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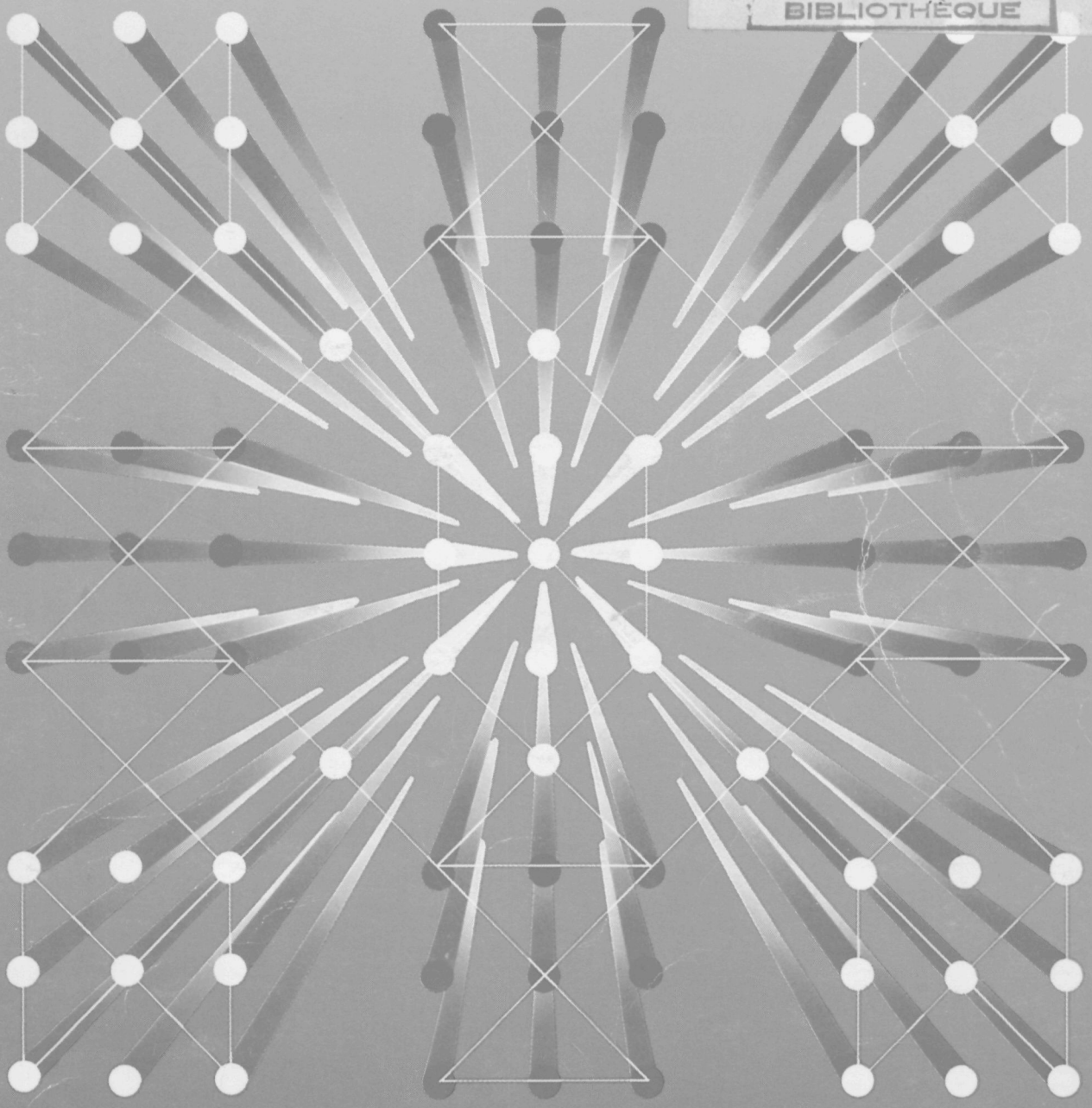

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Symbols

The following standard symbols are used in Statistics Canada publications:

. .	figures not available.
. . .	figures not appropriate or not applicable.
–	nil or zero.
- -	amount too small to be expressed.
p	preliminary figures.
r	revised figures.
x	confidential to meet secrecy requirements of the Statistics Act.
*	data inferior to 4,000 but included in the total.
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NOTE

Some table cells may not sum to the totals shown because of rounding.

Preface

This report describes both the problems involved in creating, analysing and using human resource indicators and the methodology underlying the collection of statistics for these indicators. It is one of a series of background papers on science and technology indicators to be published by Statistics Canada. The purpose of the series is to describe the theoretical development, limitations and application of various statistics suggested as indicators of science and technology.

Science and technology indicators may be defined as statistics that measure quantifiable aspects of the creation, dissemination and application of science and technology. As indicators, they should help describe the science and technology system, providing a better understanding of its structure, how it is affected by policies and programs and how it affects society and the economy.

Current indicators of Canada's scientific and technological activities include:

- expenditures on research and development;
- federal government scientific activities;
- personnel working in science and technology;
- Canadian research output;
- Canadian patented inventions;
- international receipts and payments for technology;
- trade in selected commodities;
- capital investment.

Statistical tabulations of the indicators will be released in **Science and Technology Indicators**, Catalogue No. 88-201, an annual summary; **Industrial Research and Development Statistics**, Catalogue No. 88-202 (Annual); **Resources for Research and Development in Canada**, Catalogue No. 88-203 (Annual); **Federal Scientific Activities**, Catalogue No. 88-204 (Annual); and a monthly service bulletin, **Science Statistics**, Catalogue No. 88-001.

This study of human resources in science and technology was prepared by Louis Marc Ducharme, an analyst in the Science, Technology and Capital Stock Division.

Ivan P. Fellegi
Chief Statistician of Canada

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Introduction

> "Industrialized countries will survive world disorder only by creating, based on the current technological revolution (information, micro-processing, robotics, biotechnology and its applications), the employment of the future. **Creation of those jobs rests on the education and training of human resources...**" (Conclusion from "The Technological Development Research Group of MITI" (Free translation), Japan 1980)

It is now widely accepted that one of the most important resources that a country has is its human capital. Know-how and the supply of highly qualified human resources have become as crucial in industrial policy as technology and the supply of natural resources. The emergence of the new micro-electronic and biological technologies heralds the replacement of energy-intensive technologies by those requiring large amounts of human capital (know-how). In what is often referred to as the third industrial revolution, that of micro-electronics and computers, highly qualified personnel will become the key component of all economic development strategies.

The extent to which this factor will contribute to the growth of Canada's well-being depends primarily on the quality and training of present and future human resources. It therefore seems paramount both to document the current status of human resources and to construct an analytical framework capable of identifying requirements for highly qualified personnel.

In this study, we shall first attempt to describe the problems involved in creating, analysing and using human resource indicators in S&T policy formulation. Then, from a strictly national perspective, we shall go on to discuss the most widely accepted definitions and methods and the sources used. Limitations and avenues of research will be identified wherever possible.

Chapter 1

THE ISSUE

It is important to have information about human resources in science and technology because they are one of the vital components in the formulation of scientific and industrial policies. This category of highly qualified personnel (HQP) incorporates the human "know-how" needed to increase the pool of scientific knowledge and the technical expertise required to foster technological, economic and social change. A shortage of skilled workers in a particular industry can produce bottlenecks in scientific, social and economic development, resulting in lost opportunities for the industry. Conversely, a surplus of specialized personnel in a given field is a sign of misallocated human resources, which places a heavy burden on society. Furthermore, in many industries rapid technological change has made some types of jobs obsolete, resulting in the displacement of workers.

In short, it seems quite clear that data on highly qualified personnel are not simply useful, but necessary to planners in the fields of education, science, technology and industry. An analytical framework for studying the stocks and flows of this type of labour is also essential in order to monitor trends in the supply of and demand for specialized personnel.

The information we gather should help us to determine the importance of scientific personnel in each industry and occupation, explore how this specialized labour market interacts with the market for non-specialized workers, and measure the present and future requirements in each sector and the supply of specialized labour needed to meet those requirements.

To do so, we must first define what is meant by highly qualified personnel. Some analysts use this term to refer exclusively to persons holding a university degree, while others extend it to include community college graduates as well. We have adopted the latter definition, which is more complete because it also encompasses technical personnel without university training, whose numbers are increasing rapidly in some sectors (such as computers and electronics). Then we must ascertain the stocks and flows of this labour pool and construct the labour supply and demand equations that form part of a more comprehensive socio-economic model in which the needs of the economic, technological and industrial subsystems are taken into account. With such a model, it would be possible to examine:

- the career profile of workers in each field of study;
- the adjustment and integration of graduates into the work force in each field;
- the interactions between occupations and fields of study;
- occupational and geographic mobility;
- the effects of this mobility on the various occupational categories;
- supply and demand forecasts for HQP; and
- the impact that the introduction of various technologies will have on employment.

An information source of this type would be an excellent tool for planners since it would enable them to identify industries that are in decline and steer the retraining of workers and the production of new graduates toward more promising sectors.

The collection of this kind of data entails comprehensive documentation of the state of HQP and disaggregation by variables such as age, sex, educational attainment, occupation, citizenship, geographic area and industry. Such detailed information can be obtained only through a census, a postcensal survey or various surveys of public and private institutions to gather data on the relevant characteristics of highly qualified personnel.

Unfortunately, such an analysis cannot be carried out with currently available data. A self-contained project separate from the Science, Technology and Capital Stock Division's indicators program would be needed to analyse the stocks and flows of HQP. We shall therefore confine ourselves to providing a descriptive inventory of the various components of the available statistics on science and technology personnel as a whole.

Chapter 2

SCIENTIFIC AND TECHNOLOGICAL PERSONNEL

Our inventory of human resources in S&T includes not only scientists, engineers, technologists and university and community college teachers, but also the students and graduates of postsecondary institutions, the scientists and technologists of tomorrow. The data on these aspects of HQP come from a variety of sources. Since we do not have a coherence model for the reconciliation of these sources, it is difficult to aggregate all the different elements to obtain the HQP total. Nevertheless, each element reveals various facets of the whole picture of human resources in S&T, thus providing the analyst with necessary (though not sufficient) information for policy-making. In this chapter, we shall attempt to describe all these elements, which we feel, despite their diverse sources, make up the body of what is commonly called highly qualified personnel.

One of the most important categories in the available data on human resources is the scientists, engineers and technologists group (SETs), which must be taken into account in the implementation of scientific and technological development policy. By virtue of their occupations, they conduct today's research and lay the groundwork for the research of the future. It is important, therefore, to have medium- and long-range data on the number of workers both in the natural sciences and engineering (NSE) and the social sciences and humanities (SSH).

To this end, occupations of the Standard Occupational Classification have been organized into NSE and SSH categories, as shown in the table below.

Natural Sciences and Engineering

SOC code	Occupation[1]
211	Physical sciences
213	Life sciences
214/215	Architects and engineers
216	Other occupations in architecture and engineering
218	Mathematics, statistics, systems analysis and related fields
31	Medicine and health

Social Sciences and Humanities

SOC code	Occupation[1]
231	Social sciences
233	Social work and related fields
235	Library, museum and archival sciences
239	Other occupations in social sciences and related fields

[1] The individual occupations within these groups are listed in Appendix II.

To avoid duplication, we have excluded postsecondary teachers from these occupations. They will be considered in the section on postsecondary teachers. The available data on this first segment of HQP, scientific and technological personnel, are taken primarily from two sources: the 1971 and 1981 censuses, and the Labour Force Survey (LFS) for 1982 and subsequent years.(1)

The census data were collected either on a full-coverage basis (from all households) or from a random sample of households. Data collected by the latter method have been weighted to provide estimates for the entire population.(2)

See footnote(s) at the end of text.

The monthly Labour Force Survey covers about 48,000 representative households across the country. "Estimates of employment, unemployment and non-labour force activity refers to the specific week covered by the survey each month, normally the week containing the 15th day. The sample used in the surveys of the labour force has been designed to represent all persons in the population 15 years of age and over residing in Canada, with the exception of the following: residents of the Yukon and Northwest Territories, persons living on Indian reserves, inmates of institutions and full-time members of the armed forces."(3) For a more comprehensive explanation of the methodology used in the LFS, see **Methodology of the Canadian Labour Force Survey**, Statistics Canada Catalogue No. 71-526E.

A comparison of the two sources reveals that there are differences in the quantity and wording of questions and in the level of data collection and disaggregation (the Census has a higher level of disaggregation than the LFS). "The census and the LFS also differ with respect to coverage, methodology and reference period. The census data cover all persons 15 years and over except inmates, whereas the LFS data also exclude residents of the Yukon, the Northwest Territories and Indian Reserves as well as members of the Armed Forces and households living abroad."(4)

Further details on data comparability can be obtained from Appendix B-2 of the **1981 Census Dictionary** (Statistics Canada, Catalogue No. 99-901), **Data Quality - Sample Population** (Statistics Canada, Catalogue No. 99-905) and **A User's Guide to 1976 Census Data on Labour Force Activity** (Statistics Canada, No. 1 - EC 79) by K. Ashagrie.

TABLE 1. Comparison of 1981 Census Data and 1982 Labour Force Survey Estimates for Scientists, Engineers and Technologists, by Occupational Group

Occupational group	1981 Census	LFS average 1982	Difference between 1981 Census and 1982 LFS
	thousands		per cent
Natural Sciences and Engineering	**873**	**907**	4
Physical sciences	38	48	26
Life sciences	26	29	12
Architects and engineers	139	134	-4
Other occupations in architecture and engineering	116	100	-14
Mathematicians, statisticians and systems analysts	66	72	9
Medicine and health	488	523	-7
Social Sciences and Humanities	**129**	**128**	-1
Social sciences	26	25	-4
Social work and related fields	70	65	-7
Library, museum and archival sciences	22	24	9
Other occupations in social sciences and related fields	11	14	27
Total	**1,001**	**1,035**	3

Note: The 1971 Occupational Classification has been used to classify persons in both data bases.
Source: Appendix Table 1.

With respect to data on scientists, engineers and technologists, Table 1 shows that the differences between census data and LFS data vary by occupational group. As shown in Appendix Tables 1, 2, 3 and 4, we cannot be certain of the full comparability of statistics from the two sources, particularly as the statistics are further disaggregated. To avoid these compatibility problems, we have chosen to analyse each source independently. As the time series of LFS data accumulates, more detailed analysis will be possible. The Census provides a snapshot of the situation every five or 10 years and serves as a reference point for the analysis of LFS data.

See footnote(s) at the end of text.

TABLE 2. Scientists, Engineers and Technologists, by Occupational Group: Censuses of 1971 and 1981

Occupational group	1971	1981
	thousands	
Natural Sciences and Engineering	**535**	**873**
Physical sciences	32	38
Life sciences	17	26
Architects and engineers	79	139
Other occupations in architecture and engineering	69	116
Mathematicians, statisticians and systems analysts	26	66
Medicine and health	312	488
Social Sciences and Humanities	**54**	**129**
Social sciences	11	26
Social work and related fields	27	70
Library, museum and archival sciences	10	22
Other occupations in social sciences and related fields	6	11
Total	**589**	**1,001**

Source: Appendix Table 1.

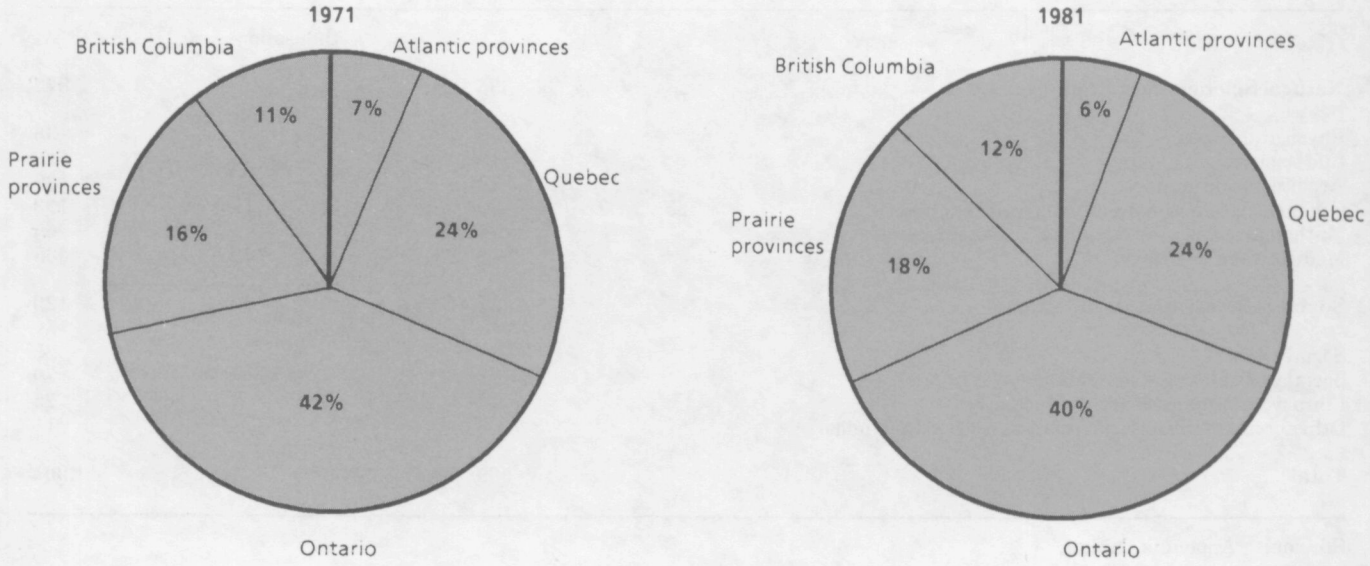
TABLE 3. Scientists, Engineers and Technologists, by Occupational Group: Labour Force Survey Estimates

Occupational group	1982	1983	1984
		thousands	
Natural Sciences and Engineering	**907**	**914**	**931**
Physical sciences	48	47	41
Life sciences	29	29	32
Architects and engineers	134	132	130
Other occupations in architecture and engineering	100	87	85
Mathematicians, statisticians and systems analysts	72	81	99
Medicine and health	523	537	544
Social Sciences and Humanities	**128**	**130**	**132**
Social sciences	25	27	26
Social work and related fields	65	60	66
Library, museum and archival sciences	24	29	27
Other occupations in social sciences and related fields	14	14	13
Total	**1,035**	**1,044**	**1,063**

Source: Appendix Table 1.

Census data and LFS data can be used to produce a geographic distribution of SETs (Figure 1) and a breakdown by industry group. This kind of classification furnishes planners with a picture of the geographic concentration of HQP, enabling them to formulate regional labour policies. For some industries, a distribution by occupational group is also available. This breakdown is especially important for HQP planners as it indicates the degree of concentration of each occupation in a particular industry. This information provides an initial outline of the many facets of the labour supply of HQP. Tables 4, 5 and 6 present examples of Labour Force Survey estimates according to various breakdowns, to illustrate the points made above. The same information can be obtained from the Census (see Appendix Tables 1, 2, 3, 4, 5 and 6).

Figure 1
Distribution of Scientists, Engineers and Technologists by Region



Source: Science, Technology and Capital Stock Division.

TABLE 4. Scientists, Engineers and Technologists, by Region and Occupational Group: Labour Force Survey Estimates, 1984

Occupational group	Atlantic provinces	Quebec	Ontario	Prairie provinces	British Columbia	Canada
			thousands			
Natural Sciences and Engineering	**67**	**230**	**354**	**179**	**101**	**931**
Physical sciences	*	10	15	10	4	41
Life sciences	*	6	13	6	4	32
Architects and engineers	7	27	58	24	14	130
Other occupations in architecture and engineering	7	16	32	20	10	85
Mathematicians, statisticians and systems analysts	*	25	49	15	7	99
Medicine and health	45	146	187	104	62	544
Social Sciences and Humanities	**9**	**33**	**47**	**27**	**16**	**132**
Social sciences	*	8	10	4	*	26
Social work and related fields	4	17	22	14	9	66
Library, museum and archival sciences	*	6	11	5	*	27
Other occupations in social sciences and related fields	*	*	4	4	*	13
Total	**76**	**263**	**401**	**206**	**117**	**1,063**

Source: Appendix Table 2.

TABLE 5. Scientists, Engineers and Technologists, by Occupational Group and Age: Labour Force Survey Estimates, 1984

Occupational group	15-24	25-34	35+	Total
		thousands		
Natural Sciences and Engineering	**130**	**352**	**449**	**931**
Physical sciences	5	16	20	41
Life sciences	4	15	13	32
Architects and engineers	10	46	74	130
Other occupations in architecture and engineering	15	33	37	85
Mathematicians, statisticians and systems analysts	20	49	30	99
Medicine and health	76	193	275	544
Social Sciences and Humanities	**24**	**48**	**60**	**132**
Social sciences	*	11	12	26
Social work and related fields	16	25	25	66
Library, museum and archival sciences	4	7	16	27
Other occupations in social sciences and related fields	*	5	7	13
Total	**154**	**400**	**509**	**1,063**

Source: Appendix Table 3.

TABLE 6. Scientists, Engineers and Technologists in the Services Industry, by Occupational Group: Labour Force Survey Estimates

Occupational group	1981	1983	1984
		thousands	
Natural Sciences and Engineering	**565**	**596**	**611**
Physical sciences	12	11	11
Life sciences	7	7	8
Architects and engineers	42	41	38
Other occupations in architecture and engineering	28	28	27
Mathematicians, statisticians and systems analysts	20	26	32
Medicine and health	457	483	495
Social Sciences and Humanities	**88**	**98**	**97**
Social sciences	12	14	15
Social work and related fields	50	45	49
Library, museum and archival sciences	17	25	23
Other occupations in social sciences and related fields	9	14	10
Total	**653**	**694**	**708**

Source: Appendix Table 5.

Limitations

The limitations of the data on scientists, engineers and technologists become clear when the constraints due to the LFS sample size are examined more closely. The LFS data, based on a sample of 48,000 representative households, may be different from census data. This difference is attributable to sampling error. Both the Census and LFS are subject to non-sampling error; "Errors which are not related to sampling may occur at almost every phase of a survey operation. Interviewers may misunderstand instructions, respondents may make errors in answering questions, the answers may be incorrectly entered on the questionnaires and errors may be introduced in the processing and tabulations of the data."(5) In addition,

errors can be caused by rounding. To maintain a minimum level of data reliability, estimates lower than 4,000 are not published for LFS data. Also, multiple cross-tabulations cannot be prepared because of the sample size, which narrows the scope of the analysis.

