tax incentives relating to R&D and eliminated the SRTC. The credit earned by small Canadian-controlled private corporations for current expenditures on R&D will be completely refundable. At present, the refundable portion is limited to 40% - a provision scheduled to expire on April 30, 1986. The increased refund provision for R&D will not be subject to an expiry date, and will be effective for qualifying expenditures made after May 23, 1985. The new tax credit rate is 20% to 35% of the first \$2 million worth of R&D performed in a year by one company or an associated group of companies. Other budget changes have removed restrictions on the definition of R&D that qualifies for tax credits.

In the Statistics Canada survey of industrial R&D, firms are asked to identify amounts allowed for previous years and the amount claimed for the current year. Details of these

data are provided in **Science Statistics**, Catalogue 88-001, Vol. 9, Nos. 1 and 2, 1985. The table below summarizes these data.

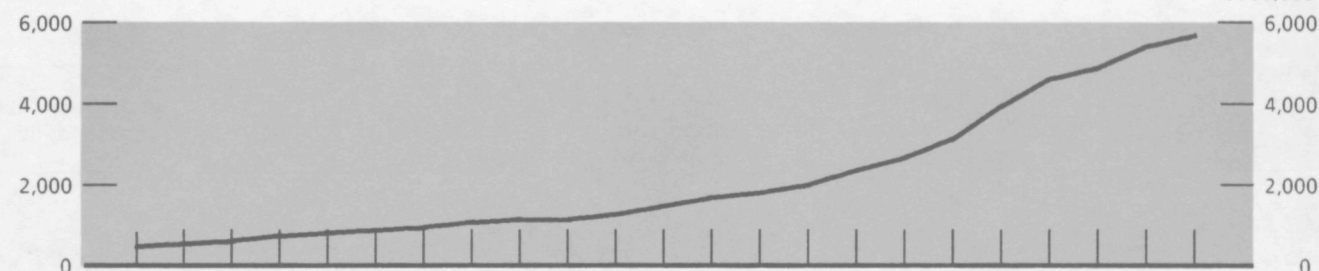
Year	Investment tax credit		Additional allowance	
	Credit claimed	R&D expenditures of claimants	Deduction claimed	R&D expenditures of claimants
	\$000,000			
1977	11	340	-	-
1978	28	586	50	510
1979	58	772	128	814
1980	78	999	182	1,070
1981	122	1,451	279	1,654
1982	127	1,482	271	1,805

8.0 NATIONAL GROSS EXPENDITURES ON RESEARCH AND DEVELOPMENT (GERD) IN THE NATURAL SCIENCES

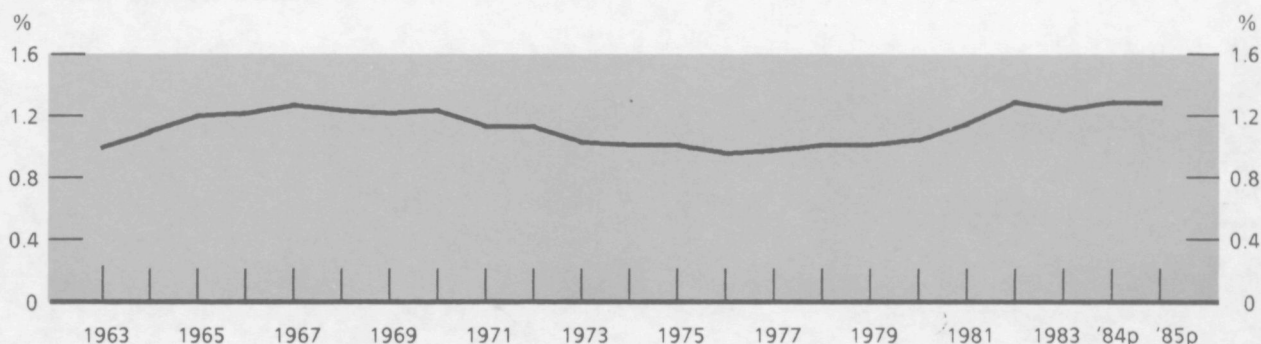
Chart - 20
GERD

GERD Expenditures

\$000,000



GERD / GNP Ratio 1963 - 1985



Total expenditures on R&D within a country are often referred to as GERD (gross domestic expenditures on R&D). The Federal Government adopted the ratio of GERD in the NSE only, to Gross National Product (GNP) as an indicator of the level of R&D performed in the country. In January 1981, the Government announced its R&D planning framework which called for the country's R&D effort to reach 1.5% of the GNP by 1985. The Federal Government's share would be 0.5% of the GNP while the target for industrial funding would be 0.75% of the GNP with the balance funded by provincial governments, universities and other sources.

