THE UTILIZATION OF WOMEN SCIENTISTS IN CANADA

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INTRODUCTION

Science has assumed a very important role in our society in recent decades because of the rapidly developing technology of production and defence. The supply of scientists and engineers is barely keeping up with demand.

Shortages of scientists and engineers had already begun to develop during World War II and have continued ever since.[1] As recently as 1962 the Department of Labour found that Canadian universities expected their staff requirements for engineers to increase by 49 per cent in the following five years and that for scientists by 34 per cent. The federal government anticipated its requirements for scientists to increase 40 per cent in the ensuing five years.[2]

Early in 1963 the Chemical Institute of Canada reported: "The chronic and increasing shortage of chemists and chemical engineers in Canada is reaching alarming proportions."[3] Advertisements appearing daily in the

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[1]Royal Commission on Canada's Economic Prospects, Skilled and Professional Manpower in Canada, 1945-1965, Ottawa, Queen's Printer, 1957, p.26.

[2]Department of Labour, Economics and Research Branch, Employment Outlook for Professional Personnel in Scientific and Technical Fields, 1962-1964, Ottawa, Queen's Printer, 1962, p.21.

[3]Chemistry in Canada, Ottawa, Chemical Institute of Canada, February, 1963, p.12.

newspapers and the professional periodicals attest to the urgent need for scientists and engineers, particularly those with post graduate training.

This need is not likely to decline in future years; the Canadian Nuclear Association goes farther in its prediction and indicates that ten times as many technically trained people will be needed in 1972 as in 1962.[4]

The Unemployment Insurance Commission in its bulletin "Supply and Demand: University Graduates, 1962-63" quotes the National Aeronautics and Space Administration of the United States, which predicts a 70 per cent increase in the number of scientists required by 1970, particularly physicists and mathematicians.[5]

The supply of scientists and engineers cannot be increased quickly by training more persons since ordinarily a minimum of four years after senior matriculation is required for a bachelor's degree in honour science or engineering and an additional three to four years' training for a doctor of philosophy degree. Only the brightest students with an aptitude for scientific work are suitable for university training and they must have had at least a minimum of science and mathematics at high school.

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[4] Financial Post, Toronto, April 27, 1963, p.49.

[5] Unemployment Insurance Commission, Supply and Demand: University Graduates, 1962-63, Ottawa, Queen's Printer, 1962, p. 28.

One factor limiting supply is that until now only men have been practically considered potential students of science and engineering. Although no legal restrictions have been placed on women either in respect to training or employment, few women enter the sciences, particularly the physical sciences, and hardly any enter engineering.

Steps have already been taken to increase the number of young men training in science and engineering.[6] The other half of the potential science and engineering brain-power, that of young women, has been relatively little considered.[7] Although many girls study mathematics and the sciences in high school and some do extremely well in them,[8] comparatively few go on to the honour courses in science in university. For many reasons, girls go into the courses traditionally followed by women, such as nursing, teaching, household science, social work and librarianship.[9]

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[6]F. T. Rosser, "Our Position in the World," Wanted...More Experts.!, Ottawa, Department of Labour, 1958, p.21.

[7]Marguerite Ritchie and Mollie Gillen, "How Canada Wastes its Woman-Power," Saturday Night, Toronto, April 2, 1960, p.18.

[8]J. Bascom St. John, "A Problem Without a Solution," The Globe and Mail, Toronto, November 12, 1963, p.7.

[9]Agness P. Beckett, Women in the Professions, Speech Prepared for the Alberta Association of Registered Nurses, Ottawa, Department of Labour, Women's Bureau, May, 1960, p.4.

INTRODUCTION

Could a larger number of women scientists and engineers be utilized to fill the universities' and the economy's needs? The United States Committee on Scientists and Engineers has advocated public education programs of many varieties to encourage young women to undertake science and engineering studies and ensure that they receive satisfactory employment after training. It observed that: "Long established prejudices against women in engineering and science need to be broken down not only among employers, supervisors and co-workers, but among the women themselves."[10]

The Director of the United States Office of Defense Mobilization has stated: "There is no question at all but that more women should be enrolled in our engineering schools. This is one of the ways of dealing adequately with the present and potential shortages in this area."[11]

Mr. F.L.W. McKim of the National Research Council in Canada has quoted a report of the United States National Science Foundation in 1961, which stated that: "...for women with the aptitude and desire to become scientists,

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[10] United States, Department of Labor, Careers for Women in the Physical Sciences, Washington, U.S. Government Printing Office, 1959, p.1.

[11] United States, Department of Labor, Employment Opportunities for Women, Washington, U.S. Government Printing Office, 1954, p.1.

ample opportunity and encouragement should be provided them to consider careers in these fields. The extent to which such encouragement may result in an influx of women into scientific careers may not be large and cannot be foreseen at this time. Since the primary career of women will continue to be that of wife and mother, many young women will undoubtedly choose to forego a professional career."[12]

A prominent woman educator in the United States, Mirra Komarovsky of Barnhart College, said that: "In the immediate future, it is obvious that out of a hundred coeds, the overwhelming majority would do better to enter the 'feminine fields', to go into, for example, social work rather than physics...But what inference for long-range policy are we to draw from these observations? The segregation is greater than is warranted by sex differences in aptitudes. Many a first-rate male teacher is lost to teaching because it is a feminine and underpaid occupation. Many a woman scientist would prove more competent than the man who has her place in the laboratory because science is not a feminine field."[13]

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[12] F.L.W. McKim, Notes prepared for presentation in Symposium at meeting March 21, 1962, sponsored by the Women's Bureau, Department of Labour, Ottawa, p.3.

[13] Mirra Komarovsky, Women in the Modern World: Their Education, and Their Dilemnas, Boston, Little, Brown & Co., 1953, p.269.

Classifying occupations arbitrarily as being suited to one sex or the other is the most expensive thing a society can do, according to Margaret Mead, distinguished anthropologist now associated with the American Museum of Natural History. When an occupation is so characterized, Dr. Mead notes that: "It loses to that occupation not only the brightest members of the other sex but 50 per cent of the top talent. It loses also the balancing and complementary values gained by the differing approaches of the two sexes to the same problems."[14]

"When male engineers are in short supply it is inevitable that the marginally-productive talent among them will be used," stated Beatrice A. Hicks, herself an engineer and executive of a large American manufacturing company. She added that: "The best potential talent among women engineers and scientists has hardly been sampled."[15]

Speaking of the small proportion of women students at the doctor's level, Dr. M.M. Chambers of the University of Michigan wrote in 1962: "This may be partly due to

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[14]Robert Amon, "Engineering Talent in Short Supply," Industrial Bulletin, New York State Department of Labor, Albany, N.Y., June, 1962, p.3.

[15]Beatrice A. Hicks, Our Untapped Source of Engineering Talent, Paper given before the Western Society of Engineers, U.S.A., September 4, 1952, p.1.

the different biologic roles of the two sexes, but it is assuredly also largely due to social traditions and prejuces...best overcome and forgotten. We could use to very great advantage more women physicians and surgeons, more women in all scientific fields, more women in university and college teaching." Dr. Chambers feels this will eventually come about as a result of society's commitment to the optimum development of all available talents.[16]

The British Federation of University Women refers to its country's responsibility to the millions of people in the world who need the developments brought about by improved science and technology. It observed that: "We cannot afford to neglect any talent which may help us in the search for new ideas and ways of developing them."[17]

The Women's Bureau of the Canadian Department of Labour stated in a 1963 bulletin: "Sustained economic growth requires the constructive use of all potential resources of brainpower. There are new possibilities for the employment of women interested in and trained for work outside the home."[18]

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[16]M.M. Chambers, Chance and Choice in Higher Education, Danville, Ill., Interstate Publishers, 1962, p.10.

[17]British Federation of University Women Ltd., Opportunities for Girls and Women in Science and Technology, London, October, 1961, p.4.

[18]Department of Labour, Opportunities for Continuing Education, Women's Bureau Bulletin Number IX, Ottawa, July, 1963, p.5.

Dr. F.T. Rosser, Vice President of the National Research Council in Canada, has made the point: "In many other countries much greater use is made of women in all fields of science, medicine and engineering. In fact the female proportion is about 50 per cent over all the branches of engineering in Russia compared with less than 1 per cent in the United Kingdom or Canada. In thinking that engineering is socially less creditable and less suited to women than other careers perhaps we are neglecting a potential supply of good engineers that would help to solve the shortage problem." Dr. Rosser mentioned that women have a special aptitude for medical, biological, biochemical, analytical and statistical work. He also noted that Canada has a reserve of trained women above the age of 40 whose children have grown up and whose housekeeping duties are light. "It is possible," he says, "that much greater use could be made of them in laboratories and in teaching."[19]

Is it possible that larger numbers of women scientists and engineers can be effectively utilized in Canada? One may wonder why more women do not come forward for training in the sciences. Some of the factors concerning women's participation in these fields will be considered in the following pages.

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[19] F.T. Rosser, loc. cit., p. 21.

INTRODUCTION

To obtain a clearer view of women's participation in the sciences and engineering, their entry into science fields and various aspects of their work will be considered in some detail.

The gradual entry of women into the science and engineering professions in Canada is reviewed from 1920 to 1962, with particular emphasis on current or recent trends. To gain an idea of supply, statistical data are introduced where available.

Trends in the utilization and general characteristics of women scientists are studied with emphasis on occupational specializations, functions, educational level and marital status. A section on post graduate training is also included.

Working conditions as they affect the supply of women scientists and engineers are considered with attention given to such points as hours of work, part-time work, the average level of women scientists' earnings, promotions, and return to work after an absence.

Because sociological factors have a bearing on the supply of women for science and engineering work, these are considered in some detail. Particular attention is given to the pattern and length of women's work life, women's ability for scientific work, and the effect of tradition on girls' selection of studies.

The demand for women scientists and engineers will be ascertained as far as it is possible to assess it from current available data. The attitudes of some government employers toward women scientists and some conditions of work in research and development are introduced as examples of Canadian opinion at this time.

The comparatively small utilization of women scientists and engineers is considered in the light of fairly widespread needs for scientific personnel in Canada and is also compared briefly to the utilization of women scientists in other countries, notably the Soviet Union.

Who is included in this study of women scientists? The Department of Labour in its report to the Royal Commission on Canada's Economic Prospects defined a professional person as one for whom the minimum qualification is either graduation from a university of recognized standing or some generally accepted equivalent combination of special training and experience.[20] Membership in a professional organization, usually granted only to those with appropriate university degrees but occasionally to those who occupy professional positions as a result of upgrading, is also accepted by the Department of Labour as proof of competence.

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[20]Royal Commission on Canada's Economic Prospects, Skilled and Professional Manpower in Canada, 1945-1965, p.9.

The fields of science used in this study are those selected by the Department of Labour's Register of Scientific and Technical Personnel, viz: agriculture; architecture; engineering (civil, mechanical, industrial, electrical, mining, chemical, business and other engineering); forestry; the physical sciences (physics, chemistry, mathematics and the geosciences); the biological sciences and veterinary medicine.[21]

By using in this study the same definitions of scientist and engineer as those used by the Department of Labour, the central source, in Canada, of information on science and engineering manpower, the data may be used and understood without confusion. Census data on occupations can be reconciled to a large extent with these statistics and the United States figures are also comparable. The only difficulty in classification lies with the biological sciences. The Department of Labour in its Register excludes those working in medical fields, and these have also been excluded in this study. When working with statistics of post graduate students of the biological sciences, careful selection has been necessary to remove the medical specializations.

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[21] Department of Labour, Economics and Research Branch, Engineering and Scientific Manpower Resources in Canada, 1957, Ottawa, Queen's Printer, 1959, p.9.

Although data on supply ordinarily cover only university graduates in science and engineering fields, the Scientific and Technical Personnel Register does include graduates in arts who are actually occupying science or engineering positions and effectively doing the work of a scientist. For the same reason, scientists and engineers who have transferred to a non-scientific field of employment are excluded from the Register data.

In speaking of both scientists and engineers throughout the study reference will sometimes be made to them collectively as scientists, for convenience.

CHAPTER I

SUPPLY

The current supply of scientific and engineering personnel consists of all university trained and professionally recognized workers in scientific occupations and those so trained but unemployed and seeking work. Supply has been derived from the following three sources: graduates from universities in Canada and abroad, net immigration, and upgrading.[1] The supply coming from each source will be discussed in this chapter, and reference will also be made to post graduate training.

No attempt will be made in this study to add the components of supply as several are missing or incomplete. Although Canadian university graduations since 1920 are known in detail, the number of Canadian science and engineering students who have graduated in the United States or other countries and returned to Canada is not known, statistics on immigration by field of occupation go back only to 1953, and emigration data do not show men and women separately.

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[1]United States, National Science Foundation, A Program for National Information on Scientific and Technical Personnel, Washington, D.C., August, 1958, p.12. As well as defining current supply, this bulletin goes on to define potential supply as including those trained but not working and those who could be trained.

Similarly, withdrawals from active work are not known.[2] In the case of women scientists and engineers, withdrawals and transfers are more likely to affect supply than mortality because most women graduates in these fields are in the younger age groups.

1. Graduations in Science and Engineering

A few women were graduating each year in the sciences by 1924 and the number had reached an average of 51 per year by 1935-1939. Twenty years later, in the period 1955-1959, 183 women were graduating annually in the sciences and by 1960-1962 the average was 298 per year. Table I shows total graduates, and the number of women graduates, by five-year averages from 1920-1924 to 1960-1962.

The proportion representing women science and engineering graduates in Canada, although higher than its 1.8 per cent annual average in 1920-1924, was still not more than 6.6 per cent in the years 1960-1962. The proportion of women graduates rose in the late 1920's, increased during the 1930's and reached a higher level during, and particularly after, the war. The proportion dropped sharply in the early 1950's but reached a higher level in 1960-62

[2]However, the Department of Labour keeps its Register up to date by withdrawing the records of those no longer working in a science field.

TABLE I

Science and Engineering Graduates from Canadian Universities, by Five-Year Averages, 1919/20-1960/62

	Archi-tecture		B.Sc. (Arts)		Agri-culture		Engin-eering		Vet. Med.		Annual Average		Per Cent
	Tot.	F.	Tot.	F.	Tot.	F.	Tot.	F.	Tot.	F.	Tot.	F.	Female
1919/20-1923/24	14	-	86	10	161	2	418	1	27	-	729	13	1.8
1924/25-1928/29	18	-	148	19	105	2	339	-	20	-	653	21	3.2
1929/30-1933/34	27	-	261	41	164	2	486	1	29	-	1002	44	4.4
1934/35-1938/39	34	3	295	41	243	6	589	1	57	-	1245	51	4.1
1939/40-1943/44	18	2	344	60	226	8	731	-	58	-	1416	70	4.9
1944/45-1948/49	46	5	808	147	377	18	1540	5	58	1	2868	176	6.1
1949/50-1953/54	134	5	944	136	446	19	2076	3	114	5	3881	168	4.3
1954/55-1958/59	93	2	922	162	257	8	1732	5	74	3	3177	183	5.8
1959/60-1961/62	99	3	1598	277	302	9	2352	6	65	3	4537	298	6.6

Source: Dominion Bureau of Statistics, Higher Education Section, Special Tables, Unpublished, 1963.

