READING FOR RETENTION
(or) How to make a difference for (almost) no money...or "I am not alone, I am not crazy.
It is not my fault. There are some things I can do."

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Carnegie Mellon faculty and administrators have initiated a small reading group for graduate
students and faculty members on gender in science and technology during the 1989-90 academic
year. Because many academics are reluctant to discuss issues related to gender without a sound
grounding in research, the explicit purpose of the group is to provide an opportunity for women in
the sciences and engineering to read and discuss the social science literature on gender issues which
effect education and work. We have a "leader" assigned to to each session who chooses the articles
and facilitates our review, discussion, and critique of each. The implicit purpose of our group is
equally important -- to provide an opportunity for women to get together, relate our own
experiences to the articles, and help each other cope with issues as they arise. The group provides
support and encouragement, and serves as a forum for individual problem solving and community
action. Issues raised in our discussion, for example, have already surfaced in a successful grant
proposal for a graduate student luncheon seminar series and a major fall symposium on Gender in
Science and Engineering open to the whole community.

The reading group meets monthly throughout the academic year and summer. Starting from a
set of general readings, the group has developed and addressed a series of themes:

- science, engineering and gender
- a historical perspective on women scientists and engineers
- stress and gender in graduate school
- difficulties for women in the professoriat
- women in (specific field e.g. computer science, physics, biology, etc.)
- balancing family and occupation
- survival strategies
- science and math education for girls

"Science, engineering and gender" was one of our liveliest discussions because of the wide range
of views unrepresented in the articles read and in our group. "Difficulties for Women in Academia"
provided an opportunity to discuss our own lives and suggest individual change strategies. "Science
and math education for girls" was selected as a theme because it echoed a common topic in many of
our earlier readings. It provoked a serious discussion on the role that students can plan in outreach
to the schools.

Questions about our approach or the annotated bibliography which follows can be address to the
authors.

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WOMEN IN ENGINEERING CONFERENCE: A NATIONAL INITIATIVE
Reading Set 1; July 1989.


   In what has become a landmark article on the entry and retention of women in the engineering and science pipeline, Sheila Widnall, Abby Mause Professor of Aeronautics and Astronautics at MIT, describes the sequentially increasing attrition of women from high school to college to university. Based on studies done at MIT and Stanford, Widnall looks at the lower confidence level of women compared to their male colleagues and recommends that we must adopt a more sensitive strategy of advising and encouragement in graduate school if we are to recruit and retain women and minorities in science and engineering.


   The introductory chapter of a book, this article sets the stage for discussion of gender issues in the workplace. The book is the result of a survey research project. Issues of and perspectives about sexual harassment and models to describe women’s work situation are discussed. Implications for organizations and management are briefly outlined.


   This article about the special problems and the advantages of employing women in management examines a series of controversial questions about women’s opportunities given their child-rearing responsibilities. This is the article that elicited several discussions in the media about the "mommy track".

Reading Set 2; August 1989


   Based on a survey of graduate students, this article explores the association between the nature of life change on psychological stress symptoms and physical health complaints as reported by the subjects. Male and female graduate students were compared for these symptoms associated with events including those personal relationships, academic programs and career concerns. The study showed an increased sensitivity to interpersonal conflict and more reports of stress symptoms on the part of women compared to the men. Type of life-changes stressed by men and women differ. The authors suggest that these differences may have to do with traditional gender roles. While both men and women experience considerable stress as measured by symptom scores, women seem to report more stress from role conflicts while men report more from economic difficulties. These findings may have implications for graduate student counselors and mentors.
Reading Set 3; and Reading Set 4; September and October, 1989.

We began a two set sequence of readings that specifically focused on "Science/Engineering study and profession and gender".

Set 3:

In a volume dedicated to research on women in science, the authors compared the number of publications by a group of 263 women who received their doctorates in 1969-70 over a period of 12 years to a matched control group of 263 men and their publications in the same period. They used the number of papers as the measure of productivity. The results of total numbers are comparable to prior studies and showed that women published only 57% as many papers as men. However, while in the earlier studies of the 50's only 8% of the most prolific scientists (those who published more than 1.6 papers annually) were women, in this study, women constituted 26% of the most prolific scientists. Citations were also counted for the populations studied. It was found that, paper for paper, women are cited as often as or more often than men.