GERD/GNP peaked at 1.28% in 1967 and declined through to 1976 when it reached a value of 0.96%. It subsequently rose again to a value of 1.30% in 1982 but dropped to 1.25% in 1983. The preliminary GERD/GNP values for 1984 and 1985 have plateaued at 1.30%. In the period from 1979 (the base year selected for the R&D framework) to 1982, there was substantial progress towards the goal of GERD equaling 1.5% of GNP. Recent estimates show that the progress has halted, strongly suggesting that the 1985 target will not be met.

The major contributors to GERD are the

TABLE 8.1 GERD - Funder Shares

Year	GERD	Federal government	Provincial government	Business sector	Higher education	Other
	\$000,000	%				
1979	2,695	36.0	6.8	39.7	12.2	5.3
1980	3,153	35.4	6.5	43.6	8.0	6.5
1981	3,946	35.0	6.2	45.9	6.2	6.6
1982	4,647	36.0	6.5	43.5	6.9	7.2
1983	4,876	38.0	6.2	42.3	6.0	7.5
1984P	5,466	39.4	5.8	41.9	5.6	7.3
1985P	5,796	37.2	5.8	43.0	6.6	7.4
1985 target		33.3	6.6	50.0	7.6	2.5

business sector and the Federal Government with the provincial government and university sectors funding smaller shares.

In its adoption of an R&D planning framework, the Government selected as a 1985 target a distribution of funding shares more in line with that of other OECD countries. Table 8.1 traces the changes in distribution by funder from 1979 to 1985.

It should be noted that the GERD figures for the Federal Government will not agree with the R&D expenditures presented in previous sections. The GERD is constructed from expenditures reported by performing institutes, and not as reported by the funder. Some funds considered extramural R&D payments by the Federal Government are not recognized as such by the extramural performers. Government

estimates of industrial R&D are usually higher than those reported by the business sector.

During 1980 and 1981 the percentage of GERD funded by the Federal Government and the business sector seemed to be moving towards the 1985 target. However, figures from 1982 to 1985 indicate a reversal of this trend with the Federal Government now funding a greater percentage of the GERD than it did in 1979.

The distribution of GERD by the performing sectors is given in Table 8.2. A similar trend to that for the funder distribution is observed. Progress towards the desired performer distribution was made in 1980 and 1981 for the Federal Government and the business sector, but this trend was reversed in 1982. Consequently, the Federal Government may now perform a greater percentage of the total R&D than it did in 1979.

TABLE 8.2 GERD - Performer Shares

Year	Federal government	Provincial governments	Business sector	Higher education	Other
	%				
1979	24.0	2.4	47.0	24.2	2.4
1980	23.4	2.5	49.8	21.8	2.4
1981	21.9	2.2	53.9	19.6	2.4
1982	22.4	2.4	53.7	19.3	2.2
1983	24.0	2.3	51.6	19.6	2.4
1984P	25.7	1.9	51.1	18.7	2.5
1985P	24.5	1.9	52.5	18.5	2.6
1985 target	15.7	2.5	63.0	18.4	0.5

The regional distribution of GERD by funder and performer across Canada is given in Table 8.3. About 54% of the GERD is performed in Ontario compared to 19% in Quebec and 9% in Alberta.

Percentage shares by the funders is given in chart 21. Nationally, the Federal Government

funds 38% of the GERD compared to about 42% by the industrial sector. In the Atlantic provinces the Federal Government funds 76% of the GERD compared to 9% by industry. It funds lesser amounts of GERD in Alberta (25%) and Quebec (30%). Industry funds larger proportions of GERD in Ontario (49%), Quebec (46%), Alberta (37%) and B.C. (36%).