Women graduating with a bachelor of science degree comprised in the period 1960-1962 the largest proportion, 86 per cent, of graduates in any field included in the study. In all other specializations, including engineering, the number of women graduates is very small.

It is also in the natural and the physical sciences that women graduates represent the greatest proportion of all graduates, within the fields included here. They comprised nearly 12 per cent of the bachelor of science graduates in Canada during the period 1920-1924 and over 17 per cent in 1960-1962.

During the 42 years from 1920 to 1962, the total number of men and women science and engineering graduates was 89,012, of which 4,522 or 5.1 per cent were women.

The number of women graduating each year in the major fields of science are shown in Table II for the period 1948 to 1963. In this fifteen year span there were 271 honours graduates in biology, 224 in chemistry, 34 in geology and 196 in mathematics and physics. In recent years the number of biology graduates and those in mathematics and physics appear to be increasing faster than the number of chemistry graduates. The total number of women science graduates has been over 300 a year since 1961.

TABLE II

Women Science and Engineering Graduates
Canadian Universities, 1947/48 to 1962/63

Year	All[3] Science	Pure[4] Science	Honour Science (Included in totals on left) Biol.	Chem.	Geol.	Math/Phys.	Other[5]
1947/48	215	173	15	19	1	15	18
1948/49	217	175	15	15	1	8	14
1949/50	163	129	11	9	3	12	18
1950/51	189	152	21	15	1	9	18
1951/52	172	125	10	9	-	7	13
1952/53	158	139	13	15	-	11	18
1953/54	142	122	10	7	-	10	13
1954/55	136	128	13	6	1	10	8
1955/56	167	151	12	22	1	5	10
1956/57	176	159	12	11	3	7	10
1957/58	203	170	18	11	3	7	5
1958/59	225	201	18	15	7	17	13
1959/60	269	247	23	14	2	10	10
1960/61	311	287	21	14	4	21	24
1961/62	329	310	29	16	6	22	24
1962/63	n/a	n/a	30	26	1	25	24

Source: Dominion Bureau of Statistics, Higher Education Section, Special Tables, Unpublished, compiled by Department of Labour and forwarded with letter from A.D. Boyd, February 14, 1964.

[3]Total includes: agriculture, architecture, engineering, forestry, veterinary medicine and pure science.

[4]Includes only graduates receiving a B.Sc. Those receiving a B.A. degree in science are included in Arts and cannot be separated. Graduates in Honour Science receiving a B.Sc. are included. The University of Toronto began granting a B.Sc. in 1960/61.

[5]Includes bacteriology, biochemistry, chemistry and physics, and other courses.

SUPPLY

The number of women engineering graduates, included in the totals of Table II but not shown separately, was low but fairly steady during the years 1948 to 1963, reaching a total of 68 for the period. The number of women who graduated in the veterinary sciences during these years totalled 54, and the number in forestry fifteen.[6] In agriculture there were 231 women graduates between 1948 and 1963; in architecture 59, fewer in the last half of the period than in the first.

While Canadian university graduates in science and engineering represent the largest part of the supply, those Canadians who graduate in these fields of study in universities outside Canada, together with immigrant scientists and engineers coming to Canada from other countries, must be also considered part of the supply and will be discussed in the next section.

2. Canadians Studying Science and Engineering Outside Canada

A small part of Canada's supply of engineers and scientists has come from Canadian students graduating abroad, notably in the United States. Although data on graduations are not available, the enrolment of Canadian science students in the United States is shown in Table III.

[6] Twelve of the women forestry students graduated from the Sopron School of Forestry at the University of British Columbia in 1957/58 and 1958/59.

SUPPLY

TABLE III

Canadian Students of Science and Engineering
Enrolled in United States Universities, 1962/63

Field of Study	Total		Undergraduate		Post-Graduate	
	Tot.	F.	Tot.	F.	Tot.	F.
Engineering						
Civil	169	2	116	1	53	1
Mechanical	149	1	111	-	38	1
Mining and geological	66	1	51	1	15	-
Other[11]	447	1	278	1	169	-
Total Engineering	831	5	556	3	275	2
Science						
Agronomy	39	1	10	-	29	1
Biology	113	18	64	12	49	6
Biological Sciences	60	7	21	4	39	3
Botany	100	2	43	1	57	1
Chemistry	166	14	67	9	99	5
Geo-science	161	5	46	2	115	3
Husbandry	44	1	23	1	21	-
Mathematics	173	16	76	9	97	7
Physics	135	4	36	2	99	2
Science undesignated	24	3	16	3	8	-
Other[12]	83	-	26	-	57	-
Total Science	1,098	71	428	43	670	28
Total Engineering and Science	1,929	76	984	46	945	30

Source: United States, Institute of International Education, as reported in letter received from Department of Labour, Economics and Research Branch, October 2, 1963.

[11]Includes aeronautical, agricultural, chemical, electrical, electronic, industrial, metallurgical, petroleum, sanitary, and textile.

[12]Includes agriculture, food technology, astronomy, atomic science, mineralogy, and metallurgy.

The number of women students among Canadians enrolled in the sciences and engineering in United States universities in 1962/63 is not large; of 428 undergraduate science students 43 were women, and of 556 undergraduate engineering students only 3 were women. As in Canadian universities, more Canadian women students in the United States were enrolled in biology, chemistry and mathematics than in other science specializations.

Although not all Canadian students of the sciences and engineering in the United States return to work in Canada, a fairly large proportion do so. A survey of Canadians receiving master's degrees in these fields in the United States in 1960 and 1961 showed that 76 per cent of those who replied intended to return to work in Canada; of those taking doctor's degrees 67 per cent intended to return. It is not known if more, or fewer, Canadian women than men scientists who have graduated in the United States return to Canada.[9]

3. Immigration of Women Scientists

The immigration of women scientists and engineers to Canada increases the supply of trained persons for scientific work. Immigration is one of the few ways in which the

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[9]National Research Council, After-Graduation Plans of 1960 and 1961 Doctorates and Masters of Science and Engineering, Ottawa, 1962, p.4.

number of scientists and engineers may be increased fairly rapidly,[10] although administrative difficulties may cause several months' delay.

The number of immigrant women scientists admitted to Canada during the decade 1953 to 1962[11] ranks large when compared with Canadian graduations, as shown in Table IV. This table compares the number of immigrants with the number of graduates for three specializations, architecture, chemistry and engineering. In two of these, architecture and chemistry, the number of women specialists entering Canada by immigration was larger than the number of Canadian women graduates. However, the number of graduate women engineers in this period is over twice the number of immigrants due to a larger number of graduations in the last half of the decade.

4. Emigration of Women Scientists

Emigration of scientists and engineers from Canada negates to some extent the beneficial effects of immigration. Most emigration is to the United States, of which details are available from the U.S. Department of Justiee,

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[10] Bringing trained persons out of retirement or transferring them from non-scientific fields to scientific ones are other ways.

[11] Details on the number of women immigrants by specialization go back only to 1953.

TABLE IV

Women Architects, Chemists and Engineers
Entering Canada by Immigration, 1953 to 1962,
Compared with Canadian Graduations

	Architects		Chemists		Engineers	
Period	Immig.	Grad.	Immig.	Grad.	Immig.	Grad.
1953-1962	49	29	159	131	19	39

Source: Data on immigration received from Mr. J.P. Delisle, Chief, Statistics Division, Department of Citizenship and Immigration, in letter of March 1, 1963. Data on Canadian graduations received from Mr. A.D. Boyd, Economics and Research Branch, Department of Labour, in letter of February 14, 1964. The original data on graduations were compiled by the Higher Education Section, Dominion Bureau of Statistics.

Emigration and Naturalization Service, although the data do not show men and women separately.

In the decade 1950-1960 Canada was the eventual beneficiary of trained science manpower, although in the two years 1959 and 1960 more engineers emigrated from Canada than were received by immigration. Over the decade the net immigration of engineers was 6,984 which may be compared with Canadian engineering graduations during the same period of 21,234. The net immigration of chemists in the same years was 1,278 compared with 1,275 Canadian chemistry graduates, an almost identical number. Similarly, the net immigration of architects, 1,286 in 1950-1960, was very close to the total graduations of architects which reached 1,292 for the ten year period.[12]

It is not known, however, whether or not the emigration pattern for women in the scientific professions is similar to that of men.

5. Upgrading

Data are not available on the number of women scientists and engineers who obtained professional positions by upgrading and who are not graduates of recognized universities. Professional organizations ordinarily

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[12]Department of Labour, Economics and Research Branch, The Migration of Professional Workers into and out of Canada, 1946-1960, Ottawa, Queen's Printer, 1961, p.43.

grant membership only to university graduates or those who have had sufficient equivalent experience to pass qualifying examinations. The latter way of entry is not likely to be open to women since they are not found to any extent in positions which would likely lead to promotion as professionals.

6. Post-graduate Training

Although the first or bachelor's degree in science or engineering is considered sufficient training for a graduate to be called "professional" and it is first graduations which represent supply, additional training beyond the graduate level has been most useful in the past and is now becoming more and more necessary.

Not as large a proportion of women take post graduate degrees in science and engineering as take first degrees in these fields. For example in 1950/51 only 5.5 per cent of the masters of science degrees were awarded to women although 14.2 per cent of the first degrees in science were obtained by women. A larger proportion of women take advanced degrees in the biological sciences than in the physical sciences, according to figures for 1959/60 and 1960/61 shown in Table V.

Women represented no higher a proportion than 10 per cent of those who obtained advanced degrees in the

TABLE V

Post-Graduate Degrees in Science and Engineering, 1959/60 and 1960/61

	Engineering	Physical Sciences	Biological Sciences	Both Sciences
1959/60				
M.A.'s, Men	185	242	136	378
M.A.'s, Women	2	13	27	40
% Women of Total	1.1	5.1	16.6	9.8
Ph.D.'s, Men	14	119	61	180
Ph.D.'s, Women	-	3	10	13
% of Total	-	2.5	14.1	6.7
1960/61				
M.A.'s, Men	217	288	270	558
M.A.'s, Women	2	15	43	58
% of Total	1.1	5.0	15.9	9.4
Ph.D.'s, Men	19	101	81	182
Ph.D.'s, Women	-	3	8	11
% of Total	-	3.0	9.9	4.0

Source: Dominion Bureau of Statistics, Survey of Higher Education, 1954-1961, Ottawa, Queen's Printer, 1963, p.55.

physical and biological sciences in 1959/60 and 1960/61, although they comprised nearly 19 per cent of the bachelor of science graduates in 1959/60 and over 17 per cent in 1960/61. The proportion of women among those taking higher degrees in those years was larger in the biological sciences.

A substantial proportion of Canadian post graduate science students have been enrolled at universities in the United States. For example the number of Canadian men doing post graduate work in the physical and biological sciences in the United States in 1962/63 represented nearly 31 per cent of their counterparts in Canada. At the same time, Canadian undergraduate male science and engineering students in the United States totalled only 3 per cent of enrolment at home. Women post graduate science students from Canada enrolled in United States universities represented 11 per cent of similar graduate enrolment at home, but on the undergraduate level totalled less than 2 per cent of the number of women undergraduates in these fields in Canadian universities.[13]

Because post graduate training is so necessary in our technological society this section has been included with supply to round out the picture of education.

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[13]Letter received from Dr. P.H. Casselman, Economics and Research Branch, Department of Labour, October 2, 1963, based on information obtained from the Institute of International Education, New York.

CHAPTER II

SOME CHARACTERISTICS AND UTILIZATION OF WOMEN SCIENTISTS IN CANADA

1. Occupational Specializations

The number of women occupied in science and engineering has increased from four, all women architects, reported in the Census of 1921, to a total of 1,133 in 1961.[1] In spite of the increase in their numbers, however, women still represent only a small proportion, less than 1 per cent, of the engineers in Canada and less than 6 per cent of the biological and physical scientists. The number of women in major science and engineering fields in 1961 are shown in Table VI.[2]

The total 1,133 women scientists in 1961 comprised 116 engineers, 591 physical scientists, 360 biological scientists and 66 architects. Of the engineers, the specialization in which most women were found was electrical engineering, followed by civil engineering. Among the physical scientists, by far the largest group were in chemistry, 442 women chemists or 7.2 per cent of the total in that occupation. There were only 269 women biologists,

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[1] Census of Canada, 1961, Bulletin 3.1-3, p.6-4.

[2] Mathematicians are not shown with the scientists in Table VI because in Census data they are included with accountants and auditors, and other groups, and not shown separately.

TABLE VI

Scientists and Engineers in Canada
Census 1961

	Men	Women	% Women
Engineers			
Civil	11,888	29	0.24
Mechanical	8,122	15	0.18
Industrial	3,960	2	0.05
Electrical	8,723	40	0.46
Mining	2,347	2	0.08
Chemical	2,982	14	0.09
Engineers n.e.s.	14,928	14	0.09
Total	42,950	116	0.25
Physical Scientists			
Chemists	5,702	442	7.2
Geologists	2,716	54	1.9
Physicists	673	26	3.7
Physical Scientists n.e.s.	1,380	69	4.8
Total	10,471	591	5.3
Biological and Agricultural Scientists			
Biological	1,397	269	16.1
Agricultural	2,681	65	2.4
Veterinarians	1,498	26	1.7
Total	5,576	360	6.1
Architects	2,874	66	2.2
Total Scientists and Engineers	61,871	1,133	1.8

Source: Census of Canada, 1961, Bulletin 3.1-3, p.6-4.

Note: Only the Census of 1961 is shown in this table because the more detailed classifications introduced in this year made comparisons with previous years difficult. The 1951 Census was the first in which women engineers were recorded - 23 in that year. Women architects have appeared in the Census since 1921 and have risen gradually.

representing 16.1 per cent of all workers in biological specializations, the highest proportion of women in any science field.

In addition to the Census data on the number of men and women in the major science and engineering fields, it is of interest to note the number and proportion of women in the Register of Scientific and Technical Personnel maintained by the Department of Labour. The composition of the Register in 1962 is shown in Table VII. Here women biologists represented 17.5 per cent of all biologists, women chemists 5.9 per cent of the total and women mathematicians 11.5 per cent of those working in this field. In geography, women represented 6.4 per cent of the total. In all other fields the proportion of women was quite small.

Also available from the Census of 1961 are details showing that a fairly large proportion of Canada's scientists and engineers were born outside the country. Over 32 per cent of the male engineers and scientists were born outside Canada and over 30 per cent of the female scientists, who are shown separately in Table VIII.

The largest number of women scientists not born in Canada came from European countries, while only a small number came from the United States.

TABLE VII

Register of Scientific and Technical Personnel
Department of Labour, 1962, by Field

Specialization	Total	Women	Per Cent Women
Agriculture	3,733	40	1.1
Biological sciences	1,118	196	17.5
Chemistry	2,874	170	5.9
Forestry	1,721	3	0.2
Geography	156	10	6.4
Geosciences	1,714	19	1.1
Mathematics	893	103	11.5
Physics	1,221	24	2.0
Veterinary science	1,072	16	1.5
Engineering	27,768	43	0.2
Other	9,334	163	1.7
Total	51,604	787	1.5

Source: Department of Labour, Economics and Research Branch, received in letter from Dr. P. H. Casselman September 6, 1963.

