

on bryozoa and pursued her interests in human evolution and the origin of the Earth.

HELEN REYNOLDS BELYEA (1913-1986)

Helen Belyea was born in St. John. She completed a B.A. in languages and geology at the University of New Brunswick in 1934, an M.A. in geology in 1936 at Dalhousie University, and a Ph.D. at Northwestern University with her thesis entitled "The Geology of Musquach Area, New Brunswick." Belyea joined the Geological Survey of Canada as a sub-surface stratigrapher and field geologist in 1945. She focussed on the Devonian of the Western Plains, and in her first paper in 1952 she explored the facies relations in the Upper Devonian and the implications of the reef/off-reef sequences. In 1955, her paper outlining the southern margin of the reef complexes was the beginning of an extensive and important investigation into the problems of relationships in the upper part of the succession above the Woodbend reefs and biostromes. Helen Belyea was given many honours for her work, including an appointment as an Officer of the Order of Canada. She retired officially in 1975, but continued to work for several years as a Research Scientist Emeritus at the Institute of Sedimentary and Petroleum Geology.

GABRIELLE DONNAY (1920-1987)

Gabrielle Donnay (née Hamburger) emigrated to Los Angeles from Poland at the age of 17. She studied at the University of California in Los Angeles, graduating with the highest honours in chemistry, and an interest in crystallography. She completed her Ph.D. in 1949 at the Massachusetts Institute of Technology with her investigation into the non-centrosymmetric rhombohedral structure of tourmaline. In 1970, after 20 years with the Geophysical Laboratory, Carnegie Institution of Washington, she moved to Canada, becoming a member of faculty at McGill University. Gabrielle Donnay published 134 papers about crystal chemistry and structural crystallography, and together with her husband Jose Donnay, became internationally known for their compilation of crystallography *Crystal Data* (1954, 1963). She received many honours and awards for her excellence in mineralogy and crystallography, including the Past Presidents' Medal of the Mineralogical Association of Canada. The mineral **Galdonnayite** [$\text{Na}_2\text{ZrSi}_3\text{O}_9 \cdot 2\text{H}_2\text{O}$], discovered at Mont St. Hilaire, Quebec, was named after her.

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REFERENCES/ SUGGESTED READING

- Ainley, M.G., ed., 1990, *Despite the Odds: Essays on Canadian Women and Science*: Véhicule Press, Montreal, 452 p.
- Connolly, K.T., 1927, *A Woman Prospector*: Canadian Magazine, v. 68, p. 28-30.
- Heise, H., 1986, *Alberta owes much to Helen Belyea*: Calgary Herald, May 29, p. F4.
- Martin, R.F., 1989, *Memorial of Gabrielle Donnay*, March 21, 1920–April 4, 1987: *American Mineralogist*, v. 74, p. 491-493.
- Meadowcroft, B., 1990, *Alice Wilson, 1881-1964: Explorer of the Earth beneath her feet*, in Ainley, M.G., ed., *Despite the Odds: Essays on Canadian Women and Science*: Véhicule Press, Montreal, p. 204-219.

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Women in Earth Science/Geology Departments of Canadian Universities: 1983-1992

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ABSTRACT

The proportion of female students in Canadian earth science/geology departments has increased slowly in the past decade, from 20% to 28% at the B.Sc. and M.Sc. levels and at the Ph.D. level (based on small numbers) from 8% to a peak of 21% in 1991. The proportion of female faculty remains at less than 5% and only 13% of new faculty hirings since 1983 have been women. These percentages are similar to those in other physical science disciplines; they are higher than those in the United Kingdom, but lower than those in the United States. Vigorous action is required both at the elementary/high school and university levels to avoid wasting female talent and to ensure that female undergraduate students have role models among graduate students and faculty.

