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# MOSST Background Paper

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THE STOCK OF RESEARCH  
TRAINED PERSONNEL

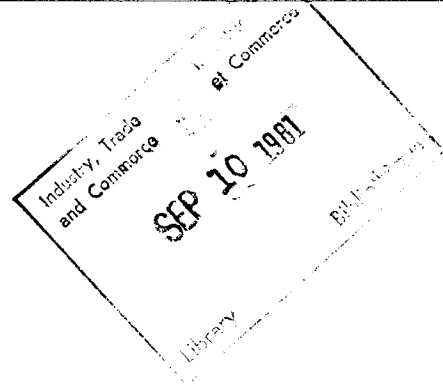


Ministry of State

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Canada



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THE STOCK OF RESEARCH  
TRAINED PERSONNEL

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## SUMMARY

The purpose of this paper is to provide estimates of the number of persons engaged in R&D by performing sector in the natural sciences consistent with gross domestic expenditures on R&D in the Natural Sciences and Engineering (GERD-NSE) for recent years, and estimates of the regional distribution of these stocks.

For 1978, the national stocks of professional R&D manpower (excluding support staff) are estimated to be 21,800 full-time equivalent person-years, of which some 6,000 are located in the Federal Government, 10,000 in industry, 5,000 in universities, 700 in the provincial governments, and 150 in the private non-profit sector.

This report shows estimates of the regional distribution of R&D personnel by performing sector for the year 1975. In the industrial sector, the 1975 estimate shows that one-third of Canada's R&D personnel is located in Quebec, 56 percent in Ontario and 10 percent in the West. Ontario has 38 percent of the university research personnel, Quebec, 24 percent, and the West, 28 percent. About 46 percent of federal R&D personnel are located in the National Capital Region (Hull, Quebec and Ottawa, Ontario), 20 percent elsewhere in Ontario and 5 percent elsewhere in Quebec.

Of the total provincial government R&D manpower, it is estimated that Quebec has 34 percent, Ontario 39 percent and the West, 26 percent.

Estimates of R&D personnel classified by educational level (B.A., M.A., Ph.D) are also provided in this report. The proportion of graduate level researchers in the industrial sector increased from 29 percent in 1971 to 37 percent in 1977. In 1971, 61 percent of the R&D personnel in the Federal sector possessed graduate level qualifications compared to 68 percent in 1974. The proportion of graduate level researchers fell from 64 percent in 1971 to 53 percent in 1978 at the provincial research institutes.

## INTRODUCTION

This study is one of several monographs concerned with issues related to highly qualified manpower in Canada. The particular focus of this paper is to provide estimates of the stock of persons employed in R&D in the natural sciences (consistent with GERD<sup>1</sup>), by performing sector (government, industry and university) and by region.

The inventory of researchers in the country is measured through a variety of surveys and imputations. For this reason, the statistics on R&D manpower presented in this paper should be regarded as approximations rather than as firm numbers.

This study is organized as follows: Section A discusses the national estimates of R&D manpower stocks by performing sector, with particular attention to data sources and necessary assumptions required to use these data. Sections B and C review the regional distribution of these stocks and the educational level of researchers, respectively.

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<sup>1</sup>Throughout this study "GERD" refers to gross domestic expenditure on research and development in the natural sciences (including health) and engineering.

A. NATIONAL ESTIMATES OF RESEARCH TRAINED PERSONNEL BY PERFORMING SECTOR

The manpower estimates provided in Table 1 are based on a number of data sources and the estimating procedures described below. These data pertain to professional and scientific manpower engaged in R&D activities in the natural sciences and exclude technical and other support staff. Manpower estimates are in terms of full-time equivalent man-years and include casual, part-time, and term employees as well as permanent staff<sup>2</sup>.