Note: Differences between the figures shown by the Census and those of the Register of Scientific and Technical Personnel are probably due to differences in enumeration practice and in requirements for inclusion. The Register is a voluntary participation, while the Census is intended to include everyone. Only scientists and engineers with a university degree or otherwise professionally qualified are included in the Register, but in the Census some 25 per cent of the men engineers and 21 per cent of the women engineers are shown as having either no university education or only partial university training without graduation. Their inclusion among professional engineers may have been due to enumerators' errors. At the same time, the Census table may not include women scientists classified as university teachers or business managers, placing these in another classification.

TABLE VIII

Country of Birth of Women Scientists in Canada, 1961

	Total	Canada	United Kingdom	Europe	U.S.	Other
Engineers	116	74	9	27	3	3
Physical Scientists						
Chemists	442	276	26	106	13	21
Geologists	54	40	-	10	3	1
Physicists	26	16	3	6	-	1
Physical Scientists, n.e.s.	69	58	5	1	3	2
Total	591	390	34	123	19	25
Biological and Agricultural Scientists						
Biologists	269	191	15	43	6	14
Agriculturists	65	50	6	7	1	1
Veterinarians	26	17	4	4	-	1
Total	360	258	25	54	7	16
Architects	66	27	6	27	-	6
Total Scientists and Engineers	1,133	749	74	231	29	50

Source: Census of Canada, 1961, Bulletin 3.1-15, p.21-15.

Obviously, the number of women scientists and engineers now working is much less than the number who have qualified through graduation in a science, currently at the rate of well over two hundred per year. The Department of Labour's study of women in science and engineering in 1952 included 830 respondents to a survey of all the women in the Register at that time.[3] In 1962 the number of respondents to a similar enquiry was only 787.[4] Because of the voluntary nature of the Register the totals can not be considered comparable, but the very fact that the number was smaller and not larger ten years later may be significant.[5] Many women qualified in the sciences have become full time housewives or changed to another type of work.[6] Men, too, are often lost to the science and engineering professions through transfers to other occupations, but not to the same extent.

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[3]Department of Labour, Economics and Research Branch, Report on Women in Science and Engineering, Ottawa, 1956, p.1.

[4]Department of Labour, Economics and Research Branch, Letter received from P.H. Casselman, September 6, 1963,p.3.

[5]Department of Labour, Economics and Research Branch, Letter received from P.H. Casselman, March 27, 1963. The letter explains: "Our files (the Register) contain approximately 2,150 female graduates. About two-thirds of these are married and most of the remainder are employed in Canada. These figures are low when compared with the graduating statistics. This inconsistency may be

2. Functions of Women Scientists

A particular feature of women scientists' employment is their narrower range of duties. The three functions "teaching, instructing, extension work", together with "research, development" and "testing, inspecting and laboratory services" represent the work of the majority of women scientists and engineers - 87 per cent of all those surveyed by the Department of Labour in 1952 and 79 per cent of those in 1962, as shown in Table IX.

The women science teachers and those engaged in instructing and extension work are most likely to be found in universities or other educational institutions, the research scientists are concentrated mainly in government departments, educational institutions and manufacturing, and the women scientists who do laboratory work are most usually in government laboratories or in manufacturing firms. Not many women scientists were engaged in designing, performing administrative duties or working in sales, marketing or purchasing.

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due to our incomplete records on general science graduates and to labour force withdrawals prior to the establishment of the cycle survey program."

[6] Mr. J.E. McCannel of the Agricultural Institute of Canada, in a letter of February 6, 1963 wrote in answer to an enquiry: "Many of the female graduates from agricultural faculties seem to find employment in positions either remotely connected or not related to the classifications normally included in our professional ranks."

TABLE IX

Functions of Women Scientists and Engineers, 1952 and 1962

Function	1952	1962
Construction, Installation, Erection	-	1
Design	22	25
Administration	10	20
Field Exploration	-	1
Veterinary Diagnosis, Treatment	5	24
Production, Operation, Maintenance	24	10
Research, Development	333	211
Sales, Service, Marketing, Purchasing	5	18
Teaching, Instructing, Extension Work	110	278
Testing, Inspecting, Laboratory Services	305	129
Other, or not stated	19	70
Total	830	787

Source: Department of Labour, Economics and Research Branch, Report on Women in Science and Engineering, Ottawa, 1956, p.5. Also letter received from Dr. P.H. Casselman September 6, 1963.

Women engaged in different occupational specializations were often concentrated in certain functions only, according to the 1952 study of the Department of Labour. For example women biologists and chemists were to be found mainly in testing and laboratory work or in research; very few were engaged in teaching. Among the women physicists, on the other hand, most were in research or teaching. About one-third of the women agriculture specialists were in teaching as well as one-third of the women mathematicians. Of the 20 women architects, 14 were doing designing and draughting work.

Among women scientists there has been a trend toward teaching and away from research and laboratory work in the ten years 1952 to 1962 referred to in the Department of Labour's studies. The number of women engaged in teaching rose by 153 per cent[7] while the number in research and development dropped by nearly 40 per cent. The number in testing and laboratory work also dropped by 58 per cent in the ten year period.

Women with doctor's degrees in science and engineering were almost entirely to be found in research and teaching, according to the Department of Labour study of 1952.[8]

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[7]This percentage increase in the number of women scientists in "teaching" is shown to represent a trend only, as high school teachers were omitted in the 1952

Considering all those engaged in teaching, about one-third had a doctor's degree and one-third a master's. In research, 14 per cent of the women had a doctor's degree and 38 per cent a master's. In the function "testing, inspecting and laboratory services", nearly all the women had a bachelor"s degree only.

Because the academic level reached by scientists and engineers has an important bearing on the type of work they do and the promotions and earnings they receive, the academic level of women scientists will be considered in the next section.

3. Educational Level

The average level of academic degree of women scientists is not as high as that of men, although a substantial number of women have taken some, if not complete, post graduate training. In 1957 a Department of Labour study showed that 19 per cent of the men scientists had a master's degree compared with only 16 per cent of the women, and 21 per cent of the men had obtained a doctor's degree while only 14 per cent of the women scientists had

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study and some were included in 1962, although in 1962 the largest proportion of teachers were at universities.

[8] Report on Women in Science and Engineering, op.cit., p.6.

done so. Even in the biological sciences, in which women were strongly represented, 26 per cent of the men had a master's degree compared with only 18 per cent of the women, and 38 per cent of the men biologists had a doctor's degree compared with just 17 per cent of the women.[9] Results of a 1959 Department of Labour study were similar.[10]

Their lower average level of training is no doubt one of the factors why women scientists' earnings are not as high as those of men and why they do not receive as many promotions. This will be discussed in more detail later in the study. The next section will deal with women scientists' marital status and age, since these factors have a very important bearing on their work.

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[9] Department of Labour, Engineering and Scientific Manpower Resources in Canada, 1957, Ottawa, 1959, p.51.

[10] Department of Labour, Economics and Research Branch, Engineering and Scientific Manpower Resources in Canada, 1959, Ottawa, 1961, p.101.
The Department of Labour bulletin Women at Work in Canada, Ottawa, 1958, p.37, refers to the fact that in the Department's 1952 study, Report on Women in Science and Engineering, p.9, the statement is made that "the average academic level for women included in the Register is higher than for men". This is because, in that study, the average age of the women was lower than that of the men, and younger persons had been trained at a time when increased education was becoming more common. It was also because of the inclusion of engineers when calculating the percentages, as engineers did not usually take training beyond the bachelor's degree and many more men were in engineering.

4. Marital Status and Age

It is only in post-war years that married women have been entering the labour force in larger numbers. By 1962, some 48 per cent of the women at work were married, almost 42 per cent were single and about 10 per cent were widowed, separated or divorced.

In science and engineering, the women who are working are more likely to be single than married.[11] In 1961 some 51 per cent of the physical scientists were single women, as were 56 per cent of the biological and agricultural scientists and 60 per cent of the women engineers.[12] The proportion of single women varied among scientists in the different specializations, as shown in Table X. In chemistry approximately the same proportion were single as were married; among women geologists, twice as many were single as married. In both architecture and veterinary science more women were married than single, possibly because self-employment is possible to a larger extent in these fields.

It is of interest to note that there has been a trend among women scientists toward a larger proportion

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[11] Department of Labour, Women's Bureau, Facts and Figures About Women in the Labour Force in 1962, Ottawa, 1963, p.1.

[12] Census of Canada, 1961, Bul. 3.1-13, 1963, p.18.

TABLE X

Marital Status and Age of
Women Scientists and Engineers, 1961

	Single	Married	Widowed or Divorced	Average Age
Engineers				
Civil	14	13	2	34
Mechanical	6	9	-	36
Electrical	28	8	4	31
Chemical	8	6	-	34
Engineers, n.e.s.	10	4	-	33
Total	69	41	6	34
Physical Scientists				
Chemists	217	212	13	32
Geologists	36	18	-	29
Physicists	14	10	2	35
Physical Scientists, n.e.s.	36	30	3	34
Total	303	270	18	33
Biological and Agricultural Scientists				
Biologists	149	103	17	34
Veterinarians	9	15	2	36
Agricultural Scientists	45	18	2	33
Total	203	136	21	34
Architects	27	35	4	38

Source: Census of Canada, 1961, Labour Force: Occupations, Bulletin 31-13., p.18-15.

of working women who are married. Approximately 43 per cent of the women scientists in the 1961 Census were married compared to only 32 per cent in the Department of Labour's 1952 study.[13] This is consistent with the trend in the labour force as a whole, in which the proportion of single women declined from 48.5 per cent in 1956[14] to 41.7 per cent in 1962.

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[13] Department of Labour, Economics and Research Branch, Report on Women in Science and Engineering, 1956, p.4.

[14] Department of Labour, Women's Bureau, Women at Work in Canada, Ottawa, 1958, p.19.

CHAPTER III

WORKING CONDITIONS AS THEY AFFECT SUPPLY OF WOMEN SCIENTISTS

The supply of women scientists is affected by actual or anticipated conditions of work, and for this reason it is useful to look briefly at some current aspects of Canadian working conditions for women scientists and engineers.

1. Legislation

Working conditions in Canada, the subject of much provincial legislation, are on the average better than the minimum standards provide for.[1] On two important matters affecting married women, however, maternity leave and benefits and the provision of day nursery care for small children, Canada has fallen short of standards in many other countries.[2] Legislation requiring the provision of maternity leave is in effect in the federal civil service and in the civil service of several of the provinces, although it does not apply to private industry. The collective agreements of some industrial firms provide for maternity leave, although the leave is nearly always

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[1] Department of Labour, Economics and Research Branch, Working and Living Conditions in Canada, Ottawa, 1958, p.45.

[2] Department of Labour, Women's Bureau, Maternity Leave, No. VIII, Ottawa, June, 1963, p.7.; and The Labour Gazette, Vol. LX, No.7, Ottawa, July 29, 1960, p.674.

without pay and the right to such leave does not generally, in industry, guarantee that the woman will be given the same job on her return to work. With regard to day care for children, there has been no move here, as in a number of other countries, to encourage the scheduling of part-time work for married women or to provide services such as day care of children in order to permit women with family responsibilities to work outside the home.[3] Those who wish to work ordinarily make their own arrangements for care of their children, and this is done most often with a relative or paid housekeeper.[4]

2. Part-time Work

The opportunity to do part-time work in her specialization is extremely useful to the woman who cannot take full time work yet wishes to keep her skills up to date and keep abreast of new developments. Although many mothers of young children are so occupied at home they find it impossible to get away even for part of the day, others, perhaps with older children, may find a half day's work fits in very well with their domestic responsibilities.

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[3]Department of Labour, Women's Bureau, Women in the Labour Force in Nine Countries of Europe, Ottawa, 1962, p.6.

[4]Department of Labour, Women's Bureau, Married Women Working for Pay, Ottawa, 1958, p.61.

Part-time work is not generally characteristic of science and engineering unless the worker is self-employed, doing consulting, writing or other free lance work.[5] Some fields of biological or chemical research may be suitable for work on a part-day basis, although administration rigidities in government or industry may make part-time arrangements difficult.

University teaching, in which many women scientists and engineers are employed full time, may lend itself to part-time work. The Women's Bureau of the Department of Labour stated in a recent bulletin that: "University teaching makes such a dual life quite possible. One science department head of a university said he could employ many more competent married women biologists than he could get, especially for demonstration work. He felt there were many jobs in biology that 'fit in and around a private life.'"[6] Writers and editors may be employed on a part-time basis by firms or associations concerned with science, and laboratory testing jobs may be available with research firms. Such jobs are not always widely advertised and it may require some initiative on the part

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[5]United States, New York State Department of Labor, Information Bulletin, June, 1962, p.3.

[6]Department of Labour, Women's Bureau, Opportunities for Women in the Biological Sciences, No. X, October, 1963, p.2.

of the worker to seek them out. As scientists' skills become more urgently needed it is possible that arrangements will be made by industry and by educational institutions to employ women for half time or a twenty-hour week, and at higher levels of wages. At present part-time jobs are usually associated with routine, low paid work.

The Canadian Universities Foundation reflects the concern felt by many people over the lack of part-time jobs for married women with degrees. Dr. Edward Sheffield, its director, refers to the "untapped pool" of qualified women graduates in a number of fields where they are seldom called on to help. "If employers would try using women for interesting, part-time work, I'm sure the jump in production would be fantastic,"[7] Dr. Sheffield is quoted as saying.

One of the recommendations of the Conference in 1962 on The Real World of Women was that the employment pattern of our country be modified to fit in with the part-time hours which numbers of women could devote to work outside their homes.[8]

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[7]Jane Becker, The Ottawa Journal, March 5, 1963, p.7.

[8]Canadian Broadcasting Corporation, The Real World of Women, Conference held in Toronto, September 6-9, 1962, p.90.

3. Level of Earnings

Although there is some evidence to show that in past years the salaries of women scientists have not been as high as those of men, definite comparisons are difficult to make because the number of women has not been large and they may not, on the average, have been doing the same work. In recent years even if women's salaries have not been as high as those of men the salaries paid women scientists are sufficiently high to attract women to this profession.

The lower salaries of women in the early stages of their work as scientists may be partly due to the fact they are often concentrated in the lower paid specializations - biology, bacteriology, and chemical laboratory work. They are less often to be found in engineering, architecture, physics and geology which carry higher initial salaries. Later on, men are nearly always selected for advancement to managerial positions, which carry higher salaries, while women are likely to interrupt their career for marriage and childbearing.

Part of the reason for lower salaries of women in science in recent years has been that most of the women working in these fields are quite young. In the Department of Labour's survey of earnings in 1959, over

62 per cent of the women had graduated within the last ten years compared with only 46 per cent of the men.[9] According to this survey the 1959 earnings of scientists at all levels of experience and education were $7,150 for males and $4,700 for females, giving an overall male-female earnings differential of $2,450 per year. The difference between male and female earnings was smaller when comparing those with higher degrees or with more than twenty years' experience. For example, there was a difference of $2,350 between men's and women's earnings at the bachelor degree level but only $1,550 at the doctorate level. Similarly, although the differential was an average $2,100 for those who had graduated within the previous ten years, it was only $100 for those who had graduated 31-40 years before.

