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Women Inventors in Canada: Research and Intervention

What is an inventor or an invention? In this essay, we use the definition of the Canadian Patent Act, which considers a patentable invention to be a new or improved product or process or a new application of an existing product or process. An invention must be technically feasible — it must “work” — and it must be novel enough so as not to be an “obvious” extension of a previous invention.

In this essay we only consider patentable inventions, because this is how the term is widely used, both in academe, and in business and government. Most scholars who study inventions and inventors rely exclusively on patent office data. Similarly, economists and statisticians generally use such data to measure the level of innovation in a given country.

However, there are some ambiguities and difficulties in defining invention, which should be recognized at the outset. In particular, the line between “invention” and “discovery” (the uncovering of *pre-existing* knowledge) is often a fuzzy one. As any scientist can attest, the two are, in practice, inextricably linked. A new discovery, such as the structure of DNA, is dependent on many inventions, such as x-ray diffraction instrumentation, and, in turn, generates other inventions.

In recent years, the legal definition of invention has been greatly eroded, and this has further eroded the distinction between invention and discovery. For example, when one of us (R.S.B.) was a

graduate student in molecular biology in the late 1960s, bacterial mutants were considered "discoveries." Today, such bacteria, and even fragments of their DNA, are routinely patented. In the United States, plants and animals (mice) are patentable in some cases, as are drugs.

In this essay, we have used the term invention in the new and broader sense. Some of the examples used may be on the "fuzzy border" between invention and discovery, but we believe that all are, arguably, patentable by today's criteria.

In Canada, the stereotypical inventor is an eccentric man tinkering alone in an ill-equipped basement laboratory or garage workshop on an idea that might never see the light of day. The inventor is an outsider, someone not totally accepted or acceptable, a person whose creativity refuses to be channeled into more desirable or familiar directions.

If the male inventor is something of a pariah, the female inventor bears a double stigma, both as an inventor and as a woman. According to most of the literature on inventors, as well as the popular perception, women are not supposed to invent at all.¹ Clearly, women and their inventions have received little attention in history books or the news media.

With the increasing scholarship in feminist history, however, some fascinating examples of women's inventions are now coming to light.² One study suggests that prehistoric women were inventors, in that "gathering food was an early critical invention and an important step in the divergence of the hominid line."³ This was largely women's work. Similarly, women have been credited with developing the earliest domesticated plants.⁴

Even in historical times, women were often "hidden" inventors. For either legal or commercial reasons, because they could not "own" a patent, or because they felt that a patent in a woman's name would not be taken seriously,⁵ women often did not patent in their own names. For this reason, the number of patents listing a woman as inventor is probably considerably smaller than the actual number of women inventors. Nevertheless, patent office records are, overall, the best sources available for identifying women inventors.

In reviewing such records, it is clear that inventions by women frequently reflect the necessities of women's lives, for example on dishwashers, sewing machines, irons⁶ and beds.⁷ A sobering reflection on women's lot in life is the large number of utility patents.

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Rachel Zimmerman, 17, of London, Ontario,
inventor of a computer for the handicapped.

Courtesy Women Inventors Project.

But women's inventions are by no means confined to the domestic sphere. According to Stanley,⁸ 20 percent of the machines patented by women in the United States between 1790 and 1888 were non-domestic in application, for example, an apparatus for raising sunken vehicles, a steam generator, and a pump.

Women have been particularly important inventors and innovators in the fields of biochemistry and pharmacology. Prehistoric women developed many herbal remedies,⁹ and mediaeval peasant women bound mouldy bread over wounds centuries before Alexander Fleming discovered that a substance produced by the *Penicillium* mould killed bacteria.¹⁰ To this day, women physicians and scientists continue to make important contributions in the biomedical area. Indeed, of the 10 Nobel prizes awarded to women in science, five have been in physiology and medicine, with Rosalyn Yalow, the inventor of the radioimmunoassay, and Gertrude B. Elion, the co-inventor of a variety of therapeutic drugs, being two notable recent recipients.

As these examples illustrate, women obviously have the drive, creativity, and ability to invent successfully, but there are still relatively few women anywhere who receive patents on their inventions. According to the Canadian Patent Office, less than one percent of Canadians receiving a Canadian patent are women; in the 1988-89 fiscal year, 99 out of 17,245 (0.6%) of the patents issued were issued to women.¹¹ In the United States, the figure is somewhat higher; approximately eight percent of American patents have the name of a woman as inventor.¹² In both cases, the figures are rough approximations based on guesses as to the gender of inventors, as neither patent office keeps records of the gender of patent holders.