Federal Government Sector

Data Sources

Federal R&D scientific manpower estimates shown in Table 1 are based on the 1974 Federal Science Survey, conducted by Statistics Canada, and the 1977 and 1978 surveys which were conducted cooperatively by Statistics Canada and MOSST in conjunction with the Treasury Board budgetary estimates process. These latter surveys employ science addenda questionnaires, which are completed by government departments and agencies in conjunction with the Treasury Board call for main estimates. MOSST publishes details of the federal science surveys annually in Federal Science Expenditures and Personnel.

TABLE 1

R&D PERSONNEL BY SECTOR  
NATURAL SCIENCES

PERFORMER	(FULL-TIME EQUIVALENT PERSON-YEARS)			
	1971	1973	1975	1978
FEDERAL GOVERNMENT	5,584	5,628	5,638	5,866
PROVINCIAL GOVERNMENT	610	668	675	712
INDUSTRY	7,928	7,733	8,299	10,091
UNIVERSITIES	4,212	4,488	4,792	4,990
PRIVATE NON-PROFIT	135	139	140	142
TOTAL	18,469	18,656	19,544	21,801

SOURCE: STATISTICS CANADA, SCIENCE STATISTICS CENTRE AND MOSST ESTIMATES.

<sup>2</sup>A recent report by Statistics Canada provides estimates of researchers which are not materially different from the results of this study (Statistics Canada, "Annual Review of Science Statistics", Cat. No. 13-212, Annual, 1979).

### Manpower Estimates

The manpower data for the federal service are reported on the basis of the Public Service Commission bargaining group categories rather than the traditional R&D classifications used by Statistics Canada. Statistics Canada states that this presents only minor problems for international comparisons<sup>3</sup>.

Since the manpower data are reported in connection with the budgetary estimates, the nominal reference period is the federal fiscal year ending March 31st. In practice, two time frames are used: continuing employees are reported as of September 30th and term, casual and seasonal employees are reported for the entire fiscal year.

Appendix Table A-1 shows the number of federal R&D personnel by year and PSC group from 1971-72 to 1979-80 based on the federal science surveys of 1977, 1978 and 1979 and the earlier Statistics Canada federal surveys.

Appendix Table A-2 shows the number and distribution of scientific and professional personnel engaged in scientific activities for selected federal departments and agencies. Of the 26 departments who complete the science addenda of the main estimates, 7 departments account for 91 percent of the total scientific personnel. The largest federal employer is Environment Canada which accounts for 28 percent of all federal scientific employees.

### Some Problem Areas in Federal R&D Manpower Data

The federal R&D manpower estimates are just that - estimates - and likely are less satisfactory in many respects than the R&D expenditure data which are collected at the same time. The origin of the problem lies in the fact that R&D is an activity and also a job function which is rarely the subject of a separate organizational structure and a full-time occupation. More often, R&D activities are part of a larger program including many other non R&D activities. Frequently, the major direct R&D costs can be identified through the accounting system, but the manpower requirements

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<sup>3</sup> Statistics Canada, "Federal Government Activities in the Natural Sciences", 1974-76, Cat. No. 13-202, p. 36.



are by no means as easily allocated to R&D or to other job functions and activities. The total staffing for the program would be known in some detail, but the proportion of time devoted to R&D, as opposed to administration or operational requirements, is a matter of judgment by the person completing the survey questionnaire. Particularly in large government programs, it is quite difficult to summarize the activities of people in anything like the degree of detail provided by financial reporting systems. The problem is compounded over time if different respondents make different judgments about the allocation of human resources. These problems are, of course, common to all R&D manpower estimates including those of industry, the provincial governments and universities.

A second problem area, particularly in the federal manpower data, lies in the changing and evolving nature of the federal "science program". There is not a specific program to fund science as such, but rather, science contributes in a greater or lesser degree to existing programs relating to energy, industry, mining, agriculture, etc. The total federal resources expended on science are really an aggregate assembled in the course of conducting the MOSST/Statistics Canada survey and are based on a departmental review and extraction of programs and sub-programs with a high scientific and technological content from the various programs of the departments and agencies of the Federal Government. Since the composition of the federal science program may change through time, the federal R&D manpower estimates are more volatile than, say, those of operational programs.