Women university professors of the biological sciences in 1960-61 were earning an average of $5,738 if they had a bachelor's degree and $7,636 with a doctor's degree.[10] Men teachers of the biological sciences earned $9,261 if they had a bachelor's degree and $9,511 with a

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[9] Department of Labour, Economics and Research Branch, Engineering and Scientific Manpower Resources in Canada, 1959, Ottawa, 1961, p.89.

[10] Dominion Bureau of Statistics, Salaries and Qualifications of Teachers in Universities and Colleges, 1962/63, Ottawa, 1963, p.60.

doctor's degree. In the physical sciences women university teachers earned $5,833 at the bachelor level in that year and $7,833 if they had their doctorate. Men earned $7,321 with a bachelor's degree and $9,040 with a doctor's degree.

There is evidence to show that women who do not marry and who are trained for a profession are likely to enjoy considerable recognition in their fields, as well as salaries often comparable to those of men in the same work.[11]

4. Promotions

The supply of women scientists may to some extent be affected by a lack of promotions, although its influence is tied in with the whole picture of women's entry into what was previously a restricted field. Broadly speaking, employers' decisions about utilizing women workers in higher level jobs have been shaped by conventional attitudes, which generally lead to decisions to promote men.

The fact that women are poorly represented in administrative and managerial jobs is largely a product of discontinuity in work, part-time work, the prevailing attitudes of co-workers and of employers, and the concentration of women in fields of employment and jobs offering limited chances for promotion. Training opportunities,

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[11] National Manpower Council, Womanpower, New York, Columbia University Press, 1957, p.66.

work experience, and seniority, which are important in the acquisition of skill and in promotion to supervisory positions, are jeopardized by interruptions in employment. A worker's position is closely governed by formal or informal systems of seniority, and a new employee usually starts out in one of the lowest ranking jobs. Advancement comes when the worker is able and willing to take advantage of such opportunities for promotion as appear. Discontinuity in work, or a lack of interest in work as opposed to home or other matters, is likely to militate against promotion.

Women who must subordinate the claims of work outside the home to their obligations in the home cannot make the effort to move up the latter of skill and responsibility.[12] Employers who are persuaded that their women workers are only temporary members of the labour force are reluctant to make an investment in providing training opportunities for them. Consequently, even women who do remain strongly attached to the labour force are often deprived of this necessary means of promotion.

If employers also believe, as many do, that women are not likely to have the qualities required to be

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[12] Ibid., p.237.

competent supervisors, and that women and men alike prefer to be supervised by men, they will be unwilling to plan to promote their women employees to positions of responsibility and authority.

Many women workers who remain employed for a considerable time, however, may advance some distance beyond their first job. Opportunities for advancement for women are greater in public than in private employment. Women are apparently gaining increasing acceptance in chemistry and biology research in the United States.[13] According to one reference, women have a much better chance of gaining responsible staff than executive or supervisory positions, partly because of the widespread belief that they are conscientious and careful with detail and so make good assistants or researchers.[14]

Available studiesof occupational advancement do not distinguish between women who work continuously and those who do not, according to this source.[15] It is known that many men advance by obtaining a series of better jobs in different organizations, but it is uncertain whether this is also a significant route to higher level jobs for women.

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[13] Ibid., p.240.

[14] Ibid., p.241.

[15] Ibid., p.246.

The Department of Labour's Women's Bureau has summed up the current situation in Canada: "It is still true that women find it difficult to achieve executive positions and are often passed over when promotions take place."[16] The Bureau points out that this can usually be accounted for by their own attitude toward their work: many women fail to obtain the training they need or perhaps do not work as hard at making a career for themselves because they expect to marry and look on a job as a temporary stop gap. As more and more married women are returning to work the situation is changing. A number of women have, during past years, made outstanding contributions to Canadian science.[17]

5. Re-entry into the Labour Force

The return to work after an absence of some years may present more of a problem to a professional woman scientist than to a person of lesser training. She may hesitate to offer her services to an employer for fear she may have lost her skills and not be readily accepted.

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[16]Department of Labour, Women's Bureau, Women in Canada, Reference Paper No. 99, Ottawa, 1963, p.5.

[17]Ann Francis, Women in Canada, mimeographed fact sheet, unpublished, Ottawa, May, 1962, p.5.
Miss Francis mentions such women as geologist Dr. Alice E. Wilson, biologist Dr. Clare Fritz, and Elsie Gregory MacGill, consulting aeronautical engineer.

Older women returning to work undoubtedly face several disadvantages. Traditionally, employers have favoured younger workers, and their bias against older women appears to be even stronger than that against older men. The main obstacle to the return to work of a professional woman appears to be her realization of the need for retraining.

Retraining programs in the fields of teaching or nursing are already well established in Canada. Although programs for retraining or for upgrading the skills of women in the sciences, among other fields, are well under way in the United States at such universities as Rudgers, Minnesota, Radcliffe, and the Sarah Lawrence College, New York, their movement is just getting started in Canada. A special program has been announced by Carleton University, Ottawa, directed toward women who have been out of the labour force for some time.[18] The program of continuing education is designed to offer extension and evening courses to women who wish to work toward a bachelor's or more advanced degree or to do supplementary study in field of interest to them.

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[18]Letter received from Miss Shirley Gillespie, Information Officer, Carleton University, Ottawa, December 31, 1963.

Actually, many Canadian universities have for some years had programs whereby students may proceed towards a degree over a period of several years.[19] Some civil servants in Ottawa, for example, have taken advantage of the University of Ottawa's evening classes for undergraduates in a wide range of courses leading toward degrees. The purpose of a special women's program would be to encourage, or even financially assist as in some United States university programs, women to increase their educational qualifications in the field of their choice. To this end, definite programs might be arranged on a part-time basis and at hours the housewife would find most convenient.

The need for a coordinated program of study is voiced by Mrs. Virginia Senders, one of the originators of the Minnesota Plan, an outstanding special program for married women's studies in the United States: "For millions of American women, the lack of a starting place means that they simply do not start. Others invest heavily in scattered courses adding up to nothing..."[20] The Women's Bureau of the Department of Labour in Canada commented on Mrs. Senders' remarks: (They)..."are

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[19] Bill Stephenson, The College That's for Everyone, Maclean's Magazine, Toronto, May 12, 1956, p.34.

[20] Department of Labour, Women's Bureau, Opportunities for Continuing Education, Ottawa, July, 1963, p.5.

similarly applicable to Canada. There is a lack of services that provide full information about the opportunities available to women in continuing education and that provide competent help in developing a sound program of studies."[21]

6. Cost of Training in Relation to Length of Work Life

The cost of university education in Canada continues to rise and is higher now than at any time in the past. Taken by itself this fact would seem to show that it would be harder for both men and women, and especially women, since in families with several children money is more often made available for the boys' education, to take the undergraduate and often graduate study needed for a career in science.

At the same time, several factors speak more positively for increased education for women. Salaries for professional positions in science are sufficiently high, in many cases higher than those of teachers, nurses, librarians or home economists, to permit a graduate to pay back the entire cost of university education while working for a relatively short period of time. More scholarships and student loans are available from universities and many

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[21] Ibid., p.5.

other sources. In addition, a woman's working life is becoming longer, because her life span is increasing, earlier marriage and the custom of having children at an earlier age is leaving many women relatively free of household duties when they are still in their late thirties or early forties. Labour-saving devices - the automatic washer, dryer, dishwasher, oven timer, together with the large and nutritious variety of prepared foods and easy to clean clothing - have freed the housewife from many daily hours of heavy toil. More women are entering and re-entering the labour force, and there is every likelihood that the average woman will spend a larger proportion of her life working outside the home.

A greater anticipation of a return to employment should influence young women's decisions about courses of study and college attendance and completion. An understanding of the educational experience in relation to an adult life of both home and paid employment, perhaps at different stages, might lead women to be more serious about their studies.[22]

To take as much education as she can before her marriage is important to the gifted woman who may expect

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[22] Womanpower, p.217.

to use it in the labour force later in her life. Nevertheless the possibility of being able to take university training at a later stage means that the high school graduate's decision about whether or not to attend university is not as final as it once was when it was the custom to take it early in life or not at all.

Mrs. Doris Anderson, Chatelaine editor, has noted that: "The Conference (CBC Conference, The Real World of Women) felt there should be more flexibility in education to allow women to go back to school at all levels of training."[23]

There is evidence that young women do not think too far ahead in preparing for an adult life. One authority says it is difficult to do much more at the high school and college level than to establish an awareness and understanding of the various kinds of adult lives which women now lead and will be likely to lead in the future. For women who marry early, it may not be feasible to help them with their educational and occupational problems until they reach the point in their lives when they are interested in, and able to, work outside the home.[24]

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[23]Doris Anderson, Chatelaine, November, 1962, p.1.

[24]Womanpower, p.217.

The cost of training to reach a first degree in honour science is still no higher than the cost of many other four year degrees more often taken by women. Training in science is a valuable experience in the art of thinking and its influence affects the student's whole life. Such training is valuable for its own sake and should not be denied the capable and interested student who is not definitely job oriented.

An authority on education in the United States, Dr. M.M. Chambers of the University of Michigan, has written that: "As we open higher educational opportunities to larger and larger percentages of our young people, it would be very unrealistic to suppose that all college students can be of very superior ability and give the most devoted and altruistic allegiance to their highest obligations. This, of course, has not been true at any time in the past."[25]

In a report in 1961 the U.S. National Foundation affirms that: "A general familiarity with matters scientific would seem to be of importance to the wife and mother meeting family responsibilities in an economy with growing dependence upon science and technology."[26]

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[25] M.M. Chambers, Chance and Choice in Higher Education, Danville, Ill., Interstate Printers, 1962, p.10.

[26] National Science Foundation, Women in Scientific Careers, 1961, p.18.

CHAPTER IV

SOCIOLOGICAL FACTORS AFFECTING SUPPLY OF WOMEN SCIENTISTS AND ENGINEERS

1. Pattern and Length of Work Life

One of the most important factors discouraging women from a career in the sciences, as in other professions, is the realization that marriage may take them out of the labour force for part, or all, of their lives.

Most Canadian women do marry. Of all those 25 years of age or older, three out of four were married, according to a Women's Bureau study in 1958.[1] Among women 60 years of age or older at the time of the 1961 Census, only about 10 per cent had never married. In the United States only about 7 per cent of all women remain single throughout their entire lives.[2] Better educated women are likely to marry somewhat later than the average, but are only slightly less likely than women of lower education to have children by the time they reach their early thirties.[3]

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[1] Department of Labour, Women's Bureau, Women at Work in Canada, Ottawa, 1958, p.20.

[2] Womanpower, p.66.

[3] Ibid., p.74.

It is often taken for granted that a married woman will spend the greater part of her life looking after home and children. In actual fact the period during which the average mother is needed full time at home is a relatively short portion of her life. The average age of marriage of women in Canada is 23 years; in the United States it is just over 20. In both countries, women tend to have their children early in their marriage. In the United States, according to one reference, "Since the majority of women marry before they are 21 and have their first child soon afterwards, a great many mothers no longer have children of preschool age by the time they reach 30. Today, it has been estimated, the average mother is only 32 when her last child reaches school age."[4]

According to Dr. Esther Lloyd-Jones of Columbia University's Teachers' College, under social patterns evolving today the educated girl may work for about five years before her family takes her out of the labour force for about ten years. After this, she is ready to return to work to establish a twenty-five to thirty year career.[5] "At this time," Dr. Margaret Mead is quoted as saying, "women develop a great burst of energy and ability. It

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[4] Ibid., p.69. In Canada the age of women at the time their last child starts to school is probably higher.

[5] United States, New York State Department of Labor, Industrial Bulletin, June, 1962, p.2.

comes after the last child is launched, and ...also at widowhood."[6]

Mrs. Doris Anderson, in speaking of The Real World of Women Conference held by the Canadian Broadcasting Corporation in September, 1962, wrote in an editorial in Chatelaine: "It seemed to be generally accepted that married women work in two life shifts - before the first child is born and after the last child is in school, and that girls should be prepared for this kind of gear-changing."[7]

The number of women in the labour force in Canada is increasing rapidly, and between 1950 and 1961 the number of married women working increased two and one half times. Almost half the women in the 20-24 year age group were working for pay in 1962, but a much smaller proportion, 28 per cent, of those in the 25-34 year age group were working. For them, home responsibilities tend to be the heaviest.[8]

Canadian and American mothers generally believe they should look after their children themselves during their

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[6] Ibid., p.3.

[7] Doris Anderson, Chatelaine, November, 1962, p.1.

[8] Department of Labour, Women's Bureau, Facts and Figures about the Labour Force in 1962, Ottawa, 1963, p.1.

formative years, although part of the reason for this is the difficulty of getting adequate help at home. Canadian mothers of small children who do work outside the home usually have a grandmother or other relative at home.[9] Only a small proportion of mothers with children under 6 have full time jobs, and details are not available as to the number of women scientists and engineers with small children. Among married women who were working in 1956, some 44 per cent had no dependent children. Women who do not have children, as well as single women, are likely to stay in the labour force for the major part of their lives.

2. Ability, Intelligence, Physical Characteristics, and Motivation

The undermining of the belief in the innate inferiority of women, and continuing changes in popular ideas about their intellectual capacities and emotional traits, have been interwoven with the changing nature of women's employment.[10] In sharp contrast to older conceptions, which had a restrictive effect upon employment opportunities, is the contemporary view that measurable variations between men and women in intelligence, aptitudes and

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[9] Department of Labour, Women's Bureau, Married Women Working for Pay in Eight Canadian Cities, 1957, Ottawa, p.53.

[10] Womanpower, p.15.

abilities are probably not determined by sex but are produced by differing interests, expectations and cultural experiences.[11] These are reflected in different motivations and early training.[12]

The answer to the simple question: "But which sex is the more intelligent?" is elusive because they differ in the various aptitudes which enter into the measurement of intelligence, explains Mrs. Mirra Komarovsky.[13] In the younger age groups, girls are more likely to do well in school tests. With increasing age, gifted boys are more likely to retain their high IQ's or even to show a rise, while girls with the same initial IQ's are more likely to show a drop. Boys excel in arithmetical reasoning, nature study, science and history while girls do better in reading, language usage, spelling, and computation. Taking school grades alone, girls excel consistently even in the subjects in which boys later prove more competent, perhaps because of their more conscientious application to studies.

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[11] J. Bascom St. John, "A Problem Without a Solution," The Globe and Mail, Toronto, November 12, 1963, p.7.

[12] Womanpower, p.228.

[13] Mirra Komarovsky, Women in the Modern World: Their Education and Their Dilemnas, Boston, Little, Brown and Company, 1953, p.20.