INTRODUCTION

It is well known that women are under-represented among both students and academic staff in earth science/geology departments of Canadian universities. The purpose of this paper is: 1. to document the degree of under-representation and to see how it compares with other sciences, 2. to determine whether there has been any change in the representation of women among geology students (both undergraduate and graduate) since 1985, 3. to document the participation of women in hiring tenure-track faculty since 1983, and 4. to make some suggestions for improving the participation of women in university departments. This task has been attempted through an analysis of data provided by the Council of Chairs of Canadian Earth Science Departments (CCESD), a questionnaire sent out to

chairs of earth science/geology departments, Statistics Canada data, anecdotal information from selected universities, and enlightening discussions with several colleagues.

WOMEN IN HIGHER EDUCATION: THE GENERAL SITUATION

As background for an analysis of the role of women in earth science, we need to review first what has happened to the women in higher education and, in particular, in science in the last few years before focussing on the earth sciences. The information in this section is summarized from Bellamy and Guppy (1991). In recent years, differences between sexes in high school attendance, and in completion and transition to post-secondary education have been reduced. By 1985, the transition of females (29.2%) directly from high school to university equalled that of males (29.5%). A rapid increase in full time enrollment of women in university began in the 1960s. One way of illustrating the trend in university enrollment patterns is to note that in the last 35 years, the number of male students has increased by 294%, while female enrollments have risen by an astounding 1420%. By 1975, more than 49% of university de-

grees were awarded to women. Since 1981-1982, more women than men have obtained bachelor and first professional degrees.

Men still dominate in graduate schools; however, there is steady progress in attainment of graduate degrees by women. Since 1970-71, the number of masters degrees granted by universities has grown by 69.3% and the number obtained by women has escalated by 245.3%, representing 44.9% of all masters degrees awarded in 1988-89. At the doctoral level, the overall increase in numbers of degrees awarded has been 48.6%, but the increase for women has been 388.7% (compared to a 12.2% increase for men). Yet only 30.6% of all doctorates in 1988-89 were awarded to women.

These overall figures mask substantial variation in women's participation in different fields of study. The content of courses and degree programmes followed by women and men are very different and this produces a "gendered division of education." Women have made remarkable gains in certain fields, especially in commerce, veterinary medicine, and engineering. Statistics for physical science, which includes geology, show that some progress oc-

curred (from 19.4% in 1971 to 27.9% in 1988), but that the under-representation of women persists.

Although the number of degrees awarded to women almost tripled between 1970-1971 and 1989-1990, the increase in the number of women on university teaching staffs (in particular at the full professor rank) has been very slow: female faculty increased from 12% to 18% from 1961 to 1986 and the proportion of female full professors grew from 4% to 6% within the same time period.

WOMEN STUDENTS IN EARTH SCIENCE/GEOLOGY

The Council of Chairs of Canadian Earth Science Departments has compiled statistics on the gender representation of students in geology, geophysics and geological engineering (but not geography or soil science) since 1984-85. These data are summarized in Figures 1 to 3 and Table 1.

Overall, there has been an increase in the female undergraduate student population from approximately 20% in 1985 to approximately 28% in 1992 (Fig. 1), despite considerable regional fluctuation, with Ontario and Quebec generally having the highest percentage. The percentage of degrees obtained by female

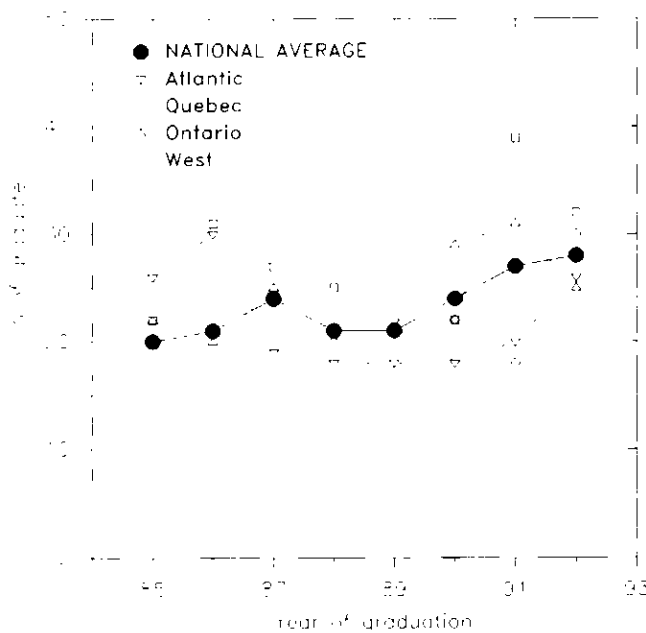


Figure 1 Percentage of female B.Sc. students who graduated from earth science/geology departments of Canadian universities for the academic year 1984/85 to 1992/93. (Based on CCCESD statistics).