The authors examine three explanations for the differences. The first, a view that women publish less because they collaborate less, is not borne out judged from multiple authorship. Secondly, overall gender differences are not attributable to differences in first authorships. However, the authors find some support for a third explanation that women are less reinforced by citations (that is, they are not apt to publish more following citations) than are men.

Several apparently more valid explanations may be found and were discussed at the meeting.

-Introduction
-Chapter 4: Gender and Science
-Epilogue.

Evelyn Fox Keller is a biochemist who has written extensively about science and gender over the last decade. Her first noted work was *A Feeling for the Organism*, the biography of the biologist Barbara McClintock (W.H.Freeman, 1983). In this collection, she explores the idea that the edifice of science as it exists now has been the "preserve of men". Therefore, has characteristics "evolved under the formative influence of a particular ideal of masculinity". She points to this as part of the reason for the disenfranchisement of many women from science. Gender development and the interplay between cognitive and effective development are examined to illustrate and elaborate on this theme in the Chapter on "Gender and Science". The Epilogue makes a plea for "reclamation, from within science, of science as a human instead of masculine project, and the renunciation of the division of emotional and intellectual labor that maintains science as a male preserve". Keller defines a "healthy science" as "one that allows for the production of survival of diverse conceptions of mind and nature, and of correspondingly diverse strategies..."

This paper is one of an impressive collection presented at the national Conference on Women in the Professions: Science, Social Science, Engineering held in 1981. Trescott's analysis is based on four sources: interviews with over fifty women engineers mostly over fifty years of age; a survey of professional women engineers which was answered by women mostly in their twenties, thirties and forties; another survey of engineering students and, archival research. Thus the study spans several generations of women engineers.

Trescott comes to the conclusion that women engineers who have made substantive intellectual contributions to the theory and practice of engineering are a highly select group of holistic thinkers. She finds in them characteristics of: "(1) persistent, independent-thinking pioneer, (2) exceptionally bright intellect (3) engineer, who, whether male or female, often deals with systems, and (4) woman, who may have evolved a more holistic approach to life, in general, than man."

Set 4:

As an example of her thesis that women may have fashioned a different kind of science, Keller presents the work of Barbara McClintock. "Known to her colleagues as a maverick and a visionary, McClintock occupies a place in the history of genetics at one and the same time central and peripheral - a place that, for all its eminence, is marked by difference at every turn." Keller writes. Although McClintock has achieved the highest honor - the Nobel Prize in Biology - in her field, Keller points to the hard road McClintock has had in finding a formal appointment worthy of her achievements, the lateness in recognition of the significance of her work and the marginal position she has occupied among her colleagues as evidence of the scientific majority's unwillingness to accept the different, more holistic and synthetic (rather than analytic) way of thinking through which McClintock approached biology. She makes a point diverse ways of thinking is not accepted in science.


Coauthored by Professor Susan Henry, now Head of the Department of Biological Sciences at Carnegie Mellon and a member of our reading group, this article is a review of Keller's biography of McClintock, "A Feeling for the Organism". Henry is a cytogeneticist who is very familiar with and has taught McClintock's work. The authors of this review disagree with Keller's view of the professional life of McClintock in particular, and of the gender and science question in general. They attribute the lateness in professional recognition to the fact that McClintock's work "not only preceded any understanding of the structure and mechanism of replication of the genetic material, but her studies were also part of the genetics literature rather than molecular biology.... Even within the context of classical genetics her findings were counter to existing dogma ... despite the radical departure from existing dogma, (her findings) were not rejected...". It was the existing establishment practices that had no room for a woman intellectual. Although Keller's analysis of society's treatment of this "intense and unique" scientist is flawed, write the reviewers, the account of McClintock's life is well worth reading.

WOMEN IN ENGINEERING CONFERENCE: A NATIONAL INITIATIVE

This article describes the controversial scientist, Lynn Margulis and her role in promoting the symbiotic theory of the origin of the cell. This theory describes evolution as a combination of microbial cooperation and traditional Darwinian competition. Although she drew criticism when she first proposed that a eukaryotic cell (cell with a nucleus) evolved when two prokaryotes (single-celled organisms with no nuclei) merged, some parts of this symbiotic theory have come to be an accepted in biological theory. Currently a professor at the University of Massachusetts, and working on a couple of children's books on biology with her son, the article portrays a dynamic women with radical ideas on evolution.