According to one Canadian writer, "A girl will try harder to obtain approval from parents and teachers than a boy. Being taught to be more submissive, she will work harder at studies, because she is told to, or is expected to."[14]

Important to a career in the sciences is a natural interest in them, but perhaps the most important single factor of importance is mathematical ability.

In university entrance tests, boys are more likely than girls to do well in mathematics and science.[15] However, although results are not conclusive as to the proportion of students of high mathematical ability women represent, comprehensive tests in the United States have shown that they reach as high levels of general intelligence as men and many women reach as high levels of mathematical ability. Indeed, the point has been made that tests used in selecting candidates for admission to university and for scholarship aid merely reveal the poorer preparation of girls in mathematics and science, a reflection of their curriculum choices.

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[14] J. Bascom St. John, "A Problem Without a Solution," The Globe and Mail, Toronto, November 11, 1963, p.7.

[15] Womanpower, p.184.

In the physical sciences, in addition to mathematical reasoning ability, reading comprehension and ingenuity are important. For a career in the natural sciences, intelligence, creative imagination, intuition, patience and curiosity are needed.[16] Engineering requires a higher level of insight into mechanical relations and a greater ability to visualize in three dimensions than is needed by those working in the physical sciences.[17] In engineering, too, there must be a preference for mechanical work.[18]

Do girls possess mathematical ability and the other characteristics needed for scientific work? It is incorrect to imagine that group traits are typical of each individual in a group or even of the large proportion of that group, explains Mrs. Komarovsky, pointing out that psychological tests have generally revealed much greater differences between members of the same sex than between the sexes. If we learn, for example, that tests have shown that girls excel in verbal ability and men in mathematical ability, we may assume that most girls exceed

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[16] Department of Labour, Careers in Natural Science, Ottawa, 1961, p.18.

[17] Department of Labour, Careers in Engineering, Ottawa, 1960, p.31.

[18] United States, Department of Labor, Engineering Employment Opportunities for Women, Washington, 1954, p.24.

most boys in verbal ability and most boys excel in mathematical ability. The truth is more nearly the reverse, Mrs. Komarovsky concludes. Most girls are similar to most boys, but a minority of boys who excel in mathematics raise the average for the boys' group while a minority of girls who excel in verbal ability raise the girls' average in this subject. In terms of the proportion of women who do well in mathematics, while it may not be as large as the proportion of men, it is nevertheless substantial and represents a large number of women who might have the capacity for scientific work.[19]

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[19] Mirra Komarovsky, op. cit., p.22.
Mrs. Komarovsky points out about one test: "Boys are, thus, superior in the mathematical part of the scholastic aptitude test and in physics and social studies. Girls do better in English composition and are about the same in the verbal tests. But even where divergences between the sexes are great, some overlapping exists. Everybody knows that physics is a 'masculine subject' - in at least one school, girls were apprehensive about enrolling in physics because of the widely quoted views of the physics teachers that the subject was not for girls. And yet, on the college entrance tests, 54 per cent of the boys fell below the scores made by the top third of the girls. If we decided that only the gifted in physics should be encouraged to develop fully their potentialities, a greater proportion of boys would, of course, be eligible. And yet, out of every 100 girls the top 33 would surpass the lower 54 per cent of the boys who would then have to turn to social studies, English composition, or what not."

A particular aptitude which is important to the scientist but vital to the engineer is mechanical ability. This is the aptitude which has been termed most masculine of all. Are men born more mechanically minded?

Any man who has tried to explain to his wife the workings of a car would feel that we need go no farther in search of an answer, writes Mrs. Komarovsky. That tests of mechanical aptitude repeatedly favour men is to him but proof of the obvious. However, in order to see to what extent this ability is inherited, tests of mechanical ability have been given to small children in an attempt to rule out environmental training of boys and girls. Results of the tests were not too conclusive; little boys did better on some and little girls on others, although all were mechanical tests of one kind or another.[20]

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[20] Ibid., p.26.
Mrs. Komarovsky comments: "Perhaps boys are initially attracted to mechanical objects because of their greater strength and better motor co-ordination and this advantage further encouraged their mechanical interests. But if this is all there is to it, it is a far cry from what is usually understood by inheritance of mechanical aptitudes." She refers to a point made by Anastasi and Foley: "If in our society we gave baby girls erector sets, toy clocks and mechanical puzzles, their lesser strength would not handicap them in such play. With their superior manual dexterity they, too, might have developed mechanical interests. The same writers call attention to the fact that male superiority in adulthood is more pronounced in tests depending on mechanical information than in the more abstract tests of spatial relations, which may be equally unfamiliar to both sexes."

"With results so inconsistent and variable," Mrs. Komarovsky writes, "it is not easy to assign to either sex a clear superiority in mechanical aptitudes during the early childhood period." The fact that boys do better in mechanical tests than girls as they grow older may be more a result of environmental training than inborn abilities. The superior achievement of men in mechanical things is very largely a matter of training, and there is nothing in scientific tests to discourage a move to give more technical education to women.[21]

In another reference the comment is made that: "It is frequently stated that women do not have as much mechanical ability as men, but that they have greater manual dexterity; that they are emotional and unstable, but that they are admirably adapted to routine or detailed work. Many of these judgments are based on opinion rather than careful investigation, but their wide acceptance strongly influences the occupational distribution of women."[22]

Emotional stability or temperament, like other characteristics, varies from one person to another. Group tests of men's and women's personalities reveal many

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[21] Ibid., p.27.

[22] Womanpower, p.226.

overlapping areas. One test described by Mrs. Komarovsky gives women higher scores in neuroticism, introversion, submissiveness and lack of self-sufficiency. But, she points out, if some educational task demanded emotional stability, selecting students in terms of the stereotypes, "emotionally stable male" and "unstable female," would be highly misleading. The healthy group, those who rated under a certain arbitrary score of emotional traits, would consist of 43 women and 56 men out of 100 of each sex.[23] A similar picture of overlapping traits among college men and women appears with respect to other personality measures devised by the psychologist Bernreuter, such as introversion, submissiveness, and relative self-confidence.

Books dealing with the psychology of women discuss women's special nature which is, in general, receptive rather than aggressive.[24] This characteristic, among others such as the special interest women have in preserving life and in working to help people, has been cited by some writers as a reason why women who want a profession should confine themselves to those fields in which they are traditionally found and which make special use

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[23]Mirra Komarovsky, op.cit., p.23.

[24]Katharine Elizabeth McBride, "Women's Opportunities and Responsibilities," The Annals of the American Academy of Political and Social Science, Vol.251,May,1957.

of these characteristics - fields such as teaching, nursing, home economics, social work, medical specializations, and library work.

Actually there are many fields of science which make use of women's special characteristics and inclinations. Teaching is an occupation which lends itself as well to science as to other fields, and much of the work in the biological sciences has a close connection with life and its preservation. Today, even fields which contain a very large majority of men may stand to benefit from the complementary and supporting values and viewpoints a minority of women may bring to the group.

From the point of view of the woman worker herself, she is likely to find most satisfaction in her work when her talents are used to the full. There are many examples of women who have achieved success in work which required long hours of abstract thought and the ambition to keep searching for facts or principles which may not have immediate application. For people who have this aptitude their greatest satisfaction in work may be found this way.

Variations in average ability and aptitude might help to explain why differing proportions of men and women are employed in various occupations, but not why so many

jobs are filled almost entirely by either men or women, according to one source.[25]

Obviously, those women who find their way into mechanically-based careers are in the minority, according to the United States Women's Bureau, but many of them exceed individually the average requirements for men.[26]

The Canadian Occupations Monograph, "Careers in Engineering," mentions that women are unlikely to be employed where a high degree of mechanical or manual activity is required, and refers to the most usual functions of women in scientific work: research, testing, inspection, laboratory work, teaching and certain production duties.[27]

The National Society of Professional Engineers in the United States makes the suggestion: "Since science and engineering have become so closely integrated, phases of engineering well suited to women's aptitudes and abilities have rapidly developed. The testing laboratory has become

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[25] Womanpower, p.227.

[26] United States, Department of Labor, Professional Engineering Employment Opportunities for Women, Women's Bureau Bulletin No. 254, 1954, p.6.

[27] Department of Labour, Careers in Engineering, Canadian Occupations Monograph 20, Ottawa, 1960, p.32. Note: The reference, "Women in Engineering," Journal of Engineering Education, Scranton, June, 1962, Vol.52, No.10, p.655, points out that engineering work has become much less heavy in recent years.

an integral part of large engineering corporations. Discovery of new scientific techniques and principles requires painstaking but rewarding research."[28] Planning and designing have also become important functions in all phases of engineering - these are the activities in which women have proved that their contribution can be extremely useful.

Women's physical suitability is steadily becoming a less important factor in many jobs, as advancing technology provides a substitute for human effort. This is particularly true in the case of science and engineering work. The fact that women are, on the average, less strong than men (they average only 85 per cent as heavy and have only 60 per cent the physical strength) and are smaller in size, does not necessarily mean they will fatigue more easily except in jobs requiring heavy physical labour.[29]

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[28]United States, National Society of Professional Engineers, Engineering, A Career of Opportunity, Washington, April, 1962, p.13.

[29]Womanpower, p.227, quoting from Anna M. Baetjer, Women in Undustry: Their Health and Efficiency, Philadelphia, 1946.

Mrs. Baetjer had said: "In most occupations today, the type of fatigue which is associated with a decrease in production ability is due chiefly to changes in the nervous system or to psychological states rather than to chemical changes in the muscles or blood."

Most science and engineering jobs require little actual physical exertion.[30]

There are many jobs, indeed, where the talent and interests of women gifted in science may be utilized to the full. Whether women are motivated to specialize in it depends to a large extent on the attitudes and values of their husbands, family and friends, and not on their interests alone. The effect of tradition and of families' attitudes and values will be discussed in the following sections.

3. Effect of Tradition

The strongest factor discouraging women from science and engineering is not the nature of the work, much of which is quite suitable for women, but simply tradition. The influence of tradition is a powerful one, as most men and women prefer to follow the patterns of custom and not stand out from the crowd.

Although at first glance it may be assumed that the effect of tradition is to protect women from having to do the heavier tasks or the more complicated ones, the system is by no means completely rational. The authors of Womanpower point out that local traditions with respect to male and female job assignments are not always consistent

[30] United States, Professional Engineering Employment Opportunities for Women, Bulletin No.254, 1954, p.7.

For example, in one district of the United States, the Midwest, women are traditionally hired as corn huskers while trimmers are almost always men. In the Far West, corn huskers are men and trimmers are women. The West Coast fishpacking industry is considered men's work, while a few miles away, in California's Salinas Valley, fruit-packing is considered women's work.[31]

In Canada in pioneering times it was customary for women to do all the heavy tasks of establishing and caring for a household, from which modern conveniences have now to a large extent liberated them.

The effect of custom in our own times arises in part from the apparent difficulty of having men and women work together on scientific projects. Although men and women work side by side in factory and office every day, the supervisors are usually men. The difficulty apparently arises when men and women have to work together as a team, and suggestions for furthering the work come from members of the group themselves. In this situation, psychologists say, as in those in which the woman is supervisor, men find it difficult to accept orders or suggestions from the women and the solidarity of the group is destroyed.

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[31] Womanpower, p.91.

According to Theodore Caplow, "Women are barred from four out of five occupational functions, not because of incapacity or technical unsuitability but because the attitudes which govern inter-personal relationships in our culture sanction only a few working relationships between men and women and prohibit all the others on grounds that have nothing to do with technology."[32]

Whether or not this explanation seems completely valid, it is nevertheless a drawback to women's participation in jobs in which men predominate, and to women's promotion to higher positions. There is no doubt that tradition is responsible, directly or indirectly, for many women choosing fields other than science, even if they are interested in it.

Women are also prohibited by social custom from working with men crews in isolated areas because of the greater difficulty of accommodation.[33]

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[32]Theodore Caplow, The Sociology of Work, University of Minnesota, 1954, p.243.

Mr. Caplow explains: "There are two central themes: (1) that it is disgraceful for a man to be directly subordinated to a woman, except in family...relationships; and (2) that intimate groups, except those based on family or sexual ties, should be composed of either sex but not both." The reason for this, he contends, is that: "From the time when the early adolescent is taught to scorn those of his fellows who associate with the opposite sex in the classic terms of 'sissy' or 'tomboy', a good deal of

The requirements and mores of tradition are passed on by family and associates to young people in their formative years, and are no doubt responsible in large measure for their ultimate choice of work. This will be discussed in the next section.

4. Effect of Family Attitudes and Values

For a woman to choose to go into science it is important that her family approve her choice. Not only is it difficult for a girl to go against the wishes of her parents, but if she has not heard about science as a possible vocation or does not think of it seriously she may choose other subjects in high school, making it difficult for her to change courses later on.

Social values exert a pervasive influence on attitudes as to when and under what circumstances it is appropriate for a woman to work outside the home, and they underline judgments about the kinds and conditions of employment they should take and its impact upon their maternal functions.

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opprobrium is associated with any emotionally weighted relationships between the sexes which do not have explicit sexual connotations. Especially in the male group, which tends to reject overtly, if superficially, the official morality sponsored by women in the family, there is a culturally recognized atmosphere which symbolizes the exclusion of women."

[33]United States, Professional Engineering Employment Opportunities for Women, Women's Bureau Bulletin No.254, 1954, p.7.

The entrance of women into fields of employment previously closed to them required, just as it mirrored, changes in conventional views about the types of work which are suitable to women and about the capacities of women for performing certain tasks.[34]

The disposition of women to work outside the home is inevitably conditioned by widely shared values and attitudes. North Americans view the man in the family as the primary breadwinner and, when jobs are scarce, are inclined to believe that women workers should not compete with men who have families to support. Americans also believe that mothers should personnaly care for their children during their formative years, and there is little sympathy with the idea of mothers holding full time jobs when their children are of preschool age unless they are compelled by economic necessity to do so.

Many people believe women should not attempt to have ambitions beyond the home. Rabbi Abraham Feinberg describes women's position in the home thus: "For women, child-bearing always will remain the central reality of life. It explains why women shield themselves from overwork in industry, safeguard their health, think more subjectively (not, therefore, less intelligently), feel

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[34] Womanpower, p.15.

instinctively, act intuitively, and react protectively and emotionally concerning their children. Their entire psyche coheres around a different drive."[35]

Dr. N. B. Epstein believes there is an internal conflict in women when they are required to exert aggressive traits: "The intrapsychic structure of the female should contain in large doses the ability to give a lot of the self to others, the ability to function in a highly expressive manner, the ability to be receptive and passive."[36] Dr. Epstein feels these requirements are dictated by anatomy and biology as well as by the sociocultural directions of many aspects of the female role, and that many other roles require other, often clashing, characteristics.

Society's values and attitudes are said to have evolved during long periods of trial and error when the interests most in harmony with men's and women's personalities have come to the fore. Psychoanalytic theory claims to show the clear differentiation of the fundamental roles of men and women and their importance in adult personality.

Katharine Elizabeth McBride commented on these basic roles of men and women when she wrote in 1947: "It is not

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[35]Abraham Feinberg, "Twentieth-Century Woman", The Globe and Mail Magazine, February, 1963, p.12.