Chart - 21
Funders of Regional GERD, 1983

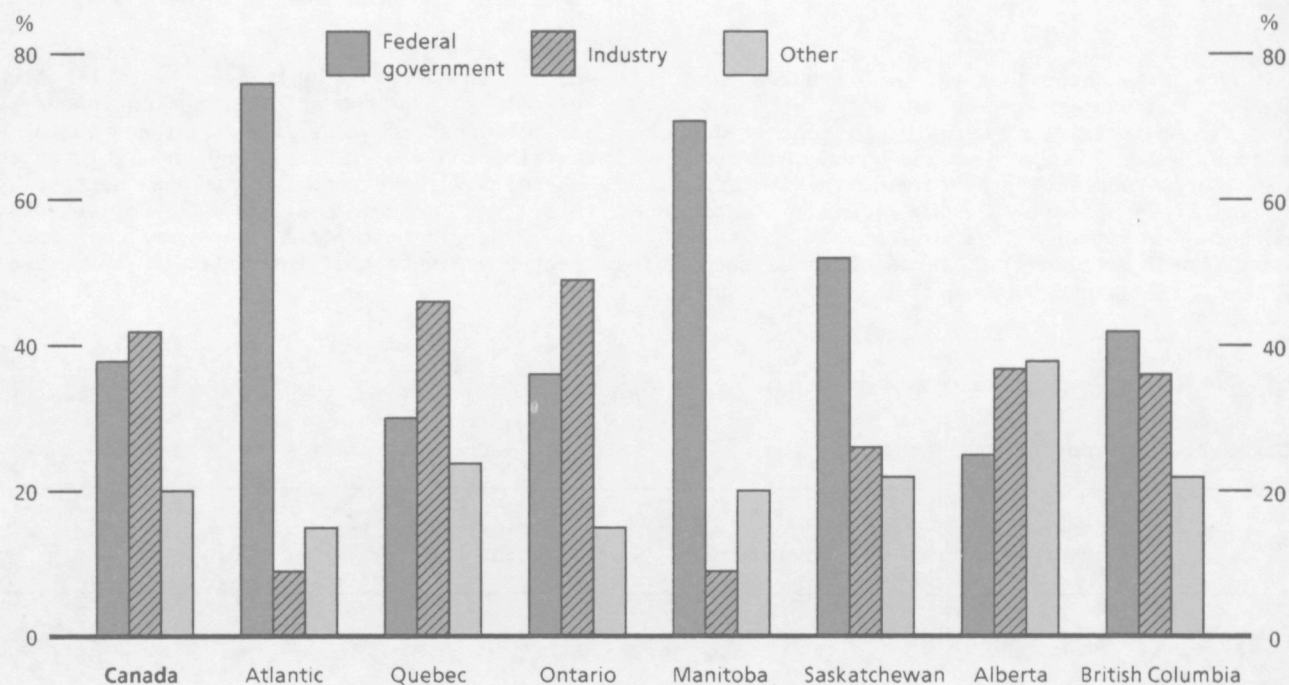


TABLE 8.3 1983 Regional GERD

Sector	Canada(1)	Atlantic	Quebec	Ontario	Manitoba	Saskat- chewan	Alberta	British Columbia
	\$000,000							
Funding sector								
Federal	1,852	195	289	934	131	57	110	136
Provincial government and research organizations	304	6	79	87	5	11	94	22
Business	2,064	23	435	1,267	16	29	165	118
University	291	24	39	110	21	11	58	28
Private non-profit	-	8	37	68	7	-	8	13
Foreign	225	2	71	132	5	2	6	7
Total	4,876	258	950	2,598	185	110	441	324
Performing sector								
Federal	1,171	160	124	604	105	35	65	77
Provincial government and research organizations	170	8	31	54	3	8	51	15
Business	2,518	22	561	1,533	22	35	195	141
University	958	67	214	377	51	32	129	88
Private non-profit	59	1	20	30	4	-	1	3
Total	4,876	258	950	2,598	185	110	441	324

(1) Including the Yukon and North West Territories.

9.0 R&D - AN INTERNATIONAL PERSPECTIVE

This section compares Canada's R&D effort with those of other developed countries. The Organization for Economic Cooperation and Development (OECD) collects R&D data from its member countries and provides international comparisons. Although the bulk of the data presented in other sections of this report deals with expenditures up to 1985-86, data from other countries available from OECD are firm only up to 1981, with estimates for 1982.