This article examines the various aspects of the masculine imagery of physics including the self-image of physicists, the public's image of physics, school children's images of physics and explores the grounds for and the implications of such an imagery. Easlea finds that physicists exhibit certain traits: aggressive, competitive behavior, remoteness from concern with living beings, and a scientific method that makes the claim of "inexorably following the dictates of logic and experimental evidence. Science is also commonly portrayed as the domination of a (Female) Nature by a (male) scientist. Several authors has also expressed the view that the study and practice of physics in particular is unattractive to girls because of the strong association of physics with work of destruction in military applications. The article ends with an expression of the importance of the demasculinization of physics. The way to humanize physics, says the the author, citing Nicholas Maxwell's book, From Knowledge to Wisdom, is to give intellectual priority to a consideration of human problems, and to return to "an attitude of love for nature".


Newton uses the Bem Sex Role Inventory, a measure of psychological androgyyny, to compare a set of female trainee engineers with their female school friends and with male trainee engineers. Her research concludes that contrary to the popular image of the female engineer as a "masculine person", the female engineer does not have predominantly masculine characteristics and differs from male engineers in that she sees her role in terms of improving social conditions through contributions to technology rather than through the more traditional female service jobs.

Reading Set 5; December 1989.

Topic focus: "Difficulties encountered by women faculty in academia and strategies for change"

- Preface
- Chapter 3, Rules of the Game and
- Chapter 7, Countervalues and Change.

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**Women in Engineering Conference: A National Initiative**
This thought provoking book that should be required reading for members of the academe, is the result of a "formal study of women's deflection from expected academic careers". The Preface explains the study. The study was conducted in two phases. The first phase consisted of interviews with thirty-seven women who were off the normal career track and the second with twenty-five tenured women. These interviews revealed strongly similar patterns, between different locales, across disciplines, age groups, and diversity in marital status and class origins. General themes of "experience of professional marginality and of exclusion from the centers of professional authority" emerged.

Chapter 3, "Rules of the Game" examines the range of issues women face in the institutional structure of the academy. Learning to "negotiate the maze of rule and custom in the successful building of a career" is difficult for all, but particularly for women who very often work without essential support. The priority of allocating scarce resources preferentially to men's education followed in many families usually follows the woman to the academe where administrators award fellowships preferentially to men and teaching assistantships to women. This, added to the often hidden second job of caring for a family, seriously the woman's professional progress. Several such traps as well as the need to have a career strategy are discussed clearly by the authors. The discussion hits home to many of us and is thought provoking and helpful.

Chapter 7, "Countervalue and Change" calls for a transformation of the social system of the academe to "one that opposes excessive hierarchy and exclusivity in the holding of authority, one that incorporates diversity, spreads authority through the processes of cooperation, resists centrality both in the holding of political and intellectual authority and in the defining of truth and value, and protects individuality through the legitimizing of a personal component in professional life, a personal component to a professional voice."

-Chapter 2, "A Question of Genius: Are men really smarter than women?"
-Chapter 7, "Sex and Science: A Conclusion"
[This reading should have been part of the previous set on the science-gender issue but we only came across it later.]

Fausto-Sterling, Professor of Biology and Medicine at Brown University, uses biological and genetic evidence to assess critically the literature that claims a science-gender connection. The author discusses the often incomplete or inaccurate conclusions drawn about this connection by examining the premises in detail. Following a careful scrutiny of known biological facts, the author finds no ground for the claims that women are less mathematically or scientifically inclined than men, or that there are sex differences in lateral specialization of the brain.

In the final chapter of the book, the author reiterates that the "real issues in cognition center upon how one learns both in and out of the classroom". The problem has to do with resource allocation and establishing really equal opportunity for young people to learn science rather than with any biological differences.

Reading Set 6; February 1990.

Topic focus: Science and math education of girls


Using a survey of science attitudes, the authors found that "by age nine, girls, although expressing similar or greater desires to participate in science activities, were offered less
science experiences such as experiments and field trips than boys of the same age. The same was found in older girl students. These girls also display negative attitudes (science classes rated as boring, and not particularly useful; little faith that science or technology have the potential for solving worldwide problems such as food and energy shortages.) and take fewer science courses than boys. Increasing science experiences, role models of slightly older girls involved in science, opportunities to talk with college students are suggested as ways of eliminating the inequalities observed.