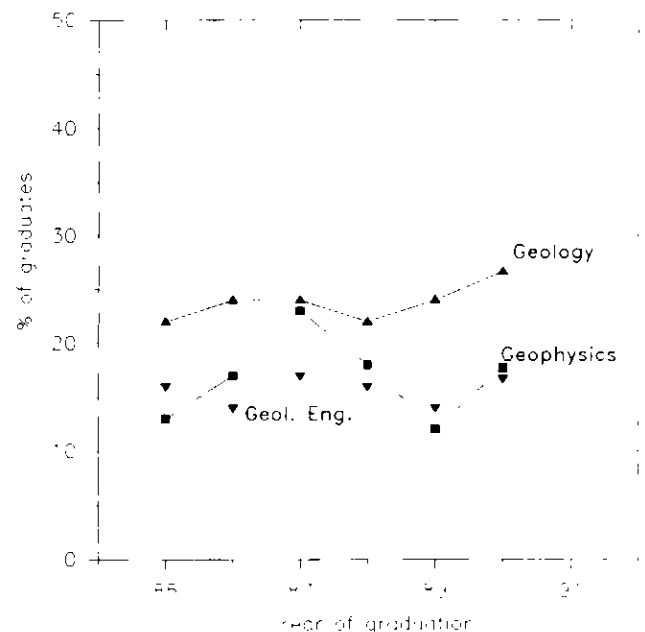


Figure 2 Percentage of female B.Sc. students who graduated from earth science/geology departments of Canadian universities for the academic year 1984/85 to 1992/93 according to discipline areas (geology, geophysics, geological engineering). N.B. "other" is not shown. (Based on CCCESD statistics).

students in all the physical sciences in 1988-89 was approximately 28%, comparable with the percentage in geoscience in 1992. The growth in female enrollment has not been concentrated in any particular field of geoscience (*i.e.*, geology, geophysics, geological engineering) (Fig. 2). The proportion of female graduates is rather higher than in the United Kingdom (Ward, 1992), but lower than in the United States (Simrski, 1992).

The percentage of female M.Sc. graduates increased in 1987, then remained almost constant at approximately 23% until 1991, and then increased to 27% in 1992 (Fig. 3). Although numbers are small, there appear to be significant re-

gional differences, with the lowest proportion of women in recent years in Atlantic Canada and the highest proportion in Quebec.

There has been an increase in female Ph.D. graduates from approximately 8% in 1985 to approximately 21% in 1991, dropping to 12% in 1992 (Fig. 3). Regional fluctuations (Fig. 4) are based on such small numbers (Table 1) as to be not statistically valid.

WOMEN FACULTY IN EARTH SCIENCE/GEOLGY

In order to assess the change in the number of women faculty in earth science/geology departments over the same time period as we have data for

students, we sent out a simple questionnaire to all Canadian earth science/geology departments listed in the American Geological Institute (AGI) directory. This questionnaire asked for statistics on tenure track hirings since 1983 and comments on the availability of women candidates. Of 106 tenure track earth science faculty hired in 27 departments since 1983, only 14 were women (Table 2). Overall, the total number of female faculty members (based on the AGI directory) was less than 4% in 1990: a figure comparable with the United Kingdom (4.9%) (Ward, 1992).

Many departments indicated that they would have liked to have hired more women: the most common reasons cited for not hiring women were 1. a lack of qualified candidates and 2. problems of spousal employment. The percentage of women hired, approximately 13%, is substantially lower than the percentage of female Ph.D. graduates (Fig. 3), although hirings in the mid 1980s may have been influenced by probable low numbers of female Ph.D. graduates before CCCESD statistics were first compiled (1984-85).