[36]N. B. Epstein, The Real World of Women, CBC Public Affairs Conference, Toronto, September 6-9, 1962, p.17.

shown, however, that all energies directed toward a goal other than the family and home in the case of the woman actually impoverish these." It has not been shown outside of analytic theory that the woman in modern society can actually devote her full energies to her family and her home - that is, without bridge, without committees, without all the widely accepted but casual outside activities. Mrs. McBridg suggests there is something positive in these outside interests for which women have free energy and in which they find satisfaction: "Indeed, outside interests represent a much more 'normal' situation in the present world than would an absorption in home and family complete enough to match that of primitive times."[37]

If women are to go beyond their function as wife and mother, Mrs. McBridg believes, this fact of diversity of interests has great significance for education. For those who do wish to go beyond the home, the range of individual interests is very broad and their demands in education equally broad.

Miss Mary Winspear of Weston School, Westminster, Quebec, has stressed the need for both men and women to

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[37]Katharine Elizabeth McBridg, "What is Women's Education?" The Annals of the American Academy of Political and Social Science, May, 1947, vol.251, p.146.

pursue their natural bent. She feels that obstacles should not be placed in the way of people who have a leaning towards a special field.[38]

Writing recently in the United States, Betty Friedan describes prevalent college attitudes in which girls feel they must hold themselves back and not be considered too clever or prone to spend too much time on educational pursuits.[39]

Two other Canadian writers deplore society's attitude in discouraging women from fields of training which appeal to them.[40]

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[38]Mary Winspear, The Real World of Women, CBC Public Affairs Conference, Toronto, September 6-9, 1962, p.17.

[39]Betty Friedan, "Modern Woman: Her Dilemma," The Star Weekly, Toronto, January 25, 1964, p.6. Mrs. Friedan quotes a junior from a southern United States university: "Ever since I was a little girl, science has had a fascination for me. I was going to major in bacteriology and go into cancer research. Now I've switched to home economics. I got so caught up in science the first two years I never got out of the laboratory, but I realize I shouldn't go into anything so deep. I'll go home and work in a department store until I get married." And another student: "Maybe education is a liability. Even the brightest boys at home want just a sweet, pretty girl. Only sometimes I wonder how it would feel to be able to stretch and stretch and stretch, and learn all you want, and not have to hold yourself back."

[40]Marguerite Ritchie and Mollie Gillen, "How Canada Wastes its Woman-Power," Saturday Night, April 2, 1960, p.18. These authors wrote: "A girl is frequently convinced by relatives, friends, or even college advisors, to take a

in describing the women about whose careers she wrote in "Women of Modern Science," commented that: "In talking with scientists, both men and women, of other than American birth and early education, I found some who were outspoken in their conviction that young women possessing scientific talents in their own countries had one great advantage over similarly gifted young women of America. They had the good fortune to be able to grow up in an environment in which psychological freedom for recognizing and developing scientific talents exists for both sexes alike."[41]

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course because it is thought to be more socially acceptable, although it is not quite what she really wanted. It often turns out to be infinitely less challenging to her."

[41]Edna Yost, Women of Modern Science, New York, Dodd, Mead & Co., 1957, p.6. Miss Yost has written: "These scientists of other nationalities had been surprised to find in America..." an attitude that a girl should not possess scientific talents. This attitude, they said,"has deprived many of our gifted young people of true freedom of choice in the period when strong innate gifts are usually recognized and vocational choices made. The basic need of our educational system, so far as its adequacy for developing scientists is concerned, is an environment in which scientific talents express themselves without meeting prejudices that make their possession and development less desirable to any one."

"The truth is that each woman must work out her own way of life for herself and her family" wrote Doris Anderson in a recent editorial in Chatelaine.[42]

The wide divergency of opinions concerning women's work emphasizes the necessity for a woman's choice to be her own. The most helpful climate of opinion would be one which recognizes the great differences between individuals and encourages them to follow without hesitancy their greatest interests.

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[42]Doris Anderson, Chatelaine, July, 1963, p.1.

CHAPTER V

DEMAND

The demand for scientists and engineers is measured in terms of currently filled positions and unfilled positions reported to be available.[1] This represents total demand, but the demand for women cannot be assumed to be the same as that for men because it may be more difficult for women to find employment.

Commenting on difficulties women may find in obtaining employment in these fields, a Department of Labour bulletin states that: "Many women find successful and satisfying careers in science although, simply because they are women, they tend to encounter more obstacles and difficulties on the road to success than their male counterparts. Ambitious young women should expect their progress in a scientific career to be impeded to some extent unless they hold very high qualifications."[2]

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[1]The term "demand" ordinarily comprises: (a) scientific and engineering personnel currently employed as such; (b) established but unfilled positions for such persons, and (c) recognized needs not yet formalized (potential demand). See: National Science Foundation, A Program for National Information on Scientific and Technical Personnel, Washington, August, 1958, p.24.

[2]Department of Labour, Careers in Natural Science, Canadian Occupations Monograph 21, Ottawa, 1961, p.19.

Another bulletin contains the warning: "It is apparent that the woman engineer is likely to have difficult hurdles to take, but if she has the appropriate aptitudes and interests and is willing to persevere in the face of obstacles, she may be assured of a satisfying career."[3] The situation is similar in the United States, according to a Women's Bureau bulletin: "When engineering prospects are good for men, they are apt to be almost as good for women; when they decrease for men, women's opportunities in engineering are likely to be curtailed more than men's, out of proportion to the total manpower need..."[4] In the United States, while many employers hesitate to hire women engineers, many others are willing to do so, and the few who graduate from engineering schools each year do not appear to have great difficulty in securing acceptable jobs.[5]

1. Occupational Specializations

The demand is greater for scientists and engineers in some specializations than it is for others, and is reflected to some extent in the higher salaries offered to new graduates (Table XI).

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[3]Department of Labour, Careers in Engineering, Canadian Occupations Monograph 20, Ottawa, 1960, p.33.

[4]United States, Department of Labor, Professional Engineering Opportunities for Women, Women's Bureau Bulletin No. 254, Washington, 1954, p.4.

[5]Womanpower, p.283.

TABLE XI

Estimated Monthly Starting Salaries
University Graduates, Bachelor's Degree
1957 and 1962

Field of Study	Dollars per Month 1957	1962
General Arts and Science (Pass Degree)	$246	$360
Biological Sciences	310	395
Chemistry and Biochemistry	376	408
Geology	391	430
Mathematics	324	390
Agriculture	347	395
Forestry	355	400
Chemical Engineering	383	430
Civil Engineering	369	424
Electrical Engineering	375	423
Engineering Physics	381	420
Mechanical Engineering	375	430
Metallurgical Engineering	380	425
Mining Engineering	394	448
Petroleum Engineering	396	435

Source: Unemployment Insurance Commission, Supply and Demand: University Graduates, 1962-63, Ottawa, 1962, p.6 and Department of Labour, Working and Living Conditions in Canada, Ottawa, 1958, p.41.

The fact that starting salaries for scientists and engineers were higher in 1962 than they were in 1957 is not complete evidence of a higher demand, since the trend in salaries of all kinds has been upwards in those years. However, a higher demand may be indicated in the larger salary of one specialization over another. For example, the engineering occupations command higher average salaries than those of the physical and biological scientists, except geologists. Furthermore, in all cases the starting salaries of the honour science specializations are higher than those for graduates in general arts and science, as well as for those in social work, education, and commerce. The starting salaries offered men and women are the same, although it may be more difficult for a woman to obtain a first job.

The Department of Labour in recent years has been gauging the extent of demand for scientists and engineers by a periodic survey, usually once every two years, of recruitment difficulties in different sectors of the economy. The greatest expected increase in requirements for personnel in the two years following the most recent survey in 1962 were in industrial and metallurgical engineering, mathematics, and physics.[6]

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[6]Department of Labour, Economics and Research Branch, Employment Outlook for Professional Personnel in Scientific and Technical Fields, 1962-1964, Professional Manpower Report No. 13, December, 1962, p.20.

Demand for scientists and engineers may vary between different sectors of our economy, and for this reason it is of interest to note the various fields of employment of women scientists.

2. Field of Employment

Women scientists and engineers have found their most likely field of employment to be that of educational institutions, followed by government departments and agencies and some branches of manufacturing.

More women scientists have, in recent years, been employed by educational institutions than by other employers. The Department of Labour's 1962 study of the distribution of women scientists and other features of their employment, shown in Table XII, found 335 women to be engaged in work for educational institutions, representing over 42 per cent of those in the Register at that time. Only half as many women scientists were employed by government departments, and considerably fewer by industry.[7]

The field of employment in which women scientists and engineers are most often working ties in closely with

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[7] Department of Labour, Economics and Research Branch, Letter, with tables, received from Dr. P.H. Casselman, October 2, 1963.

Note: According to the Dominion Bureau of Statistics, Salaries and Qualifications of Teachers in Universities and Colleges, 1962-63, Ottawa, 1963, p.31, Canadian universities employed 218 women professors and instructors in the biological sciences and 67 in the physical sciences. Thirteen taught agriculture, 3 architecture and 7 engineering.

TABLE XII

Women in Science and Engineering, 1962
by Employer Type and Work Function

Function	Total	Manufacturing	Education	Government	Other
Construction, Installation, Erection	1				1
Design	25	3	-	3	19
Administration	20	3	5	6	6
Field Exploration	1				1
Veterinary Diagnosis, Treatment	24		2	8	14
Production, Operation, Maintenance	10	4	1	1	4
Research, Development	211	24	54	82	51
Sales, Service, Marketing, Purchasing	18	8			10
Teaching, Instructing, Extension	278	2	256	9	11
Testing, Inspecting, Laboratory Services	129	34	4	46	45
Other, or Not Stated	70	14	10	2	44
Total	787	92	335	170	190

Source: Economics and Research Branch, Department of Labour, Letter received from Dr. P.H. Casselman, October 2, 1963.

their most usual occupational specializations, biology and chemistry, and with their functions, most likely to be teaching or research. Women are seldom found in such fields of work as construction, production, operation and field exploration which are more common to the primary industries.

Nearly 80 per cent of the women scientists and engineers are engaged in the functions of teaching, research, and testing. Both the functions and the fields of employment of women scientists tend to be more restricted than the wider range of function and field for men.

It is of interest to note that the major employment field for women scientists has apparently changed during the ten years between the Department of Labour's 1962 study, as shown in Table XII, and its 1952 study.[8] In 1952 the major employer of women scientists and engineers was the government sector, with educational institutions the next largest employer. In 1962 educational institutions employed the largest number.

3. Regional Concentration

As might be expected because of the concentration of industry, women scientists and engineers are more often to

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[8]Department of Labour, Economics and Research Branch, Report on Women in Science and Engineering, Ottawa, September, 1956, p.7.

be found working in Ontario than any other province (40 per cent in this province alone) followed by Quebec - 28 per cent, and British Columbia and Alberta - 10 per cent each.[9] Male scientists are similarly situated. Within these provinces, women scientists tend to be working in the major cities because of university and industrial concentration there.

The largest single concentration of women scientists was, however, in Montreal, where 41 per cent of all Canadian women engineers were working, 23 per cent of the female physical scientists and 17 per cent of the biologists. In each case this was a larger proportion of women scientists than in Toronto, where the next largest number were found. Ottawa fell behind Montreal and Toronto in the number of women scientists and engineers working within its boundaries, in spite of its being the location of most federal government departments. The fairly large proportion of women teachers in colleges and universities may account for the concentration of women scientists in Montreal and Toronto. It is of interest to note that women geophysicists are found almost entirely in Alberta; 62 per cent in Calgary and 27 per cent in

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[9] Census of Canada, 1961, Bul.3.1-3, p.7.

Edmonton. Women biologists and agricultural scientists tended to be scattered among the various large centres in Canada. In the specialized work of research and development, women scientists were most likely to be located in Ontario - 45 per cent, Alberta - 21 per cent, and Quebec - 17 per cent.[10]

4. Demand for Women with Higher Degrees

Demand for scientists and engineers is stronger for those with advanced degrees. Not only are the salaries offered to prospective employees larger (for example $620 per month in 1962 for a biologist with a doctor's degree compared to $395 for one with a bachelor's degree, and similarly good opportunities for chemists, mathematicians and physicists with a master's degree or better),[11] but advertisements for scientific personnel attest to the need for particularly highly trained workers.

In their level of education as a whole, women have fallen behind men and smaller proportions of women have post graduate training. By raising their qualifications women could, of course, make it easier for themselves to get positions. The booklet "Women at Work in Canada," points out: "It may also be that women who are pioneering

[10]Department of Labour, Economics and Research Branch, Interview with A.D. Boyd, February 10, 1964.

in new fields need outstanding academic equipment if they are to compete..."[12] There is no doubt that women who do pursue their post graduate training to the doctor's level have a more serious and permanent attachment to the labour force than those who do not.

In government departments and universities where entry for women scientists and engineers is possibly less difficult than in industry and other types of employment, there is a higher demand for those who have advanced degrees. Among teachers - and teaching is traditionally a woman's field - higher salaries are offered to those with higher qualifications.

Because the demand for women scientists depends not only on the availability of positions but on employers' attitudes toward utilizing women scientists and engineers, it is of interest to consider how important this is. Reference to this will be made in the following section.

5. Women's Working Life as it Affects Demand

One of the objections most often voiced against the use of women in science and engineering is that their work

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[11]Unemployment Insurance Commission, Supply and Demand: University Graduates, 1962-63, Ottawa, 1962, p.6.

[12]Department of Labour, Women at Work in Canada, Ottawa, 1958, p.37.

life may be very short and not justify a firm's expense in hiring them.

This objection must also apply to other positions in which a person's value to the employer increases with experience. However in the professional positions women more often fill, those of teacher, nurse or librarian, usually require less continuity on the part of the worker than do many science positions. Teaching is ordinarily contracted for from year to year and in nursing most working arrangements may be altered on short notice. Also, the steady accumulation of knowledge is perhaps less important in these professions than it is to the scientist. The research worker,[13] to perform best, must acquire a large store of knowledge and experience. The broader this experience, the more extensive the stock of knowledge, the greater the possibility of valuable scientific discoveries.[14]

Many women scientists are teachers - their employment in university lecture room and laboratory similar to that in high school. Others are in government branches or

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[13]Only some 27 per cent of women scientists were engaged in research in 1962, according to the Economics and Research Branch, Department of Labour, Ottawa, in a special table sent with letter dated October 2, 1963.

[14]Ann Roe, "The Psychology of the Scientist," Scientific Manpower, 1960, National Science Foundation, Washington, May, 1961, p.50.

departments, where equality of opportunity is stressed and team projects not seriously affected by the drop-out of a member. In industry, however, where careful control of funds is the rule, employers may be reluctant to take on a young woman whom they think will not stay with the firm.

The problem of lack of continuity is expressed by F.L.W. McKim of the National Research Council: "There is one general point that works against women embarking on a dual career of scientist and mother. Science and technology are developing so rapidly that an absence of ten years to perform the vital role of mother in the home would be an almost irreparable break in a career in a research laboratory. On the other hand, a few months or a year's absence would be easier to work out than in many occupations."[15]

Discontinuity in employment poses the problem of skill maintenance for those women who temporarily leave the labour market and of skill development when they return.