R&D expenditures by OECD convention cover R&D in both the natural sciences and engineering and in the social sciences and humanities. GERD data presented in this section include R&D in both sciences and are thus about 12% higher than the Canadian GERD presented in the previous section. Also, the previous section compares GERD to Canada's Gross National Product (GNP). OECD compares GERD to the Gross Domestic Product at purchaser's values (GDP).

TABLE 9.1 GERD (NSE + SSH) as a Per Cent of GDP

Country	1979	1980	1981	1982
	% of GDP			
Canada	1.11	1.16	1.22	1.39
France	1.81	1.84	2.01	2.11
Germany	2.40	..	2.49	2.58
Japan	2.10	2.22	2.38	2.47
Netherlands	1.88	1.89	1.88	1.88
United Kingdom	2.46	..
United States	2.37	2.47	2.52	2.70

Source: Recent Results. Selected S&T Indicators 1979-1984, OECD, December, 1984.

TABLE 9.2 GERD(1) in Selected OECD Countries, 1982

Sector	Canada	France	Germany	Japan	Nether-lands(2)	United Kingdom(2)	United States
	% of GERD						
Funding sector							
Government	50.0	55.1	42.1	25.5	47.2	49.0	48.8
Industry	41.8	40.2	56.9	63.7	46.3	41.3	49.4
Other(3)	8.2	4.7	1.0	10.8	6.5	9.7	1.8
Performing sector							
Government(4)	25.3	26.1	14.3	14.5	23.5	24.9	14.6
Industry	50.3	58.0	69.7	61.9	53.3	61.8	71.9
University	24.4	15.9	16.0	23.6	23.2	13.3	13.4

(1) R&D expenditures include those in NSE and SSH.

(2) 1981 Data.

(3) Includes that funded by universities.

(4) OECD includes private non-profit with government as a performer.

Source: Recent Results. Selected S&T Indicators 1979-1984, OECD, December, 1984.

Additional insight into Canada's R&D effort is obtained by examination of the percentage of GERD funded by the Government and by industry, as well as the distribution among performers.

In Canada, exactly half of the Gross Expenditures on R&D is government funded, with industry funding 41.8% and other sectors (including universities) contributing the remaining 8.2%. Of the seven OECD member countries listed, only the French Government funds proportionately more than does the Canadian Government. In the United States, government and industry fund almost equal amounts at 48.8% and 49.4% respectively. At the other end of the scale is Japan, whose government funds proportionately half as much as the Canadian government, with industry funding the bulk of R&D activities (63.7%) and other sectors funding 10.8%.

The distribution among the three major performers of R&D reveals that every country's government sector funds more R&D than it performs intramurally. However, Japan is the only

country whose industrial sector funds proportionally more R&D than it performs. Not surprisingly, the academic sectors of all countries rely heavily on government funding for R&D.

OECD also categorizes government R&D expenditures of its member countries by socio-economic objectives. Netherlands and Japan both spend over 50% of their R&D expenditures on advancement of knowledge compared to 21% by the Canadian Government. In the agriculture, forestry and fishing objective, Canada spends about 20% of its R&D budget, by far the highest of any of the selected countries. Under the objective of production of energy, the Canadian Government spends a relatively high percentage, being equal to Germany's at 15%. In the industrial growth category, Canada spends 13% of its R&D, more than any of the other countries. Canada spends little in the area of defence; less than the United Kingdom (52%), the United States (52%), France (37%), and Germany (9%). Japan and Netherlands spend the least in the defence area.

TABLE 9.3 R&D Expenditures(1) by Socio-economic Objective, for Selected OECD Countries 1981

Socio-economic objectives	Canada	France	Germany	Japan(1)	Netherlands	United Kingdom	United States
	%						
Advancement of knowledge	21	25	42	52	54	22	4
Agriculture, forestry, and fishing	20	4	2	1	8	4	2
Production of energy	15	7	15	12	5	6	10
Health	7	4	4	3	5	1	11
Industrial growth	13	9	11	6	8	8	--
Defence	7	37	9	2	3	52	52
Transport and telecommunication	4	2	2	1	2	--	2
Other	13	11	15	11	16	6	18

(1) 1980 data.

Source: OECD Science and Technology Indicators, May 1983.