#### Industry Sector

##### Data Sources

Data on industrial R&D have been collected since 1955 by Statistics Canada from business enterprises, government enterprises and industrial research institutes and associations. Until 1969, the survey was biennial. Since 1969 all known performers of industrial R&D have been surveyed for odd numbered years and a sample, including the leading performers, has been surveyed for even numbered years.

The surveys are conducted through questionnaires mailed out early in May. Respondents report expenditures for the two previous calendar years, estimated expenditures for the current year and forecast expenditures for the coming year. R&D personnel estimates are provided for the immediate past year only. Personnel are reported on a full-time equivalent basis and include professionals and supporting staff. Professionals, as reported in Table 1, include scientists and engineers and senior R&D administrators.

#### Manpower Estimates

The estimates of R&D manpower in industry shown in Table 1 for the years 1971, 1973 and 1975 are taken directly from the industry survey data as reported by Statistics Canada. The estimate for 1978 (10,091) was based on the trend in the value of R&D per professional researcher during the 1970s. Appendix Table A-3 shows recent data concerning the value of R&D performed and the number of industrial researchers.

The number of scientists and engineers engaged in industrial R&D by industry group and education is shown in Appendix Table A-4. The firms most likely to employ graduate level scientists and engineers are related to the electrical and chemical based industries. These two sectors employ over half of the graduate level scientists and engineers.

#### Problem Areas

The number of researchers in industry in 1978 is probably somewhat lower than indicated here. The reason for this is the method by which the 1978 figure had to be estimated. The last Statistics Canada survey shows an R&D expenditure level of \$855 million for 1977, and 9,685 researchers, implying a significant decline in real R&D per researcher compared with the earlier years (\$94,000 compared with \$105,000 in 1975, in 1978 dollars, see Appendix Table A-3). The 1978 level of R&D per researcher is calculated by log-linear trend<sup>4</sup>. The decline in R&D "output" per researcher for 1977, implied by the survey, requires further analysis.

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<sup>4</sup>Since the publication of this report, Statistics Canada has provided estimates of industrial intramural expenditures to 1979. However, no new estimates of industrial R&D personnel have been provided. (Statistics Canada "Annual Review of Science Statistics", Cat. No. 13-212 Annual, 1979.)

## University Sector

### Data Sources

It is really not known how many researchers are located in Canadian universities. There is no survey of university R&D, as in government or industry. There are, however, reasonably accurate records of the number of full-time university teachers, by field of teaching, available from the UCASS<sup>5</sup> file at Statistics Canada. For some of the granting councils' programs, the number of teachers who apply for, and the number who receive research awards or grants, are also known. The number of graduate students by field of study is also available through the USIS<sup>6</sup> data file at Statistics Canada. In order to use any of these data sources for estimating researchers at universities, it is necessary to formulate certain assumptions.

In developing the national science statistics, the Science Statistics Centre calculates the number of university researchers based on the number of full-time university teachers in the health sciences, other natural sciences, and the social sciences, and a set of research coefficients. These coefficients are estimates of the proportion of time, on average, that a university teacher in each field is assumed to devote to research. The coefficients used are 30, 40, and 15 percent, for health, other natural sciences and social sciences, respectively. This is the procedure that was followed in developing the estimates of the university researchers in this paper<sup>7</sup>.

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<sup>5</sup>Statistics Canada, University and Colleges Academic Staff System (UCASS), Ottawa.

<sup>6</sup>Statistics Canada, University Student Information System (USIS), Ottawa.

<sup>7</sup>In its most recent review of R&D manpower, Statistics Canada used a ratio of .30 for all natural science fields. Thus, these estimates of R&D manpower employed in the universities are lower than the MOSST estimates. See Statistics Canada, "Annual Review of Science Statistics", Cat. No. 13-212 Annual, 1979.