Avenues of Research

Aside from the usual indicators for scientific and technological personnel (by occupation, industry, age group, sex, region and level of education), it would be desirable to have information on items such as:

- the unemployment rate;
- functions of Scientists, Engineers and Technologists (e.g., R&D, administration, production).

It is expected that the data from the 1986 Census will improve the level of detail available for the analysis of personnel in science and technology.

See footnote(s) at the end of text.

Chapter 3

R&D PERSONNEL

R&D personnel make up a large portion of the supply of human resources in science and technology. It is this subgroup of scientists, engineers and technologists that carries out research and development. The data on this group come from surveys conducted by the Science, Technology and Capital Stock Division and are independent of LFS and census data. In the Division's surveys of R&D, personnel is considered a supplementary measure to intramural R&D expenditures. The Frascati Manual states that "... labour costs normally account for 50%-70% of total R&D expenditures; (personnel) is also a reasonable short-term indicator of efforts devoted to R&D."(6) Data on the number of persons engaged in R&D are essential to realistic science policy planning, since R&D personnel cannot be trained rapidly nor inexpensively.

To obtain these data, personnel must be classified into categories. Two classification systems are currently in use in OECD countries: classification by occupation and classification by level of formal qualification.

The former distinguishes three occupational levels: researchers, technicians and equivalent staff, and other supporting staff (ISCO).(7) The formal qualification categories are university graduates, holders of other postsecondary diplomas and high-school graduates. (They correspond respectively to ISCED(8) level categories 6 and 7, 5 and 3.)

Canada uses primarily the occupational classification, whose levels are defined below:(9)

- **Scientists and engineers** are engaged in the conception or creation of new knowledge, products, processes, methods and systems. This level also includes managers and administrators engaged in the planning and management of the scientific and technical aspects of a researcher's work. They are usually equal in rank to the researchers and are often former or part-time researchers themselves.

- **Technicians** participate in R&D projects by performing tasks normally under the supervision of scientists and engineers or researchers in the social sciences and humanities. These tasks might include, for example, preparing computer programs, carrying out tests and experiments or statistical surveys and interviews.

- **Other supporting staff** are skilled and unskilled craftsmen, secretarial and clerical staff participating in R&D projects or directly associated with such projects. Those providing an indirect service, such as canteen and cleaning staff, are excluded.

Since these workers do not all spend the same amount of time on R&D, it is necessary to express the effort in terms of full-time equivalents (FTE) or person-years. If only those persons employed in R&D are counted, the number of R&D personnel will be understated, just as counting every person who spends some time on R&D will result in an overstatement. On a full-time equivalent basis, then, a person devoting a third of his or her time on R&D will be counted as 0.3 of a person-year.

In addition to the three occupational levels, R&D personnel are classified according to the sector of the institutions that employ them:

- federal government;
- provincial government;
- business enterprise;
- higher education;
- private non-profit organizations.

See footnote(s) at the end of text.

Wherever possible, they are also classified by field: natural sciences and engineering (NSE) or social sciences and humanities (SSH). More information about R&D personnel is contained in the working paper "Estimates of Research and Development Personnel, 1975-1984".

TABLE 7. Persons Engaged in R&D in the Natural Sciences and Engineering, by Sector and Category, 1983-1984

Sector	Scientists and engineers	Technicians	Other support staff	Total
		full-time equivalent (rounded)		
Federal government	6,510	4,860	5,390	16,760
Provincial government	1,330	1,110	860	3,300
Business enterprise	19,480	12,630	7,230	39,340
Higher education	4,580	1,650	1,810	8,040
Private non-profit organizations	620	880	350	1,850
Total	**32,520**	**21,130**	**15,640**	**69,290**

Source: Statistics Canada, Science, Technology and Capital Stock Division.

(1) Federal Government

This sector comprises the permanent, temporary and casual employees of all federal departments and ministries of state and the public and semipublic agencies listed in Table 2, Appendix II. The data on federal government R&D personnel were taken both from a questionnaire called the **Main Estimates Science Addendum (MESA)** and from information included in the annual Main Estimates.(10) All departments and agencies engaged in scientific and technological activities are required to complete a MESA, reporting the funds and personnel assigned to those activities during the three-year period covered by the Estimates.

TABLE 8. Persons Engaged in R&D in the Federal Government, by Category

Occupation	1976[1]	1977	1978	1979	1980	1981	1982	1983	1984
				full-time equivalent (rounded to the nearest 10)					
Natural Sciences and Engineering	**15,510**	**15,380**	**15,580**	**15,320**	**15,270**	**15,750**	**16,410**	**16,580**	**16,760**
Scientists and engineers	5,620	5,650	5,870	5,790	5,800	5,890	6,310	6,400	6,510
Technicians	4,910	4,860	4,760	4,680	4,680	4,870	4,830	4,680	4,860
Other supporting staff	4,980	4,870	4,930	4,850	4,790	4,990	5,270	5,500	5,390
Social Sciences and Humanities	**1,410**	**1,090**	**1,020**	**930**	**820**	**840**	**760**	**640**	**650**
Scientists	930	700	630	560	480	510	480	410	420
Support staff[2]	480	390	390	370	340	330	280	230	230
Total	**16,920**	**16,470**	**16,580**	**16,250**	**16,090**	**16,590**	**17,170**	**17,220**	**17,410**

[1] 1976 = the 1976-77 fiscal year, and so on.
[2] Includes technical personnel.
Source: Statistics Canada, Science, Technology and Capital Stock Division.

See footnote(s) at the end of text.

In tables 9 and 10, the 1983-84 utilization of federal employees in R&D is presented. Some indication of the wide ranging nature of the R&D activity is given by the departmental identification. For example, scientists and engineers in applied agricultural research need more support staff than those in many other research areas.

TABLE 9. Federal Personnel Engaged in R&D in the Natural Sciences and Engineering, by Category and Department, 1983-84

Department	Scientists and engineers	Technicians	Other supporting staff	Total
		person-years		
Agriculture Canada	1,349	1,306	2,072	4,727
Atomic Energy of Canada Ltd.	739	910	835	2,484
Energy, Mines and Resources Canada	913	397	345	1,655
Environment Canada	491	135	242	867
Fisheries and Oceans	621	482	430	1,533
National Defence	665	471	648	1,782
National Research Council Canada	1,260	936	645	2,841
Other	469	227	173	870
Total	**6,507**	**4,863**	**5,390**	**16,759**

Source: Statistics Canada, Science, Technology and Capital Stock Division.

TABLE 10. Federal Personnel Engaged in R&D in the Social Sciences and Humanities, by Category and Department, 1983-84

Department	Scientists	Support staff	Total
		person-years	
Canada Mortgage and Housing Corporation	21	13	34
Canadian Transport Commission	21	13	34
Consumer and Corporate Affairs Canada	26	9	35
Economic Council of Canada	68	45	113
Law Reform Commission of Canada	2	5	7
National Museums of Canada	60	–	60
Secretary of State	45	5	50
Statistics Canada	95	59	154
Other	85	82	167
Total	**423**	**231**	**653**

Source: Statistics Canada, Science, Technology and Capital Stock Division.

Limitations

Since the survey of federal government departments and agencies forms part of the budgetary system, coverage is complete. Nevertheless, some employees in management positions may not be directly involved in planning and managing the scientific aspects of projects, but instead may deal primarily with administrative matters. On the basis of the definitions given in the Frascati Manual, these workers should be classified as "other supporting staff" and not "scientists and engineers". Experience has shown, however, that most employees reported in the Management Category are engaged in activities directly connected with R&D and that misclassifications are minimal. It is, however, intrinsically difficult to estimate the time spent on R&D by persons for whom it is a part-time occupation. Another limitation is the lack of information about the persons considered to be engaged in R&D (e.g., age, background, other functions).

(2) Provincial Governments

The second group of R&D personnel is employed in the provincial government sector, which consists of all provincial government departments, ministries and agencies and provincial research organizations.

Government Departments and Agencies

Each year, the Science, Technology and Capital Stock Division surveys the governments of seven provinces: British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, New Brunswick and Newfoundland. Since 1983, Quebec has conducted its own survey of provincial government science activities. For the two remaining provinces, R&D personnel figures are estimated on the basis of expenditure/person ratios applied to R&D spending estimates taken from the estimates, public accounts and departmental annual reports tabled in the provincial legislatures. This procedure is described in greater detail below.

1. R&D expenditures and personnel data, obtained in the Science, Technology and Capital Stock Division's surveys of provincial governments, are used to compute an expenditure-per-person (full-time equivalent (FTE)) ratio for both NSE and SSH.

$$\text{Expenditure-per-person ratio (FTE)} = \frac{\text{Sum of R\&D expenditures for the surveyed provinces}}{\text{Total R\&D personnel for the surveyed provinces}}$$

2. R&D expenditures for the unsurveyed provinces are divided by this ratio to provide the total R&D personnel.

$$\text{Total R\&D personnel (FTE)} = \frac{\text{Sum of R\&D expenditures for unsurveyed provinces}}{\text{Expenditure-per-person ratio}}$$

3. The ratios for the three occupational levels (scientists and engineers, technicians and other support staff), estimated from the data provided by the surveyed provinces, are applied to the total R&D personnel estimated for the other.

Provincial Research Organizations

Data on the R&D personnel of provincial research organizations are estimated on the basis of an annual survey of the resources of the eight provincial foundations and councils. The estimation procedure is described below.

R&D is only one of the activities of these provincial research organizations. In surveys conducted by the Science, Technology and Capital Stock Division, they are asked to specify the nature of their activities and break down their expenditures accordingly. The ratio of R&D expenditures to total expenditures is applied to total personnel to produce an estimate of R&D personnel. Since the three occupational categories are already specified in the survey,(11) there is no need to calculate this breakdown.

See footnote(s) at the end of text.

TABLE 11. Persons Engaged in R&D in the Provincial Government Sector, by Category

Occupation	1976[1]	1977	1978	1979	1980	1981	1982	1983	1984
	full-time equivalent (rounded to the nearest 10)								
Natural Sciences and Engineering	**2,470**	**2,660**	**2,740**	**2,950**	**3,100**	**3,060**	**3,500**	**3,350**	**3,300**
Government departments	1,740	1,910	1,950	2,100	2,120	2,070	2,610	2,390	2,300
Scientists and engineers	740	840	840	870	820	830	1,010	930	890
Technicians	620	630	610	700	780	740	940	820	770
Other supporting staff	380	440	500	530	520	500	560	640	640
Provincial research organizations	730	750	790	850	980	990	990	960	1,000
Scientists and engineers	300	310	310	340	390	400	410	410	440
Technicians	240	250	290	300	350	360	340	320	340
Other supporting staff	190	190	190	210	240	230	240	230	220
Social Sciences and Humanities	**530**	**510**	**470**	**500**	**570**	**600**	**660**	**790**	**670**
Departments only	530	510	470	500	570	600	660	790	670
Total	**3,000**	**3,170**	**3,210**	**3,450**	**3,670**	**3,660**	**4,160**	**4,410**	**3,970**

[1] 1976 = the 1976-77 fiscal year, and so on.
Source: Statistics Canada, Science, Technology and Capital Stock Division.

Limitations

In the absence of a full survey of all provinces, it seems reasonable to assume that provinces not covered by the survey have an expenditure/personnel ratio similar to that of the others. Obviously this estimate will contain errors, since not every province actually has the same ratio. In small organizations, for example, personnel perform both administrative and R&D duties, which makes it difficult to separate the two activities.

Because some of the data on R&D personnel in provincial governments are estimates, it is recommended that they be used with caution. As the provinces expand their science and technology programs, there will probably be a growing need for surveys, which will make it possible to obtain more accurate data and to disaggregate them by region, as is now done with expenditures. In addition, the data have the limitations noted above for the Federal Government.

(3) Business Enterprise

For the purposes of the Science, Technology and Capital Stock Division, the term "business enterprise" includes all private or public enterprises, industrial research institutes and professional associations. The list of respondents for the annual survey was taken from the files of previous surveys, the lists of other government departments and agencies, and newspaper and magazine articles.

The reporting unit of the survey of business enterprises conducting R&D is normally the company or enterprise. For companies whose research arms are in different locations, the reporting unit may be the division, provided the accounting system contains the required data. The larger performers and funders receive 'long forms', covering four years, and the firms with smaller programs receive 'short forms', covering only one year.(12)

See footnote(s) at the end of text.

Until 1981, complete personnel data for firms performing R&D were collected only in odd-numbered years (only major R&D performers were sampled in even-numbered years). Estimates for 1976, 1978 and 1980 were computed by averaging the figures for 1975 and 1977, 1977 and 1979, and 1979 and 1981 respectively. Since 1982, however, all performers, regardless of size, have been surveyed annually. Note that the data are for NSE occupations only. For further information, see **Industrial Research and Development Statistics,** Statistics Canada, Catalogue No. 88-202.

TABLE 12. Persons Engaged in R&D in the Business Enterprise Sector

Occupation	1976	1977	1978	1979	1980	1981	1982	1983	1984
	full-time equivalent (rounded to the nearest 10)								
Scientists and engineers	9,020	9,720	10,520	11,310	13,090	14,870	16,790	17,590	19,480
Technicians	6,910	7,230	7,570	7,910	9,450	11,000	11,550	11,480	12,630
Other supporting staff	4,800	4,640	5,150	5,650	6,080	6,510	6,510	7,470	7,230
Total	**20,730**	**21,590**	**23,240**	**24,870**	**28,620**	**32,380**	**34,850**	**36,540**	**39,340**

Source: Science, Technology and Capital Stock Division.

The survey also provides a breakdown by industry that includes all sectors except those in which little or no R&D is performed – agriculture, forestry, fishing and trapping, trade, finance, insurance and real estate, community and personal services and most business services. The distribution of the three occupational categories by industry is shown in Table 13.

In addition, the scientists and engineers engaged in R&D may be classified by level of degree, a valuable aid for analysis and planning. This breakdown by level of degree is presented in Appendix Table 9.

TABLE 13. Number of Persons Engaged in R&D in the Business Enterprise Sector, by Industry and by Category, 1984

Industries	Professionals	Technicians	Other	Total
		person-years (rounded to nearest 5)		
Mining and oil wells				
Mining	335	325	110	765
Crude petroleum and natural gas	250	105	95	445
Total mining and oil wells	**585**	**430**	**205**	**1,220**
Manufacturing				
Food, beverages and tobacco	610	450	225	1,285
Rubber and plastic products	145	120	60	325
Textiles	80	45	80	205
Wood	145	70	60	275
Pulp and paper	395	385	175	955
Primary metals (ferrous)	170	90	60	320
Primary metals (non-ferrous)	445	575	235	1,255
Metal fabrication	190	175	70	435
Machinery	395	455	380	1,230
Aircraft and parts	1,475	1,130	930	3,535
Other transportation equipment	615	445	310	1,375
Telecommunication equipment	3,150	1,300	1,685	6,135
Electronic parts and components	500	270	140	915
Other electronic equipment	1,210	775	265	2,245
Business machines	1,250	595	285	2,125
Other electrical products	575	525	125	1,225
Non-metallic mineral products	85	100	25	215
Refined petroleum and coal products	625	525	210	1,365
Drugs and medicines	360	135	180	675
Other chemical products	1,170	705	230	2,105
Scientific and professional equipment	290	215	60	565
Other manufacturing industries	175	135	70	375
Total manufacturing	**14,050**	**9,220**	**5,870**	**29,140**
Services				
Transportation and other utilities	1,295	520	215	2,030
Electrical power	645	555	255	1,455
Computer services	825	340	230	1,395
Engineering and scientific services	1,530	1,145	355	3,025
Other non-manufacturing industries	550	425	100	1,075
Total services	**4,845**	**2,980**	**1,155**	**8,980**
Total all industries	**19,480**	**12,630**	**7,230**	**39,340**

Source: Statistics Canada, Science, Technology and Capital Stock Division.

The regional distribution of data on R&D personnel, as illustrated by Appendix Tables 10 and 11, is particularly important for analysts as it supplements the indicators of the regional concentration of specialized personnel based on census and LFS data.

Limitations

The major limitation is unquestionably the reliability of the data. As in the provincial government sector, each organization determines the number of staff assigned to R&D. There may be errors in these estimates where staff do both administrative and R&D work, or where R&D is carried out by employees who have other duties (production, testing, quality-control engineers and so on). We adjust for this bias by checking that the labour costs for R&D match the number of persons engaged in R&D. Moreover, since 1982 the annual survey covering all performers has provided much more complete, detailed data, thus eliminating the problem of computing estimates for even-numbered years. Other limitations are due to the lack of related data such as age of personnel engaged in R&D and the specialization of training or education.

(4) Higher Education

This sector includes universities, colleges of technology and other institutions of postsecondary education. Since there are no R&D surveys of this sector, it is necessary to make estimates. The number of persons working in the sector was calculated from census data and then allocated to the NSE and SSH fields and occupational categories (scientists and engineers, technicians and other support staff) using ratios. The final step was to produce R&D full-time equivalents by means of coefficients.

The procedure for estimating R&D personnel in the higher education sector is detailed below.

1. A special tabulation of university and college personnel, broken down by occupation and level of education, was prepared for 1971 and 1981 (see Tables 14 and 15). Part-time teachers are not included in this tabulation.

2. Then the data are separated into NSE and SSH occupations (see Table 16) in accordance with the 1971 Occupational Classification Manual. In cases where it is impossible to distinguish between NSE and SSH, the coefficients for NSE and SSH teachers, derived from the Education, Culture and Tourism Division's survey of teaching staff, are used.

3. The workers in these two fields must then be separated into scientists and engineers, technicians and other support staff. It is assumed that scientists and engineers have at least a university degree and that the other categories do not (see Table 18). The result is the distribution shown in Table 19.

4. From the data given in Table 19, we can calculate ratios for each occupational category (scientists and engineers, technicians and other support staff) in each field (NSE and SSH). The coefficients are shown in Table 20.

TABLE 14. Persons Employed in Universities and Colleges, by Occupational Group and Level of Education, Canada, 1971

Occupational group		Less than Grade 9	Grades 9-13	Post-secondary	University graduate	All levels
				number		
211	Physical sciences	30	315	1,280	2,195	3,825
213	Life sciences	130	395	1,285	2,120	3,935
214/215	Architects and engineers	20	50	215	700	985
216	Other occupations in architecture and engineering	30	125	700	60	915
218	Mathematicians and systems analysts	–	165	605	1,025	1,805
31	Medicine and health	55	430	1,010	1,235	2,730
235	Library, museum and archival sciences	25	215	445	1,250	1,935
231/233/ 234/239	Social sciences and related fields	5	50	230	1,065	1,350
2792	Fine arts teachers	5	40	95	205	340
83	Machining and related occupations	35	135	165	10	350
81/82	Processing	60	95	40	10	200
75	Forestry and logging	5	5	5	5	20
71	Farming, horticulture and animal husbandry	445	315	465	110	1,335
1131	Management occupations, natural sciences and engineering	–	5	5	30	40
1132	Management occupations, social sciences and related fields	–	–	–	10	15
	University and other teachers[1]	60	420	1,595	25,555	27,630
	Other occupations[2]	1,515	10,330	10,290	7,370	29,500

[1] Includes groups 2711, 2719, 2733, 2791, 2793, 2795, 2797 and 2799.
[2] Includes groups 1130, 1133, 1134, 1135, 1136, 411, 413, 414, 416, 85, 87, 91, 95 and 991.
Source: Statistics Canada, Labour and Household Surveys Analysis Division.

TABLE 15. Persons Employed in Universities and Colleges, by Occupational Group and Level of Education, Canada, 1981

Occupational group		Less than Grade 9	Grades 9-13	Post-secondary	University graduate	All levels
				number		
211	Physical sciences	30	85	835	1,965	2,915
213	Life sciences	15	90	775	1,960	2,840
214/215	Architects and engineers	5	35	330	745	1,115
216	Other occupations in architecture and engineering	10	85	1,140	235	1,470
218	Mathematicians and systems analysts	–	85	990	1,650	2,725
31	Medicine and health	65	295	1,765	2,710	4,835
235	Library, museum and archival sciences	–	185	990	2,385	3,560
231/233/ 234/239	Social sciences and related fields	–	70	355	1,950	2,375
2792	Fine arts teachers	–	30	205	340	575
83	Machining and related occupations	5	25	320	–	350
81/82	Processing	35	95	170	25	325
75	Forestry and logging	10	10	20	–	40
71	Farming, horticulture and animal husbandry	185	320	545	120	1,170
1131	Management occupations, natural sciences and engineering	5	20	25	135	185
1132	Management occupations, social sciences and related fields	–	5	20	160	185
	University and other teachers[1]	125	670	5,220	42,575	48,590
	Other occupations[2]	1,085	9,145	18,960	10,555	39,745

[1] Includes groups 2711, 2719, 2733, 2791, 2793, 2795, 2797 and 2799.
[2] Includes groups 1130, 1133, 1134, 1135, 1136, 411, 413, 414, 416, 85, 87, 91, 95 and 991.
Source: Statistics Canada, Labour and Household Surveys Analysis Division.

TABLE 16. Allocation of Occupational Groups to Natural Sciences and Engineering and Social Sciences and Humanities Fields

Natural Sciences and Engineering

- 211 Physical sciences
- 213 Life sciences
- 214/215 Architects and engineers
- 216 Other occupations in architecture and engineering
- 218 Mathematicians and systems analysts
- 31 Medicine and health
- 1131 Management occupations, natural sciences and engineering
- 71 Farming, horticulture and animal husbandry
- 75 Forestry and logging
- 81/82 Processing
- 83 Machining and related occupations

- A1 = (University and other teachers)[1] X a_1 where a_1 is the NSE coefficient based on teaching staff data (see table 17).

- A2 = (Other occupations)[2] X a_1 where a_1 is the NSE coefficient based on teaching staff data (see table 17).

Social Sciences and Humanities

- 231 Social sciences
- 233 Social work and related fields
- 234 Law and jurisprudence
- 235 Library, museum and archival sciences (excluding university graduates)
- 239 Other occupations in social sciences and related fields
- 2792 Fine arts teachers
- 1132 Management occupations, social sciences and related fields
- B1 = (University and other teachers)[1] X a_2 where a_2 is the SSH coefficient based on teaching staff data (see table 17).

- B2 = (Other occupations)[2] X a_2 where a_2 is the SSH coefficient based on teaching staff data (see table 17).

1 Includes groups 2711, 2719, 2733, 2791, 2793, 2795, 2797 and 2799.
2 Includes groups 1130, 1133, 1134, 1135, 1136, 411, 413, 414, 416, 85, 87, 91, 95 and 991.
Source: Statistics Canada, Science, Technology and Capital Stock Division.

