



## FOREWORD

# International Progress and Opportunities for Women

Lynnette D. Madsen  
Division of Materials Research  
National Science Foundation  
United States<sup>1</sup>

**W**OMEN have made remarkable scientific discoveries and important innovations. Forty-nine times women have been awarded the Nobel Prize or the Prize in Economic Sciences in Nobel's memory; Marie Curie has been honoured twice.<sup>2</sup> Emily Roebling assumed the role of field engineer and technical leader of the Brooklyn Bridge in the 1880's.<sup>3</sup> In the 1920's and 1930's, Beulah Henry patented many inventions including a bobbin-free lockstitch sewing machine, and a typewriter that made multiple copies without carbon paper. Hedy Lamarr invented a remote-controlled communications system during World War II. More recently, Stephanie Louise Kwolek of DuPont was recognized for her invention of liquid crystalline polymers, now used in the product Kevlar. Martha Coston created a signaling flare system. Edith Clarke of General Electric brought sophisticated electrical engineering concepts to dam building and held a patent for a specialized calculator. Mary Anderson invented and patented the now common-place windshield wiper. Throughout history and continuing today, women succeed in science, technology, engineering and mathematics (STEM) fields despite the obstacles in their paths.

If we could employ everywhere, the highest requirements, standards and practices, and improve cultural expectations and norms from around the world, we could make great strides towards the full inclusion of women in STEM, and significantly increase the world's creative and inventive capacity. To this end, I examine the key issues: (i) health; (ii) education; (iii) work opportunities and environment; and (iv) positions of power.

Underlying equality of the sexes is equal health and survival expectancies. According to The Global Gender Gap (GGG) Report<sup>4</sup>, 40 of 145 countries have achieved equity based on two measures: (i) recorded births showing no daughter-son preference, and (ii) equal life expectancies that captures lost years due to violence, malnutrition and disease. Although traditionally, the focus on women has been limited to their reproductive health; it is now recognized that many issues, e.g., cardiovascular and Alzheimer's disease, lung cancer and depression vary significantly between women and men. Effective in 2015, sex is required as a biological variable in National Institute of Health funded research in the United States.<sup>5</sup> The Canadian government provides guidance on how to best account for sex and gender in biomedical research studies<sup>6</sup> and the Gendered Innovations project<sup>7</sup> offers up-to-date information on progress in this field.

Health is crucial, but so is equality in education. Promisingly, 25 countries have fully closed the gap on the educational attainment (at the primary-, secondary- and tertiary-levels). In a few countries (e.g., Bahrain, Barbados, Guyana, Jamaica, Kuwait, and Qatar) women exceed men in enrollment for post-secondary education by more than a factor of two. However, available data show that female tertiary-level graduates in STEM are  $\leq 43\%$  in these same countries.<sup>8</sup>

With respect to economic participation and opportunity for women, Norway tops the list. However, Rwanda edges out Norway for best wage equality for similar work. I speculate that countries with academic systems that allow professors to progress through the ranks independently such as in the United States are advantageous for women in science and engineering.<sup>9</sup> Additionally, women from American universities enjoy high stature when working abroad.<sup>10</sup> Paid parental leave is important – Swedish parents are entitled to 16 months with nearly 80% retained salary (when a child is born or adopted); three months are reserved for the father.<sup>11</sup> In turn, this changes the atmosphere and attitudes at work since men are also absent for parental leave. Unfortunately, sexual harassment in the workplace (from rape through to a hostile work environment) has not been eliminated;<sup>12</sup> however, many countries have laws that can address (at least the most egregious) infractions, even marital rape.

Iceland, with one of the oldest parliaments, places first in terms of political empowerment and first overall in gender equity. "In Iceland, 41% of parliamentarians are women, 44% of ministers are women and, out of the last 50 years, 20 were spent with a female head of state." The other countries in the top five in terms of political empowerment include: Finland, Norway, Nicaragua and Sweden. Late in 2015, the Canadian Prime Minister created the first cabinet with an equal number of women and men.<sup>13</sup> Six economies – Belgium, France, Iceland, Italy, Norway and Rwanda – have established quotas for women on boards of publicly listed companies.<sup>14</sup>

It is said that you must walk before you run. I have tried to illustrate that women first need to be healthy, educated and welcomed into equitable workplaces, to show their full leadership talents. Many countries are making tremendous advances towards these goals – in turn, this will help women to become leaders in STEM.

### (ENDNOTES)

- 1 Disclaimer: Any opinion, finding, recommendation, or conclusion expressed in this material are those of the author and do not necessarily reflect the views of NSF.
- 2 [http://www.nobelprize.org/nobel\\_prizes/lists/women.html](http://www.nobelprize.org/nobel_prizes/lists/women.html)
- 3 <http://www.iveyengineering.com/famous-female-engineers/>
- 4 The Global Gender Gap Report, World Economic Forum (2015).
- 5 <http://grants.nih.gov/grants/guide/notice-files/NOT-OD-15-102.html>
- 6 <http://www.cihir-irsc-igh-isfh.ca/>
- 7 L. Schiebinger, I. Klinge, I. Sánchez de Madariaga, H.Y. Paik, M. Schraudner and M. Stefanick (Eds.) (2011-2015). Gendered Innovations in Science, Health & Medicine, Engineering, and Environment (genderedinnovations.stanford.edu).
- 8 Breakdown of education data was not available for Jamaica.
- 9 L.D. Madsen, Successful Women Ceramic and Glass Scientists and Engineers: 100 Inspirational Profiles, Wiley (2016).
- 10 <http://huweb.neu.edu/zipfel/research.php>
- 11 <https://sweden.se/society/10-things-that-make-sweden-family-friendly/>
- 12 [http://www.stopvaw.org/prevalence\\_of\\_sexual\\_harassment](http://www.stopvaw.org/prevalence_of_sexual_harassment)
- 13 <http://www.theguardian.com/world/2015/nov/04/canada-cabinet-gender-diversity-justin-trudeau>
- 14 Women, Business and the Law 2014