### Manpower Estimates

It is expected that better data, bearing on the question of research coefficients, may be forthcoming in the near future. A joint project of CAUBO-CCFUR<sup>8</sup> is directed towards determining the costs of university research, and a result of this exercise will be a set of empirically based research coefficients, hopefully with a more detailed breakdown by teaching field.

It was decided not to use the number of applicants and award holders of grants and post-graduate scholarships from the Granting Councils as estimates of the number of university researchers for two reasons. First, the councils, while significant contributors to the funding of university R&D (about 50 percent of sponsored research in recent years) are by no means the only supporters of university research. One is left, therefore, with a question as to the number of non council supported researchers who are working in the universities. Moreover, university professors also engage in "free time" research which is not directly supported by external funders.

A second major consideration is the problem of deriving full-time equivalent man-year estimates based on the number of applicants or award holders. It is a moot point, working from the number of council award holders, as to the time, on an annual basis, that a researcher actually devotes to research. On the whole, the number of researchers supported by the councils is not a practical data source with respect to the problem of estimating equivalent research man-years engaged in university R&D. Similar problems are involved if the graduate student and scholarship data bases are used.

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<sup>8</sup>Canadian Association of University Business Officers and the Canadian Committee on Financing University Research. The CCFUR released its report entitled "Report of the Pilot Study on the Costs of University Research" in December 1979. Appendix "E" to this report contains relevant information on the allocation of faculty time to research.

## Problem Areas

The previous discussion on data sources identified the main problem area as the lack of empirical data on university researchers, either by means of direct survey or by means of research coefficients based on time diaries or other methods. The diary method has been used in other countries (Britain and United States, for example) and is a well established technique. The coefficients used in the Canadian estimates, although they are based on assumptions, are in line with those used by other countries for the same purpose.

## Provincial Government Sector

### Data Sources

There are two main sources of survey information on provincial government activities in the natural sciences:

1. Provincial Government Activities in the Natural Sciences; and
2. Provincial Non-Profit Industrial Research Institutes.

Statistics Canada surveys have been conducted annually on behalf of the participating provinces since 1974 in Nova Scotia, Ontario and Alberta and since 1975 in Saskatchewan<sup>9</sup>. British Columbia was included for the first time in 1977. These surveys collect data on expenditure and manpower and are used as a basis for estimating provincial R&D expenditures for the national GERD statistics.

Estimates for Quebec are prepared from reports in the series "Inventaire de la R-D au gouvernement du Québec 1972-1973" and the provincial government expenditure estimates. Due to the extensive estimating required, provincial distributions of the national estimates are not provided by the Science Statistics Centre of Statistics Canada. However, for background purposes, Appendix Table A-5 shows the intramural R&D expenditures, R&D professional staff, and expenditures per scientist from the 1975-76 surveys for the provinces where survey data are available.

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<sup>9</sup>Nova Scotia no longer participates in these provincial surveys.

Provincial research institutes are surveyed annually by Statistics Canada and certain statistics are available from 1963. These surveys provide data on expenditures for R&D and the number of scientists employed at the institutes. The personnel data, however, are in terms of numbers of staff but not full-time equivalent man-years which presents a problem in terms of aggregation across performing sectors with a common unit of measure. Estimates of the number of scientists and engineers employed by the provincial research organizations are shown in Appendix Table A-6.

#### Manpower Estimates

Since not all provinces are covered in the provincial surveys, it was found necessary to base the national estimates of provincial R&D man-years on the provincial R&D expenditure estimates of the Science Statistics Centre of Statistics Canada. Also, in view of the fact that the provincial research institutes do not report on the basis of equivalent man-years, it was decided to derive the total provincial R&D professional staffing level (provincial governments and institutes) from the total value of provincial intramural R&D and the R&D performed by the institutes.

The calculation involved dividing the value of total provincial R&D performed (including the provincial research institutes) by the assumed output per researcher. This assumed output was the average output per researcher in the Federal Government. Appendix Table A-7 shows the historical data used in these calculations.