TABLE 17. Coefficients for NSE and SSH Teachers

	Coefficient	1971	1981
a_1 =	NSE Teachers / Total Teachers	0.41	0.43
a_2 =	SSH Teachers / Total Teachers	0.57	0.55

Note: The coefficients do not add up to 1 because of the unclassified teachers.
Source: Statistics Canada, Education, Culture & Tourism Division.

TABLE 18. Distribution of Persons Employed in Universities and Colleges, by Occupational Category and Level of Education

Category	Standard Occupational Classification		Level of education	Name of variable
	Scientists and engineers (S)			
NSE	• 211	Physical sciences	University	
	• 213	Life sciences		
	• 214/215	Architects and engineers		
	• 216	Other occupations in architecture and engineering		= S(NSE)
	• 218	Mathematicians and systems analysts		
	• 31	Medicine and health		
	• A1	University and other teachers		
SSH	• 231	Social sciences	University	
	• 233	Social work and related fields		
	• 234	Law and jurisprudence		
	• 239	Other occupations in social sciences and related fields		= S(SSH)
	• 2792	Fine arts teachers		
	• B1	University and other teachers		
	Technicians (T)			
NSE	• 211	Physical sciences	All levels except university	
	• 213	Life sciences		
	• 214/215	Architects and engineers		
	• 216	Other occupations in architecture and engineering		= T(NSE)
	• 218	Mathematicians and systems analysts		
	• 31	Medicine and health		
SSH	• 231	Social sciences	All levels except university	
	• 233	Social work and related fields		
	• 234	Law and jurisprudence		
	• 235	Library, museum and archival sciences		= T(SSH)
	• 239	Other occupations in social sciences and related fields		
	Other support staff (O)			
NSE	• A1	University and other teachers	All levels except university	
	• A2	Other occupations	All levels	
	• 1131	Management occupations, natural sciences and engineering		= O(NSE)
	• 71	Farming, horticulture and animal husbandry		
	• 75	Forestry and logging		
	• 81/82	Processing		
	• 83	Machining and related occupations		
SSH	• B1	University and other teachers	All levels except university	
	• 2792	Fine arts teachers		= O(SSH)
	• B2	Other occupations	All levels	
	• 1132	Management occupations, social sciences and related fields		

TABLE 19. Estimated Number of Personnel Employed in Universities and Colleges, by Category and Field of Science

Category and field of science	1971	1981
Scientists and engineers (S)		
Natural Sciences and Engineering	17,810	27,570
Social Sciences and Humanities	15,835	25,705
Technicians (T)		
Natural Sciences and Engineering	6,860	6,635
Social Sciences and Humanities	970	1,600
Other support staff (O)		
Natural Sciences and Engineering	14,865	21,745
Social Sciences and Humanities	18,145	25,590

TABLE 20. Occupational Coefficients by Category and Field

Category	Natural Sciences and Engineering		Social Sciences and Humanities	
	1971	1981	1971	1981
Scientists and engineers	1.00	1.00	1.00	1.00
Technicians	0.39	0.24	0.06	0.06
Other support staff	0.84	0.79	1.15	0.99

5. Having obtained the ratios for 1971 and 1981, the ratios for the intervening years are estimated. For lack of a better method, the average change for each variable over the decade is computed, added to the 1971 value to obtain the 1972 value, added again to this value to obtain the 1973 value and so on up to 1981. Since there are no data for the years after 1981, it is assumed, in order to avoid a simple linear projection, that the ratios for those years are the same as the 1981 value.

For example:

$$\text{Average change} = \frac{T(NSE)_{1981} - T(NSE)_{1971}}{(1981 - 1971)}$$

$$T(NSE)_{1972} = T(NSE)_{1971} + (\text{average change})$$
$$T(NSE)_{1973} = T(NSE)_{1972} + (\text{average change})$$

•
•
•

We thus obtain the estimated coefficients shown in Table 21 below.

TABLE 21. Occupational Coefficients, by Category and Field

Year	Natural Sciences and Engineering			Social Sciences and Humanities		
	Scientists and engineers	Technicians	Other support staff	Scientists and engineers	Technicians	Other support staff
1971	1.00	0.39	0.84	1.00	0.06	1.15
1972	1.00	0.38	0.84	1.00	0.06	1.13
1973	1.00	0.36	0.83	1.00	0.06	1.12
1974	1.00	0.35	0.83	1.00	0.06	1.10
1975	1.00	0.34	0.82	1.00	0.06	1.08
1976	1.00	0.32	0.82	1.00	0.06	1.07
1977	1.00	0.31	0.81	1.00	0.06	1.05
1978	1.00	0.29	0.81	1.00	0.06	1.04
1979	1.00	0.28	0.80	1.00	0.06	1.02
1980	1.00	0.26	0.80	1.00	0.06	1.01
1981	1.00	0.24	0.79	1.00	0.06	0.99
1982	1.00	0.24	0.79	1.00	0.06	0.99
1983	1.00	0.24	0.79	1.00	0.06	0.99
1984	1.00	0.24	0.79	1.00	0.06	0.99

6. To estimate total R&D personnel in the higher education sector, the ratios given in Table 21 are multiplied by the total number of full-time teachers based on the Education, Culture and Tourism Division's survey (Table 22). As university personnel are involved in other activities besides R&D, the values so obtained must be multiplied by the R&D full-time equivalent coefficients listed in Table 23. Since we have no accurate measurements of these coefficients, we have assigned arbitrary values to them. This may change if and when more accurate information on R&D activities in this sector becomes available.

TABLE 22. Full-time University Teachers, by Field

Field	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
	number									
Natural Sciences and Engineering	12,946	13,330	13,491	13,677	13,879	14,287	14,381	14,637	14,784	15,261
Social Sciences and Humanities	17,636	17,995	18,373	18,592	18,481	18,582	18,646	18,801	18,989	19,115

Source: Statistics Canada, **Teachers in Universities**, Catalogue No. 81-241.

TABLE 23. R&D Full-time Equivalent Coefficients by Occupational Category and Field

Field	Scientists and engineers	Technicians	Other support staff
Natural Sciences and Engineering	0.30	0.45	0.15
Social Sciences and Humanities	0.20	0.30	0.10

The results of this estimation process are presented in Table 24. Since the distinction between technicians and other support staff is unclear in the SSH, these two categories have been combined for publication.

TABLE 24. Persons Engaged in R&D in the Higher Education Sector, by Occupational Category

Category	1975[1]	1976	1977	1978	1979	1980	1981	1982	1983	1984
					full-time equivalent – rounded					
Natural Sciences and Engineering										
Scientists and engineers	3,880	4,000	4,050	4,100	4,160	4,290	4,310	4,390	4,440	4,580
Technicians	1,980	1,920	1,880	1,790	1,750	1,670	1,550	1,580	1,590	1,650
Other support staff	1,590	1,640	1,660	1,660	1,710	1,720	1,720	1,730	1,750	1,810
Sub-total	**7,450**	**7,560**	**7,590**	**7,550**	**7,620**	**7,680**	**7,580**	**7,700**	**7,740**	**8,040**
Social Sciences and Humanities										
Scientists	3,530	3,600	3,670	3,720	3,700	3,720	3,730	3,760	3,800	3,820
Support staff[2]	2,220	2,250	2,260	2,210	2,210	2,210	2,180	2,220	2,220	2,240
Sub-total	**5,550**	**5,850**	**5,930**	**5,930**	**5,910**	**5,930**	**5,910**	**5,960**	**6,020**	**6,060**
Total	**13,190**	**13,390**	**13,520**	**13,480**	**13,530**	**13,610**	**13,490**	**13,660**	**13,760**	**14,100**

1 1975 = the 1975-76 academic year, and so on.
2 Includes technical personnel.

Limitations

The use of large-scale estimates naturally creates data reliability problems. For this sector, it is very difficult to determine what might be the error associated with these estimates. We therefore urge extreme caution in the interpretation of these statistics. Nevertheless, in the absence of more reliable data, these estimates provide us with a general idea of the situation in this sector, given certain assumptions.

(5) Private Non-profit Organizations

This sector comprises private and semipublic organizations and entities for which profit-making is not a primary goal. It includes institutions whose principal sources of funds are fees, donations from members or the public, or grants from government and business.(13) They may also earn revenue from the sale of products, services or publications. On the other hand, "it excludes private non-profit organizations which are largely funded and controlled by government (e.g., Canada Council) or by business enterprises (e.g., Pulp and Paper Research Institute of Canada)".(14)

There are four types of organizations in this sector:

- private philanthropic foundations;
- voluntary health organizations;
- associations and societies; and
- research institutes.

See footnote(s) at the end of text.

Since 1983, the Science, Technology and Capital Stock Division has been collecting personnel data through its survey of R&D by private non-profit organizations in Canada. In this survey, respondents are asked to estimate the number of employees engaged in R&D by occupational category (scientists and engineers, technicians and technologists and other supporting staff).

Estimates for R&D personnel in these organizations for the years prior to 1983 were made by the procedure described below.

1. First, for 1983 and subsequent years, the full-time-equivalent number of R&D personnel was calculated using the data given in Table 25, with the following assumptions for full-time equivalents:

   - one hundred per cent of full-time staff engaged primarily in R&D (Table 25, Column 1);
   - fifty per cent of full-time staff engaged part-time in R&D (Table 25, Column 2); and
   - fifty per cent of part-time staff engaged primarily in R&D (Table 25, Column 3).

TABLE 25. Persons Engaged in R&D, by Occupational Category, 1984

Category	Full-time staff		Part-time staff	Total full-time equivalent (rounded)
	Mainly engaged in R&D	Engaged part-time in R&D	Mainly engaged in R&D	
	number			FTE
Scientists and engineers	465	235	73	770
Technicians and technologists	798	78	80	960
Other	327	12	41	380
Total	**1,590**	**325**	**194**	**2,110**

Source: Statistics Canada, "R&D Expenditures of Private Non-profit Organizations, 1983", **Science Statistics**, Catalogue No. 88-001, Vol. 9, No. 12, 1984.

2. For earlier years, personnel were estimated from the expenditure data. The standard average salary, $36,600 in 1983, was calculated by dividing R&D expenditures by the full-time-equivalent number of persons engaged in R&D.

3. Intramural R&D expenditures in constant 1983 dollars were calculated by applying the implicit price index for the Gross National Expenditure to the R&D expenditures of earlier years.

4. The FTE R&D personnel were estimated for each year by taking the intramural R&D expenditures in constant 1983 dollars and dividing them by the standard average salary.

5. Finally, the data are broken down by category (scientists and engineers, technicians and other support staff) on the basis of proportions found in the 1983 survey: 30% for scientists and engineers, 45% for technicians and 25% for other support staff.

   The results are presented in Table 26.

TABLE 26. Personnel in the Private Non-profit Sector

Category	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
	full-time equivalent – rounded									
Scientists and engineers	240	250	290	340	340	360	400	430	510	620
Technicians	370	380	430	500	510	530	590	650	790	880
Other support staff	200	210	240	280	280	300	330	360	390	350
Total	**810**	**840**	**960**	**1,120**	**1,130**	**1,190**	**1,320**	**1,440**	**1,690**	**1,850**

Source: Statistics Canada, Science, Technology and Capital Stock Division.

Limitations

The limitations of these estimates are obvious and similar to those outlined earlier in this report. Nevertheless, since more accurate figures are not available, they provide an approximation for the sector. With the new survey, data quality will improve as the time series accumulates.

Avenues of Research

R&D personnel are seldom distinguished from their colleagues with similar backgrounds but different functions (the Research Scientist category in the federal goverment may be an exception). In fact, we know very little about the various characteristics of the R&D personnel. The actual full-time equivalent estimates does not provide us with their profile (field of study, level of education, age and gender). Information on those characteristics would allow the evaluation of the supply and probable demand of such researchers.

Perhaps, the most fruitful avenue of research would be a study of the higher education sectors, the key sector for training researchers and the location of most of the basic research activity. In particular, the extent of the use of part-time teachers and researchers in their sector should be investigated.

Chapter 4

POSTSECONDARY TEACHERS

Another important component of highly skilled labour is university and community college teachers. They are the leading producers of international scientific literature and major consumers of scientific and technical goods and services. They also form a class of researchers whose chief aims are to expand and transmit the knowledge and know-how acquired by their predecessors and promote scientific research in its broadest sense. Data relating to them are derived from annual surveys of full-time academic staff in degree-granting institutions and community colleges by Statistics Canada's Education, Culture and Tourism Division.(15) For convenience of analysis, we have separated the data on postsecondary teachers into two levels: university and community college.

Teachers in Universities

The data on university teachers are taken from reports submitted by universities and affiliated colleges in the 10 provinces. These data include "... all academic staff within faculties (colleges, schools, etc.) who are teaching or performing administrative duties. Also included are senior administrative staff, academic staff in teaching hospitals and visiting academic staff".(16) For analytical purposes, the data are broken down by NSE and SSH subject area, as shown in Table 27. The data are also available by province, sex, age, educational attainment, academic rank and citizenship. Some of these breakdowns are presented in the following tables.

TABLE 27. Full-time University Teachers, by Teaching Field

Teaching field	1971	1975	1979	1982
			number	
Natural Sciences and Engineering	**11,171**	**12,946**	**13,874**	**14,637**
Agriculture and biological sciences	1,870	2,281	2,315	2,406
Engineering and applied sciences	2,050	2,283	2,462	2,544
Health sciences	3,348	4,175	4,791	5,251
Mathematics and physical sciences	3,903	4,209	4,306	4,436
Social Sciences and Humanities	**15,285**	**17,636**	**18,481**	**18,801**
Social sciences	6,171	7,438	8,132	8,622
Humanities[1]	6,691	6,900	7,181	7,034
Education	2,423	3,298	3,168	3,145
Non classified	**494**	**200**	**447**	**641**
Total	**26,950**	**30,782**	**32,802**	**34,079**

[1] Includes fine and applied arts.
Source: Appendix Table 12.

The distribution of university teachers by sex and province (Table 28) is also significant, because it provides valuable information, to analysts on regional and gender differences. Another combination of relevant characteristics is shown in table 29: age and teaching field. The age structure within a field is an important element for science and educational policy. It also has implications for the research output of the different fields.

See footnote(s) at the end of text.

TABLE 28. Full-time University Teachers, by Province, Sex and Major Teaching Field

Teaching field		Nfld.	P.E.I.	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	B.C.	Canada
							number					
Natural Sciences and Engineering												
1971	Total	245	41	523	330	2,684	4,183	660	525	959	1,021	11,171
	Male	217	35	450	283	2,424	3,795	573	466	849	912	10,004
	Female	28	6	73	47	260	388	87	59	110	109	1,167
1975	Total	311	38	647	362	3,088	4,897	714	663	1,083	1,143	12,946
	Male	281	31	546	315	2,782	4,363	624	590	963	991	11,486
	Female	30	7	101	47	306	534	90	73	120	152	1,460
1979	Total	395	38	699	354	3,288	5,276	687	692	1,179	1,266	13,874
	Male	342	32	579	298	2,943	4,677	588	618	1,033	1,081	12,191
	Female	53	6	120	56	345	599	99	74	146	185	1,683
1982	Total	415	38	741	385	3,492	5,522	704	723	1,317	1,300	14,637
	Male	362	32	612	323	3,101	4,858	597	642	1,125	1,091	12,743
	Female	53	6	23	62	391	664	107	81	192	209	1,894
Social Sciences and Humanities												
1971	Total	354	84	786	543	3,100	6,139	751	692	1,375	1,461	15,285
	Male	289	72	661	462	2,598	5,293	638	603	1,172	1,225	13,013
	Female	93	12	125	81	502	846	113	89	203	236	2,272
1975	Total	360	83	877	661	3,629	7,313	853	692	1,475	1,693	17,636
	Male	301	77	716	533	3,011	6,196	729	585	1,255	1,405	14,808
	Female	59	6	161	128	618	1,117	124	107	220	288	2,828
1979	Total	410	82	946	731	3,976	7,399	787	762	1,603	1,785	18,481
	Male	329	77	754	601	3,227	6,223	661	640	1,323	1,461	15,296
	Female	81	5	192	130	749	1,176	126	122	280	324	3,185
1982	Total	426	83	951	713	4,214	7,421	795	774	1,649	1,775	18,801
	Male	337	77	715	563	3,385	6,116	677	646	1,347	1,439	15,338
	Female	89	6	35	150	829	1,305	118	128	302	336	3,463

Source: Statistics Canada, Education, Culture and Tourism Division.

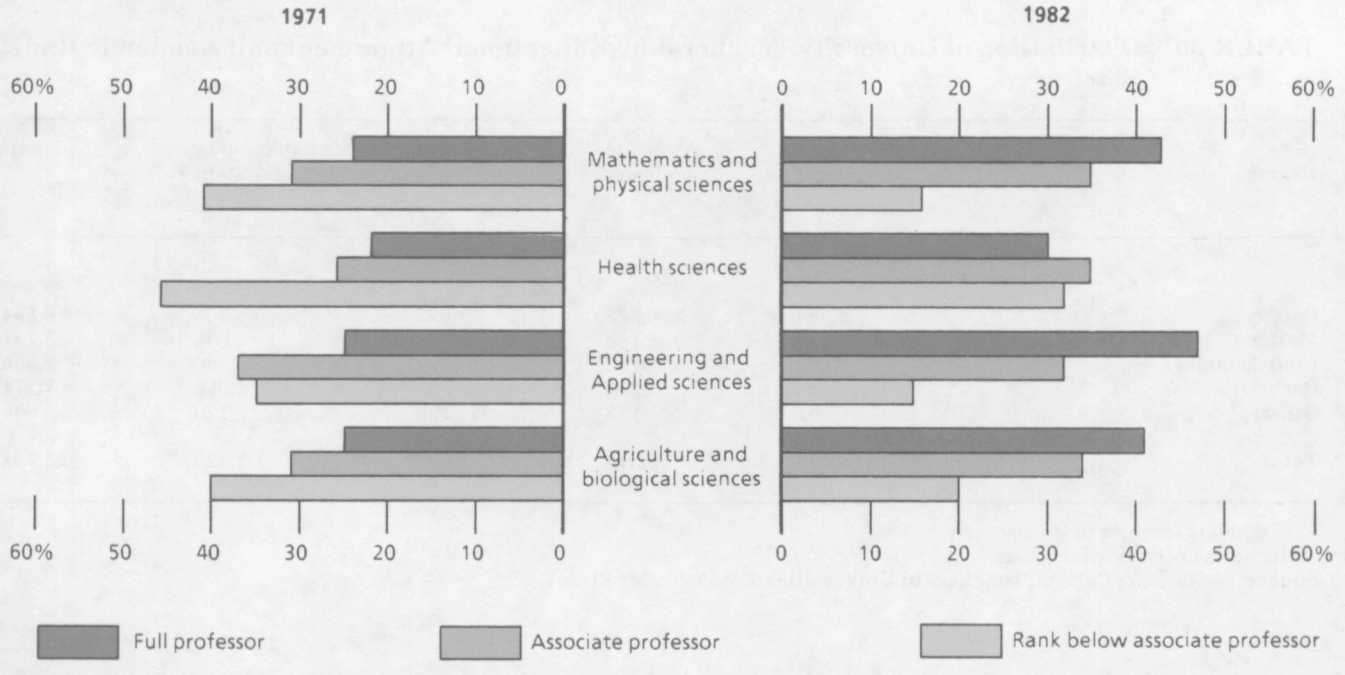
TABLE 29. Median Age of Full-time University Teachers, by Selected Teaching Field

Teaching field	1971	1975	1982	Change (1982-1971)
		median age		years
Natural Sciences and Engineering	**39**	**41**	**45**	**+ 6**
Agriculture and biological sciences	40	41	45	+ 5
Engineering and applied sciences	39	42	46	+ 7
Health sciences	41	42	45	+ 4
Mathematics and physical sciences	38	40	44	+ 6
Social Sciences and Humanities	**38**	**40**	**44**	**+ 6**
Education	40	41	45	+ 5
Humanities[1]	39	42	46	+ 7
Social sciences	37	39	42	+ 5
Total	**39**	**41**	**44**	**+ 5**

[1] Includes fine and applied arts.
Source: Appendix Table 13.

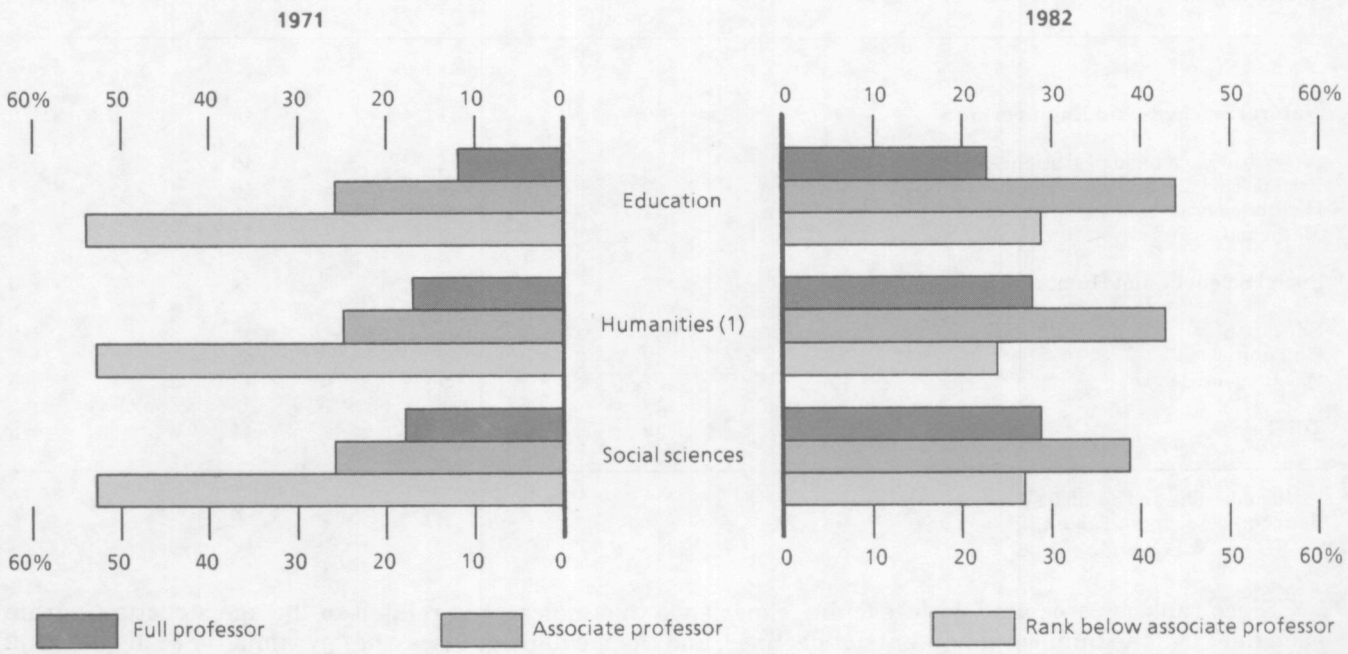
Since rank is associated with teaching experience this indicator is related to the age structure within each field. As the number of new entries declines, and the median age rises, the "pyramid" of academic rank reverses itself. This is the case of the university professors in the Natural Sciences and Engineering (see figure 2). This has implications on present university expenditures as well as future staff movements.