TECHNICAL NOTES AND DEFINITIONS

Scope and Limitations of the Data

The expenditures data for scientific activities controlled by federal departments and agencies provided in this document correspond to the budgetary expenditures by program presented in Main Estimates for the approval of Parliament. As a consequence, the following kinds of costs or expenditures are not included:

- (a) Expenditures by federal agencies which do not receive budgetary appropriations, e.g., Petrocan, Canadian National Railways, Air Canada.
- (b) Non-budgetary expenditures for advances, loans, etc.

Definitions

Federal departments and agencies in receipt of budgetary appropriations are requested to identify those resources reported in Main Estimates.

In the text which follows, the two major fields of science, the natural sciences and the social sciences, and the two kinds of S&T activities, scientific research and experimental development and related scientific activities are described, followed by a description of intramural and extramural performance of S&T activities, definitions of the performance sectors and a discussion of the funding mechanisms for extramural performance. Detailed definitions of research and experimental development and of the various related scientific activities for the natural sciences and for the social sciences are then provided and the Appendix closes with the definitions concerning personnel resources.

The definitions used in collecting the data for this report are compatible with those used by the OECD in its "Frascati Manual" and by UNESCO in its "Manual for Statistics on Scientific and Technological Activities".

A. Natural and Social Sciences

With respect to the two major S&T fields, the term, natural sciences, embraces the disciplines of study concerned with understanding, exploring, developing or utilizing the natural world. Included are the engineering, mathematical, life and physical sciences. The term, social sciences, is to be regarded as synonymous with social sciences and humanities and thus embraces all disciplines involved in studying human actions and conditions and the social, economic and institutional mechanisms affecting humans. Included are such disciplines as anthropology, demography, economics, geography, history, languages, literature and linguistics, law, library science, philosophy, political science, psychology, religious

studies, social work, sociology, and urban and regional studies.

In some situations it may be difficult to decide whether an activity falls in the natural or in the social sciences. Nevertheless, an assignment must be made, and respondents are asked to consider the dominant orientation of the work and the nature of the expertise of the personnel involved.

B. Scientific and Technological Activities

There are two main categories of scientific and technological activities (S&T):

- (i) Scientific research and experimental development (R&D), is defined as creative work undertaken on a systematic basis in order to increase the stock of knowledge, including the knowledge of man, culture and society, and the use of the stock of knowledge to devise new applications.
- (ii) Related scientific activities (RSA), are defined as those activities which complement and extend R&D by contributing to the generation, dissemination and application of scientific and technological knowledge. The kinds of related scientific activities for the two main fields of science are listed below and more fully described later:

Natural Sciences

Scientific data collection
Scientific information services
Technical feasibility studies
Educational support
Museum services
Testing and Standardization

Social Sciences

General purpose data collection
Scientific information services
Socio-economic feasibility studies
Educational support
Museum services
Operations and Policy Studies

C. Intramural and Extramural Performance

Where the S&T activities are managed and carried out primarily by federal government employees they are classified as intramural S&T. Even where major components of the project are provided by outside agencies, such as computer services, laboratory construction, testing of prototype equipment, if the planning, supervision, reporting, and key operating functions are performed by federal personnel, then the activity is considered to be intramural. This also applies to S&T activities carried out by a department or agency on behalf of another federal department or agency on a cost recovery basis.

TECHNICAL NOTES AND DEFINITIONS - Continued

On the other hand, if the management and conduct of an S&T activity is entrusted to a non-federal organization it is classified as being extramurally performed. The six extramural performance sectors used in surveying S&T expenditures by the Federal Government are: Canadian industry, Canadian universities, Canadian non-profit institutions, Canadian provincial and municipal governments, other Canadian performers and foreign performers.

Intramural performance includes:

- scientific activities carried out by personnel of units assigned to the programs;
- the acquisition of land, buildings, machinery and equipment for scientific activities;
- the administration of scientific activities by program employees;
- the purchase of support services such as EDP and travel.

The intramural expenditures reported for scientific activities are those costs associated with scientific programs. These costs include that portion of a program's contribution to employee benefit plans (e.g., superannuation) which is applicable to the scientific manpower within the program. Non-program ("indirect") costs, such as the value of services provided by other departments without charge and accommodation provided by the reporting program are also included.