#### Some Problem Areas

The main problem area in connection with provincial R&D expenditure and manpower data lies in the coverage of the provincial surveys. Since the Atlantic provinces, Quebec and Manitoba do not take part in the provincial surveys, the Science Statistics Centre of Statistics Canada must estimate R&D expenditures for these provinces when developing the GERD statistics.

## The Private Non-Profit Sector (PNP)

### Data Sources

The 1978 Annual Review of Science Statistics<sup>10</sup> included this sector for the first time as a separate funder and performer of R&D in the national GERD series. The PNP sector consists of four types of institutions: private foundations (e.g. Atkinson Charitable Foundation), voluntary health organizations (e.g. Canadian Heart Foundation), associations and societies (e.g. Canadian Medical Association) and operating institutes (e.g. Alcoholism and Drug Addiction Research Foundation).

Estimates of R&D performed in this sector were based on the Statistics Canada 1976 survey of private non-profit institutions. The value of R&D is small compared to other sectors (about \$19 million in 1978), but the PNP sector is important as a collector of funds from business and individuals for research projects which are largely performed at Canadian universities. Provincial governments provide about 60 percent of the funds for research performed in the PNP sector itself.

Historical estimates of R&D performed in the PNP sector were based on the distributions of funding provided in the previously noted 1976 survey and the assumption that expenditures had increased by 8 percent per year, 1963 to 1977. While this is clearly an arbitrary assumption, the dollar values involved are not large and the absolute size of any error is not significant in terms of its impact on aggregate GERD estimates.

### R&D Personnel

The 1976 survey of private non-profit institutions did not collect statistics on R&D personnel. For the purpose of preparing national estimates of R&D personnel, the value of R&D performed in the PNP sector was divided by the average of R&D per researcher in the federal government sector. The results of these calculations for selected years 1971 to 1978 are shown in Table 1.

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<sup>10</sup> Statistics Canada, "Annual Review of Science Statistics", Cat. No. 13-212, Annual, 1978.

Problem Areas

The PNP sector is important largely in the health research field. The funds directed to university research from the PNP sector are identified by the PNP survey and also in the university accounts as sponsored research funds. However, some PNP funded medical research is also carried out in hospitals outside of the university financial reporting system, and to this extent the estimates shown for PNP performed research are underestimated.

It would be desirable for future PNP surveys to clarify the identity of R&D performers in order to capture this research activity.



B. REGIONAL DISTRIBUTION OF RESEARCH TRAINED PERSONNEL  
BY PERFORMING SECTOR

The regional distribution of professional R&D manpower by performing sector for the year 1975, the year for which data are available for all sectors, is shown in Table 2.

In the industrial sector, the 1975 estimate shows that one-third of the R&D personnel is located in Quebec, 56 percent in Ontario and 10 percent in the West. The most recent data, 1977, indicate that the proportion of R&D personnel in Ontario has increased slightly to 58 percent while the proportion in Quebec has fallen to 31 percent<sup>11</sup>.

Federal Government R&D personnel are located in the National Capital Region (Hull, Quebec and Ottawa, Ontario) (46 percent), elsewhere in Quebec (5 percent) and Ontario (20 percent) and in the West (20 percent). This 1975 regional distribution of federal R&D personnel had to be based on the earlier Statistics Canada federal survey which provided a regional breakdown of research personnel. A 1979 publication by Statistics Canada indicates that these proportions have not changed significantly from 1975<sup>12</sup>.

Estimates of the regional capacity of university R&D manpower were based on the distribution of full-time university teachers in the natural sciences, as described in the previous section. Manpower resources are located in Quebec (24 percent), Ontario (38 percent) and in the West (28 percent).

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<sup>11</sup>Statistics Canada, "Service Bulletin", Vol. 3, No. 8, Cat. No. 13-003.

<sup>12</sup>Statistics Canada, Science Statistics Centre, "Listing of Federal Scientific Establishments 1978-79", Statistical Tabulations, 1979.