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[15]National Research Council, Notes prepared by F.L.W. McKim for presentation in symposium at meeting March 21, 1962 sponsored by the Women's Bureau, Department of Labour, p.3. Mr. McKim makes a suggestion for utilizing women scientists who may have lost touch to some extent with their fields: "Less sensitive to change with time are two growing fields of work where training in science and mathematics is required and where women have already established themselves as very competent. These are editorial work on technical reports...and (science) librarian."

There are indications in the United States that much of the job leaving by both men and women is concentrated among particular groups and that a fairly large proportion of women remain employed more or less continuously.[16]

6. Employers' Attitudes

Studies made in Canada and the United States, as well as Britain and France, indicate that some employers do not accept women scientists and engineers as readily as they would a man. Part of the reason for this, women's lack of mechanical aptitude, was described by F.L.W. McKim in 1962: "At the present time very few women, even those who may have a doctor's degree in science, are skilled in using electronic instruments or working with machine tools in a small laboratory workshop."[17]

Some prejudice against hiring women engineers in Canada was reported by Miss Diane Hallamore as a result of a small survey in 1957. The reasons given by the one-sixth of the employers who said they would not hire women engineers (some others had partial reservations) were

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[16] Womanpower, p.253.

[17] F.L.W. McKim, op.cit., p.3. To overcome lack of mechanical ability among girls Mr. McKim suggests that "early training in mechanical and electrical work would help overcome one of the deficiencies of women in laboratory work." He also notes: "I believe that girls as well as boys should be given some training in woodwork, metal work, electricity and electronics..."

based on established precedent, friction with women technical aids, and the fact that particular types of production did not lend themselves to the employment of women engineers.

Some more detailed opinions by Canadian government employers of women scientists will be given in the next section.

7. Some Government Employers

An enquiry was sent out by the author to several federal government employers early in 1963 asking if they employed women scientists and engineers and if they would like to comment on their work performance. The following are the comments of personnel officers in several government departments.

The National Research Council employed 21 women scientists, who represented 3 per cent of all scientists in the Council's employment.[18] Several of the women received salaries much beyond the starting level, which indicated they must have been promoted at various stages in their careers. Although two had higher salaries, most of the women scientists were in the more moderate

[18] In addition there were 83 technicians (not professional employees) who represented 8 per cent of the technicians. Mr. McKim wrote: "Considering the group of 83 technicians, only 8 are receiving salaries above $4,600, the maximum being $5,600. Twenty-three of the technicians have...training...to the university degree level."

salary groups. Mr. McKim wrote: "There are 11 in the Assistant Research Officer grade, receiving salaries from $7,800 to $8,500. The average age here is 39; there are five with doctor's degrees, three with master's and three with bachelor's degrees. Below this there are four Junior Research Officers with an average age of 44; two with a master's degree and two with a bachelor's degree in science."[19] Four women were postdoctorate Fellows, whose fellowship appointments were for a maximum of two years and whose average age was 31 years. Women comprised only 2.4 per cent of the post doctorate Fellows working on projects at the National Research Council at his time of writing.

Mr. McKim commented about the trend in numbers of women scientists in the National Research Council in recent years, observing that: "I would like to be able to say that although the percentage of women in these two groups - scientists and technicians - is small, the trend is towards an increase in the number and percentage of women. This, however, is not the case."[20]

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[19] F.L.W. McKim, op.cit., p.2.

[20] Ibid., p.2. Mr. McKim illustrates his point: "Over the five year period from 1955 to 1962 (sic) the total group of scientists has increased from 563 to 728 and the number of women scientists has dropped from 22 to 21 or, percentage-wise, from 4 per cent to 3 per cent.

The number and proportion of women scientists in the Department of Agriculture's Research Branch are also small. In all their establishments across Canada there were only 27 women or 2.8 per cent of the total of 950 professional research officers.[21]

The Department of National Health and Welfare late in 1962 reported employing 89 professional women and 10 technicians as well as 15 women in administrative positions. Most of the professional group were in the salary range $5,100 to $6,000 or that of $6,000 to $8,000, although about one-quarter were in the "over $8,000" bracket. The technicians and technical officers were mainly in the $6,000 to $8,000 range, and the administrators in this and the $8,000 to $10,000 range. The report did not specify how many of these women were scientists, although the categories included architects, bacteriologists, biologists, chemists and engineers.[22]

Looking at the supporting technical staff, the total group has increased from 727 to 995; the women technicians have increased from 70 to 83; this gives a small drop in percentage from 9.6 to 8.4 per cent."

[21] Ibid., p.2. In the Department of Agriculture the supporting staff of technical officers (usually university-trained) and technicians, there were no technical officers, 22 women were classed as technicians and 51 as assistant technicians. The total women in the supporting group numbered 73 out of 554, or 13 per cent compared with 8 per cent at the National Research Council.

[22] Note received from Dr. J.W. Willard, Department of National Health and Welfare, Ottawa, November 6.1962.

The Department of Mines and Technical Surveys in February 1963 had 18 women scientists among a total of 565, and two women engineers among 115 engineers. Of the 18 women scientists two had degrees in arts rather than science and one of the women engineers did not have a degree in engineering. The areas of specialization of the women scientists varied considerably: the most in any one field were six women chemists and four geologists - in each other specialization there was only one woman. Salaries ranged from $5,160 to $13,100, often with only one woman in each salary level. Of these, however, five women earned over $10,000, indicative of opinions for women at the higher levels.

Commenting on the performance of these women the letter from the Department of Mines and Technical Surveys said: "Some of our women scientists, particularly those engaged in geological, chemical and observatory work, are making noteworthy contributions to the Department's whole scientific effort."[23]

Two other government departments reported having only one woman scientist each, about whom they spoke highly. Commenting on the performance of a woman

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[23]Department of Mines and Technical Surveys, Ottawa, Letter received February 18, 1963.

development chemist, who has her doctor's degree, one personnel officer said that: "There is very little doubt that she would rank at or near the top of our applied research group."[24] The other Department was utilizing a woman scientist as an administrator and commented that she showed much potential in this field.[25]

The Fisheries Research Board of Canada reported in 1963 having ten women scientists employed in a total of 171, the women's salaries ranging from $4,560 to $7,300.[26] "Our comment on the quality of the performances of our women scientists," said the Fisheries Research Board letter, "is that their work has been very satisfactory although there is often a period between graduation and the time when they decide that science is their life's work, that performances suffer from a sufficient depth of interest."

A large government organization reported in confidence that it employed several women scientists in a wide range of specializations, with salaries ranging from

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[24]Atomic Energy of Canada Limited, Ottawa, Letter received January 21, 1963.

[25]Department of Northern Affairs, Ottawa, Letter received January 25, 1963.

[26]Fisheries Research Board, Ottawa, Letter received February 27, 1963.

$4,680 to over $10,000. Several of the women had salaries over $8,800, and the only two with salaries as low as $4,680 were not science graduates but arts graduates used in supporting work.

Commenting on the employment of women scientists, this organization reports: "Men and women are equally eligible for employment, although there are appointments which do not seem to be particularly attractive to women and other positions, which, because of their nature, could not be filled by women." Examples of jobs which are regarded as not suitable for women are field trials undertaken under hard-lying conditions and certain combined exercises with the services. This organization had 18 women scientists at the time of writing; 12 who were graduates in science and 6 who were graduates in psychology, medicine and arts.[27]

Among these federal government employers there does not appear to be prejudice against women scientists and engineers. It may be that prejudice is more widespread among industrial employers whose work may be more keenly

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[27]The report also comments on women employed in a supporting capacity in their organization: "In addition to the foregoing there are females employed in a supporting capacity who, for a variety of factors, are utilized in other than professional classifications, their salaries reflecting their competence."

competitive. An attempt will be made in the following Chapter to evaluate the supply and demand for women scientists.

In addition to the experiences of these government employers, it may be of interest to look briefly at some characteristics of women's work in research and development.

8. Research and Development

A Department of Labour study in 1961 showed that about 8.6 per cent of the scientists and engineers engaged in research and development were women. Of the 67 women concerned in this study, 21 were working in the federal government, 8 in the chemical products industry and 37 in other industry.

A fairly large proportion of these women scientists were born outside Canada - about 18 per cent. However, only some 3 per cent were not Canadian citizens at the time of the study.

A point of importance was that the women scientists' salaries were much below those of men in the same survey. The average salary for the women research and development scientists was $4,700 a year while the average for men scientists was $7,700 and engineers $7,900. Even the first year salaries for men in this work were higher than

the average of all the salaries of the women. Male engineers with one year's experience received an average of $5,300 and male scientists with one year's experience, $4,700.[28]

The small number of women scientists in any particular area does, however, make meaningful comparisons difficult.

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[28]Department of Labour, Economics and Research Branch, Tables received from A.D. Boyd during interview, February 10, 1964.

CHAPTER VI

EVALUATION OF SUPPLY AND DEMAND FOR WOMEN SCIENTISTS

It is difficult to judge the adequacy of supply of women scientists and engineers in Canada because, as previously noted, demand for women scientists may not be as strong as that for men. An attempt will be made, however, to evaluate supply and demand for women scientists in the light of shortages, the need for more workers, and the way in which women scientists and engineers are utilized in other countries.

1. Shortages

Shortages of a widespread and general nature during and ever since the war indicate that greater supplies of engineers and scientists must be found. The Department of Labour reported in 1957 to the Royal Commission on Canada's Economic Prospects that, "...during the past decade intense shortages have occurred of certain kinds of professional workers, particularly engineers, scientists and graduates in commerce and business administration."[1]

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[1]Department of Labour, Report to the Royal Commission on Canada's Economic Prospects, Skilled and Professional Manpower in Canada, 1945-1965, Ottawa, 1957, p.30.

Among industrial establishments surveyed by the Department of Labour in 1956, half reported shortages of professional staff and of these nearly half said the shortages resulted in curtailed production and expansion plans. In addition, development and research activities were curtailed, personnel overloaded with work and some positions had to be filled with inadequately trained staff.

"The Progress of the economy can be seriously impaired by shortages of professionals," said the Gordon Commission report,[2] "for when the supply is insufficient, productivity tends to fall and production costs to rise, new products fail to be introduced, technological changes cannot be made rapidly enough to meet competition...thus having far-reaching repercussions...on efficiency and morale in future years."

Although these shortages were described in 1956, more recent indications are that the demand is still strong, particularly in such fields as industrial and metallurgical engineering, mathematics, and physics. In 1962, demand was strongest in the government sector of the economy.[3]

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[2] Ibid., p.34.

[3] Department of Labour, Employment Outlook for Professional Personnel in Scientific and Technical Fields, 1962-64, Ottawa, 1962, p.11.

A strong demand does not automatically mean that more women will be used to fill the gap, particularly in engineering, but it may mean that more chances of employment will gradually be opened to women. Just as the special circumstances of the war opened more positions of every kind, so may the need for more scientists open new and varied opportunities.

Indeed, there is some indication that when rigid divisions of men's and women's work are deterrents to the best utilization of professional workers and contributes to shortages, they are likely to be relaxed or even abandoned.[4]

One country in which a large number of science and engineering positions have already been opened to women is the U.S.S.R., and some features of their work will be described in the next section.

2. Women Scientists in Other Countries

Only in the socialist countries is the proportion of women scientists and engineers strikingly different from that in Canada. Even by 1929 the proportion of women[5]

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[4] Womanpower, p.284.

[5] Nicholas DeWitt, Soviet Professional Manpower, National Science Foundation, Washington, 1955, p.241.

engineers to the total in the U.S.S.R. was 14.7 per cent, part of the drive to relieve the backwardness of the country. By 1957 it was established that 28 per cent of the Soviet engineering positions were filled by women[6] and some authorities have made this estimate even higher.[7]

The position of women scientists in Canada is similar to that of the United States, to which frequent reference has been made in this study. In both countries less than 1 per cent of engineers are women; some 8 per cent of United States scientists in 1959 were women: in Canada in 1961 the proportion was 6 per cent. In England, as in Canada, 6 per cent of the scientists and less than 1 per cent of the engineers are women. In France in 1954 about 2.3 per cent of the engineers were women.[8]

The major difference between the soviet republics and the western countries, as far as the employment of women is concerned, is that in a directed society all workers are utilized to the full extent of their abilities. The countries are not yet sufficiently developed that

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[6]L.S. Soutar and R. Winslade, Women Engineers in the U.S.S.R., London, 1960, p.14.

[7]F.T. Rosser, "Our Position in the World," Wanted... More Experts!, Department of Labour, Ottawa, 1958, p.21.

[8]Department of Labour, Women's Bureau, Women in the Labour Force in Nine Countries of Europe, 1962, p.6.

large numbers of men and women may be allowed the luxury of staying out of the labour force. A social climate has developed in which talented students, particularly in the sciences, are encouraged without regard to whether they are men or women. They are urged to sacrifice their own interests to further the needs of the state.

Women engineering students in the Soviet Union are directed and guided into definite fields both by their own choice and by the state's manpower needs as passed down to vocational counsellors. Women are discouraged from entering types of work which are regarded as unsuitable, like the forging or rolling processes of metallurgical engineering, some chemical engineering processes, and work which is physically dangerous or arduous.

Women students in the U.S.S.R. have a preference for engineering economics and design; "The attraction of research work was evident in all the higher institutes and factories which were visited...the comment was always the same, 'Women like research and laboratory work'".[9] According to this report, Soviet women engineers are more likely to be found in the textile, food, and watch

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[9] L.S. Souter and R. Winslade, op.cit., p.10.

industries than in heavier types of enterprise. Fewer women are found in civil engineering, metal processing or mining.

Two of the major obstacles to women in science and engineering in the western world are apparently not considered obstacles in the Soviet Union. One is the objection of some employers that a trained woman may leave her employment and her training be wasted, and the other is that it is extremely difficult to have a woman in a position of authority over men and that even her position among a team of male workers might be resented.[10]

In the Soviet Union men and women engineering students frequently marry within their own group in their fifth and last year of engineering school, and when they graduate husband and wife are often assigned positions in the same firm or, after graduation, the husband may go on to post graduate study. Paid maternity leaves of four to six months are granted women engineers and they may take additional leave up to a year without pay. They are

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[10] L.S. Souter and R. Winslade, op.cit., p.26. The authors explain that although Soviet women engineers do not go in for higher education as much as men do and are not as highly represented in directing or managing positions, they are apparently accepted without difficulty when this occurs. The attitude towards them is reflected in remarks like: "The vice-chairman...of the Institute is a woman. She is clever and able and I am quite happy to obey her." Or, "she holds all the men tightly in her hand."

reinstated in jobs at their former level when they return to work. The concentrated, short work or study day and the provision of hot meals to eat at work or buy to eat at home makes it possible for the working woman to spend much time with her family. Children of working mothers are looked after by a relative or in one of the many nursery schools and kindergartens available, both for day care or by night or longer period if the mother is ill or required to go out of town.[11]

Although there is apparently no rule which says that a woman trained in engineering or science at the state's expense must work, salary and prestige considerations encourage her to do so.[12] Soviet women seemed glad to go back to work after an absence on maternity leave. The authors of the report on women engineers concluded that, while a high proportion of wives needed to work for the extra income involved, for very many this was not the main motivation.[13]

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[11] L.S. Souter and R. Winslade, op.cit., p.20.