Canadian industry. This sector is composed of business and government enterprises, including public utilities and government-owned firms. It also includes industrial research institutes such as the Pulp and Paper Research Institute. Industrial research institutes located at Canadian universities are considered to be in the university sector.

Canadian universities. This sector is made up of all Canadian universities, including institutes owned, administered or staffed by universities.

Canadian non-profit institutions. Charitable foundations, voluntary health organizations, scientific and professional societies, and other organizations not established to earn profits comprise this sector. Non-profit institutions primarily serving or controlled by another sector should be included in that sector (e.g., the Pulp and Paper Research Institute is in Canadian industry).

Canadian provincial and municipal governments. Departments and agencies of these governments

form this sector. Government enterprises, such as provincial utilities are included in the Canadian industry sector, and hospitals in the Canadian non-profit institutions or university sector.

Other Canadian performers. This sector includes all individuals or organizations not belonging to any of the above sectors. In particular, it includes provincial research councils and foundations.

Foreign performers. All foreign governments, foreign companies (including foreign subsidiaries of Canadian firms), international organizations, non-resident foreign nationals and Canadians studying or teaching abroad, are included in this sector.

D. Contracts, Grants and Contributions

The Federal Government uses three methods of funding extramurally-performed S&T activities:

- (i) A contract is a legal agreement between two or more parties which will usually specify the nature and general objective of the S&T activity to be performed and the provision of the corresponding results according to an agreed schedule and cost.
- (ii) A grant is an unconditional payment to a recipient and the government does not necessarily receive any services (information, goods, etc.) as a direct result. It is to be noted, however, that there may be eligibility conditions which prospective recipients must meet.
- (iii) A contribution requires an agreement between the government and recipient specifying the terms and conditions under which funds will be paid to the recipient. In particular the payments are conditional on performance or achievement and the recipient's use of the funds provided is subject to audit. In this report the term grants is used for both grants and contributions and data according to the method of funding extramural performance is collected only for R&D activities.

E. Definitions for the Natural Sciences

Research and experimental development (R&D). Creative work undertaken on a systematic basis to increase the stock of scientific and technical knowledge or to discover new applications for existing knowledge. The central characteristic of R&D is an appreciable element of novelty and of uncertainty. The work is normally performed by, or under the supervision of, persons with postgraduate degrees in the natural sciences or engineering.

TECHNICAL NOTES AND DEFINITIONS - Continued

R&D is generally carried out by specialized R&D units. An R&D project however, may also involve the use of non-R&D facilities (e.g., testing grounds), the purchase or construction of specialized equipment and materials, and the assistance of other units. Costs of such items, attributable to the project, are considered R&D costs.

R&D units may also be engaged in non-R&D activities such as technical advisory services, testing, and construction of special equipment for other units. So far as is practical, the effort devoted to such operations is excluded from R&D.

On the other hand, R&D may be carried out by units normally engaged in other functions (e.g., a marine survey ship used for hydrological research, a geological survey team may be directed to work in a certain area in order to provide data for a geophysical research project). Such effort is part of an R&D project and again, so far as is practical, the costs are assigned to R&D expenditures.

Examples:

1. Routine autopsy on the causes of death is not research, but special investigation of a particular mortality in order to establish the side effects of certain treatments is research. Similarly, routine tests, such as blood and bacteriological tests, are not research, but a special program of blood tests in connection with the introduction of a new drug is applied research.
2. The keeping of daily records of temperature or of atmospheric pressure is data collection and not research. The investigation of new methods of measuring temperature is research as is the study and development of new systems and techniques for interpreting the data.

Research fellowships. Awards to individuals for advances in research training and experience. Such payments are included as expenditures for R&D activities. Awards intended primarily to support the education of the recipients are reported as education support.

Scientific data collection. The gathering, processing, collating and analyzing of data on natural phenomena. These data are normally the results of surveys, routine laboratory analyses or compilations of operating records.

Data collected as part of an existing or proposed R&D project are costed against R&D. Similarly the costs of analyzing existing data as part of a research project are R&D costs, even when the data were originally collected for some other purpose. The development of new techniques for data collection is also

considered an R&D activity.

Examples of scientific data collection are routine geological, hydrographic, oceanographic and topographic surveys; routine astronomical observations; maintenance of meteorological records; and wildlife and fisheries surveys.