Together with our colleagues, we set out to explore the reasons for the paucity of women inventors, and to develop an intervention program which would encourage innovative Canadian women to develop their ideas. In this essay, we review our research on the lives of contemporary Canadian women inventors. What are the challenges and barriers these women face, and how do social and gender structures impinge on their lives so as to render them invisible, or to denigrate their work? After attempting to answer these questions, we discuss the experience of the Women Inventors Project in helping women inventors to surmount some of the obstacles.

Background

A social structure that undermines the legitimacy of women's experiences as innovators overwhelms the attributes of any individual woman inventor.¹³ When the dominant society focusses on men, men's ideas, and men's understanding of the world, we are given "a one-sided standpoint [that] comes to be seen as natural, obvious and general."¹⁴ A deep-seated sexist ideology, that says that only what men do matters¹⁵ has profound and negative effects on women. It also structures society's reaction to women's creativity and innovation, making their achievements insignificant or invisible.

Women who come into work or professions that have been established and shaped by men in both content and form, tend to be seen as inadequate in comparison to men. They are immigrants to foreign cultures.

Science and technology are the epitomy of such a male culture. As Evelyn Fox Keller¹⁶ and many others have pointed out, science was, from its beginnings, conceptualized as a specifically masculine endeavour — the quest for simple and often hierarchical relationships, the search for mastery over nature (the latter often seen in feminine terms), and the distant, objective, and rational stance of the scientist. Women scientists, such as Rosalind Franklin in DNA research,¹⁷ Ursula Franklin in metallurgy, Lynn Margulies in evolutionary biology, Barbara McClintock in genetics,¹⁸ Barbara Wright in embryology, and Ruth Hubbard in biology of gender, who have provided innovative conceptualizations of scientific problems, have had an uphill battle to gain acceptance.

Much of the literature (by men) implies that women are incapable of high-level creativity. It is argued that women are *biologically* prevented from full development of creativity because of their natures, which are seen to centre on reproduction and childrearing. Given such pressures, it is not surprising that women often rechannel their creative urges into more acceptable forms. "One cannot help but wonder how much female creativity is, and has been, channelled into . . . creative living, ranging all the way from interior decoration (sometimes called nest making) to how to live for a month on an income that leaves nothing for food."¹⁹

creativity associated with personal home decoration and per-
 appearance is less esteemed in our society than creativity which

designs new machines or produces esthetic works for public consumption."²⁰ As Cockburn (1986) suggests, women have largely been excluded from the crucial role of tool-maker, and thus often lack the technical expertise so valued in the public realm. Domestic creativity is discounted, as is women's creativity in the more public worlds of science and art.

A Study of Contemporary Women Inventors

For the purpose of this study, we interviewed 21 women who had registered their inventions for an assessment by the Canadian Industrial Innovation Centre in Waterloo. Most were "independent" inventors, who worked on their inventions at home, and most were at an early stage in developing their ideas — they had not yet marketed or even patented their inventions.²¹

We employed an open-ended interview schedule, in which we asked about the process of inventing in the women's own terms, how and why they got into it, how they saw themselves and how others reacted, how they dealt with the reaction of others, the challenges they faced as inventors, and the multiple roles they occupied.

The 21 women who participated in the study were diverse in every respect. They ranged in age from 24 to 66, with a mean age of 42.6. Sixty-one percent (13) of the respondents had had some post-secondary education, but some (10%) had had only grade 11. Most of them (76.2%) were married at the time of the interview, with equal numbers cohabiting, divorced, and widowed. Ten percent were never married. Two-thirds of the respondents had children, while 20 percent (4) did not. For three additional respondents, it was not known whether or not they had children. At the time the women were involved in inventing, 43 percent (9) had children still at home. The majority of respondents (76%) were employed outside the home at the time of the interview, with the remainder seeing themselves as homemakers, or not in the labour force. The latter category includes a student, a retired person, and a person on long-term disability. The range of occupations represented was impressive: a food services worker, sales clerks, a bar teller, an artist, a singer, a business consultant, a marketing analyst, special education teacher, a university professor, a teaching assistant at a university, and a nursing supervisor.

Tables 1 and 2 reveal some of the complexities involved for our sample in the process of invention. For the vast majority of women (81% plus) we interviewed, inventing was done at home (Table 1). This should not be interpreted as meaning that their inventions were all domestic, however. Table 2 shows the tremendous diversity in types of inventions on which the women worked. One third of them, however, were involved in working on inventions to improve domestic life.

