Journal of Technology Management & Innovation

EDITORIAL

The "Athena Paradox:" Bridging the Gender Gap in Science.

Henry Etzkowitz [1]
Editor

Science is fraught with gender inequities that depress women's professional careers and invade their personal space, as well (Tri-national Conference (2003); Commission on Professionals in Science and Technology, 2004; Rosser, 2004). For example, female PhD students in the U.S. are often excluded from the informal social groupings that advance professional socialization (Etzkowitz, Kemelgor and Uzzi, 2000). Not too long ago, a party celebrating the completion of the PhD by a female scientist in Brazil was interrupted by word that her husband was filing for divorce, apparently unable to countenance her rise in status symbolized by attainment of an advanced degree. A "gender tax" in evaluation of scientific work has been identified in experiments that assign the same paper to male and female authors.

The Athena Paradox, after the Greek goddess of wisdom and innovation, is the gap between the ideal values of science, codified in the normative structure of science and deleterious gender relations of science, as they operate in practice. Paradoxically, discriminatory social practices are accompanied by norms of science that expect scientists and their work to be assessed according to universalistic criteria (Merton, [1942]1973). In a disjuncture between ideal and reality, theory has overridden practice and, all too often, served to invisibilise rather than expose harms. A university "ombudsman" observed in an interview conducted as part of a study of women in academic science that there were many more complaints from female humanities and social science students, than those from the natural sciences and engineering, of unequal treatment.. She attributed this difference to "norms of science" that she believed insured equal treatment of women in science in comparison to other fields.

Our investigation suggested that the larger numbers of women in the humanities and social sciences had organized themselves into support groups that actively pressed for change in their departments. The smaller number of women in science and engineering departments were relatively isolated and tended not to organize, even though their treatment was worse. The "ombudsman" view from a distance of the positive working of scientific norms was, close-up, the lack of application of these very " norms." In the following, we discuss the forces for change in the traditional gender relations of science.

Changing Gender Relations in Science

By the late nineteenth century, a few women broke through gender barriers and entered the laboratory as "honorary men" but had to accept subordinate status. Like Lise Meitner, they were relegated to a basement lab, literally or figuratively (Sime, 1996). Marie Curie was putative junior partner to her husband, a fiction maintained after his death despite the award of successive Nobel prizes (Goldsmith, 2005). Nobelist Marie Goeppert Meyer was a research associate in her husband's university lab, reprising an earlier household gendered structure of science, until the shortage of male scientists during World War II allowed her to emerge as a researcher in her own right. Nevertheless, she did not receive an appropriate academic appointment to match her achievements until just before being awarded the highest scientific honor.

Despite the fact that women have entered academic science in ever larger numbers in recent years, they also leave traditional fields, in larger numbers than men, at each "critical transition" (Etzkowitz et al., 1995; National Science Foundation, 1996). Although lost to academia, women reappear in science-related occupations in the media, law, research management, and technology transfer that

[1] Business School, Newcastle University, United Kingdom

have opened up as a result of the increasing economic and social relevance of science. A "coming gender revolution in science" also transcends the traditional "sexual separation of labor" in science.

Thus, the seemingly ineluctable negative relationship between female gender and scientific status is subject to change under conditions where there is (1) pressure from female scientists organizing to receive due recognition and reward as part of a broader feminist movement, (2) an ever tighter connection between human capital and economic development that militates against wasting human resources, and (3) the transformation of scientific work from hierarchical organizational to flat network structures in growing fields like biotechnology. Despite signs of change, inequality persists, making difficult the determination whether the proverbial glass is half full or half empty.

In the past, women's rise in science occurred when men were not available, for example, in wartime or when discriminatory priorities based on class and ethnicity were stronger than gender concerns. However, when men again became available, women tended to disappear from the bench. Women are still less often found at the upper reaches of academic science, even as they reappear in emerging science-related professional scenes that appear to offer an enhanced environment for women.

Change in the Role of Science in Society

As the role of science in society changes, the role of women in science may also be affected as individuals with training in scientific and technological disciplines are hired into law firms, technology transfer offices, newspapers, and other media.[8] Shake-up of traditional rigid organizational structures such as academic departments by new interdisciplinary fields opens the way for new people in new posts. New positions are created, such as Director of the Media X program at Stanford University, with faculty status, held by a Ph.D. in psychology who previously worked as a partner in a venture capital firm. Her job is to identify new interdisciplinary research themes, recruit companies to membership in the program, and manage a grant program targeted at faculty members.

Some have argued that the advancement of women in the professions is enhanced by strengthening procedural safeguards, relying on the apparently neutral structure of bureaucracy to promote women's rise (Reskin, 1977). Others hold that when patriarchy is embedded in hierarchy, as in science, such a strategy may fail or even prove counterproductive by providing a "veil" for discrimination (Witz, 1992). For example, behind apparently neutral academic appointment procedures where women are invited for interviews to meet formal criteria, the "old boy" network may still determine the final result, with little external scrutiny possible owing to academic freedom concerns.