Scientific information services. All work directed to recording, classifying, and disseminating scientific and technological information. Included are the operations of scientific and technical libraries, S&T information and advisory services, the Patent Office, the publication of scientific journals and bibliographies, and the organizing of scientific conferences. Grants for the publication of scholarly works are also included.

General purpose information services or information services directed primarily towards the general public are excluded, as are teaching activities.

Testing and standardization. Work directed towards the establishment of national and international standards for materials, devices, products and processes, the calibration of secondary standards, and non-routine quality testing. The development of new measures for standards, or of new methods of measuring or testing, is R&D and is reported as such. Excluded is routine testing such as monitoring radioactivity levels or soil tests before construction.

Feasibility studies. Technical investigations of proposed innovative engineering projects to provide necessary additional information for decisions on implementation. Excluded is routine work such as selection of road routes and bridge sites unless there are conditions which impose innovative solutions.

Educational support. Grants to individuals or institutions intended to support the post-secondary education of students in technology and the natural sciences. The activity includes the support of foreign students in their studies of S&T at Canadian or foreign institutions. General purpose grants to educational institutions are excluded. Grants intended primarily to support the research of individuals at universities are either R&D grants or research fellowships.

Museum services. The collecting, cataloguing, and displaying of specimens of the natural world or of representations of natural phenomena. The scientific activities of natural history museums, zoological and botanical gardens, aquaria, planetaria and nature reserves are included.

The activity represents a systematic attempt to preserve and display items from the natural

TECHNICAL NOTES AND DEFINITIONS - Continued

world; in some ways it could be considered an extension of scientific information services. Parks which are not primarily restricted reserves for certain fauna or flora are excluded.

Where practical, efforts of such institutions devoted to R&D or to other activities such as S&T information are excluded from museum services and assigned to those activities. The costs of providing entertainment and recreation to visitors are excluded (e.g., restaurants, children's gardens and nurseries).

Administration of extramural programs. The costs of identifiable units engaged in the administration of contracts and grants and contributions for scientific activities that are to be performed outside the Federal Government. These expenditures are broken down by the type of scientific activity supported, i.e., R&D or RSA.

F. Definitions for the Social Sciences

Research and experimental developmental (R&D). Creative work undertaken on a systematic basis towards the acquisition of new knowledge about man, his actions and his institutions, and the application of this knowledge in new ways.

R&D requires the acquisition of knowledge and not just information. New knowledge involves the integration of newly acquired information into existing hypotheses, the formulation and testing of new hypotheses or the re-evaluation of existing observations.

An R&D project generally has three characteristics:

- A substantial element of uncertainty, novelty and innovation;
- A well-defined project design;
- A report on the procedures and results of the project.

Examples:

1. Investigation of the factors determining regional variations in economic growth.
2. Studies of the effects of an urban development scheme on family group cohesiveness.
3. Investigation of variables affecting the educational performance of children drawn from different social and ethnic groups.
4. Development of reward systems which take into account the different motives, attitudes and perceptions of management and workers.

Both "research" and "development" are often used with different meanings in the Government. For example, it is increasingly common to hear that a person is "researching" something (i.e., the person is looking for information about something). Similarly, there are many units with either research or development or both terms in their titles which are concerned primarily with information gathering, speech writing, preparation of position papers or departmental organization. These are excluded from the scientific activity for R&D.

Research fellowships. Awards to individuals for advanced research training and experience. Such payments are included as expenditures for R&D activities. Awards intended primarily to support the education of the recipients are reported as educational support.

General purpose data collection. The routine gathering, processing, collating, analysis and publication of information on human phenomena using surveys, regular and special investigations and compilations of existing records. It excludes data collected primarily for internal administrative purposes (e.g., departmental personnel statistics) as well as the collection of data as part of an R&D project.

Data collected as part of an existing or proposed research project are costed against research. Similarly the costs of analyzing existing data as part of a research project are R&D costs, even when the data were originally collected for some other purpose. The development of new techniques for data collection is also considered a research activity.

Examples of general purpose data collection are the quinquennial censuses, and surveys of employment and production.

Scientific information services. The recording, classifying and disseminating activities of units concerned primarily with providing information for scientific activities in the social sciences and humanities.