As noted in connection with the provincial government R&D manpower estimates, it was not possible to secure an "official" regional distribution for provincial expenditure data; however, a distribution was estimated from partial provincial survey coverage, as shown in Table 2. Provincial research manpower is located in Quebec (34 percent), Ontario (39 percent) and the West (26 percent). Table 2 also contains provincial research institute manpower estimates for 1975.

TABLE 2

REGIONAL DISTRIBUTION OF R&D PERSONNEL - 1975  
NATURAL SCIENCES AND ENGINEERING

	PERCENTAGE DISTRIBUTION				
	INDUSTRY	UNIVERSITIES	PROVINCIAL GOVERNMENT TOTAL PROVINCIAL (A)	INDUSTRIAL RESEARCH INSTITUTES (B)	FEDERAL GOVERNMENT (C)
ATLANTIC	0.8	10.7	1.3	14.0	8.2
QUEBEC	33.3	23.8	33.8	12.1	5.1
NATIONAL CAPITAL REGION (D)	-	-	-	-	45.7
ONTARIO	55.7	37.8	39.0	19.5	20.7
MANITOBA & SASKATCHEWAN	1.2	10.5	5.1	12.8	7.5
ALBERTA	4.7	8.3	13.0	26.5	6.1
BRITISH COLUMBIA	4.3	8.9	7.8	15.0	6.5
NWT & YUKON	-	-	-	-	0.3
TOTAL	100.0	100.0	100.0	100.0	100.0

SOURCE: STATISTICS CANADA, SCIENCE STATISTICS CENTRE AND EDUCATION DIVISION.

(A) PROVINCIAL DISTRIBUTION ESTIMATED BY MOST FROM PARTIAL PROVINCIAL SURVEY DATA. INCLUDES INDUSTRIAL RESEARCH INSTITUTES.

(B) PROVINCIAL NON-PROFIT INDUSTRIAL RESEARCH INSTITUTES.

(C) DATA AVAILABLE ONLY FOR PERSONNEL ENGAGED IN ALL SCIENTIFIC ACTIVITIES (INCLUDING R&D).

(D) THIS CATEGORY IS AVAILABLE ONLY IN FEDERAL GOVERNMENT DATA, AND RELATES TO THE HULL, QUEBEC AND OTTAWA, ONTARIO AREA.

NOTE: THE REGIONAL DISTRIBUTION OF PRIVATE NON-PROFIT RESEARCH PERSONNEL IS NOT AVAILABLE.

C. EDUCATIONAL LEVEL OF RESEARCHERS

The available industry, federal and provincial institute surveys provide information on the educational level of professional staff. Table 3 summarizes this information for selected years (1974 is the most recent data available on educational level for the Federal Government). As can be seen, there has been a general trend towards staffing at higher degree levels in industry and in the federal service. In industrial R&D, the proportion of graduate level researchers has increased from 29 percent to 37 percent, from 1971 to 1977. In the federal sector 68 percent of the positions were staffed by graduate level researchers in 1974 compared to 61 percent in 1971. At the provincial institutes, the proportion of graduate level researchers fell from 64 percent in 1971 to 53 percent in 1978.

TABLE 3

EDUCATIONAL LEVEL OF R&D PERSONNEL BY PERFORMER  
NATURAL SCIENCES AND ENGINEERING

	PERCENTAGE DISTRIBUTION							
	INDUSTRY			PROVINCIAL INSTITUTES			FEDERAL GOVERNMENT	
	1971	1975	1977	1971	1975	1978	1971	1974
BACHELOR	70.6	64.0	63.0	35.9	39.4	46.9	31.1	27.0
MASTER	14.9	18.5	19.8	26.3	29.6	23.1	22.8	23.4
PH. D.	14.5	17.5	17.2	37.8	31.0	30.0	38.1	44.3
NO DEGREE	-	-	-	-	-	-	7.9	5.4
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

SOURCE: STATISTICS CANADA, INDUSTRIAL, PROVINCIAL RESEARCH INSTITUTES AND FEDERAL SURVEYS: CAT. NOS. 13-202, 13-209 AND 13-212.