DISCUSSION AND SUGGESTIONS

Other papers in this issue deal more fully with some of the factors behind statistics presented above. A few observations, however, are appropriate. The low proportion of women at all levels in geoscience is similar to that in other physical sciences. Many commentators have identified the importance of the teenage years in attracting young women into the physical sciences although opinions remain divided on how this is best achieved. We can perhaps learn from our colleagues in physics and chemistry.

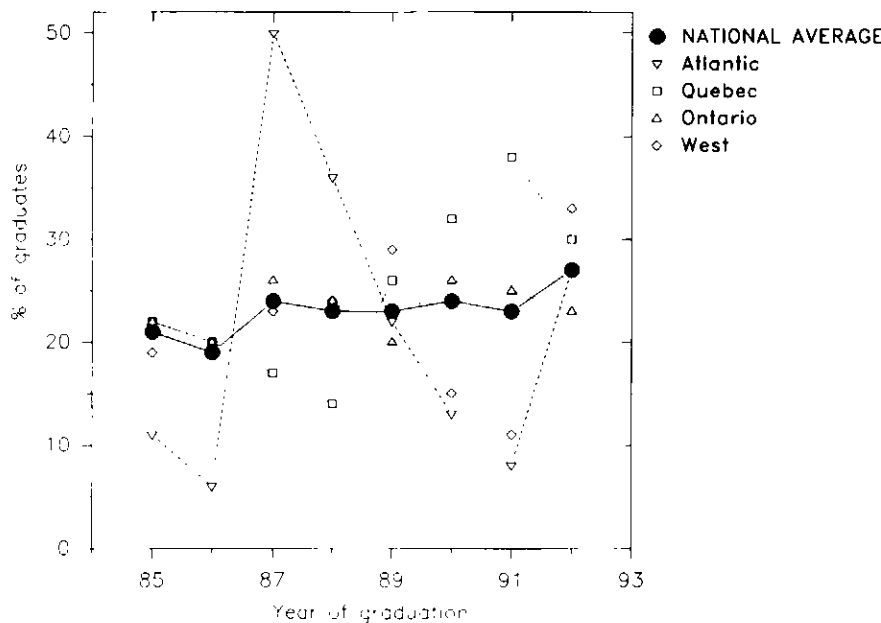


Figure 3 Percentage of female M.Sc. students who graduated from earth science/geology departments of Canadian universities for the academic year 1984/85 to 1992/93. (Based on CCCESD statistics).

Year	Atlantic Canada			Quebec			Ontario			Western Canada		
	B.Sc.	M.Sc.	Ph.D.	B.Sc.	M.Sc.	Ph.D.	B.Sc.	M.Sc.	Ph.D.	B.Sc.	M.Sc.	Ph.D.
1984-85	127	18	2	158	68	13	418	109	33	379	37	12
1985-86	131	16	7	177	66	9	361	94	28	367	56	28
1986-87	102	14	8	170	77	19	280	95	16	219	65	22
1987-88	98	14	9	107	36	9	225	68	40	267	86	21
1988-89	66	9	3	85	38	6	174	75	33	182	55	15
1989-90	36	16	13	73	37	8	130	73	30	155	27	8
1990-91	50	24	10	83	40	14	145	80	44	159	37	19
1991-92	83	33	12	99	30	15	135	88	25	133	45	29

The university environment in geosciences is not always particularly attractive to female students. More female role models (graduate students, post-docs, faculty and even alumni) are needed. The traditional male dominance of social events and department organization must be reduced: in many cases, female students are now playing an increasingly important role in student affairs.