Included are the operations of specialized libraries or national archives, the publication of scholarly journals and bibliographies, grants for the publication of scholarly works and the support of scientific and academic conferences.

General purpose information services or information services directed primarily towards the general public are excluded, as are teaching activities.

TECHNICAL NOTES AND DEFINITIONS - Concluded

Economic and feasibility studies. Investigations of the socio-economic characteristics and implications of specific situations. Such studies are generally limited to a specific problem and involve the application of established social science techniques and methodologies. Examples are a study of the viability of an iron foundry in a foreign country, or cost-benefit study of a proposed paper manufacturing centre in Manitoba.

Operations and policy studies. The analysis and assessment of departmental programs, policies and operations, the activities of units concerned with the continuing analysis and monitoring of external phenomena (e.g., foreign economic statistics, defence and security information) as well as studies to provide an information base for policy development. The work is carried out by specialized units in some government departments, by consultants, by royal commissions and by task forces.

Educational support. Grants to individuals or institutions intended to support the post-secondary education of students in the social sciences and humanities. General purpose grants to educational institutions are excluded. The activity includes the support of foreign students in their studies of the social science at Canadian or foreign institutions.

Grants intended primarily to support the research of individuals at universities are either R&D grants or research fellowships.

Museum services. The collecting, cataloguing and displaying of specimens and representations relating to the history, social organization and creative efforts of man.

The activity represents a systematic attempt to preserve and display the works of man and to provide information on his works, history and nature. The scientific activities of historical museums, archeological displays, and art galleries are included.

The costs of providing entertainment and recreation to visitors are excluded (e.g., restaurants, children's gardens and museums).

Administration of extramural programs. The costs of identifiable units engaged in the administration of contracts and grants and contributions for scientific activities that are to be performed outside the Federal Government. These expenditures are broken down by the type of scientific activity supported, i.e., R&D or RSA.

G. Personnel Resources

Data are also collected on the personnel resources devoted to or in support of intramurally-performed S&T activities. These resources include both scientific and technical personnel directly engaged in the S&T activities, such as scientific and engineering staff, technical staff, operational staff (e.g., field hands in agricultural research) and auxiliary staff such as secretaries, typists, administrative and financial staff. In regard to auxiliary staff there are two caveats:

- (i) where the S&T activities are a part of the program being reported only the auxiliary staff relevant to the S&T activities are reported on a prorated basis,
- (ii) whenever financial and administrative support is provided from another program, that support is allocated to the S&T resources for the program being reported.

Personnel resources are reported on an equivalent full-time basis. The unit used is person-years. Thus an employee working half-time on S&T activities is reported as 0.5 person years.

STATISTICAL PUBLICATIONS

Catalogue

88-001 **Science Statistics.** The 12 issues for 1985 (Volume 9) are:

1. "The Investment Tax Credit for Research and Development, 1978-1982"
2. "The Additional Allowance for Scientific Research, 1978 to 1982"
3. "Industrial Research and Development Expenditures, 1976 to 1985"
4. "Research and Development Expenditures, 1985 Forecasts"
5. "The Regional Distribution of Federal Expenditures on Science and Technology, 1983-84"
6. "Regional Distribution of R&D in Canada, 1977 to 1983"
7. "Federal Government Activities in the Natural Sciences, 1985-86"
8. "Federal Government Activities in the Social Sciences, 1977-78 to 1985-86"
9. "Federal Government Personnel Engaged in Scientific and Technological Activities, 1977-78 to 1985-86"
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- "Canadian Patent Trends, 1984"
- "Estimates of Research and Development Personnel, 1975-1983"
- "Estimation of Research and Development Expenditures in the Higher Education Sector, 1983-84"
- "Indicators of Canadian Research Output, 1982"
- "Estimates of Research and Development Expenditures, by Region, 1980-1983"

The above working papers are available from Science and Technology Statistics Section.

The semi-annual report, **Activities of the Science and Technology Statistics Program** (previously entitled **Activities of the Science and Technology Statistics Division**) is also distributed free of charge. These reports are intended to provide information about Statistics Canada's programs for science and technology statistics, the services and publications resulting from them and plans for enhancing existing programs and developing new ones. If you would like to be put on the mailing list for this report, please contact the Science and Technology Statistics Section.

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