APPENDIX TABLES

APPENDIX TABLE A-1

FEDERAL R&D PERSONNEL  
(INTRAMURAL R&D IN THE NATURAL SCIENCES)

PSC CATEGORY (1)	(FULL TIME EQUIVALENT PERSON-YEARS)								
	1971/72	1972/73	1973/74	1974/75	1975/76	1976/77	1977/78	1978/79	1979/80
SCIENTIFIC AND PROFESSIONAL	4,882	4,933	4,954	5,127	5,016	5,066	5,047	5,091	4,982
ADMIN. AND FOREIGN SERVICE	536	530	498	523	403	490	560	561	575
EXECUTIVE	36	41	36	49	61	57	55	54	56
MILITARY R&D	130	135	140	145	158	156	160	160	160
TOTAL	5,584	5,639	5,628	5,844	5,638	5,769	5,822	5,866	5,773

SOURCE: STATISTICS CANADA, "FEDERAL GOVERNMENT EXPENDITURES ON SCIENCE", CAT. NO. 13-202, 1970 TO 1975; MOSST, "FEDERAL SCIENCE EXPENDITURES AND PERSONNEL", 1976 TO 1979.

(1) THESE CATEGORIES ARE USED BY THE PUBLIC SERVICE COMMISSION IN ITS ADMINISTRATIVE RECORDS FILES. PERSON YEARS SHOWN REFER ONLY TO PERSONS ENGAGED IN SCIENTIFIC ACTIVITIES AND INCLUDE RESEARCHERS, RESEARCH MANAGERS, ENGINEERS, ETC.

APPENDIX TABLE A-2

PROFESSIONAL RESEARCHERS AT FEDERAL RESEARCH ESTABLISHMENTS  
(NATURAL SCIENCES)

	(PERSON YEARS)	
	1978-79	( PER CENT )
AGRICULTURE	1,020	14.2
ATOMIC ENERGY OF CANADA LIMITED	639	8.9
ENERGY	907	12.6
ENVIRONMENT	2,027	28.2
NATIONAL DEFENCE	553	7.7
NATIONAL RESEARCH COUNCIL	1,053	14.7
NATIONAL HEALTH AND WELFARE	369	5.1
OTHER DEPARTMENTS AND AGENCIES	616	8.6
TOTAL	7,189	100.0

SOURCE: STATISTICS CANADA, SCIENCE STATISTICS CENTRE,  
"LISTINGS OF FEDERAL SCIENTIFIC ESTABLISHMENTS,  
1978-79", FEBRUARY 1980.

NOTE: DATA ONLY AVAILABLE FOR THE SCIENTIFIC AND  
PROFESSIONAL CATEGORY.

APPENDIX TABLE A-3

ESTIMATE OF INDUSTRY R&D MANPOWER - 1978

		CURRENT DOLLARS			CONSTANT 1978 DOLLARS		
		R&D EXPEND. (MIL)	NUMBER RESEARCHERS	R&D EXPEND./ RESEARCHER	R&D EXPEND. (MIL)	NUMBER RESEARCHERS	R&D EXPEND./ RESEARCHER
SURVEY DATA	1971	464.5	7,928	58,590	848.6	7,928	107,038
	1973	502.2	7,733	64,942	800.6	7,733	103,530
	1974	603.5	8,120	74,323	834.7	8,120	102,791
	1975	696.5	8,299	83,926	869.8	8,299	104,807
	1977	854.9	9,685	88,271	909.7	9,685	93,926
ESTIMATE	1978	927.5	10,091	90,918	927.5	10,091	90,918

SOURCE: STATISTICS CANADA, "INDUSTRIAL R&D EXPENDITURES IN CANADA", CAT. NO. 13-203, AND "SCIENCE STATISTICS SERVICE BULLETIN", VOL. 3, NO. 8, 1979.