The most striking finding of the study was the fact that the women inventors interviewed had so internalized the myth that women are not inventors that they denied their own experience. Only a small percentage (23%) would label themselves as inventors; a typical comment was, "I would not say that I was an inventor. My invention was an 'out of the blue' sort of thing. Inventors create a lot of things that are more technical than mine." Most strongly denigrated their work, calling it "silly" or "just making do." They kept their inventing quiet, "I have never told anyone that I invent on the side" In striking contrast was their appreciation of others: they were quick to label the men in their lives (father, husband, son) as inventors.

It appears that many of these negative perceptions of the women's own experience are tied to the invisibility and denigration of home-based work in general, and the lack of a recognized connection between the private realm of the home and the public sphere, where events of "importance" are seen to transpire. Inventing is considered by many of the women to be an extension of the homemaker's role, and this connection is reinforced by the fact that a majority of their inventions (67.5% of the women contacting the Innovation Centre) were in the "personal/household" category, as compared with 18 percent for inventions by males.

There were also other common elements in the women's experiences. A major barrier for most was the financial one. Developing an invention is usually very costly: North American patents alone cost at least \$5,000, and that is just the start. In addition to the barriers faced by male inventors in raising this kind of money, women inventors also face gender-related obstacles. For example, several studies of Canadian women entrepreneurs have found that women make heavy use of their own finances in business start-ups, because they have difficulty in getting funding elsewhere.²²

Time is also a gender-specific problem for women inventors; in juggling the demands of homemaking and childcare with work outside

the home and with inventing, many women were coping with three full-time jobs. The difficulty is not only a general lack of time, but also the lack of quiet time for thinking and creating. A typical comment was, "it's hard . . . not to be left by myself. You know, to really do what I want to do. I'm not just free as the breeze."

Another challenge, again related to working at home, was isolation. Many inventors lacked family support ("My husband was the greatest doubter, definitely"), and almost all lacked a peer group, for advice and moral support, and the business and professional contacts needed to develop their ideas. In the words of one, "I'd say contacts [were the biggest problem]. I have the idea but I don't know who would have the technology, who would have the knowledge of who else I should contact. I think it's just getting over that stuff . . . because this is one that stalled me." Many expressed the view that they didn't know where to start. Most felt that "more women would invent if they knew of other women inventors."

The Women Inventors Project

In the past decade, a variety of educational programs designed to encourage young women to continue with math and science courses in high school and enter "non-traditional" occupations have been instituted. The Lawrence Hall of Science, University of California, Berkeley, has been a pioneer in this work, but many Canadian school boards have been active as well.²³

Unfortunately, there is much less programming available for adult women involved or interested in "non-traditional" fields. Prior to the inception of the Women Inventors Project, no one had ever tried to develop a program for women inventors, even though the Canadian government (and many other groups) have professed a strong interest in encouraging innovation, and even though it was clear that existing support programs for inventors (such as the Canadian Industrial Innovation Centre in Waterloo) were not reaching women effectively. In fact, historically, only five percent of the Innovation Centre's clientele had been female.

As mentioned already, our interviews with women inventors had clearly identified concerns and problems common to most. Some of these, including isolation, lack of self confidence, and the need for

information and referrals to reliable professionals, appeared amenable to an intervention program. Therefore, one of us (R.S.B.), together with Lisa Avedon, designed an educational and support program for women inventors. The organization which resulted—the Women Inventors Project—began operations in November, 1986, with funding from the federal and provincial governments. It is the first program in North America aimed specifically at women inventors.

The Project's initial mailing list of less than 100 was comprised of women inventors who were either clients of the Canadian Industrial Innovation Centre in Waterloo, or holders of a Canadian patent. Through personal referrals and media publicity, that number has grown: as of January, 1989, there were over one thousand inventors on the mailing list, and about 250 women have attended one or more workshops sponsored or co-sponsored by the Project.

The women involved with the Women Inventors Project have developed a wide variety of inventions, including a novel three-way mirror for applying eye make-up or contact lenses, an electronic car mileage recorder, a collapsible prawn trap, a pacifier holder, and artificial intelligence software (see summary in Table 2). In addition to the work with adult women described here, the Project has developed and tested a workshop on inventing for grade 10 girls. Inventions by students have included a solar-heated rabbit hutch, a folder for organizing sheet music, and a handbag organizer.

To help women inventors and innovators overcome the barriers they encountered, the Women Inventors Project designed a workshop which fills a three-day period, or which can be broken down into shorter workshop units. The content includes information and resource materials relevant to the launching of an invention and information on networking strategies. The training format was refined in two three-day programs for 51 women from across the country, all at some point in the invention process.