The low proportion of women being hired into faculty positions (lower than the proportion of women graduating with Ph.D.s) is troubling, particularly when many universities have policies of seeking women whenever well-qualified candidates are available. Is there insufficient sensitivity to employment conditions of young female faculty? Scanty statistics from the United Kingdom suggest that in recent years more female faculty have left academic posts than were hired to such posts, perhaps because of employment conditions (Ward, 1992). Are female graduate students entering a narrower range of Ph.D. disciplines than men? What is clear is that the policies of the past ten years have failed to bring the proportion of female faculty in geoscience departments (or even the proportion of new hirings) anywhere close to the proportion of female undergraduate students.

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REFERENCES

- Bellamy, L.A. and Guppy, N., 1991, Opportunities and obstacles for women in Canadian higher education, in Gaskell, J. and McLaren, A., *Women and Education* (2nd edition): Detselig Enterprises, Calgary, p. 163-192.
- Simarksi, L.T., 1992, Examining sexism in the geosciences: *Eos*, v. 73, p. 278.
- Ward, B., 1992, Women and geology at UK universities: *Geology Today*, 1992, p. 185-188.

Accepted, as revised, 1 March 1995.

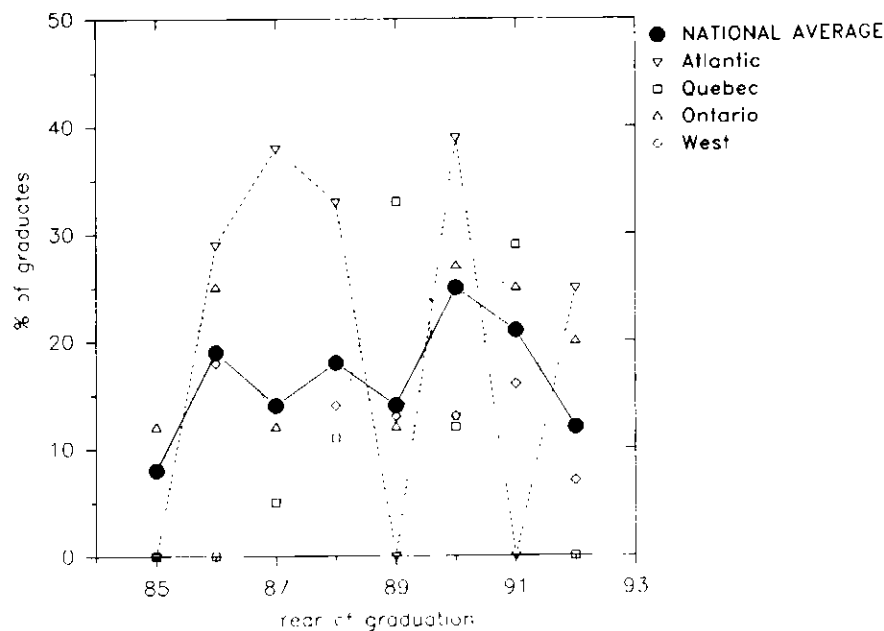


Figure 4 Percentage of female Ph.D. students who graduated from earth science/geology departments of Canadian universities for the academic year 1984/85 to 1992/93. (Based on CCCESD statistics).

Table 2 Tenure track appointments at Canadian universities, and the number of women appointed to those positions.

University	Tenure Track Appointments 1983-1993	Women
Acadia University	0	0
University of Alberta	8	0
University of British Columbia	7	1
Brock University	5	1
University of Calgary	7	0
Carleton University	5	1
Concordia University	2	2
Dalhousie University	2	0
Lakehead University	2	1
Laurentian University	3	0
University of Manitoba	3	0
McGill University	7	0
McMaster University	0	0
University of Montreal	2	0
Mount Allison University	0	0
Memorial University	13	1
University of New Brunswick	3	0
University of Ottawa	7	1
Queen's University	5	0
University of Saskatchewan	3	0
St. Francis Xavier University	3	0
Saint Mary's University	1	0
University of Toronto	4	1
University of Victoria	10	3
University of Waterloo	5	2
University of Western Ontario	3	0
University of Windsor	3	0
TOTAL	106	14
% of women appointments		13

Note: Excludes NSERC Women's Faculty Awards; includes URFs who subsequently got tenure track jobs, and includes faculty who have subsequently resigned.