Figure 2
Distribution of Full-time UniversityTeachers in the NSE, by Academic Rank



Source: Science, Technology and Capital Stock Division.

Figure 3
Distribution of Full-time Teachers in the SSH, by Academic Rank



(1) Includes fine and applied arts.
Source: Science, Technology and Capital Stock Division.

A breakdown of educational attainment can be used to measure the degree of specialization. Over 60% of university teachers have doctorates. Examples of distribution of university teachers by field of teaching and other characteristics (citizenship, age and academic rank) are presented in Appendix Tables 13 to 16.

TABLE 30. Distribution of University Teachers[1] by Educational Attainment and Academic Rank, 1982

Degree	Full professor	Associate professor	Assistant professor	Ranks below assistant professor	Total[2]
			number		
Doctorate	6,854	6,671	2,626	105	16,594
Master's	942	1,768	1,626	646	5,731
Professional	639	712	599	86	2,056
Bachelor's	156	291	293	265	1,371
Other	82	133	138	120	598
Total	**8,673**	**9,575**	**5,282**	**1,222**	**25,752**

1 Excluding teachers in Quebec.
2 Includes unclassified teachers.
Source: Statistics Canada, **Teachers in Universities**, Catalogue No. 81-241.

Community College Teachers

Community college is "a generic term for any public or private non-degree granting institution which provides postsecondary university transfer programs and/or semi-professional career programs, secondary level academic upgrading and vocational courses (the latter usually designated as 'trades-level') and other credit or non-credit educational programs oriented to community needs. Included in this classification are community colleges per se, colleges of applied arts and technology (CAATs) in Ontario, general and vocational colleges (CEGEPs) in Quebec, colleges of agricultural technology, institutes of technology and schools for specialized fields such as paramedical technologies, surveying, forestry and nautical sciences".(17)

Data on community college teachers, except for the Province of Quebec, are collected in an annual survey by the Education, Culture and Tourism Division.

Like university teachers, community college teachers are classified by major field (NSE and SSH). However, the subject areas within the two fields are different from those used for university teaching.

Analysis of community college personnel can be based on almost the same indicators as those used for university teachers (age group, sex and province) except that the former are not classified by academic rank and that the subject areas within the NSE and SSH are different (see Tables 32 and 33).

TABLE 31. Full-time Community College Teachers,[1] by Teaching Field

Teaching field	1976	1978	1980	1982
			number	
Natural Sciences and Engineering				
Agriculture and other primary industries	351	420	447	459
Medical and dental services and technologies	1,924	1,831	1,861	1,881
Natural sciences	585	527	546	571
Mathematics and computer science	326	365	407	514
Engineering trades and technologies	1,299	1,451	1,612	1,714
Electronics/electrical trades and technologies	753	811	843	929
Auto, aircraft and heavy-duty mechanics	734	764	816	932
Construction trades and technologies	484	558	608	669
Processing and manufacturing trades and technologies	130	112	109	103
Social Sciences and Humanities				
Humanities, general academic	1,981	2,145	2,308	2,474
Community and social services and behavioural services	950	1,077	941	972
Fine, applied and performing arts	1,026	1,068	1,152	1,147
Merchandising and sales	50	32	98	86
Personal services	249	281	328	371
Secretarial and business	1,804	1,987	2,108	2,257
Other	2,006	2,177	2,568	2,359
Total	**14,652**	**15,606**	**16,756**	**17,438**

[1] Excluding Quebec, hospital schools of nursing, the Nova Scotia Coast Guard College and unclassified teachers.
Source: Statistics Canada, Education, Culture and Tourism Division.

See footnote(s) at the end of text.

TABLE 32. Full-time Community College Teachers, by Teaching Field and Province, 1982

Teaching field	Nfld.	P.E.I.	N.S.	N.B.	Ont.	Man.	Sask.	Alta.	B.C.	Canada[1]
					number					
Natural Sciences and Engineering										
Agriculture and other primary industries	10	1	5	22	203	4	18	109	87	459
Medical and dental services and technologies	17	2	24	29	1,072	69	158	185	325	1,881
Natural sciences	47	1	31	10	134	18	13	145	172	571
Mathematics and computer science	44	4	60	11	2	35	19	163	176	514
Engineering trades and technologies	56	11	40	58	999	59	44	258	189	1,714
Electronics/electrical trades and technologies	45	7	28	34	363	69	29	233	121	929
Auto, aircraft and heavy-duty mechanics	56	11	19	69	332	63	73	189	120	932
Construction trades and technologies	87	16	46	58	–	41	68	263	90	669
Processing and manufacturing trades and technologies	18	1	7	6	38	4	1	27	–	103
Social Sciences and Humanities										
Humanities, general academic	87	16	89	76	1,125	107	25	301	648	2,474
Community and social services and behavioural services	5	14	14	9	670	13	23	145	79	972
Fine, applied and performing arts	18	8	13	4	700	36	6	200	162	1,147
Merchandising and sales	–	1	5	3	–	11	–	23	43	86
Personal services	38	7	10	28	107	17	18	57	89	371
Secretarial and business	136	34	84	74	1,245	84	59	259	282	2,257
Other	77	6	436	37	859	75	57	380	432	2,359
Total	**741**	**140**	**911**	**528**	**7,849**	**705**	**611**	**2,937**	**3,016**	**17,438**

[1] Excluding Quebec, hospital schools of nursing, the Nova Scotia Coast Guard College and unclassified teachers.
Source: Statistics Canada, Education, Culture and Tourism Division.

TABLE 33. Full-time Community College Teachers,[1] by Teaching Field and Sex, 1982

Teaching field	Male	Female	Total
		per cent	
Natural Sciences and Engineering			
Agriculture and other primary industries	89	11	100
Medical and dental services and technologies	16	84	100
Natural sciences	88	12	100
Mathematics and computer science	87	13	100
Engineering trades and technologies	98	2	100
Electronics/electrical trades and technologies	99	1	100
Auto, aircraft and heavy-duty mechanics	99	1	100
Construction trades and technologies	99	1	100
Processing and manufacturing trades and technologies	83	17	100
Social Sciences and Humanities			
Humanities, general academic	64	37	100
Community and social services and behavioural services	57	43	100
Fine, applied and performing arts	76	25	100
Merchandising and sales	84	16	100
Personal services	72	28	100
Secretarial and business	54	46	100
Other	74	26	100
Total	**70**	**30**	**100**

[1] Excluding Quebec, hospital schools of nursing, the Nova Scotia Coast Guard College and unclassified teachers.
Source: Statistics Canada, Education, Culture and Tourism Division.

Limitations

The data on university teachers are taken from a computerized data base known as the **University and College Academic Staff System (UCASS)**, administered by Statistics Canada's Education, Culture and Tourism Division. This data base contains a complete profile of every full-time university teacher working for a degree-granting institution. Since all such institutions in Canada respond to the survey of academic staff, coverage is complete. This does not rule out the possibility of error during the survey process, however. In fact, the Education, Culture and Tourism Division has undertaken a review of these surveys to identify and solve the problems associated with them.

Unfortunately, these surveys do not cover part-time university teachers. Since more than 11,000 persons reported working as part-time university teachers in the 1981 Census, we must acknowledge that our estimates are incomplete.(18)

According to a study carried out by the Science, Technology and Capital Stock Division,(19) data on part-time teachers are available only from:

- The Association of Canadian Medical Colleges (ACMC), for faculties of medicine only, and;
- The Council of Ontario Universities, which has developed a procedure for estimating the full-time equivalent number of part-time teachers on the basis of salaries. The method has been applied only to major Ontario universities.

Furthermore, to our knowledge, there are no data on part-time teachers disaggregated by teaching field, except for the ACMC data for the health sciences. This lack of data makes it very difficult to produce estimates for all teachers, both full- and part-time. Much work remains to be done in order to obtain better

See footnote(s) at the end of text.

estimates. With regard to data on community college teachers, Quebec data are not fully compatible with those of the other provinces, which causes difficulties in provincial comparisons. However, this problem is in the process of being solved, and by 1988 the Quebec Department of Education may be supplying data compatible with those from the other provinces.

Avenues of Research

With available indicators, it is possible to obtain a fairly detailed picture of the characteristics of full-time postsecondary teachers. However, most teachers spend considerable amounts of time on non-teaching activities. Undoubtedly, the time allocated to different professional activities varies by teaching field, academic rank and type and size of institution, and probably by age. An investigation of teachers' activities, for both full-time and part-time staff, would provide information essential to fully understanding the national teaching system. Research output is another avenue of potentially fruitful investigation, as are the relationships between teachers and non-university institutions.

Chapter 5

POSTSECONDARY STUDENTS AND GRADUATES

The last segment of highly qualified personnel to be examined here consists of postsecondary students and graduates. Like S&T personnel and teachers, this group constitutes a pool of human resources for science and technology. They are also, in essence, the scientists, engineers and technologists of tomorrow. It is therefore paramount for decision-makers to be fully aware of the status of this resource pool so that they can plan and formulate policy in the areas of education, and science and technology.

The data are taken from annual surveys conducted by the Education, Culture and Tourism Division. As in the previous section, universities and community colleges are reviewed separately.

University Students

Postsecondary enrolment data provide information about trends and potential human resources in each field of study. They are broken down by level (undergraduate, master's, and doctorate), province, sex, citizenship, age and type of student (full-time and part-time). Tables 34 through 39 are examples of the kinds of information available.

TABLE 34. Full-time and Part-time Undergraduate and First-professional Degree Students, by Field of Study

Field of study	1972		1975		1980		1983	
	Full-time	Part-time	Full-time	Part-time	Full-time	Part-time	Full-time	Part-time
	number							
Natural Sciences and Engineering	**69,682**	**3,585**	**88,364**	**7,786**	**94,100**	**9,950**	**110,567**	**12,400**
Agriculture and biological sciences	17,516	911	22,489	1,441	19,006	1,810	20,873	2,128
Engineering and applied sciences	20,429	636	30,802	1,863	35,027	2,436	38,599	2,774
Health sciences	17,146	784	21,545	2,918	21,231	2,557	22,440	2,768
Mathematics and physical sciences	14,591	1,254	13,578	1,564	18,836	3,147	28,655	4,730
Social Sciences and Humanities	**106,033**	**24,922**	**153,662**	**71,784**	**145,617**	**56,380**	**180,261**	**61,023**
Education	27,527	9,018	45,118	27,416	34,386	20,056	38,010	16,869
Humanities[1]	28,528	5,523	34,679	11,164	21,454	7,920	37,953	12,552
Social sciences	49,978	10,381	73,865	33,204	89,777	28,404	104,248	31,602
Total[2]	**175,715**	**28,507**	**242,026**	**79,570**	**239,717**	**66,330**	**290,828**	**73,423**

1 Includes fine and applied arts.
2 Excludes unclassified students in general arts and science programs.
Source: Statistics Canada, Education, Culture and Tourism Division.

TABLE 35. Full-time and Part-time Undergraduate Students, by Province and Sex, 1983

Field of study	Nfld.	P.E.I.	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	B.C.	Canada
						number					
Natural Sciences and Engineering											
Total	**2,596**	**131**	**5,556**	**4,201**	**32,608**	**47,725**	**5,368**	**5,991**	**10,033**	**8,758**	**122,967**
Male	**1,612**	**50**	**3,200**	**2,795**	**21,149**	**30,940**	**3,269**	**3,737**	**6,314**	**5,620**	**78,686**
Female	**984**	**81**	**2,356**	**1,406**	**11,459**	**16,785**	**2,099**	**2,254**	**3,719**	**3,138**	**44,281**
Agriculture and biological sciences											
Total	**460**	**97**	**1,439**	**464**	**4,915**	**8,831**	**1,509**	**1,842**	**1,557**	**1,887**	**23,001**
Male	237	30	557	219	2,231	3,688	573	862	649	882	9,928
Female	223	67	882	245	2,684	5,143	936	980	908	1,005	13,073
Engineering and applied sciences											
Total	**576**	**8**	**1,176**	**1,906**	**12,432**	**16,206**	**1,327**	**1,321**	**3,637**	**2,784**	**41,373**
Male	525	3	1,046	1,704	10,870	14,225	1,228	1,209	3,280	2,430	36,520
Female	51	5	130	202	1,562	1,981	99	112	357	354	4,853
Health sciences											
Total	**562**	**-**	**1,402**	**600**	**7,875**	**7,908**	**1,179**	**1,128**	**2,641**	**1,913**	**25,208**
Male	135	-	437	14	2,906	2,548	429	368	765	602	8,204
Female	427	-	965	586	4,969	5,360	750	760	1,876	1,311	17,004
Mathematics and physical sciences											
Total	**998**	**26**	**1,539**	**1,231**	**7,386**	**14,780**	**1,353**	**1,700**	**2,198**	**2,174**	**33,385**
Male	715	17	1,160	858	5,142	10,479	1,039	1,298	1,620	1,706	24,034
Female	283	9	379	373	2,244	4,301	314	402	578	468	9,351
Social Sciences and Humanities											
Total	**3,829**	**1,138**	**10,048**	**7,482**	**65,687**	**94,465**	**11,700**	**12,238**	**17,186**	**17,511**	**241,284**
Male	**1,470**	**515**	**4,784**	**3,327**	**29,920**	**41,022**	**4,902**	**5,114**	**6,910**	**7,587**	**105,551**
Female	**2,359**	**623**	**5,264**	**4,155**	**35,767**	**53,443**	**6,798**	**7,124**	**10,276**	**9,924**	**135,733**
Education											
Total	**1,354**	**226**	**1,239**	**2,221**	**13,907**	**15,291**	**3,400**	**4,838**	**7,377**	**5,026**	**54,879**
Male	309	55	484	706	4,230	5,234	917	9,386	2,223	1,350	16,894
Female	1,045	171	755	1,515	9,677	10,057	2,483	3,452	5,154	3,676	37,985
Humanities[1]											
Total	**752**	**153**	**2,048**	**960**	**14,562**	**21,521**	**2,123**	**2,039**	**2,669**	**3,678**	**50,505**
Male	295	67	841	367	5,564	8,045	786	1,007	1,016	1,412	19,400
Female	457	86	1,207	593	8,998	13,476	1,337	1,032	1,653	2,266	31,105
Social sciences											
Total	**1,723**	**759**	**6,761**	**4,301**	**37,218**	**57,653**	**6,177**	**5,361**	**7,140**	**8,807**	**135,900**
Male	866	393	3,459	2,254	20,126	27,743	3,199	2,721	3,671	4,825	69,257
Female	857	366	3,302	2,047	17,092	29,910	2,978	2,640	3,469	3,982	66,643
Total[2]											
Total	**6,425**	**1,269**	**15,604**	**11,683**	**98,295**	**142,190**	**17,068**	**18,229**	**27,219**	**26,269**	**364,251**
Male	**3,082**	**565**	**7,984**	**6,122**	**51,069**	**71,962**	**8,171**	**8,851**	**13,224**	**13,207**	**184,237**
Female	**3,343**	**704**	**7,620**	**5,561**	**47,226**	**70,228**	**8,897**	**9,378**	**13,995**	**13,062**	**180,014**

1 Includes fine and applied arts.
2 Excludes unclassified students in general arts and science programs.
Source: Statistics Canada, Education, Culture and Tourism Division.

TABLE 36. Full-time and Part-time Master's Degree Students, by Field of Study

Field of study	1972		1975		1980		1983	
	Full-time	Part-time	Full-time	Part-time	Full-time	Part-time	Full-time	Part-time
	number							
Natural Sciences and Engineering	**5,281**	**2,191**	**7,120**	**3,421**	**7,754**	**3,754**	**10,920**	**4,228**
Agriculture and biological sciences	1,052	412	1,611	533	1,898	485	2,241	479
Engineering and applied sciences	1,892	962	2,431	1,626	2,612	2,010	4,162	2,091
Health sciences	599	255	923	324	1,381	469	1,839	680
Mathematics and physical sciences	1,738	562	2,161	933	1,868	790	2,678	978
Social Sciences and Humanities	**11,556**	**10,417**	**16,125**	**15,889**	**16,359**	**18,490**	**19,558**	**19,627**
Education	1,579	3,979	2,472	6,779	2,544	7,679	3,162	7,177
Humanities[1]	3,782	2,515	4,883	2,745	4,151	2,724	5,390	3,100
Social sciences	6,195	3,923	8,769	6,365	9,664	8,087	11,006	9,350
Total[2]	**16,837**	**12,608**	**23,251**	**19,310**	**24,118**	**22,244**	**30,478**	**23,855**

[1] Includes fine and applied arts.
[2] Excludes unclassified students in general arts and science programs.
Source: Statistics Canada, Education, Culture and Tourism Division.

TABLE 37. Full-time and Part-time Master's Degree Students, by Province and Sex, 1983

Field of study	Nfld.	P.E.I.	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	B.C.	Canada
						number					
Natural Sciences and Engineering											
Total	**199**	–	**506**	**350**	**4,631**	**5,691**	**867**	**460**	**1,363**	**1,081**	**15,148**
Male	**136**	–	**358**	**294**	**3,329**	**4,123**	**644**	**366**	**1,008**	**750**	**11,008**
Female	**63**	–	**148**	**56**	**1,302**	**1,568**	**223**	**94**	**355**	**331**	**4,140**
Agriculture and biological sciences											
Total	**51**	–	**111**	**40**	**664**	**910**	**264**	**194**	**211**	**275**	**2,720**
Male	27	–	66	27	386	526	146	139	116	156	1,589
Female	24	–	45	13	278	384	118	55	95	119	1,131
Engineering and applied sciences											
Total	**55**	–	**183**	**216**	**1,927**	**2,367**	**364**	**127**	**610**	**404**	**6,253**
Male	54	–	170	197	1,704	2,119	326	121	527	355	5,573
Female	1	–	13	19	223	248	38	6	83	49	680
Health sciences											
Total	**40**	–	**92**	–	**879**	**1,029**	**103**	**30**	**200**	**146**	**2,519**
Male	12	–	28	–	347	407	49	19	83	36	981
Female	28	–	64	–	532	622	54	11	117	110	1,538
Mathematics and physical sciences											
Total	**53**	–	**120**	**94**	**1,161**	**1,385**	**136**	**109**	**342**	**256**	**3,656**
Male	43	–	94	70	892	1,071	123	87	282	203	2,865
Female	10	–	26	24	269	314	13	22	60	53	791
Social Sciences and Humanities											
Total	**548**	–	**1,435**	**600**	**14,873**	**14,284**	**1,258**	**789**	**2,367**	**3,031**	**39,185**
Male	**311**	–	**761**	**302**	**7,841**	**7,513**	**678**	**424**	**1,096**	**1,456**	**20,382**
Female	**237**	–	**674**	**298**	**7,032**	**6,771**	**580**	**365**	**1,271**	**1,575**	**18,803**
Education											
Total	**287**	–	**556**	**300**	**3,029**	**3,193**	**431**	**282**	**918**	**1,343**	**10,339**
Male	158	–	241	129	1,289	1,211	197	120	353	563	4,261
Female	129	–	315	171	1,740	1,982	234	162	565	780	6,078
Humanities[1]											
Total	**47**	–	**223**	**91**	**3,922**	**2,875**	**169**	**151**	**480**	**532**	**8,490**
Male	18	–	93	53	1,749	1,326	80	80	178	206	3,783
Female	29	–	130	38	2,173	1,549	89	71	302	326	4,707
Social sciences											
Total	**214**	–	**656**	**209**	**7,922**	**8,216**	**658**	**356**	**969**	**1,156**	**20,356**
Male	135	–	427	120	4,803	4,976	401	224	565	687	12,338
Female	79	–	229	89	3,119	3,240	257	132	404	469	8,018
Total[2]											
Total	**747**	–	**1,941**	**950**	**19,504**	**19,975**	**2,125**	**1,249**	**3,730**	**4,112**	**54,333**
Male	**447**	–	**1,119**	**596**	**11,170**	**11,636**	**1,322**	**790**	**2,164**	**2,206**	**31,390**
Female	**300**	–	**822**	**354**	**8,334**	**8,339**	**803**	**459**	**1,626**	**1,906**	**22,943**

[1] Includes fine and applied arts.
[2] Excludes unclassified students in general arts and science programs.
Source: Statistics Canada, Education, Culture and Tourism Division.

TABLE 38. Full-time and Part-time Doctoral Students, by Field of Study

Field of study	1972		1975		1980		1983	
	Full-time	Part-time	Full-time	Part-time	Full-time	Part-time	Full-time	Part-time
	number							
Natural Sciences and Engineering	**4,628**	**914**	**4,111**	**935**	**4,215**	**807**	**5,662**	**798**
Agriculture and biological sciences	915	196	924	189	1,058	125	1,318	143
Engineering and applied sciences	1,163	246	971	281	915	263	1,363	228
Health sciences	532	126	478	10	675	129	894	158
Mathematics and physical sciences	2,018	346	1,738	354	1,567	290	2,087	269
Social Sciences and Humanities	**4,812**	**2,562**	**5,220**	**2,878**	**5,435**	**2,486**	**6,097**	**2,420**
Education	644	421	722	624	971	693	1,080	762
Humanities[1]	2,096	1,097	2,000	1,011	1,901	748	2,065	694
Social sciences	2,072	1,044	2,498	1,244	2,563	1,045	2,952	964
Total[2]	**9,440**	**3,476**	**9,331**	**3,814**	**9,650**	**3,293**	**11,759**	**3,218**

[1] Includes fine and applied arts.
[2] Excludes unclassified students in general arts and science programs.
Source: Statistics Canada, Education, Culture and Tourism Division.