NOTE: THE NUMBER OF RESEARCHERS IN 1978 WAS ESTIMATED BASED ON THE SEMI-LOGARITHMIC TREND IN THE CONSTANT DOLLAR VALUE OF R&D EXPENDITURES PER RESEARCHER, 1971 TO 1977.

APPENDIX TABLE A-4

INDUSTRIAL R&D PERSONNEL BY INDUSTRY AND EDUCATION - 1977  
(SCIENTISTS AND ENGINEERS)

INDUSTRY	EDUCATION			TOTAL
	BACHELORS	MASTERS	DOCTORS	
MINES AND OILS	205	50	50	305
CHEMICAL BASED	1,283	303	586	2,172
WOOD BASED	222	56	171	449
METALS	452	118	139	709
MACHINERY AND TRANSPORTATION EQUIPMENT	1,268	270	108	1,646
ELECTRIC	1,607	723	318	2,648
OTHER MANUFACTURING	87	17	18	122
OTHER INDUSTRIES	979	384	271	1,634
TOTAL	6,103	1,921	1,661	9,685

SOURCE: STATISTICS CANADA, "ANNUAL REVIEW OF SCIENCE STATISTICS", CAT. NO. 13-212, ANNUAL, 1979.



APPENDIX TABLE A-5

PROVINCIAL INTRAMURAL R&D AND PERSONNEL  
1975-76

	PROVINCIAL R&D ( \$ THOUSANDS )	R&D PERSONNEL ( NUMBER )	R&D PER RESEARCHER ( \$ )
NOVA SCOTIA	30	1	30,000
ONTARIO	15,220	288	52,847
SASKATCHEWAN	950	20	47,500
ALBERTA	4,844	79	61,316
TOTAL	21,044	388	54,237

SOURCE: PROVINCIAL SURVEYS, NOVA SCOTIA, ONTARIO,  
SASKATCHEWAN AND ALBERTA.

APPENDIX TABLE A-6

PROVINCIAL RESEARCH INSTITUTE PERSONNEL BY EDUCATION  
(SCIENTISTS AND ENGINEERS, SELECTED YEARS)

SCIENTISTS AND ENGINEERS	YEAR			
	1971	1973	1975	1978
BACHELORS	122	190	178	236
MASTERS	87	112	131	116
DOCTORS	128	140	140	151
TOTAL	337	442	449	503

SOURCE: STATISTICS CANADA, "ANNUAL REVIEW OF SCIENCE STATISTICS",  
CAT. NO. 13-212, ANNUAL, 1979.

APPENDIX TABLE A-7

ESTIMATES OF PROVINCIAL R&D PERSONNEL  
(NATURAL SCIENCES)

	FEDERAL GOVERNMENT			PROVINCIAL GOVERNMENT		
	R&D EXPEND. (MIL)	RESEARCHERS	R&D/ RESEARCHER	R&D EXPEND. (MIL)	R&D/ RESEARCHER	RESEARCHERS
1971	342.2	5,584	61,282	37.4	61,282	610
1972	364.8	5,639	64,692	41.9	64,692	648
1973	397.1	5,628	70,558	47.1	70,558	668
1974	440.0	5,844	75,291	49.0	75,291	651
1975	466.4	5,638	82,724	55.8	82,724	675
1976	495.0	5,768	85,818	62.0	85,818	722
1977	547.2	5,822	93,988	68.5	93,988	729
1978	606.9	5,866	103,461	73.7	103,461	712

SOURCE: STATISTICS CANADA, 'ANNUAL REVIEW OF SCIENCE STATISTICS, 1978', (13-212); 'FEDERAL GOVERNMENT EXPENDITURES ON SCIENCE', 1970 TO 1975, (13-202); AND MOSSY, 'FEDERAL SCIENCE EXPENDITURES AND PERSONNEL', 1976 TO 1978.

NOTE: PROVINCIAL R&D PERSONNEL WAS ESTIMATED BASED ON THE VALUE OF R&D PER RESEARCHER IN THE FEDERAL SECTOR AND PROVINCIAL R&D EXPENDITURES.