The women inventors who participated in the Project's initial three-day workshops found that they learned and worked most effectively when there were opportunities to relate personally to workshop leaders, develop a sense of community with other women in the group, and see the relevance of workshop materials to their personal projects. This is a relational learning style.²⁴ In order to enhance the quality of the training, the workshops were especially designed to include time for one-on-one conversing between workshop leaders and participants,

hands-on prototype building, role models the women could relate to, displays of the women's inventions, and brainstorming situations from the women's own experience. Much peer learning — learning from each other's experience — occurred during the training; some of the women found this to be the most stimulating part of the sessions.

In a follow-up study of workshop participants, carried out about a year later, all the women interviewed accorded high scores to the training received.²⁵ As compared to the women inventors in the earlier study, there was a dramatic difference in self-perception. While over 80 percent of the original sample had poor self confidence (as evinced by the fact that they saw their own "lack of ability" as a major barrier), 83 percent of the workshop participants rated their self-confidence as good or very good.

In order to widely disseminate the workshop experience, the information covered and the experiences of the participants themselves, were summarized and published as an inventors' manual, *The Book for Women Who Invent or Want To*. Unlike most material for inventors, the book was written simply and clearly, using non-sexist language. Interestingly, we have found that demystifying technology for women also makes it more accessible to many men, as indicated by the fact that we have sold many books to, and have had very favourable feedback from, male inventors.

In parallel with the distribution of the book, the Project has helped to establish networks of women inventors in several Canadian cities. These networks provide "moral" support for otherwise isolated inventors, run workshops, and even work on inventions as a collective. The Project also publishes a newsletter for inventors, to enable women in more isolated communities to keep up to date; it also works with teenage girls.

Conclusion

In our research into the lives of contemporary women inventors, we have found that they face many of the same obstacles and barriers as do women in other male-dominated professions. They must balance the constraints of primary responsibility for home and family with careers, the parameters of which are established by men, for men. They face challenges in being taken seriously by their families, friends, an

neighbours. They feel the stigma of being in a field that is unusual in general, but particularly so for women. They are reluctant to see themselves as inventors, because they experience ghettoization of their work into areas thought to be appropriate for women. In short, meshing the roles of inventor, mother, and worker is far from straightforward.

A further problem faced by many women inventors is the isolation of working at home without colleagues for support and companionship. As with housework, this isolation means that women inventors lack a peer group by which to measure their accomplishments. They also lack business and professional contacts to help their inventions come to fruition. Home-based inventors may feel the particular sense of alienation from the public sphere that has characterized homemakers for decades.

Yet, home-based creative work has its positive aspects as well. Possibilities exist for balancing paid work with family responsibilities that so far are few in the workplace. The late 1980s was a time of rapid growth in a number of home-based industries, although this work is often poorly paid with limited opportunities for the workers to help each other to organize. The 1980s saw a rather dramatic growth in the numbers of successful women entrepreneurs and business people, many of whom work out of their homes. Many new women entrepreneurs find this work a viable option to the lack of opportunity women face as salaried workers. It may be that women inventors could increase in numbers in the future for some of the same reasons that have contributed to the increase in women entrepreneurs. Indeed, many of the most successful women inventors are entrepreneurs as well—they have taken their own products to market.²⁶ Unlike many women involved with science and technology, they are in the fortunate position of being able to work, at least to some extent, autonomously and outside of male-dominated organizational hierarchies.

Women inventors may be pioneers in another sense as well. They provide one model of women coping independently with technology, and hint at the type of transformation process suggested by Franklin,²⁷ Menzies,²⁸ and others. As one woman inventor, Deborah New, says, "I went to an engineering department in Cambridge but they couldn't work on it (my invention) for me. So I decided to go ahead and learn enough electronics to do it myself. And that's where it became a reality, on my kitchen table at home."

Table 1: Location of Inventing

	PERCENT	NUMBER
Home	81	17
Work	10	2
Home and Work	5	1
Unknown	5	1

(T = 21)

Table 2: Women's Inventions, By Category

	CIC ¹ GROUP		WIP ² GROUP	
	PERCENT	NUMBER	PERCENT	NUMBER
Environmental	5	1		
Recreational	14	3	17	4
Teaching Aid	10	2	9	2
Medical	10	2	17	4
Domestic/Personal	33	7	30	7
Chemical	5	1	4	1
Electronic/Computer			13	3
Mechanical			9	2
Not Known	24	5		

1 Canadian Industrial Innovation Centre, Waterloo. T = 21.

2 Women Inventors Project (group attending the Project's first workshop).

T = 23.