TABLE 39. Full-time and Part-time Doctoral Students, by Province and Sex, 1983

Field of study	Nfld.	P.E.I.	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	B.C.	Canada
						number					
Natural Sciences and Engineering											
Total	**69**	–	**189**	**97**	**1,555**	**2,791**	**276**	**288**	**615**	**580**	**6,460**
Male	**52**	–	**151**	**84**	**1,221**	**2,253**	**221**	**223**	**484**	**487**	**5,176**
Female	**17**	–	**38**	**13**	**334**	**538**	**55**	**65**	**131**	**93**	**1,284**
Agriculture and biological sciences											
Total	**23**	–	**57**	**14**	**273**	**588**	**88**	**65**	**157**	**196**	**1,461**
Male	19	–	42	11	185	424	63	50	116	150	1,060
Female	4	–	15	3	88	164	25	15	41	46	401
Engineering and applied sciences											
Total	**9**	–	**21**	**43**	**417**	**746**	**75**	**24**	**126**	**130**	**1,591**
Male	9	–	18	39	386	690	72	24	119	124	1,481
Female	–	–	3	4	31	56	3	–	7	6	110
Health sciences											
Total	**13**	–	**23**	–	**376**	**411**	**51**	**13**	**115**	**50**	**1,052**
Male	6	–	17	–	237	251	32	10	68	37	658
Female	7	–	6	–	139	160	19	3	47	13	394
Mathematics and physical sciences											
Total	**24**	–	**88**	**40**	**489**	**1,046**	**62**	**186**	**217**	**204**	**2,356**
Male	18	–	74	34	413	888	54	139	181	176	1,977
Female	6	–	14	6	76	158	8	47	36	28	379
Social Sciences and Humanities											
Total	**18**	–	**92**	**30**	**2,894**	**4,118**	**194**	**57**	**602**	**512**	**8,517**
Male	**11**	–	**68**	**17**	**1,729**	**2,332**	**110**	**33**	**327**	**268**	**4,895**
Female	**7**	–	**24**	**13**	**1,165**	**1,786**	**84**	**24**	**275**	**244**	**3,622**
Education											
Total	–	–	**22**	–	**570**	**727**	**14**	**8**	**344**	**152**	**1,842**
Male	–	–	12	–	317	354	9	3	178	64	937
Female	–	–	10	–	253	373	5	5	171	88	905
Humanities[1]											
Total	**1**	–	**40**	**24**	**982**	**1,418**	**57**	**10**	**114**	**113**	**2,759**
Male	1	–	32	14	573	811	27	5	57	58	1,578
Female	–	–	8	10	409	607	30	5	57	55	1,181
Social sciences											
Total	**17**	–	**30**	**6**	**1,342**	**1,973**	**123**	**39**	**139**	**247**	**3,916**
Male	10	–	24	3	839	1,167	74	25	92	146	2,380
Female	7	–	6	3	503	806	49	14	47	101	1,536
Total[2]											
Total	**87**	–	**281**	**127**	**4,449**	**6,909**	**470**	**345**	**1,217**	**1,092**	**14,977**
Male	**63**	–	**219**	**101**	**2,950**	**4,585**	**331**	**256**	**811**	**755**	**10,071**
Female	**24**	–	**62**	**26**	**1,499**	**2,324**	**139**	**89**	**406**	**337**	**4,906**

1 Includes fine and applied arts.
2 Excludes unclassified students in general arts and science programs.
Source: Statistics Canada, Education, Culture and Tourism Division.

TABLE 40. Full-time Foreign University Students,[1] by Field of Study and Level of Degree

Field of study and level	1974	1976	1978	1980	1982	1983
			number			
Agriculture and biological sciences						
Undergraduate	3	4	3	3	4	3
Master's	12	17	14	14	18	17
Doctorate	15	24	26	25	26	25
Engineering and applied sciences						
Undergraduate	8	9	10	9	8	7
Master's	25	27	31	35	36	28
Doctorate	20	25	34	42	55	52
Health sciences						
Undergraduate	2	2	2	1	1	1
Master's	8	9	10	10	12	12
Doctorate	8	12	13	16	19	19
Mathematics and physical sciences						
Undergraduate	5	9	10	10	14	12
Master's	19	25	26	29	30	27
Doctorate	14	25	33	36	38	35
Social sciences						
Undergraduate	5	5	5	5	7	7
Master's	13	15	14	12	11	11
Doctorate	20	26	26	26	26	27

[1] Students who do not have Canadian citizenship or landed-immigrant status.
Source: Estimated by Dr. Max von Zur-Muehlen, Education, Culture and Tourism Division.

University Graduates

Just as an examination of enrollment at the various degree levels is useful, so it is important to have a statistical profile of university graduates, since they are preparing to enter the job market and are thus the newest wave of highly skilled labour.

The breakdown of university graduates by field of study is the same as that used for teachers and students. In addition, the same basic variables (sex, citizenship, age and province) are employed in the analysis of graduates at each level (bachelor's and first professional degrees, master's degree and doctorate).

Bachelor's and First Professional Degrees

Generally, "an undergraduate degree program (bachelor's) lasts from three to five years depending upon entrant's qualifications and the nature of the degree sought (pass or honour)".(20). These degrees are related to the general fields of arts and sciences. "Bachelor's degrees at the honour level are also necessary for acceptance into a master's program".(21). Professional degrees are awarded in disciplines such as medicine, dentistry and related specializations, architecture and engineering. They are different lengths (usually three to five years). "Students are accepted either with senior matriculation or with entrance requirements completed in university undergraduate programs or academic programs of community colleges".(22). The tables below illustrate some of the important characteristics related to this type of degree.

See footnote(s) at the end of text.

TABLE 41. Bachelor's and First Professional Degrees Awarded, by Field of Study

Field of study	1975	1979	1983
		number	
Natural Sciences and Engineering	**18,983**	**22,275**	**24,136**
Agriculture and biological sciences	5,025	5,594	4,799
Engineering and applied sciences	4,809	6,632	7,728
Health sciences	5,092	5,752	6,089
Mathematics and physical sciences	4,057	4,297	5,520
Social Sciences and Humanities	**53,148**	**57,375**	**56,598**
Education	18,420	18,250	15,348
Humanities[1]	12,258	12,111	11,493
Social sciences	22,470	27,014	29,757
Total[2]	**80,754**	**87,238**	**89,124**

[1] Includes fine and applied arts.
[2] Includes unclassified degrees.
Source: Statistics Canada, Education, Culture and Tourism Division.

TABLE 42. Bachelor's and First Professional Degrees Awarded, by Field of Study and Province, 1983

Field of study	Nfld.	P.E.I.	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	B.C.	Canada
						number					
Natural Sciences and Engineering	**381**	**32**	**1,138**	**601**	**6,313**	**9,676**	**1,036**	**973**	**2,054**	**1,932**	**24,136**
Agriculture and biological sciences	58	21	270	102	1,135	1,893	246	297	267	510	4,799
Engineering and applied sciences	69	-	268	253	2,254	3,319	209	217	616	523	7,728
Health sciences	154	-	306	98	1,678	1,884	313	292	844	520	6,089
Mathematics and physical sciences	100	11	294	148	1,246	2,580	268	167	327	379	5,520
Social Sciences and Humanities	**1,137**	**222**	**2,053**	**1,588**	**15,155**	**23,788**	**2,703**	**4,978**	**3,451**	**4,226**	**56,598**
Education	541	41	531	560	4,126	5,217	741	990	1,666	935	15,348
Humanities[1]	224	54	392	261	3,045	5,351	547	350	298	971	11,493
Social sciences	372	127	1,130	767	7,984	13,220	1,415	935	1,487	2,320	29,757
Total[2]	**1,518**	**254**	**3,503**	**2,256**	**22,220**	**39,430**	**3,929**	**3,272**	**6,450**	**6,292**	**89,124**

[1] Includes fine and applied arts.
[2] Includes unclassified degrees.
Source: Statistics Canada, Education, Culture and Tourism Division.

TABLE 43. Bachelor's Degrees Awarded to Women, by Field of Study

Field of study	1975	1979	1983
		per cent	
Natural Sciences and Engineering	**32**	**35**	**37**
Agriculture and biological sciences	46	49	53
Engineering and applied sciences	3	7	11
Health sciences	53	59	63
Mathematics and physical sciences	22	28	29
Social sciences	**35**	**42**	**46**
Other[1]	**58**	**64**	**65**
Total[2]	**44**	**49**	**51**

1 Includes fine and applied arts, humanities and education.
2 Includes unclassified degrees.
Source: Appendix Table 18.

Master's Degrees

To be accepted into a master's program, a bachelor's degree at the honours level or the equivalent is necessary. "Most entail one year of study, but some master's degrees take two years to complete".(23) Master's degrees are given in most fields of arts and sciences as well as in professional programs such as engineering, architecture, medicine, etc. As with bachelor's degrees, master's degrees can be broken down by sex, province, field of study and citizenship.

TABLE 44. Master's Degrees Awarded, by Field of Study and Province, 1983

Field of study	Nfld.	P.E.I.	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	B.C.	Canada
						number					
Natural Sciences and Engineering	**26**	–	**90**	**66**	**887**	**1,502**	**165**	**67**	**265**	**268**	**3,336**
Agriculture and biological sciences	7	–	25	4	124	267	44	30	59	64	624
Engineering and applied sciences	6	–	21	47	342	574	75	21	113	86	1,285
Health sciences	4	–	23	–	192	276	13	2	29	55	594
Mathematics and physical sciences	9	–	21	15	229	385	33	14	64	63	833
Social Sciences and Humanities	**111**	–	**389**	**202**	**2,716**	**4,981**	**275**	**208**	**675**	**949**	**10,506**
Education	74	–	137	124	493	1,274	111	71	286	413	2,983
Humanities[1]	6	–	67	26	664	1,022	29	35	102	183	2,134
Social sciences	31	–	185	52	1,559	2,685	135	102	287	353	5,389
Total[2]	**137**	–	**479**	**268**	**3,586**	**6,490**	**440**	**275**	**960**	**1,199**	**13,842**

1 Includes fine and applied arts.
2 Includes unclassified degrees.
Source: Statistics Canada, Education, Culture and Tourism Division.

See footnote(s) at the end of text.

TABLE 45. Master's Degrees Awarded, by Field of Study and by Sex

Field of study		1975	1979	1983
			number	
Natural Sciences and Engineering	**Total**	**2,560**	**3,002**	**3,316**
	Male	**2,130**	**2,339**	**2,454**
	Female	**431**	**663**	**862**
Agricultural and biological sciences	Total	473	574	624
	Male	342	449	374
	Female	132	165	250
Engineering and applied sciences	Total	963	1,160	1,285
	Male	921	1,094	1,173
	Female	37	66	112
Health sciences	Total	303	470	574
	Male	148	186	232
	Female	155	284	342
Mathematics and physical sciences	Total	821	798	833
	Male	714	650	675
	Female	107	148	158
Social Sciences and Humanities	**Total**	**8,471**	**9,347**	**10,506**
	Male	**5,792**	**5,563**	**5,721**
	Female	**2,679**	**3,784**	**4,785**
Education	Total	2,161	2,830	2,983
	Male	1,491	1,567	1,396
	Female	670	1,263	1,587
Humanities[1]	Total	2,256	2,080	2,134
	Male	1,219	952	957
	Female	1,037	1,128	1,177
Social sciences	Total	4,058	4,437	5,389
	Male	3,082	3,044	3,368
	Female	972	1,393	2,021
Total[2]	**Total**	**11,068**	**12,351**	**13,834**
	Male	**7,949**	**7,903**	**8,169**
	Female	**3,119**	**4,448**	**5,665**

[1] Includes fine and applied arts.
[2] Includes unclassified degrees.
Source: Appendix Table 19.

TABLE 46. Doctoral Degrees Awarded, by Field of Study and by Sex

Field of study		1975	1979	1983
			number	
Natural Sciences and Engineering	**Total**	**999**	**907**	**981**
	Male	**894**	**793**	**822**
	Female	**105**	**114**	**159**
Agricultural and biological sciences	Total	236	224	247
	Male	195	193	197
	Female	41	31	50
Engineering and applied sciences	Total	227	231	220
	Male	218	222	210
	Female	9	9	10
Health sciences	Total	122	134	174
	Male	97	91	119
	Female	25	43	55
Mathematics and physical sciences	Total	414	318	340
	Male	384	287	296
	Female	30	31	44
Social Sciences and Humanities	**Total**	**824**	**892**	**835**
	Male	**639**	**637**	**843**
	Female	**185**	**255**	**292**
Education	Total	172	193	189
	Male	122	137	106
	Female	50	56	83
Humanities[1]	Total	295	302	261
	Male	225	204	179
	Female	70	98	82
Social sciences	Total	357	397	385
	Male	292	296	258
	Female	65	101	127
Total[2]	**Total**	**1,840**	**1,803**	**1,821**
	Male	**1,544**	**1,434**	**1,370**
	Female	**296**	**369**	**451**

1 Includes fine and applied arts.
2 Includes unclassified degrees.
Source: Appendix Table 20.

Doctoral Degrees

Even more than for the lower degrees, statistics on earned doctorates are an important element in the creation of a realistic picture of the supply of highly qualified personnel (HQP). As shown in **Postgraduation Plans of 1984 and 1985 Ph.D. Graduates**, Statistics Canada, Catalogue No. 81-259, persons with doctorates tend to become researchers. They are also vital to the formation of future HQP and important to the scientific and technological infrastructure necessary for a modern economy.

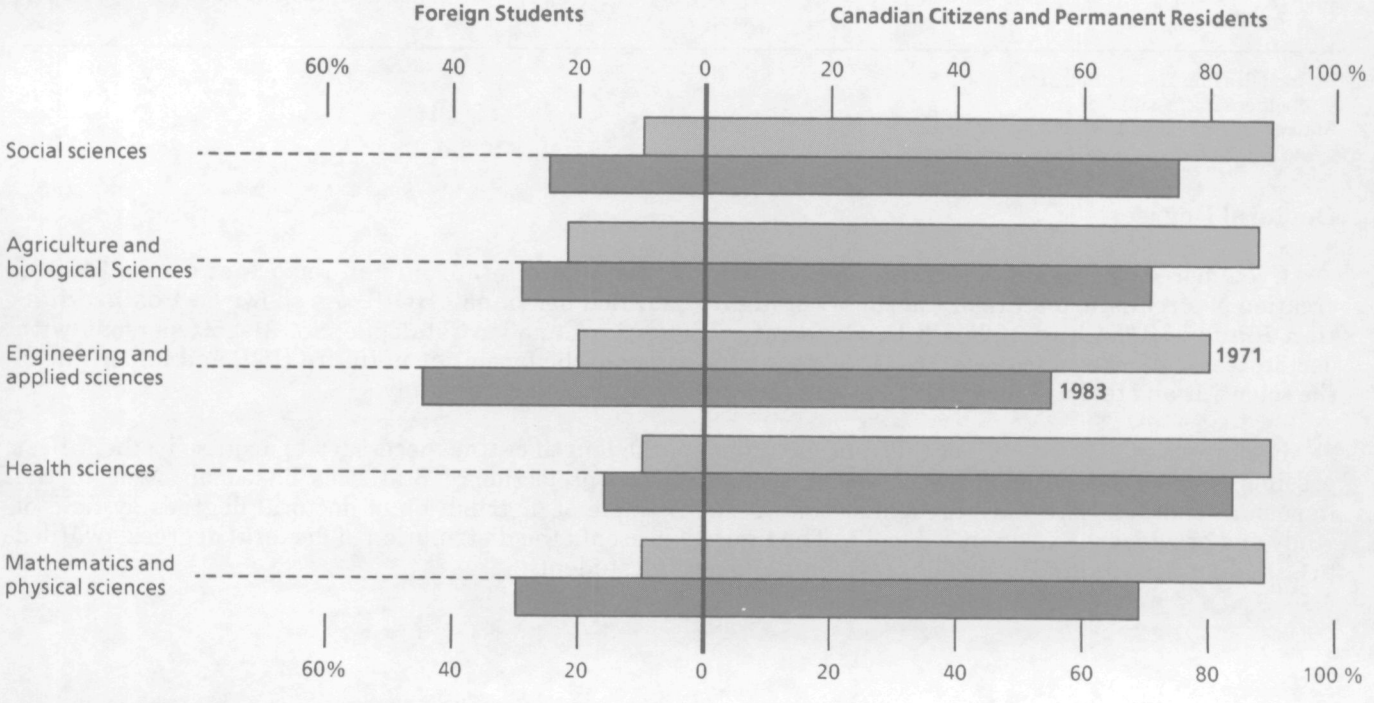
Because of the importance of this qualification and the length of time necessary to acquire it, the fullest possible range of statistics are desirable for analysis and projections. Statistics based on some of the important characteristics are presented below. An example of distribution of doctoral degrees by field of study and province is shown in Table 47. The figure 4 presents the distribution of doctoral degrees awarded to Canadian citizens and permanent residents and foreign students.

TABLE 47. Doctoral Degrees Awarded, by Field of Study and Province, 1983

Field of study	Nfld.	P.E.I.	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	B.C.	Canada
						number					
Natural Sciences and Engineering	**16**	–	**19**	**11**	**215**	**450**	**41**	**24**	**107**	**98**	**981**
Agriculture and biological sciences	7	–	2	1	46	96	16	16	31	32	247
Engineering and applied sciences	–	–	2	5	52	106	6	3	26	20	220
Health sciences	6	–	4	–	56	74	9	–	14	11	174
Mathematics and physical sciences	3	–	11	5	61	174	10	5	36	35	340
Social Sciences and Humanities	**6**	–	**10**	**3**	**202**	**418**	**28**	**8**	**98**	**62**	**835**
Education	–	–	2	–	29	87	2	2	59	8	189
Humanities[1]	1	–	5	3	68	150	3	2	14	15	261
Social sciences	5	–	3	–	105	181	23	4	25	39	385
Total[2]	**22**	–	**29**	**14**	**418**	**868**	**69**	**32**	**205**	**164**	**1,821**

[1] Includes fine and applied arts.
[2] Includes unclassified degrees.
Source: Statistics Canada, Education, Culture and Tourism Division.

Figure 4
Distribution of Doctoral Degrees Awarded to Canadian Citizens and Permanent Residents and Foreign Students



Source: Science, Technology and Capital Stock Division.

In addition to the general information available for the other types of degrees, at the doctoral level there are data on the first jobs of Ph.D. graduates who completed their degrees at Canadian universities in 1970, 1976, 1981 to 1986.

Information about the employment characteristics of 1970 graduates was derived from 1971 Census returns; they relate to persons who earned doctorates in 1970 and were employed full-time on Census Day. The data for 1976 graduates were collected in a 1978 survey which obtained information about the first full-time job they held after earning their degree.(24) A second survey of 1982 graduates was carried out in 1984. Conducted jointly by the Secretary of State and Employment and Immigration Canada, this survey obtained data not only on college and university graduates, but also on graduates of trade schools and professional training programs.(25) The data for 1981 to 1986 come from a survey conducted by Statistics Canada's Education, Culture and Tourism Division and sponsored jointly by the Canadian Association of Graduate Schools, the Medical Research Council, the National Research Council, the Natural Sciences and Engineering Research Council, the Social Sciences and Humanities Research Council, the Ministry of State for Science and Technology and the provincial government agencies responsible for university education. This survey, discontinued in 1987, was designed to collect information about doctorate holders' first full-time employment after they received their degrees.(26)

They also provided data on:

- citizenship and place of birth;
- age group;
- the desired type, field and location of employment;
- interprovincial migration, and;
- principal reasons for leaving Canada.

This information is of paramount importance to those interested in the characteristics of highly qualified personnel and its movement to the various professional and industrial sectors. It also helps identify employment opportunities for graduates in each field of study.

TABLE 48. Expected Work Activities of 1985 Ph.D. Graduates, by Field of Study

Field of study	Research	Teaching and training	Consulting	Other work	Total
			percentage		
Agriculture and biological sciences	60.7	21.3	4.9	13.1	100
Engineering and applied sciences	55.3	24.5	5.3	14.9	100
Health sciences	23.1	30.8	15.4	30.8	100
Mathematics and physical sciences	54.3	26.6	5.3	13.9	100
Social sciences	27.0	41.1	6.7	25.1	100
Education	11.1	45.8	8.3	37.4	100
Humanities	9.6	78.3	1.2	10.8	100
Total	34.7	39.5	5.9	19.9	100

Note: Includes only employed Canadian citizens and permanent residents.
Source: Statistics Canada, Education, Culture and Tourism Division.

These data can also be used to measure migration levels and the concentration of graduates in each region. Furthermore, "information from the survey is utilized by the granting councils to evaluate the impact and relevance of their various mechanisms of providing financial assistance to doctoral students, and by the provincial departments in evaluating the relevance of existing doctoral programs".(27)

Community College Students

Data are also available on community college students and graduates. These data, which can be broken down by sex, province and field of study, are valuable in that they provide information about conditions in the various fields of technology for the purpose of assessing and forecasting requirements for technical personnel.

See footnote(s) at the end of text.

TABLE 49. Students Enrolled in Community Colleges, by Field of Study

Field of study		1976	1979	1982
			number	
Technology	**Total**	**13,355**	**15,368**	**19,230**
	Male	**12,135**	**14,013**	**17,808**
	Female	**1,220**	**1,355**	**1,722**
Chemistry	Total	2,540	2,708	2,963
	Male	1,479	1,570	1,718
	Female	1,061	1,138	1,245
Electricity	Total	10,815	12,660	16,267
	Male	10,656	12,443	15,790
	Female	159	217	477
Natural resources	**Total**	**7,280**	**9,586**	**10,612**
	Male	**5,591**	**7,091**	**7,714**
	Female	**1,689**	**2,495**	**2,898**
Business services	**Total**	**41,000**	**57,194**	**73,303**
	Male	**18,156**	**23,142**	**29,021**
	Female	**22,844**	**34,052**	**44,282**
Business secretarial	Total	9,868	12,719	13,192
	Male	47	39	73
	Female	9,821	12,680	13,119
Computer science	Total	4,648	6,566	14,626
	Male	2,718	3,574	7,637
	Female	1,930	2,992	6,989
Management and administration	Total	26,484	37,909	45,485
	Male	15,391	19,529	21,311
	Female	11,093	18,380	24,174
Engineering and related fields	**Total**	**16,123**	**20,630**	**23,889**
	Male	**15,268**	**18,676**	**21,581**
	Female	**855**	**1,954**	**2,308**
Aeronautical	Total	8	459	394
	Male	8	448	378
	Female	–	11	16
Architecture	Total	4,674	6,053	6,227
	Male	4,168	5,234	5,250
	Female	506	819	977
Mechanical	Total	3,504	5,112	7,082
	Male	3,478	5,045	6,934
	Female	26	67	148
Manufacturing and production	Total	1,633	1,692	2,299
	Male	1,388	1,407	2,113
	Female	245	285	186
Food and industrial processing	Total	147	210	269
	Male	69	100	117
	Female	78	110	152
General engineering	Total	6,595	7,010	7,618
	Male	6,157	6,348	6,789
	Female	438	662	829
Health sciences	**Total**	**26,850**	**23,959**	**25,866**
	Male	**2,913**	**3,281**	**3,670**
	Female	**23,937**	**20,678**	**22,196**

See footnote(s) at the end of table.