Five dilemmas that block girls' success in school are examined and suggestions made for intervention. These were derived from analysis of activities and discussions with a multiethnic group of third, fourth, fifth and sixth grade girls. Girls often think that achievement and affiliation are mutually exclusive. The competitive environment we often set up in education is discomfiting to many girls who win a trophy but feel bad their friends did not. Cooperative situations where all are rewarded are more acceptable. Girl students who achieved something would hide their success lest it appear that they were bragging. Girls also show a tendency to internalize failure.

3. Campbell, Patricia "What's a Nice Girl Like You Doing in a Math Class?" (source unknown).

Teacher expectations and behavior as well as the general societal response to girls in math and science are targeted in this article as sources of differences in achievement by minority and girl students in these subjects. Lower expectations and interaction of teachers and parents have an impact on achievement Several programs that have been effective in increasing science and math achievement of girls are described. These programs work to increase the interest, motivation and achievement of students or to change teachers, schools or courses.

4. O'Brien, Eileen M. "Feminist Scholars Prescribe Ways to Open Engineering, Technology to More Women" (source unknown)

This article is a short report on the Women in Higher Education Conference held at Case Western University in 1988. Various speakers stressed the lack of science-related experiences for girls and women students. Others pointed out that given the same technical opportunities as men, as for example, in computing centers in single-sex colleges and schools for girls, we find as many women hackers as there are men hackers in coed colleges. Because many women prefer "connective" (or cooperative) knowing to separate (or, detached) knowing, the current science education system may not be received well by many women, according to Blythe Clinchy, Psychology Professor and the author of "Women's Ways of Knowing". Presenters recommended changes in the science education system.


The authors examined sex role stereotyping in three areas: elementary school readers, educational achievement tests and differential curricular requirements for males and females. Female characters appeared less often in readers, and the behavior depicted of girls and women differed significantly from that of boys and men. In standardized tests also
references were made more frequently to men, women were portrayed exclusively as homemakers or in pursuit of hobbies while boys and men were portrayed in responsible and leadership positions. Sex bias was also described in vocational and physical education programs in availability of activities and allocation of resources.


Math anxiety is described by Michael, a mathematics professor, as a relatively common phenomenon, "a psychological state engendered when a person experiences a loss of self-esteem in confronting a situation involving mathematics". As this leads students to become "math avoiders", and as mathematics serves as a "critical filter" in determining further educational options, math avoiders lose access to many careers. Michael suggests methods to treat the problem through discussion and resolution of negative feelings, the keeping of a math journal and through participation in study groups. She states that "to a great extent, mathematical learning is a function of teaching" and calls on teachers to work concertedly to help students overcome math anxiety.

Reading Set 7; March 1990.

Leveson, Nancy "Women in Computer Science" A Report for the NSF CISE Cross Directorate Activities Advisory Committee, Information and Computer Science Department, University of California, Irvine, CA, 1989.

Professor Leveson prepared this report for the NSF on ways to increase women's participation in computer science. A preliminary draft ideas was circulated on an electronic bulletin board and responses summarized in the report.

The report recommends extramural programs, regional workshops and contact with role models for students from the earliest level. Networking to combat isolation and to receive helpful support is recommended for professionals. Funding to bring in speakers, and establishment of a mentor program are suggested as ways to retain students in computer science. While several of these suggestions echo other reports, the several personal accounts and experiences described in the report makes it of pertinence to other scientific fields as well and a valuable addition to the literature.

Reading Set 8; April/May 1990.


This essay analyzes the ways in which the first generation of professional women responded to discrimination. "The first wave of women professionals reacted to discrimination by becoming superperformers, subordinates, career innovators or separatists", say the authors. While all these strategies offer some opportunities for women during periods of economic expansion or shortage of labor, they in no way make room for permanent and equal acceptance of and rewards for professional women. Any apparent gains made due to extraordinary measures by outstanding women are lost in periods of low economic growth and of high unemployment. To make permanent gains, women professionals and their supporters must develop new psychological and political perspectives for their professional lives.

The report examines the impact of the doubly discriminatory environment on black women students, faculty and administrators. A significant contribution to a sparse literature, this report touches on all the salient features of academia. The university culture and classroom dynamics are examined from the perspective of the black woman. Research, teaching and tenure are discussed. Several solutions to these individual problem areas as well as general policy recommendation make this paper required reading for all concerned.