A recent study suggests the efficacy of lateral, rather than hierarchical structures, for promoting the advancement of women in science and technology. Smith-Doerr's intriguing study of the biotechnology start-up and growth firm found that it offers women a flexible workplace where their contributions are acknowledged and rewarded. Moreover, biotechnology firms, with their flat organizational structures and emphasis on teamwork and cooperation, provide a better environment for women to advance. Interdisciplinary work is more open to women, and their networking skills are rewarded. She further argues that contrary to expectations that bureaucratic structures offer protection from discrimination, flexible structures serve women better than, ". . . a set of rules that function only as formal window dressing (Smith-Doerr, 2004: xiv). In addition, within the context of the lateral firm, young female Ph.D.'s were ". . . about eight times as likely to lead research in bio-tech firms . . . than in university research groups or large pharmaceutical firms" included in the study (Smith-Doerr, 2004: 115).

This finding, if supported by other indicators, may augur a coming gender revolution in science. When a new field emerges at the periphery of science, women are typically well represented, as during the early days of genetics research, but were pushed out as the status of the field rose (Kohler, 1994). However, in the early twenty-first century women's beachhead into biotech is holding. Not only has their presence persisted, but women have moved up to high positions in the industry. The collegial, less hierarchical, teams characteristic of the biotech industry are similar to the "relational" research group

that some women in academia have attempted to establish as an alternative model (Etzkowitz et al., 1994).

Advancement of women is the hopeful sign in hybrid science-society interface arenas, such as technology transfer, with women often in a position of responsibility. Traditional female socialization emphasized relationship building and networking skills that have become increasingly important, both within traditional research fields increasingly dependent on long-distance collaboration and in the new venues of science that are typically networked organizations. Thus, socialization that worked against an intense focus on solitary bench work, the hallmark of traditional science, works for success in the emerging roles of science and the reformed old ones.

Conclusion: Athena Unbound

Science is changing from an ancillary activity of the industrial revolution, systematizing its production processes and providing deeper understanding of practices arrived at through trial and error, to become the fundamental source of economic growth in increasingly knowledge-based societies. As both developed and developing countries realize the potential of science to contribute to economic and social advance, failure to take advantage of potential human resources becomes a more serious problem that moves to the forefront of attention. (Etzkowitz, Fuchs, Gupta, Kemelgor, and Ranga (2007). The Athena Paradox may be resolved through a dual strategy of exposure of gender inequities and expanding participation of women in emerging scientific fields with economic and social potential.

References

Commission on Professionals in Science and Technology (2004) *Professional Women and Minorities: A Total Data Source Compendium* (CPST Publications).

Etzkowitz, Henry, Carol Kemelgor, & Joseph Alonzo (1995) "The Rites and Wrongs of Passage: Critical Transitions for Female PhD Students in the Sciences" (Arlington, VA: Report to the NSF).

Etzkowitz, Henry, Carol Kemelgor, & Brian Uzzi (2000) *Athena Unbound: The Advancement of Women in Science and Technology* (Cambridge: Cambridge University Press).

Etzkowitz, Henry, Carol Kemelgor, Michael Neuschatz, Brian Uzzi, & Joseph Alonzo (1994) "The Paradox of Critical Mass for Women in Science," *Science* 266: 51–4.

Etzkowitz, Henry, Stefan Fuchs, Namrata Gupta, Carol Kemelgor, and Marina Ranga
"The Coming Gender Revolution in Science? In *STS Handbook* Cambridge: MIT Press

Goldsmith, Barbara. 2005. *Obsessive Genius: The Inner World of Marie Curie* New York: W.W. Norton

Kohler, Robert (1994) *Lords of the Fly: Drosophila Genetics and the Experimental Life* (Chicago: University of Chicago Press).

Merton, Robert K. ([1942]1973) "The Normative Structure of Science," in *The Sociology of Science. Theoretical and Empirical Investigations* (Chicago, London: The University of Chicago Press).

National Science Foundation, Science Statistics (1996) *Women, Minorities and Persons with Disabilities in Science and Engineering*. Available at: www.nsf.gov.

Reskin, Barbara (1977) Scientific Productivity and the Reward Structure of Science, *American Sociological Review* 42: 491–504.

Rosser, S. (2004) *The Science Glass Ceiling: Academic Women Scientists and the Struggle to Succeed* (New York: Routledge).

Sime, Ruth (1996) *Lise Meitner* (Berkeley: University of California Press).

Smith-Doerr, Laurel (2004) *Women's Work: Gender Equality vs. Hierarchy in the Life Sciences* (Boulder: Lynne Rienner).

Tri-national Conference: UK/France/Canada (2003) "The Role of the National Academies in Removing Gender Bias" (London: Royal Society), July.

Witz, A. (1992) *Professions and Patriarchy* (London: Routledge).