TABLE 49. Students Enrolled in Community Colleges, by Field of Study – Concluded

Field of study		1976	1979	1982
			number	
Transport	**Total**	**748**	**1,218**	**1,314**
	Male	**706**	**1,164**	**1,205**
	Female	**42**	**54**	**109**
Fine and applied arts	**Total**	**15,782**	**18,662**	**20,518**
	Male	**7,108**	**7,735**	**8,527**
	Female	**8,674**	**10,927**	**11,991**
Community and social services	**Total**	**19,153**	**21,506**	**24,332**
	Male	**5,724**	**6,222**	**6,818**
	Female	**13,429**	**15,284**	**17,514**
Other	**Total**	**3,223**	**2,221**	**3,378**
	Male	**1,935**	**1,270**	**2,017**
	Female	**1,288**	**951**	**1,361**
Total[1]	**Total**	**143,514**	**169,840**	**202,442**
	Male	**69,536**	**82,594**	**98,061**
	Female	**73,978**	**87,246**	**104,381**

[1] Includes students from the North West Territories.
Source: Statistics Canada, Education, Culture and Tourism Division.

TABLE 50. Students Enrolled in Community Colleges, by Province, 1982

Field of study	Nfld.	P.E.I.	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	B.C.	Canada
						number					
Technology	**358**	**62**	**186**	**358**	**8,427**	**7,283**	**301**	**154**	**1,343**	**758**	**19,230**
Chemistry	85	–	16	50	955	1,440	50	–	278	89	2,963
Electricity	273	62	170	308	7,472	5,843	251	154	1,065	669	16,267
Natural resources	**136**	**65**	**83**	**125**	**3,493**	**4,129**	**6**	**136**	**1,734**	**676**	**10,612**[1]
Business services	**536**	**334**	**395**	**520**	**29,082**	**32,043**	**1,344**	**436**	**4,551**	**4,050**	**73,303**[1]
Business secretarial	141	140	81	–	7,825	3,886	27	31	987	74	13,192
Computer science	99	42	64	67	5,853	6,737	328	40	718	678	14,626
Management and administration	296	152	250	453	15,404	21,420	989	365	2,846	3,298	45,485[1]
Engineering and related fields	**346**	**52**	**357**	**361**	**8,535**	**10,143**	**316**	**433**	**2,501**	**845**	**23,889**
Aeronautical	–	–	–	–	360	–	–	–	34	–	394
Architecture	96	41	9	–	2,821	2,113	24	24	620	479	6,227
Mechanical	74	11	201	95	2,518	2,976	88	251	672	196	7,082
Manufacturing and production	7	–	18	41	780	1,358	–	–	95	–	2,299
Food and industrial processing	40	–	–	–	94	135	–	–	–	–	269
General engineering	129	–	129	225	1,962	3,561	204	158	1,080	170	7,618
Health sciences	**164**	**4**	**167**	**94**	**10,015**	**10,186**	**399**	**1,186**	**1,621**	**2,030**	**25,866**
Transport	**62**	**–**	**380**	**–**	**405**	**368**	**–**	**–**	**78**	**21**	**1,314**
Fine and applied arts	**–**	**103**	**–**	**57**	**4,799**	**11,181**	**180**	**–**	**2,230**	**1,968**	**20,518**
Community and social services	**35**	**108**	**60**	**–**	**9,419**	**11,398**	**233**	**95**	**1,997**	**960**	**24,332**[1]
Other	**–**	**–**	**18**	**–**	**372**	**2,595**	**–**	**5**	**374**	**14**	**3,378**
Total	**1,637**	**728**	**1,646**	**1,515**	**74,547**	**89,326**	**2,779**	**2,445**	**16,429**	**11,322**	**202,442**[1]

[1] Includes students of the North West Territories.
Source: Statistics Canada, Education, Culture and Tourism Division.

TABLE 51. Recipients of Community Colleges Diplomas, by Field of Study and by Sex

Field of study		1976	1979	1982
			number	
Technology	**Total**	**2,553**	**3,235**	**3,626**
	Male	**2,327**	**2,872**	**3,264**
	Female	**226**	**363**	**362**
Chemistry	Total	585	672	703
	Male	385	349	397
	Female	200	323	306
Electricity	Total	1,968	2,563	2,923
	Male	1,942	2,523	2,867
	Female	26	40	56
Natural resources	**Total**	**2,018**	**2,749**	**3,031**
	Male	**1,636**	**1,983**	**2,161**
	Female	**382**	**766**	**870**
Business services	**Total**	**8,682**	**11,858**	**15,434**
	Male	**3,501**	**4,086**	**5,321**
	Female	**5,181**	**7,772**	**10,113**
Business secretarial	Total	2,850	3,674	3,606
	Male	30	11	10
	Female	2,820	3,663	3,596
Computer science	Total	890	1,212	2,293
	Male	543	625	1,169
	Female	347	587	1,124
Management and administration	Total	4,942	6,972	9,535
	Male	2,928	3,450	4,142
	Female	2,014	3,522	5,393
Engineering and related fields	**Total**	**3,428**	**4,699**	**5,603**
	Male	**3,249**	**4,291**	**5,085**
	Female	**179**	**408**	**518**
Aeronautical	Total	6	6	10
	Male	6	6	10
	Female	–	–	–
Architecture	Total	780	1,171	1,214
	Male	700	1,006	1,020
	Female	80	165	194
Mechanical	Total	814	1,043	1,495
	Male	813	1,033	1,469
	Female	1	10	26
Manufacturing and production	Total	334	421	792
	Male	318	380	737
	Female	16	41	55
Food and industrial processing	Total	38	46	70
	Male	23	31	31
	Female	15	15	39
General engineering	Total	1,456	2,012	2,022
	Male	1,389	1,835	1,818
	Female	67	177	204
Health sciences	**Total**	**9,610**	**8,878**	**7,809**
	Male	**873**	**1,043**	**1,069**
	Female	**8,737**	**7,835**	**6,740**

See footnote(s) at the end of table.

TABLE 51. Recipients of Community Colleges Diplomas, by Field of Study and by Sex – Concluded

Field of study		1976	1979	1982
			number	
Transport	**Total**	**153**	**269**	**279**
	Male	**148**	**256**	**272**
	Female	**5**	**13**	**7**
Fine and applied arts	**Total**	**2,973**	**4,403**	**5,204**
	Male	**1,338**	**1,672**	**1,883**
	Female	**1,635**	**2,731**	**3,321**
Community and social services	**Total**	**5,436**	**6,305**	**6,691**
	Male	**1,418**	**1,565**	**1,626**
	Female	**4,018**	**4,740**	**5,065**
Other	**Total**	**954**	**394**	**517**
	Male	**609**	**280**	**355**
	Female	**345**	**114**	**162**
Total	**Total**	**35,807**	**40,041**	**48,194**
	Male	**15,099**	**16,065**	**21,036**
	Female	**20,708**	**23,976**	**27,158**

Source: Statistics Canada, Education, Culture and Tourism Division.

TABLE 52. Recipients of Community College Diplomas, by Field of Study and Province, 1982

Field of study	Nfld.	P.E.I.	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	B.C.	Canada
						number					
Technology	**101**	**9**	**47**	**113**	**1,178**	**1,307**	**103**	**62**	**471**	**235**	**3,626**
Chemistry	26	–	1	17	203	320	12	–	89	35	703
Electricity	75	9	46	96	975	987	91	62	382	200	2,923
Natural resources	**29**	**13**	**15**	**66**	**675**	**1,261**	**5**	**39**	**687**	**241**	**3,031**
Business services	**131**	**168**	**110**	**179**	**4,312**	**7,216**	**441**	**158**	**1,624**	**1,095**	**15,434**
Business secretarial	26	98	25	–	1,260	1,730	19	7	418	23	3,606
Computer science	30	15	45	19	694	1,035	98	23	183	151	2,293
Management and administration	75	55	40	160	2,358	4,451	324	128	1,023	921	9,535
Engineering and related fields	**66**	**13**	**127**	**119**	**1,459**	**2,487**	**98**	**164**	**760**	**310**	**5,603**
Aeronautical	–	–	–	–	–	–	–	–	10	–	10
Architecture	13	13	–	–	286	505	9	23	181	184	1,214
Mechanical	14	–	44	32	207	765	30	93	232	78	1,495
Manufacturing and production	6	–	13	17	293	420	–	–	43	–	792
Food and industrial processing	12	–	–	–	15	41	–	–	2	–	70
General engineering	21	–	70	70	658	756	59	48	292	48	2,022
Health sciences	**39**	**4**	**77**	**37**	**2,185**	**3,212**	**288**	**535**	**620**	**812**	**7,809**
Transport	**1**	**–**	**98**	**–**	**46**	**90**	**–**	**–**	**17**	**27**	**279**
Fine and applied arts	**–**	**44**	**–**	**6**	**1,292**	**2,867**	**65**	**–**	**449**	**481**	**5,204**
Community and social services	**13**	**28**	**25**	**–**	**1,783**	**3,666**	**90**	**25**	**697**	**364**	**6,691**
Other	**–**	**–**	**–**	**–**	**66**	**388**	**–**	**6**	**57**	**–**	**517**
Total	**380**	**279**	**499**	**520**	**12,996**	**22,494**	**1,090**	**989**	**5,382**	**3,565**	**48,194**

Source: Statistics Canada, Education, Culture and Tourism Division.

Limitations

As in the case of the surveys discussed earlier, there are data collection and reliability problems with the surveys on students, graduates and the postgraduation plans of Ph.D. graduates (errors of response, non-response, data capture, editing, imputation and so on). Data on students and graduates rely on the information provided by the university reports on enrolment and graduates. Because there is no commonly accepted definition of 'part-time', there are some problems in evaluating part-time students. Statistics Canada has left the decision of determining full-time or part-time registration status to each reporting institution, which may create some distortions in the data. In the case of the survey on the postgraduation plans of Ph.D. graduates: although "it was the intention to ask students to complete the questionnaire at or about the time they completed the requirements for their degree, delays in preparing the questionnaire forced many respondents to reply up to six months after completion of requirements and, in many cases, after the official granting of the degree (28)." Furthermore, the information provided by the survey, though interesting, is isolated. A longer time series will be required before it can be properly analysed.

With regard to the data on community college graduates, it would be helpful if they were broken down into the same fields as the data on community college teachers.

Avenues of Research

The data on graduates will be of greatest value when they can be used in a model of the stocks and flows of highly skilled labour, as suggested in Chapter 2. With the collection of data on the geographic mobility of students, mobility between subject areas, classroom versus on-the-job training, the specialities, funding and fields of activity of postdoctoral researchers, student funding (scholarships) and so on, it will be possible to carry out a more detailed analysis of the supply of students.

See footnote(s) at the end of text.

Chapter 6

CONCLUSION

The growth and development of Western economies are becoming more closely linked with the composition and quality of highly qualified personnel. In recent years, this increasing dependence on human capital has generated more interest in the forecasting of human resource requirements. In response to this new demand for a measure of what is often referred to as the supply of highly qualified personnel, we have attempted to briefly review the statistics which are now available as indicators for evaluating the many facets of this resource.

A wide range of statistics of varying degrees of precision, utility and comparability have been shown in this report. The Census is the most complete survey instrument and should be used as the main source for information on the stock of highly qualified personnel. Unfortunately, this instrument gives data every 5 or 10 years (the next census will be held in 1991). Current information is, therefore, often not available. Hence we must rely on the Labour Force Survey, for current occupational data. However, the LFS provides data that are far less detailed than the Census data and cannot be used to derive statistics on small geographic areas or disaggregated cross-tabulations (e.g., sex x education x occupation or industry x age group x region).

As mentioned in the beginning of this paper, the establishment of an HQP model incorporating the stock and flows of labour supply and demand within a comprehensive socio-economic model necessitate complete evaluation of the state of HQP by various variables. Such detailed information is not currently available and can only be obtained through a census or survey. In this respect, the 1986 Census provides valuable new data, permitting the linking of educational specialization to occupation for the first time since the 1973 post-censal survey.

FOOTNOTES

(1) The coding of occupations to a sufficient level of detail for the purposes of this study began only in 1982 in the LFS.

(2) For further details about the Census of Canada, see **Population, Labour Force – Industry by Occupation**, 1981 Census of Canada, Volume 1, Statistics Canada, Catalogue No. 92-923.

(3) Statistics Canada, **The Labour Force**, Catalogue No. 71-001.

(4) Statistics Canada, **Population, Labour Force – Industry by Occupation**, 1981 Census of Canada, Vol. 1, Catalogue No. 92-923, p.1.

(5) Statistics Canada, **The Labour Force**, Catalogue No. 71-001.

(6) OECD, **The Measurement of Scientific and Technical Activities**, "Frascati Manual", Paris, 1980, p. 19.

(7) International Standard Classification of Occupation. See Appendix II for further details.

(8) The International Standard Classification of Education is an established classification system of the United Nations.

(9) See Appendix II.

(10) For further details, see **A Framework for Measuring Research and Development Expenditures in Canada**, Statistics Canada, Catalogue No. 88-506E, 1984.

(11) Statistics Canada "The Provincial Research Organizations" **Science Statistics**, Service Bulletin, Vol. 8, No. 11, Catalogue No. 88-001.

(12) Statistics Canada, **Industrial Research and Development Statistics, 1982**, Catalogue No. 88-202, Appendix I.

(13) For further details on the definition of private non-profit organizations, see **A Framework for Measuring Research and Development Expenditures in Canada**, Statistics Canada, Catalogue No. 88-506.

(14) Statistics Canada, **Resources for Research and Development in Canada, 1982**, Catalogue No. 88-203.

(15) See Statistics Canada, **Teachers in Universities**, Catalogue No. 81-241, and **Educational Staff of Community Colleges and Vocational Schools**, Catalogue No. 81-254.

(16) Statistics Canada, **Teachers in Universities**, Catalogue No.81-241, 1983, p. 5.

(17) Statistics Canada, **Educational Staff of Community Colleges and Vocational Schools, 1980-81**, Catalogue No. 81-254, p. 8.

(18) Statistics Canada, **Occupation by Labour Force and Work Activity**, 1981 Census, Catalogue No. 92-919.

(19) Statistics Canada, **Research Personnel in Canadian Universities**, October 84, p. 98 (mimeograph).

(20) Statistics Canada, **Education in Canada, 1983**, Catalogue No. 81-229, p. 17.

(21) **Ibid** p. 17.

(22) **Ibid** p. 17.

(23) **Ibid** p. 17.

(24) Clark, W. and Zsigmond, Z. **Job Market Reality for Postsecondary Graduates: Employment Outcome by 1978, Two Years after Graduation**, Statistics Canada, Catalogue No. 81-572E.

(25) **The Class of 82.** Summary report on the findings of the 1984 National Survey of the Graduates of 1982. Secretary of State and Statistics Canada, 1986, 178 p.

(26) Given the intrinsic differences of different surveys, only the results of the most recent survey are presented. See, Statistics Canada, **Postgraduation plans of 1984 and 1985 PH.D. graduates**, Catalogue No. 81-259, 1987.

(27) Idem p. 7.

(28) Idem p. 7.

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APPENDIX I

Definitions

Natural sciences and engineering: Disciplines concerned with understanding, exploring, developing or using the natural world. They comprise engineering, mathematics, the life sciences and the physical sciences.

Social sciences and humanities: Disciplines concerned with human actions and conditions and the social, economic and institutional mechanisms affecting human beings. Included are anthropology, business administration and commerce, communications, criminology, 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.

Scientists, engineers and technologists: This group consists of scientists, engineers and technologists engaged in the creation or application of new knowledge, products, processes, methods and systems. They belong to the occupational categories listed in Appendix II.

R&D: Scientific research and experimental development, comprising creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society and the use of this stock of knowledge to devise new applications.

Scientists and engineers in R&D: This category consists of persons engaged in the conception, or creation of new knowledge, products, processes, methods and systems. They are generally university graduates.

Technicians in R&D: This group is engaged in performing scientific and technical tasks normally under the supervision of scientists and engineers. Equivalent staff perform the corresponding tasks under the supervision of scientists in the social sciences and humanities.

Other supporting staff in R&D: This group includes skilled and unskilled craftsmen, secretarial and clerical staff participating in R&D projects or directly associated with such projects.

Bachelor's and first professional degree: Degree given after successful completion of an undergraduate or professional program. The undergraduate program (bachelor's) lasts from three to five years depending on entrant's qualifications and the nature of the degree sought (pass or honour). Professional degrees have different lengths (usually three to five years).

Master's and doctoral degree: Degrees given after completion of master's and doctoral programs. To be accepted into a master's program a bachelor's degree at the honour level or the equivalent is necessary. A master's degree is necessary to enter a doctoral program.

Community colleges: A generic term for any public or private non-degree granting institution which provides post-secondary university transfer programs and/or semi-professional career programs, secondary level academic upgrading and vocational courses (the latter usually designated as "trades-level") and other credit or non-credit educational programs oriented to community needs. Included in this classification are community colleges per se, colleges of applied arts and technology (CAAT's) in Ontario, general and vocational colleges (CEGEP's) in Quebec, colleges of agricultural technology, institutes of technology and schools for specialized fields such as para-medical technologies, surveying, forestry and nautical sciences.

APPENDIX II

Classification

OCCUPATIONS OF SCIENTISTS, ENGINEERS AND TECHNOLOGISTS

Occupations in Natural Sciences and Engineering

211 Occupations in physical sciences:
- 2111 Chemists
- 2112 Geologists
- 2113 Physicists
- 2114 Meteorologists
- 2117 Technicians
- 2119 Physical sciences, n.e.c.

213 Occupations in life sciences:
- 2131 Agriculturists
- 2133 Biologists
- 2135 Technicians
- 2139 Life sciences, n.e.c.

214/215 Architects and engineers:
- 2141 Architects
- 2142 Chemical engineers
- 2143 Civil engineers
- 2144 Electrical engineers
- 2145 Industrial engineers
- 2147 Mechanical engineers
- 2151 Metallurgical engineers
- 2153 Mining engineers
- 2154 Petroleum engineers
- 2155 Aerospace engineers
- 2156 Nuclear engineers
- 2159 Professional engineers, n.e.c.

216 Architecture and engineering related:
- 2160 Supervisors: other occupations in architecture and engineering
- 2161 Surveyors
- 2163 Draughting occupations
- 2164 Architectural technicians
- 2165 Engineering technicians
- 2169 Other occupations in architecture and engineering, n.e.c.

218 Mathematicians, statisticians and systems analysts:
- 2181 Mathematicians, statisticians, actuaries
- 2183 Systems analysts, programmers
- 2189 Other occupations in mathematics, statistics and systems analysis, n.e.c.

311 Health diagnosing and treating occupations:
- 3111 Physicians and surgeons
- 3113 Dentists
- 3115 Veterinarians
- 3117 Osteopaths and chiropractors
- 3119 Health diagnosing and treating occupations, n.e.c.

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n.e.c. = not elsewhere classified.

313 Nursing, therapy and related assisting occupations:
- 3130 Supervisors: Nursing, therapy and related assisting occupations
- 3131 Nurses, registered, graduate and nurses-in-training
- 3132 Orderlies
- 3134 Registered nursing assistants
- 3135 Nursing attendants
- 3136 Audio and speech therapists
- 3137 Physiotherapists
- 3138 Occupational therapists
- 3139 Nursing, therapy and related assisting occupations, n.e.c.

315/316 Other occupations in medicine and health:
- 3151 Pharmacists
- 3152 Dietitians and nutritionists
- 3153 Optometrists
- 3154 Dispensing opticians
- 3155 Radiological technologists and technicians
- 3156 Medical laboratory technologists and technicians
- 3157 Denturists
- 3158 Dental hygienists and dental assistants
- 3161 Dental laboratory technicians
- 3162 Respiratory technicians
- 3169 Other occupations in medicine and health, n.e.c.

Occupations in Social Sciences and Humanities

231 Occupations in social sciences:
- 2311 Economists
- 2313 Sociologists, anthropologists and related social scientists
- 2315 Psychologists
- 2319 Occupations in social sciences, n.e.c.

233 Occupations in social work and related fields:
- 2331 Social workers
- 2333 Occupations in welfare and community services
- 2339 Occupations in social work and related fields, n.e.c.

235 Occupations in library, museum and archival sciences:
- 2350 Supervisors: occupations in library, museum and archival sciences
- 2351 Librarians, archivists and conservators
- 2353 Technicians in library, museum and archival sciences
- 2359 Occupations in library, museum and archival sciences, n.e.c.

239 Other occupations in social sciences and related fields:
- 2391 Educational and vocational counsellors
- 2399 Other occupations in social sciences and related fields, n.e.c.

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n.e.c. = not elsewhere classified.
Source: Statistics Canada, **Standard Occupational Classification, 1980**, Catalogue No. 12-565E, Ottawa, 1981.

Personnel Engaged in R&D by Occupational Classification (Suggested Relation Between OECD and ISCO[1] Classes)

OECD class	ISCO Classes	ISCO number
Researchers	Chemists, physicists, physical scientists, n.e.c	011, 012 and 013
	Biologists, medical scientists and related scientists, bacteriologists and related scientists, agronomists and related scientists	051, 052 and 053
	Statisticians, mathematicians and actuaries, systems analysts	081, 082 and 083
	Economists	090
	Lawyers, jurists, n.e.c.	121 and 129
	Sociologists, psychologists, anthropologists, geographers, historians and political scientists	192
	Librarians, archivists and curators	191
	Civil, electrical, mechanical, chemical, metallurgical, mining and industrial engineers, and engineers, n.e.c.	022-029 inclusive
	University and higher education teachers	131
	Administrators and managerial workers (part)	Major group 2
Technicians and equivalent staff	Physical and life science technicians	014 and 054
	Surveyors, draughtsmen, civil, electrical, mechanical, chemical, metallurgical, mining and other engineering technicians	031-039 inclusive
	Statistical and mathematical technicians, including computer programmers	084
	(Survey interviewers)	(none)
Other supporting staff	Agricultural, service and production and related workers	Major group 6, 7, 8 and 9
	Clerical workers and related workers	Major group 3
	Administrators and managerial workers, n.e.c.	Major group 2

n.e.c. = not elsewhere classified.
[1] International Standard Classification of Occupation.
Source: OECD, **The measurement of scientific and technical activities, Frascati Manual**, Paris, 1981, p. 68.