[12] Letter received from Miss R. Winslade through The Caroline Haslett Memorial Trust, 25 Foubert's Place, London, W.1, June 5, 1963.

[13] L.S. Souter and R. Winslade, op.cit., p.7. Additional support for this was the repeated assertion that it was only a few women of lower education who wanted to become full time housewives. There did not seem to be any signs of women engineers drifting away from their occupation because their husband's income was adequate.

The idea of women working as engineers in the Soviet Union is so much taken for granted that the authors of this study, Miss Winslade and Miss Souter, were asked to state the purpose of their enquiry. When a group of Russian workers learned that less than one per cent of engineers in the United Kingdom were women they were surprised and amused.

3. Some Commonwealth Experiences

Some of the factors affecting the training and employment of women scientists and engineers in England have been described in recent years. Although conditions of employment in England are a little different from our own (for example salaries, particularly women's are lower and the degree of social security greater) the small proportion of women in science offers a parallel situation.

Writing of women chemists in England in an article in the Journal of the Royal Institute of Chemistry, Mamie Olliver believes that employers may have a restricted idea of how women scientists can be used. To a large extent they consider young women a poor risk as chemists because they may soon get married and leave the labour force. In a 1955 study of Royal Institute of Chemistry women members, 746 of a total of 13,635 who belonged, Miss Olliver found that about half the married women were working,

two-thirds in full time jobs and one-third in part-time jobs. Marriage had accounted for a loss of only 14 per cent from full time work, Miss Olliver said, but pointed out that her study included only those with paid-up membership.[14]

Discontinuity of service is a fact that is particularly important to industry. The risk is not peculiar to science but pertains to every industry that employs professional women. While acknowledging the fact that prolonged absence from the labour force and professional life may well result in the chemist becoming out of date, Miss Olliver suggests that her basic training is still retained and it would seem to be in the national interest to see that this is not wasted.[15]

The initial salary offered women scientists is often ten to twenty per cent lower than for correspondingly qualified men, Miss Olliver explained, and she believes this to be mainly because of the possibility that marriage may interfere with the continuity of a career. She points out salaries of women scientists in the United Kingdom are very much lower than those of men. Older women chemists,

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[14]Mamie Olliver, "Women in Chemistry," Journal of the Royal Institute of Chemistry, England, August, 1955, p.413.

[15]Miss Olliver suggests retraining in specific practical techniques, such as in food, textiles, or clinical chemistry, to become qualified to teach technicians.

of which there is a larger proportion than in Canada, became accustomed to low salaries in the 1920's and 1930's and their earnings have never kept pace with those currently offered younger women graduates. Women do not have to fear unemployment now, with current shortages, as they had to before this was the case.

In encouraging more women to go into chemistry Miss Olliver mentioned particularly the shortage of women teachers at all levels of education, and in addition feels that opportunities should be extended to the administrative level. She also believes better vocational guidance in schools would make more women interested in chemistry.

The desirability of using women scientists to fill needs and alleviate shortages in the United Kingdom is stressed by Miss N.M. Brown of the University of Sheffield.[16] She wrote in 1957 that: "In spite of the threat to our economy which the shortage of scientists and technologists entails, employers still talk unequivocally in terms of men and boys." She predicts an increase in the proportion of women going into science and engineering, and suggests: "If those trained women scientists who have

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[16] N.M. Brown, "Wastage of Women Scientists," Research, April, 1957, vol. 10, Butterworth's Scientific Publications, London, p.124.

no children or whose children or whose children are at school were to seek reemployment, encouraged and supported by their husbands, the wastage rate due to marriage would be appreciably decreased..." Miss Brown also suggests that employers make better provision for maternity leaves of several months' duration and that they adjust working hours so that women may be free to welcome their children when they come home from school. One reason for the comparatively few women in science Miss Brown attributes to a lack of vocational guidance at the high school level.

An outstanding feature of English plans for utilizing women in science and engineering and one which is only just starting to receive attention in Canada is the encouragement to start as technicians in industry and work upward while studying. Girls are taken as early as at the junior matriculation level and utilized in a variety of industrial jobs while being given time off, usually with pay, to study and advance themselves in their work.[17] In some firms it is possible to advance to the university graduate level under this system and many scholarships and bursaries are available for those wishing to do so. Having women start

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[17]British Federation of University Women Ltd., Opportunities for Girls and Women in Science and Technology, Crosby,Hall, Cheyne Walk, London, S.W.3, 1961, p.43.

as technicians has the advantage of encouraging those who are really interested in science, and separating out those who are not, in such a way that the benefit to industry and the economy is probably a more lasting one.

The position of women chemists in New Zealand is discussed by Dr. Elsa B. Kidson, who says that only 7 per cent of the Fellows and Associates of the New Zealand section of the Royal Institute of Chemistry are women, and among those members of the Institute who are actually working in chemistry the proportion of women to the total is less than 6 per cent. The small proportion of women scientists in New Zealand Dr. Kidson attributes to poor teaching of mathematics and science in the schools, a shortage of science and mathematics teachers, poor laboratory facilities, improper vocational counselling and not too many positions for graduates, except in teaching. At the time of her writing the demand for scientists had increased in New Zealand, particularly in industry, with good opportunities for interesting work and good salaries.

Dr. Kidson discusses the basic reason for the small number of women in science: "Without a doubt the most serious consideration...is not their ability but their probable loss to the profession on marriage." Some people in New Zealand and overseas feel that to train women in

chemistry is wasteful and useless, Dr. Kidson observes, commenting: "It is a curious fact that it (this opinion) is held more in relation to the sciences than to the arts. Yet if it is wasteful to train women in science it is wasteful to train them in anything but housework for the same reason."[18] She believes a broader concept of education is needed, a concept where a quality of mind is as important as the ability to assist in the material progress of the country. She feels that a scientific training should help to develop a balanced judgment and the ability to weigh evidence, and for the woman with children a scientific background is immensely helpful in their education. Dr. Kidson makes the point that married women's decisions to return to scientific work later on in their lives depends on how much their services are valued and to what extent ancillary help can be provided for them.

Attitudes found in the other Commonwealth countries concerning women in science and engineering closely parallel those in Canada and the United States. The effect of these attitudes will be evaluated in the section which follows.

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[18] Dr. Elsa B. Kidson, "Women in Chemistry in New Zealand," Journal of the Royal Institute of Chemistry, London, February, 1958, p.83.

4. Effect of Economic and Social Factors

Although economic factors have a bearing on students' decisions to enter the field of science and on whether or not to remain employed in this work, their effect on women's choice of work is not as strong as that of social factors.

Altering patterns of choice among fields of study for women depends not only on the existence of good job opportunities. It involves changes in dominant ideas about suitable employment for women, changes in employers' practices, and in the way in which young women are guided while in high school and college.

A sociologist sums up Canadian attitudes toward women in the professions while comparing them with those in the United States: "The Canadian scene is not just a carbon copy of the American one," said Dr. F.G. Vallee, Professor of Sociology at McMaster University, "but the overall picture is very similar."[19] There is more conservatism in family life in Canada than in the United States; in Canada one will find more men and women conforming to something like the traditional design for living.

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[19]Dr. F.G. Vallee, The Real World of Women, CBC Conference, Toronto, September 6-9, 1962, p.14.

Dr. Vallee believes that Canadian women are more likely to be home-oriented and less likely to be work-oriented than those in the United States. One reason for this is a larger proportion of people of the Roman Catholic faith in Canada than in the United States. Dr. Vallee specifies: "About 50 per cent of our population is Roman Catholic compared with about 33 per cent in the United States...Again, almost one-third of our population is of French Canadian origin and studies have shown that, even in our cities, the French Canadians typically keep up family contacts with large numbers of relatives and it is the women who are expected to specialize in maintaining the solidarity of these kinship units."[20]

Dr. Vallee also notes the similarity between Canada and the United States in the way women are located in the power system, remarking that there is a prevailing attitude which makes it difficult for women to rise to high positions in the business world: "In the United States, as in Canada, we find very few women in top power positions in the political and economic areas but we find

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[20] Ibid., p.14. Dr. Vallee feels that where women are deeply integrated with the kinship network they will be only superficially oriented to the world of work, politics or other outside interests.

quite a number at the lower, supervisory levels. Further, it is unusual for women in Canada to receive pay equal to that received by men for doing the same job."[21] Women by and large accept this, except for a small minority. Dr. Vallee also believes that the mass movement to the suburbs, both in the United States and in Canada, seems to encourage strong family life, the having of larger families, and perhaps a more clear cut definition of what are the male and what the female spheres.

These traditional factors, reflected in the attitudes of family and friends, affect women's choices of subject and vocation. A change in community attitudes about the suitability of scientific work for women is necessary if the number of women engaged in this field is to increase substantially. Such changes ordinarily come about fairly slowly unless precipitated by some unusual circumstance, such as occurred during the war. Within the near future, although a fairly strong demand persists in some sectors, it is not likely that there will be a large enough increase in demand to precipitate changes of any magnitude. There may, however, be a gradual upward trend in the number of women engaged in science as more opportunities are opened.

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[21] Ibid., p.14.

CHAPTER VII

CONCLUSIONS AND RECOMMENDATIONS

From time to time there have been suggestions for encouraging more young women to specialize in the biological and physical sciences and in engineering, in which they are now poorly represented.

Measures providing for the greater utilization of women in scientific fields would, in the long run, help to alleviate shortages and ensure that the talents of women who are interested in this work are not wasted. Although the number of women interested in training in these fields may not be large and the problem of retraining following an absence from the labour force a difficult one, encouragement should be given those who are seriously interested.

Because most vocational choices are made in high school it is important that students interested in the sciences be guided to take suitable courses and helped to make intelligent choices of future work. Vocational guidance officers might be made more aware of the opportunities for employment available in science and engineering and of employers' general attitudes for and against the employment of women scientists. They might also describe to interested students the programs and events of special value for them,

such as special television programs or lectures, science fairs, summer science camps,[1] or tours of scientific establishments. In addition to the necessary high school courses, one authority suggests for girls who are interested in science a wider academic background of elementary mechanical concepts to compensate for their usually poorer informal mechanical experience.[2]

Many valuable booklets are prepared by the Women's Bureau of the Department of Labour outlining job opportunities and working conditions in various areas as an aid to those who are choosing a field of work. These and similar bulletins prepared by various agencies are designed to help guidance officers as well as the students themselves.

Women who are already working in the sciences would undoubtedly benefit from improved working conditions such as more kindergartens or nursery schools,[3] paid maternity

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[1] J. Bascom St. John, The Globe and Mail, Toronto, January 16, 1964, p.7.
Jack Hutton, "Seek Young Scientists," The Ottawa Journal, March 7, 1964, p.50.
Fred Billings, "Science at Summer School," The Ottawa Journal, March 11, 1964, p.6.

[2] William G. Torpey, "Shortage of Highly Qualified Engineers and Scientists," International Labour Review, December, 1957, p.599.

[3] Department of Labour, Women's Bureau, Day Care Services for Children of Working Mothers, No. XI, January, 1964, p.2.
Department of Labour, Women's Bureau, Married Women Working for Pay in Eight Canadian Cities, 1958, p.60.

benefits of greater length,[4] and more part-time jobs or shorter hours of work.[5]

Retraining programs would aid married women scientists who have been absent from the labour force and wish to prepare to reenter employment. A large number of women already trained (and the proportion of graduates has been higher in recent years) would undoubtedly be able to reenter the labour force in future years if education programs were geared to their needs.

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[4]Department of Labour, Women's Bureau, Maternity Leave, June, 1963, p.9.
Maternity leave provisions in Canada ordinarily cover leave only, without the cash or medical benefits inherent in the standards established by the ILO, and leave is usually for no more than 12-14 weeks except in the civil service. The wider provision of maternity benefits of greater length and with continued salary would do a great deal to facilitate women's return to work and would improve the status of maternity leave.

[5]In their booklet: Women Engineers in the U.S.S.R., p.23, Miss Souter and Miss Winslade described working conditions in schools, colleges and factories which make it easier for the working mother to organize her day: ordinary school hours are 9 a.m. to 2 p.m.; the Institutes have a six hour day for students, teachers and research staff. Facilities for meals are then provided. In industry the 7 hour work day (41 hour week) ordinarily runs, for women, from 7 a.m. to 2 p.m. Nursery schools and kindergartens offer day care and overnight care if needed. Hot food may be bought in factory or apartment building and taken home as an aid to housekeeping.

Useful also for Canada would be a program one author suggested recently for the United States, namely: "...a national education program...for women who seriously want to continue or resume their education." Such a program would provide properly qualified women with tuition fees, plus a subsidy to defray other expenses - books, travel, even household help."[6] It should be of a flexible nature to be adapted to the time of day and amount of study women may find it possible to fit in while devoting their main energy to their home and family.

Because much of the hesitancy of women to enter the science professions is due to social pressures, it would be helpful if the lead were taken by government, university and industry to persuade ordinary citizens to broaden[7]

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[6]Betty Friedan, "Modern Woman: Her Dilemma," The Star Weekly, Toronto, January 25, 1964, p.12.
Mrs. Friedan believes that mature women taking retraining courses would work quickly and seriously toward their goals. She suggests that mothers be permitted to use educational facilities on a part-time basis, and in the summer, in order to gain a regular degree through a combination of home research projects and classroom attendance. Home projects might be guided by tutorial conferences or television courses, and a system of equivalents worked out to provide credits for study done this way.

[7]Not only to broaden their views but avoid prejudice. Dr. J. Roby Kidd, in an Address to the Ottawa Area Girl Guides of Canada, The Ottawa Journal, February 4, 1963,p.26 said that vigilance is necessary to ensure that women are permitted to use their full potential in the world of work.

their views. There is little difference between the work performed by graduate women scientists and those in sub-professional positions as technicians - yet the latter are considered eminently suitable for women. The traditional division of men into professional work and women to sub-professional ignores the potential gifts of the most talented women. Although their work life may be shorter than that of men, they may still have many years to contribute to the aid of society as a whole.

The greatest need for women science graduates is probably in the high school teaching field, where the opportunities for employment are greatest and where breaks in employment may be fairly easily arranged. For those who prefer the more advanced levels, university teaching offers an ever-increasing opportunity and government departments will no doubt in future, as in the past, attempt to provide equal opportunity for women scientists of ability.

It is likely that the biological sciences will continue to hold the greatest attraction for women, lending themselves to the broad areas of medical science and of nutrition. Mathematics and chemistry are also fields which provide a wide range of opportunity.

Although there may not be a large increase in the number of women in scientific work in the near future, the

proportion of women should increase gradually as larger numbers decide it would be worthwhile to follow an interest in its various branches.

Society stands to gain from the optimum use of all resources. In the world of science which is playing an an increasingly important role in our lives, it is to be hoped that more women will come forward to take their part, encouraged and welcomed by employers who recognize and appreciate the special contribution they are able to make.

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