APPENDIX III

Data Reliability

Labour Force Survey

Sampling Error

Labour Force Survey estimates are based on a sample of households. Somewhat different figures might have been obtained if a complete census had been taken using the same questionnaires, interviewers, supervisors, processing methods, etc., as those actually used in the Labour Force Survey. In the design and processing of the Labour Force Survey extensive efforts have been made to minimize the sampling error. The sampling error (expressed as a per cent of the estimate it refers to) is not the same for all estimates; of two estimates the larger one will likely have a smaller per cent sampling error and of two estimates of the same size the one referring to a characteristic more evenly distributed throughout the population will tend to have a smaller per cent sampling variability. Also, estimates relating to age and sex are usually more reliable than other estimates of comparable size.

"Data based on very small samples are not published and are indicated in the tables by (...)."(1)

For further details on the types of error that may arise in the Labour Force Survey, see **The Labour Force**, Statistics Canada, Catalogue No. 71-001.

The Census

Data that are collected from a sample of the population and then weighted are subject to error because the distribution of characteristics in the sample is usually not identical with the distribution of characteristics in the population from which the sample was drawn.

"The potential error that sampling has introduced will vary according to the relative scarcity of the characteristics in the population. For larger cell values the potential error due to sampling, as a proportion of the cell value, will be relatively small. For small cell values this potential error, as a proportion of the cell value, will be relatively large."(2)

For more information, consult Catalogue Nos. 92-923 and 99-905.

(1) Statistics Canada, **The Labour Force**, Catalogue No. 71-001.
(2) Statistics Canada, **Population**, Catalogue No. 92-923.

APPENDIX IV

Tables

APPENDIX TABLE 1. Scientists, Engineers and Technologists, by Occupational Group and Sex

Occupational group	Census						Labour force surveys								
	1971			1981			1982			1983			1984		
	M	F	T[1]	M	F	T	M	F	T	M	F	T	M	F	T
	thousands														
Natural Sciences and Engineering	**290**	**245**	**535**	**454**	**419**	**873**	**448**	**459**	**907**	**443**	**471**	**914**	**444**	**487**	**931**
Physical sciences	29	3	32	31	7	38	36	12	48	35	12	47	33	8	41
Agricultural and biological sciences	14	3	17	20	6	26	23	6	29	22	7	29	24	8	32
Architects and engineers	77	2	79	131	8	139	125	9	134	124	8	132	122	8	130
Other occupations in architecture and engineering	66	3	69	104	12	116	90	10	100	79	9	88	75	10	85
Mathematicians, statisticians and systems analysts	22	4	26	46	20	66	53	19	72	60	21	81	69	30	99
Medicine and health	82	230	312	122	366	488	121	402	523	123	414	537	121	423	544
Social Sciences and Humanities	**29**	**25**	**54**	**50**	**79**	**129**	**55**	**73**	**128**	**55**	**75**	**130**	**46**	**86**	**132**
Social sciences	8	3	11	16	10	26	16	9	25	17	10	27	14	12	26
Social work and related fields	14	13	27	24	46	70	25	40	65	23	37	60	23	43	66
Library, museum and archival sciences	3	7	10	5	17	22	6	18	24	7	22	29	4	23	27
Other occupations in social sciences and related fields	4	2	6	5	6	11	8	6	14	8	6	14	5	8	13
Total	**319**	**270**	**589**	**504**	**498**	**1,001**	**505**	**532**	**1,035**	**498**	**546**	**1,044**	**490**	**573**	**1,063**

[1] M = Males
F = Females
T = Total

Source: Census of 1971 and 1981 and Labour Force Survey estimates for 1982, 1983 and 1984.

APPENDIX TABLE 2. Scientists, Engineers and Technologists by Occupational Group and Region

Occupational group				Atlantic provinces	Quebec	Ontario	Prairie provinces	British Columbia	Canada
						thousands			
	Natural Sciences and Engineering	**Census**	**1971**	**40**	**131**	**222**	**91**	**51**	**535**
			1981	**60**	**211**	**335**	**160**	**107**	**873**
		LFS[1]	**1982**	**61**	**218**	**350**	**174**	**103**	**907**
			1983	**61**	**224**	**344**	**180**	**106**	**914**
			1984	**67**	**230**	**354**	**179**	**101**	**931**
211	Physical sciences	Census	1971	2	8	13	6	3	32
			1981	2	5	15	9	4	38
		LFS	1982	*	9	21	11	4	48
			1983	*	11	18	12	4	47
			1984	*	10	15	10	4	41
213	Agricultural and biological sciences	Census	1971	2	3	7	3	2	17
			1981	3	7	7	5	4	26
		LFS	1982	*	6	10	6	5	29
			1983	*	6	9	7	5	29
			1984	*	6	13	6	4	32
214/ 215	Architects and engineers	Census	1971	4	19	37	11	8	79
			1981	7	27	61	28	16	139
		LFS	1982	6	26	61	26	15	134
			1983	6	27	57	27	15	132
			1984	7	27	58	24	14	130
216	Other occupations in architecture and engineering	Census	1971	5	15	30	11	8	69
			1981	7	26	45	24	14	116
		LFS	1982	7	21	39	22	12	101
			1983	6	19	30	20	13	88
			1984	7	16	32	20	10	85
218	Mathematics and related fields	Census	1971	1	7	13	3	2	26
			1981	1	18	32	10	5	66
		LFS	1982	*	15	38	11	6	72
			1983	*	21	40	12	6	81
			1984	*	25	49	15	7	99
31	Medicine and health	Census	1971	26	79	122	57	28	312
			1981	39	124	175	85	65	488
		LFS	1982	41	141	182	98	61	523
			1983	43	140	189	103	63	537
			1984	45	146	187	104	62	544
	Social Sciences and Humanities	**Census**	**1971**	**3**	**13**	**24**	**8**	**6**	**54**
			1981	**8**	**30**	**51**	**25**	**14**	**128**
		LFS	**1982**	**7**	**32**	**54**	**21**	**14**	**128**
			1983	**4**	**35**	**50**	**21**	**21**	**130**
			1984	**9**	**33**	**47**	**27**	**16**	**132**

See footnote(s) at the end of table.

APPENDIX TABLE 2. Scientists, Engineers and Technologists by Occupational Group and Region – Concluded

Occupational group				Atlantic provinces	Quebec	Ontario	Prairie provinces	British Columbia	Canada
						thousands			
231	Social sciences	Census	1971	**	3	6	1	1	11
			1981	1	7	12	4	2	26
		LFS	1982	*	7	12	*	*	25
			1983	*	9	10	4	*	27
			1984	*	8	10	4	*	26
233	Social work and related fields	Census	1971	2	6	11	5	3	27
			1981	5	14	27	15	9	70
		LFS	1982	*	17	25	12	7	65
			1983	*	17	21	12	7	60
			1984	4	17	22	14	9	66
235	Library, museum and archival sciences	Census	1971	1	3	4	1	1	10
			1981	1	7	8	4	2	22
		LFS	1982	*	5	11	4	*	24
			1983	*	5	13	5	*	29
			1984	*	6	11	5	*	27
239	Other occupations in social sciences and related fields	Census	1971	**	1	3	1	1	6
			1981	1	2	4	2	2	11
		LFS	1982	*	*	6	*	*	14
			1983	*	4	6	*	*	15
			1984	*	*	4	4	*	13
	Total	**Census**	**1971**	**43**	**144**	**246**	**99**	**57**	**589**
			1981	**68**	**241**	**386**	**185**	**121**	**1,001**
		LFS	**1982**	**68**	**250**	**403**	**195**	**118**	**1,036**
			1983	**65**	**259**	**393**	**203**	**127**	**1,044**
			1984	**76**	**263**	**401**	**206**	**117**	**1,063**

[1] LFS = Labour Force Survey.

Note: All data and estimates are disaggregated according to the 1971 Occupational Classification except for the 1984 LFS estimates where the 1980 Occupational Classification is used.

Source: 1971, 1981 Censuses and Labour Force Survey estimates for 1982, 1983 and 1984.

APPENDIX TABLE 3. Scientists, Engineers and Technologists, by Occupational Group and Age

Occupational group	Census								Labour Force Survey			
	1971				1981				1982			
	15-24	25-34	35+	TOTAL	15-24	25-34	35+	TOTAL	15-24	25-34	35+	TOTAL
	thousands											
Natural Sciences and Engineering	**127**	**173**	**235**	**535**	**153**	**333**	**387**	**873**	**149**	**339**	**421**	**907**
Physical sciences	8	11	13	32	8	15	15	38	8	20	20	48
Agricultural and biological sciences	5	6	6	17	6	10	10	26	5	11	13	29
Architects and engineers	7	27	45	79	9	54	76	139	12	51	71	134
Architecture and engineers related	20	24	25	69	32	41	43	116	22	37	42	101
Mathematicians, statisticians and systems analysts	7	12	7	26	14	33	19	66	16	35	21	72
Medicine and health	80	93	139	312	84	180	224	488	86	185	254	523
Social Sciences and Humanities	**13**	**18**	**23**	**54**	**22**	**51**	**56**	**128**	**22**	**48**	**58**	**128**
Social sciences	2	5	4	11	3	12	11	26	*	11	11	25
Social work and related fields	8	8	11	27	14	27	29	70	16	25	24	65
Library, museum and archival sciences	2	3	5	10	3	8	11	22	*	8	14	24
Other occupations in social sciences and related fields	1	2	3	6	2	4	5	11	*	4	9	14
Total	**140**	**191**	**258**	**589**	**175**	**384**	**443**	**1,001**	**171**	**387**	**479**	**1,036**

Source: Censuses of 1971 and 1981 and Labour Force Survey estimates for 1982, 1983 and 1984.

APPENDIX TABLE 3. Scientists, Engineers and Technologists, by Occupational Group and Age – Concluded

Occupational group	Labour Force Survey							
	1983				1984			
	15-24	25-34	35+	TOTAL	15-24	25-34	35+	TOTAL
	thousands							
Natural Sciences and Engineering	**135**	**349**	**430**	**914**	**130**	**349**	**430**	**931**
Physical sciences	6	20	21	47	5	16	20	41
Life sciences	5	12	12	29	4	15	13	32
Architects and engineers	9	46	77	132	10	46	74	130
Architecture and engineers related	16	36	36	88	15	33	37	85
Mathematicians, statisticians and systems analysts	18	39	24	81	20	49	30	99
Medicine and health	81	196	260	537	76	193	275	544
Social Sciences and Humanities	**22**	**49**	**59**	**130**	**24**	**48**	**60**	**132**
Social sciences	*	13	12	27	*	11	12	26
Social work and related fields	17	23	20	60	16	25	25	66
Library, museum and archival sciences	*	9	17	29	4	7	16	27
Other occupations in social sciences and related fields	*	4	10	15	*	5	7	13
Total	**157**	**398**	**489**	**1,044**	**154**	**400**	**509**	**1,063**

Source: Censuses of 1971 and 1981 and Labour Force Survey estimates for 1982, 1983 and 1984.

APPENDIX TABLE 4. Scientists, Engineers and Technologists, by Industry

Industry	Census						Labour Force Survey								
	1971			1981			1982			1983			1984		
	NSE	SSH	TOTAL	NSE	SSH	TOTAL	NSE	SSH	TOTAL	NSE	SSH	TOTAL	NSE	SSH	TOTAL
	thousands														
Agriculture	1	**	1	1	**	1	*	*	*	*	*	*	*	*	*
Primary	15	**	15	30	1	31	..	..	..	..	..	..	..	..	..
Manufacturing	67	2	69	97	2	99	138	*	141	124	*	127	124	*	126
Construction	11	**	11	16	**	16	11	*	11	7	*	8	8	*	8
Transportation	25	1	26	41	2	43	47	*	48	50	*	51	43	*	45
Trade	6	1	7	23	**	23	28	*	28	30	*	31	32	*	33
Finance	4	1	5	24	1	25	14	*	14	14	*	15	18	*	21
Services	352	37	389	565	88	653	576	89	665	596	98	694	611	97	708
Public administration	54	12	66	76	84	110	88	30	118	89	23	112	88	27	115
Total	**535**	**54**	**589**	**873**	**128**	**1,001**	**906**	**128**	**1,034**	**914**	**130**	**1,044**	**931**	**132**	**1,063**

Note: All data and estimates are disaggregated according to the 1970 Standard Industrial Classification (SIC) except for the 1984 LFS estimates where the 1980 SIC is used.

Source: Censuses of 1971 and 1981 and Labour Force Survey estimates for 1982, 1983 and 1984.

APPENDIX TABLE 5. Scientists, Engineers and Technologists in the Service Industries, by Occupational Group

Occupational group	Census		Labour Force Survey		
	1971	1981	1982	1983	1984
			thousands		
Natural Sciences and Engineering	**352**	**565**	**578**	**596**	**611**
Physical sciences	8	11	12	11	11
Agriculture and biological sciences	7	7	7	7	8
Architects and engineers	17	42	43	41	38
Other occupations in architecture and engineering	18	28	29	28	27
Mathematicians, statisticians and systems analysts	5	20	22	26	32
Medicine and health	297	457	465	483	495
Social Sciences and Humanities	**37**	**88**	**89**	**98**	**97**
Social sciences	6	12	12	14	15
Social work and related fields	18	50	46	45	49
Library, museum and archival sciences	8	17	19	25	23
Other occupations in social sciences and related fields	5	9	12	14	10
Total	**389**	**653**	**667**	**694**	**708**

Note: Because the 1982 LFS averages were done with the 1971 Occupational Classification and the 1981 Census data referred to the 1980 Occupational Classification, we decided to use the 1971 Occupational Classification in order to permit comparability between data of both sources.
Source: Censuses of 1971 and 1981 and Labour Force Survey estimates for 1982, 1983 and 1984.

APPENDIX TABLE 6. Scientists, Engineers and Technologists in the Manufacturing Industries, by Occupational Group

Occupational group	Census		Labour Force Survey		
	1971	1981	1982	1983	1984
			thousands		
Natural Sciences and Engineering	**67**	**97**	**138**	**124**	**124**
Physical sciences	11	11	27	24	20
Agriculture and biological sciences	1	2	7	6	7
Architects and engineers	27	37	46	45	48
Other occupations in architecture and engineering	17	28	30	23	22
Mathematicians, statisticians and systems analysts	7	11	16	16	18
Medicine and health	4	8	12	10	9
Social Sciences and Humanities	**2**	**2**	*	*	*
Total	**69**	**99**	**141**	**127**	**126**

Note: Because the 1982 LFS averages were done with the 1971 Occupational Classification and the 1981 Census data referred to the 1980 Occupational Classification, we decided to use the 1971 Occupational Classification in order to permit comparability between data of both sources.
Source: Censuses of 1971 and 1981 and Labour Force Survey estimates for 1982, 1983 and 1984.

APPENDIX TABLE 7. Federal Personnel Engaged in R&D in the Natural Sciences, by Category, 1977-78 to 1985-86[1]

Category	1977-78	1978-79	1979-80	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86
					person-years				
Executive	55	55	59	66	79	204	182	237	225
Scientific and Professional	5,066	5,270	5,166	5,183	5,274	5,619	5,680	5,775	5,605
Administrative and Foreign Service	585	599	620	618	619	695	723	732	765
Technical	4,862	4,763	4,675	4,684	4,867	4,828	4,682	4,863	4,617
Administrative support	1,645	1,765	1,759	1,722	1,841	1,971	2,092	1,942	1,959
Operational	3,009	2,967	2,879	2,862	2,928	2,953	3,084	3,067	2,855
Military	160	139	154	143	144	142	146	144	140
Total	**15,382**	**15,558**	**15,312**	**15,278**	**15,752**	**16,412**	**16,588**	**16,759**	**16,167**

[1] Excluding employees engaged in the administration of extramural research and development.
Source: Statistics Canada, Science, Technology and Capital Stock Division.

APPENDIX TABLE 8. Federal Personnel Engaged in R&D in the Social Sciences, by Category, 1977-78 to 1985-86[1]

Category	1977-78	1978-79	1979-80	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86
					person-years				
Executive	25	14	17	17	23	23	30	33	35
Scientific and Professional	538	421	375	321	326	342	320	329	329
Administrative and Foreign Service	165	160	157	141	162	121	76	79	81
Technical	130	107	98	81	93	79	45	46	42
Administrative support	213	201	201	185	171	140	117	111	112
Operational	6	9	6	1	1	–	–	–	–
Military	20	24	18	20	18	21	21	21	20
Total	**1,097**	**936**	**872**	**766**	**794**	**726**	**609**	**619**	**619**

[1] Excluding employees engaged in the administration of extramural research and development.
Source: Statistics Canada, Science, Technology and Capital Stock Division.

APPENDIX TABLE 9. Professional Personnel Engaged in R&D, by Industry and by Degree Level, 1984

Industries	Bachelor's	Master's	Doctorate	Total
		person-years (rounded to nearest 5)		
Mining and oil wells				
Mining	225	45	65	330
Crude petroleum and natural gas	125	50	65	245
Total mining and oil wells	**350**	**95**	**130**	**575**
Manufacturing				
Food, beverages and tobacco	405	75	100	580
Rubber and plastic products	75	20	45	140
Textiles	65	10	10	90
Wood	75	30	35	140
Pulp and paper	195	60	135	390
Primary metals (ferrous)	125	25	15	170
Primary metals (non-ferrous)	215	110	125	445
Metal fabricating	135	30	10	175
Machinery	360	15	5	375
Aircraft and parts	1,125	270	80	1,475
Other transportation equipment	530	60	20	610
Telecommunication equipment	2,015	865	270	3,145
Electronic parts and components	395	65	15	475
Other electronic equipment	805	285	100	1,190
Business machines	895	245	90	1,230
Other electrical products	500	85	25	610
Non-metallic mineral products	50	15	10	75
Refined petroleum and coal products	280	125	215	620
Drugs and medicines	125	55	150	330
Other chemical products	725	165	220	1,105
Scientific and professional equipment	185	45	35	265
Other manufacturing industries	105	10	10	125
Total manufacturing	**9,375**	**2,665**	**1,715**	**13,755**
Services				
Transportation and other utilities	985	235	85	1,310
Electrical power	240	185	225	645
Computer services	650	45	25	725
Engineering and scientific services	830	240	240	1,315
Other non-manufacturing industries	345	65	55	465
Total services	**3,050**	**775**	**635**	**4,460**
Total all industries	**12,775**	**3,535**	**2,480**	**18,790**

Source: Statistics Canada, **Industrial Research and Development Statistics, 1983**, Catalogue No. 88-202.

APPENDIX TABLE 10. Number of Persons Engaged in R&D, by Province and by Occupational Category, 1984

Province	Professionals	Other	Total
		person-years (rounded to nearest 5)	
Newfoundland	25	20	45
Prince Edward Island	5	10	15
Nova Scotia	90	135	225
New Brunswick	55	90	145
Quebec	4,255	4,710	8,965
Ontario	11,565	11,515	23,080
Manitoba	205	330	535
Saskatchewan	210	285	495
Alberta	1,055	1,025	2,080
British Columbia	1,235	930	2,165
Yukon and Northwest Territories	90	50	140
Total	**18,790**	**19,100**	**37,890**
Metropolitan areas			
Montreal	3,535	3,775	7,310
National Capital Region	3,595	3,005	6,600
Toronto	4,765	4,540	9,305

Source: **Ibid.**

APPENDIX TABLE 11. Number of Persons Engaged in R&D, by Industry Group and by Region, 1984

Industry group	Quebec	Ontario	Alberta	British Columbia	Other provinces[1]	Total
			person-years (rounded to nearest 5)			
Mining and oil wells	155	210	560	130	155	1,210
Chemical based	1,230	3,585	640	75	145	5,685
Wood based	560	305	10	300	35	1,210
Metals	555	1,325	10	45	55	1,990
Machinery and transportation equipment	2,595	2,920	65	110	380	6,065
Electrical and electronic products	2,155	9,680	260	785	215	13,090
Other manufacturing	110	330	10	25	20	490
Services	1,610	4,730	525	695	590	8,150
Total	**8,965**	**23,080**	**2,080**	**2,165**	**1,600**	**37,890**

[1] Includes the Yukon and the Northwest Territories.
Source: **Ibid.**

APPENDIX TABLE 12. Full-time University Teachers, by Teaching Field and Province

Teaching field	Nfld.	P.E.I.	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	B.C.	Canada
						number					
Natural Sciences and Engineering											
1971	245	41	523	330	2,684	4,183	660	525	959	1,021	11,171
1975	311	38	647	362	3,088	4,897	714	663	1,083	1,143	12,946
1979	395	38	699	354	3,288	5,276	687	692	1,179	1,266	13,874
1982	415	38	741	385	3,492	5,522	704	723	1,317	1,300	14,637
Agriculture and biological sciences											
1971	42	13	63	48	358	694	161	121	176	194	1,870
1975	43	13	88	58	586	749	158	167	197	222	2,281
1979	63	12	79	33	580	795	141	176	196	240	2,315
1982	65	12	115	61	609	777	149	172	205	241	2,406
Engineering and applied sciences											
1971	26	3	79	101	510	833	107	109	156	126	2,050
1975	40	3	78	110	603	946	97	103	172	131	2,283
1979	43	3	80	130	679	997	80	113	196	141	2,462
1982	43	3	93	117	695	1,031	83	117	218	144	2,544
Health sciences											
1971	57	–	204	25	891	1,230	226	161	291	263	3,348
1975	92	–	279	27	982	1,583	280	211	383	336	4,173
1979	131	–	323	30	1,056	1,839	293	262	437	420	4,791
1982	143	–	289	31	1,188	2,049	285	284	517	465	5,251
Mathematics and physical sciences											
1971	120	25	177	156	925	1,426	166	134	336	438	3,903
1975	136	22	202	167	917	1,619	179	182	331	454	4,209
1979	158	23	217	161	973	1,645	173	141	350	465	4,306
1982	164	23	244	176	1,000	1,665	187	150	377	450	4,436
Social Sciences and Humanities											
1971	354	84	786	543	3,100	6,139	751	692	1,375	1,461	15,285
1975	330	83	877	661	3,629	7,313	853	692	1,475	1,693	17,636
1979	410	82	946	731	3,976	7,399	787	762	1,603	1,785	18,481
1982	426	83	951	713	4,214	7,421	795	774	1,649	1,775	18,801
Education											
1971	88	11	107	57	508	727	116	162	330	317	2,423
1975	90	6	131	138	728	1,077	132	183	393	420	3,298
1979	86	5	136	145	752	914	125	202	401	402	3,168
1982	141	5	140	136	764	875	117	189	403	375	3,145
Humanities[1]											
1971	137	40	391	297	1,214	2,888	290	280	533	621	6,691
1975	131	43	382	303	1,159	3,101	326	262	555	638	6,900
1979	151	41	394	397	1,244	3,128	292	271	585	677	7,181
1982	103	41	384	278	1,292	3,073	296	281	595	691	7,034

See footnote(s) at the end of table.

APPENDIX TABLE 12. Full-time University Teachers, by Teaching Field and Province - Concluded

Teaching field	Nfld.	P.E.I.	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	B.C.	Canada
						number					
Social sciences											
1971	129	33	288	189	1,378	2,524	345	250	512	523	6,171
1975	139	34	364	220	1,742	3,135	395	247	527	635	7,438
1979	172	36	416	189	1,980	3,357	370	289	617	706	8,132
1982	182	37	427	299	2,158	3,473	382	304	651	709	8,622
Total											
1971	**601**	**125**	**1,322**	**876**	**5,877**	**10,536**	**1,451**	**1,310**	**2,364**	**2,488**	**26,950**
1975	**679**	**121**	**1,557**	**1,030**	**6,732**	**12,288**	**1,573**	**1,360**	**2,574**	**2,868**	**30,782**
1979	**810**	**120**	**1,661**	**1,097**	**7,289**	**12,826**	**1,622**	**1,461**	**2,830**	**3,086**	**32,802**
1982	**861**	**121**	**1,816**	**1,101**	**7,724**	**13,106**	**1,683**	**1,501**	**3,001**	**3,165**	**34,079**

[1] Includes fine and applied arts.
Source: Statistics Canada, Education, Culture and Tourism Division.

APPENDIX TABLE 13. Median Age of Full-time University Teachers, by Teaching Field and Province

Teaching field	Nfld.	P.E.I.	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	B.C.	Canada
						median age					
Natural Sciences and Engineering											
1971	37	39	39	38	39	40	39	40	38	40	39
1975	39	42	41	40	41	42	42	42	41	42	41
1979	41	44	42	42	43	44	43	44	43	42	43
1982	43	47	44	43	44	45	44	45	44	43	45
Agriculture and biological sciences											
1971	37	41	40	41	40	40	40	40	39	40	40
1975	40	44	40	40	42	42	42	41	41	42	41
1979	40	47	43	41	44	43	43	43	42	43	43
1982	41	50	44	43	45	46	44	45	44	44	45
Engineering and applied arts											
1971	36	38	40	38	38	40	39	39	39	42	39
1975	40	42	42	41	40	43	44	43	41	44	42
1979	43	39	44	42	42	45	46	45	44	45	44
1982	44	42	46	45	44	46	46	47	46	47	46
Health sciences											
1971	42	–	40	39	41	41	41	42	40	43	41
1975	42	–	42	41	42	43	42	43	41	43	42
1979	43	–	43	42	43	44	42	45	43	44	44
1982	44	–	45	41	44	45	44	45	43	44	45

See footnote(s) at the end of table.

APPENDIX TABLE 13. Median Age of Full-time University Teachers, by Teaching Field and Province – Concluded

Teaching field	Nfld.	P.E.I.	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	B.C.	Canada
						median age					
Mathematics and physical sciences											
1971	35	37	37	38	38	38	36	39	37	38	38
1975	37	42	39	39	40	41	40	41	41	41	40
1979	39	44	40	41	42	43	41	43	43	43	43
1982	42	47	42	42	44	45	43	45	44	44	44
Social Sciences and Humanities											
1971	37	37	38	37	38	39	37	39	39	40	38
1975	39	39	40	39	40	41	40	41	40	41	40
1979	41	42	41	41	42	43	42	44	42	43	42
1982	43	44	43	42	43	45	44	45	44	45	44
Education											
1971	39	38	38	36	38	40	41	42	40	43	40
1975	42	44	39	39	39	42	42	44	42	42	41
1979	44	48	41	41	41	44	44	44	44	45	43
1982	47	45	43	43	44	46	45	47	45	47	45
Humanities[1]											
1971	38	40	39	38	40	40	38	40	39	40	39
1975	41	41	42	40	42	42	41	42	40	42	42
1979	43	43	43	42	44	44	43	45	43	44	44
1982	43	46	45	45	46	46	45	46	45	45	46
Social sciences											
1971	34	34	36	35	37	37	35	37	38	38	37
1975	37	36	38	37	38	39	38	39	40	40	39
1979	39	40	40	38	40	41	41	42	41	41	41
1982	41	43	41	40	42	43	43	43	43	43	42
Total											
1971	**37**	**38**	**38**	**37**	**39**	**39**	**38**	**40**	**39**	**40**	**39**
1975	**39**	**40**	**40**	**39**	**40**	**41**	**41**	**42**	**41**	**41**	**41**
1979	**41**	**43**	**42**	**41**	**42**	**43**	**43**	**44**	**43**	**43**	**43**
1982	**43**	**45**	**43**	**43**	**44**	**45**	**44**	**45**	**44**	**45**	**44**

[1] Includes fine and applied arts.

Source: Statistics Canada, Education, Culture and Tourism Division.

APPENDIX TABLE 14. Distribution of University Teachers[1] by Teaching Field and Citizenship, 1982

Teaching field	Canada	United States	United Kingdom	Other Commonwealth	Belgium and France	Other European	Other	Total
				number				
Natural Sciences and Engineering	**8,699**	**920**	**664**	**288**	**25**	**174**	**152**	**10,922**
Agriculture and biological sciences	1,337	256	104	42	3	19	11	1,772
Engineering and applied sciences	1,473	76	78	54	4	48	43	1,776
Health sciences	3,276	252	276	103	9	49	48	4,013
Mathematics and physical sciences	2,613	336	206	89	9	58	50	3,361
Social Sciences and Humanities	**10,613**	**2,396**	**623**	**239**	**83**	**196**	**144**	**14,294**
Education	1,933	277	73	32	3	13	7	2,338
Humanities[2]	4,047	1,035	293	55	59	114	37	5,640
Social sciences	4,633	1,084	257	152	21	69	100	6,316
Total	**19,312**	**3,316**	**1,287**	**527**	**108**	**370**	**296**	**25,216**

1 Excluding teachers in Quebec.
2 Includes fine and applied arts.
Source: Statistics Canada, **Teachers in Universities**, Catalogue No. 81-241.

APPENDIX TABLE 15. Full-time University Teachers, by Teaching Field and Academic Rank

Teaching field	Full professor	Associate professor	Sub-total	Assistant professor	Ranks below assistant professor	Sub-total
			per cent of total			
Natural Sciences and Engineering						
1971	24	31	55	33	8	41
1975	29	34	63	26	5	31
1979	34	35	69	16	4	20
1982	39	34	73	18	4	22
Agriculture and biological sciences						
1971	25	31	56	33	7	40
1975	31	34	65	25	4	27
1979	37	34	71	22	3	25
1982	41	34	75	18	2	20
Engineering and applied sciences						
1971	25	37	62	30	5	35
1975	33	38	72	18	3	21
1979	41	35	76	14	3	17
1982	47	32	79	12	3	15

See footnote(s) at the end of table.

APPENDIX TABLE 15. Full-time University Teachers, by Teaching Field and Academic Rank – Concluded

Teaching field	Full professor	Associate professor	Sub-total	Assistant professor	Ranks below assistant professor	Sub-total
			per cent of total			
Health sciences						
1971	22	26	48	35	11	46
1975	25	29	54	33	9	42
1979	27	33	60	29	7	36
1982	30	35	65	26	6	32
Mathematics and physical sciences						
1971	24	31	55	34	7	41
1975	30	38	68	23	3	26
1979	37	38	75	16	3	19
1982	43	35	78	13	3	16
Social Sciences and Humanities						
1971	17	25	42	38	15	53
1975	20	32	52	32	9	41
1979	23	39	62	25	6	31
1982	27	41	68	21	3	24
Education						
1971	12	26	38	38	16	54
1975	13	29	42	33	12	45
1979	19	39	58	28	8	36
1982	23	44	67	23	6	29
Humanities[1]						
1971	17	25	42	37	16	53
1975	21	34	65	31	8	39
1979	24	42	66	23	6	29
1982	28	43	71	19	5	24
Social sciences						
1971	18	26	44	40	13	53
1975	22	31	53	33	8	41
1979	25	37	62	26	6	32
1982	29	39	68	22	5	27

[1] Includes fine and applied arts.

Note: Because of the unclassified professors, the addition of the two sub-totals does not equal 100%.

Source: Statistics Canada, Education, Culture and Tourism Division.

APPENDIX TABLE 16. Median Age of Full-time University Teachers[1] by Teaching Field and Academic Rank, 1982

Teaching field	Full professor	Associate professor	Assistant professor	Rank below assistant professor	Other	Total
			median age			
Natural Sciences and Engineering	**50**	**43**	**35**	**32**	**41**	**45**
Agriculture and biological sciences	50	42	35	33	38	44
Engineering and applied sciences	49	43	35	29	47	46
Health sciences	52	44	37	34	38	44
Mathematics and physical sciences	48	42	34	33	42	44
Social Sciences and Humanities	**51**	**43**	**38**	**34**	**40**	**43**
Education	51	45	40	36	40	45
Humanities[2]	52	44	39	35	41	44
Social sciences	49	41	35	32	40	41
Total	**50**	**43**	**37**	**33**	**40**	**44**

1 Excluding teachers in Quebec.
2 Includes fine and applied arts.
Source: Statistics Canada, **Teachers in Universities**, Catalogue No. 81-241.

APPENDIX TABLE 17. Bachelor's Degrees in Engineering, by Field of Study

Field of study	1970	1975	1981	1982	1983
			percentage of total graduates in engineering		
Chemical	14	9	11	11	12
Civil	20	24	24	21	19
Electrical	25	24	23	24	26
Mechanical	22	21	21	24	27
Other	19	22	21	20	12
			number		
Total	**3,531**	**4,078**	**6,173**	**6,257**	**6,089**

Source: Statistics Canada, Education, Culture and Tourism Division.

APPENDIX TABLE 18. Bachelor's Degrees Awarded to Women, by Field of Study

Field of study	1970	1975	1976	1977	1978	1979	1980	1981	1982	1983
						per cent				
Natural Sciences and Engineering	**24**	**32**	**33**	**32**	**34**	**35**	**35**	**35**	**37**	**37**
Agriculture and biological sciences	39	46	46	46	47	49	50	50	52	53
Engineering and applied sciences	2	3	3	3	6	7	8	8	9	11
Health sciences	51	53	54	53	57	59	59	59	63	63
Mathematics and physical sciences	18	22	23	22	25	28	28	30	28	29
Social Sciences and Humanities	**27**	**35**	**36**	**35**	**40**	**42**	**43**	**45**	**46**	**46**
Other[1]	49	58	58	58	61	64	62	64	65	65
Total[2]	**38**	**44**	**46**	**44**	**48**	**49**	**50**	**50**	**51**	**51**

[1] Includes fine and applied arts, humanities and education.
[2] Includes unclassified degrees.
Source: Statistics Canada, Education, Culture and Tourism Division.

APPENDIX TABLE 19. Master's Degrees Awarded, by Field of Study and Sex

Field of study		1975	1976	1977	1978	1979	1980	1981	1982	1983
						number				
Natural Sciences and Engineering	**Total**	**2,560**	**2,781**	**2,969**	**2,860**	**3,002**	**2,947**	**2,848**	**3,184**	**3,336**
	Male	**2,130**	**2,304**	**2,454**	**2,438**	**2,339**	**2,245**	**2,131**	**2,341**	**2,474**
	Female	**431**	**477**	**515**	**422**	**663**	**752**	**767**	**843**	**862**
Agriculture and biological sciences	Total	473	593	638	632	574	617	609	632	624
	Male	342	430	438	445	409	408	380	392	374
	Female	132	163	200	187	165	209	229	240	250
Engineering and applied sciences	Total	963	1,014	1,128	1,150	1,160	1,109	1,036	1,176	1,285
	Male	921	983	1,088	1,081	1,094	1,031	948	1,078	1,173
	Female	37	31	40	69	66	78	88	98	112
Health sciences	Total	303	321	363	424	470	504	555	594	594
	Male	148	168	143	178	186	173	216	244	252
	Female	155	153	220	246	284	331	339	350	342
Mathematics and physical sciences	Total	821	853	917	876	798	767	698	782	833
	Male	714	723	785	734	650	633	587	627	675
	Female	107	130	132	142	148	134	111	155	158

See footnote(s) at the end of table.

APPENDIX TABLE 19. Master's Degrees Awarded, by Field of Study and Sex – Concluded

Field of study		1975	1976	1977	1978	1979	1980	1981	1982	1983
						number				
Social Sciences and Humanities	**Total**	**8,471**	**8,745**	**9,408**	**9,552**	**9,347**	**4,430**	**9,997**	**9,668**	**10,506**
	Male	**5,792**	**5,706**	**6,030**	**6,046**	**5,563**	**5,531**	**5,709**	**5,347**	**5,721**
	Female	**2,679**	**3,039**	**3,378**	**3,506**	**3,784**	**3,899**	**4,288**	**4,321**	**4,785**
Education	Total	2,161	2,354	2,593	2,825	2,830	2,826	3,145	2,862	2,983
	Male	1,491	1,485	1,582	1,718	1,567	1,528	1,603	1,367	1,396
	Female	670	869	1,011	1,107	1,263	1,298	1,542	1,495	1,587
Humanities[1]	Total	2,256	2,133	2,229	2,263	2,080	1,988	2,085	1,844	2,134
	Male	1,219	1,167	1,172	1,177	952	907	934	790	957
	Female	1,037	1,026	1,057	1,086	1,128	1,081	1,151	1,054	1,177
Social sciences	Total	4,058	4,258	4,490	4,464	4,437	4,616	4,767	4,962	5,389
	Male	3,082	3,114	3,276	3,151	3,044	3,096	3,172	3,190	3,368
	Female	972	1,144	1,214	1,313	1,393	1,520	1,545	1,772	2,021
Total[2]	**Total**	**11,068**	**11,555**	**12,375**	**12,637**	**12,351**	**12,432**	**12,903**	**13,110**	**13,842**
	Male	**7,949**	**8,030**	**8,498**	**8,486**	**7,903**	**7,778**	**7,848**	**7,803**	**8,195**
	Female	**3,119**	**3,525**	**3,877**	**4,151**	**4,448**	**4,654**	**5,055**	**5,307**	**5,647**

1 Includes fine and applied arts.
2 Includes unclassified degrees.
Source: Statistics Canada, Education, Culture and Tourism Division.

APPENDIX TABLE 20. Doctorates Awarded, by Field of Study and Sex

Field of study		1975	1976	1977	1978	1979	1980	1981	1982	1983
						number				
Natural Sciences and Engineering	**Total**	**999**	**869**	**905**	**972**	**907**	**872**	**889**	**872**	**981**
	Male	**894**	**770**	**815**	**864**	**793**	**744**	**764**	**739**	**822**
	Female	**105**	**99**	**90**	**108**	**114**	**128**	**125**	**133**	**159**
Agriculture and biological sciences	Total	236	197	228	239	224	210	220	221	247
	Male	195	158	202	199	193	161	171	170	197
	Female	41	39	26	40	31	49	49	51	50
Engineering and applied sciences	Total	227	188	203	224	231	191	215	183	220
	Male	218	177	201	217	222	185	206	175	210
	Female	9	11	2	7	9	6	9	8	10
Health sciences	Total	122	105	105	125	134	137	113	150	174
	Male	97	84	78	97	91	92	80	112	119
	Female	25	21	27	28	43	45	33	38	55
Mathematics and physical sciences	Total	414	379	369	384	318	334	341	318	340
	Male	384	351	334	351	287	306	307	282	296
	Female	30	28	35	33	31	28	34	36	44

See footnote(s) at the end of table.

APPENDIX TABLE 20. Doctorates Awarded, by Field of Study and Sex – Concluded

Field of study		1975	1976	1977	1978	1979	1980	1981	1982	1983
						number				
Social Sciences and Humanities	**Total**	**824**	**818**	**797**	**846**	**892**	**859**	**922**	**837**	**835**
	Male	**639**	**599**	**581**	**623**	**637**	**591**	**609**	**549**	**543**
	Female	**185**	**219**	**216**	**223**	**255**	**268**	**313**	**288**	**292**
Education	Total	172	157	173	157	193	205	203	213	189
	Male	122	111	131	118	137	124	129	122	106
	Female	50	46	42	39	56	81	74	91	83
Humanities[1]	Total	295	264	274	278	302	251	292	243	261
	Male	225	169	182	192	204	169	182	159	179
	Female	70	95	92	86	98	82	110	84	82
Social sciences	Total	357	397	350	411	397	403	427	381	385
	Male	292	319	268	313	296	298	298	268	258
	Female	65	78	82	98	101	105	129	113	127
Total[2]	**Total**	**1,840**	**1,693**	**1,702**	**1,819**	**1,803**	**1,738**	**1,816**	**1,715**	**1,821**
	Male	**1,544**	**1,375**	**1,396**	**1,488**	**1,434**	**1,339**	**1,337**	**1,290**	**1,370**
	Female	**296**	**318**	**306**	**331**	**369**	**399**	**439**	**425**	**451**

[1] Includes fine and applied arts.
[2] Includes unclassified degrees.
Source: Statistics Canada, Education, Culture and Tourism Division.

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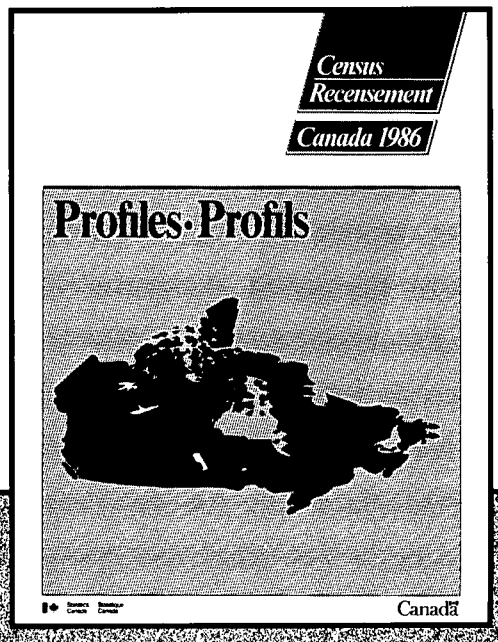

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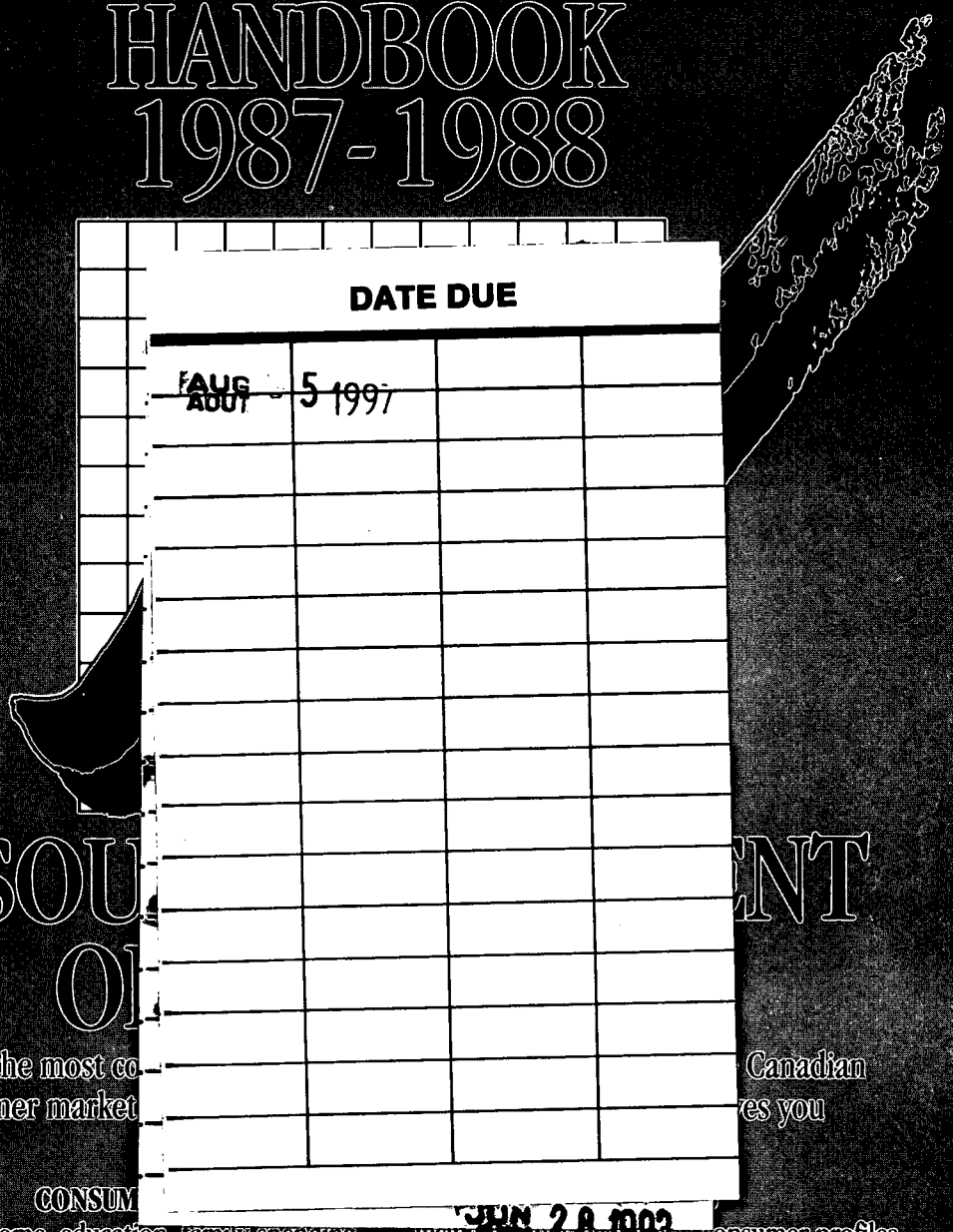

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