Recovering the Lost Voices of Women in the Field of Science and Technology: Achievements, Relevance and the Way Forward

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INTRODUCTION

"Men are men and women are women and that will never change and go home, that's where you belong" (CNN). These words may seem pre modern to you but believe me these words were uttered on the 8th of March 2011 to Egyptian women protesters who were fighting for recognition in a male dominated environment. The contradictory aspect is that March 8 is celebrated as international women's day. Many a time, women have been neglected in our societies and our technological history. The system makes it seem that women are not important. Women according to traditions are only good in the home. Tradition makes the woman dependent only on man. Without man there is no woman. In fact, the core centrality or definition of a woman adjoins manhood. Woman is a mutilated man. Thus women's contributions have been left out of technological history. Thus sets the tone for this project; to explore the reasons behind the perceived passive attitude of women in the field of science and technology and to find ways of bridging the gap between men and women.

This project will explore the topic in several stages. First, is it relevant at all to trace the negligence of women in the field of science and technology? Second what reasons account for the fewer number of women in the field of science and technology? Are there interventions to help bridge the gap between men and women in this field? While I will be engaged in the issues raised above I will also look at the way forward for women. Thus in the title the "way forward" I will suggest possible ways that can help bridge the gap between men and women in the field of science and technology and the society at large. The researcher hopes to recover the lost voices of women and refute the notion that women have been passive citizens in the society. History makes us aware that no people can know where it is heading towards if it cannot look backward from whence it came. It is with this advice in mind that I proceed to talk about the relevance of recovering the lost voices of women.

RELEVANCE

Many will think that it is simplistic for women to fight for good representation and participation in the field of science and technology and does not even deserve attention. The interest in gender and science arose out of the concern for women's position in the profession. It has been realized by feminist scholars that even the most perceptive and humanistic works with regard to the relationship between technology, culture and society rarely mentions women. Contrary to the view that women are passive participants in the society, Elizabeth Tebeaux and Mary Lay make us aware in the article "Images of Women in Technical Books from the English Renaissance" that women are active participants who engaged in a lot of activities both in the home and on the land, both in business and in trades. In their activities women depended on information in technical books to help them learn new techniques of gardening, animal husbandry, treating the sick and cooking (196). Mary Lay tells us that "women's experiences have become legitimate subjects for study: women researchers acknowledge their distinct interests as they generate knowledge, social structures have been scrutinized for sexual bias, and scholars have identified women's ways of knowing , communicating, and leading" (348).

The publishing of biographical studies has established the fact that women have made important contributions in the field. History has not been favorable to the representation of women and one field that is at fault is the field of science and technology. According to Wajcman "the history of technology represents the prototype inventor as male" (15). This makes us aware that since time immemorial, women's achievements have eroded from the history books whether as scientist, technical writers, or as inventors. This ideology however subsumes the contribution of women. The fact is that technology needs to be understood way beyond applied science and be more encompassing.

There has always been the proliferation of works of men like Aristotle, Einstein, the Wright brothers in science and technology but never have women who served as gatherers, women who prepared hearths and hoes been mentioned. The question is why? Is it that women are not creative or just that they have not created things that are worth mentioning?

REASONS

Several reasons can be accounted for this. Some feminist scholars say that it is probably because women have contributed rarely in the field of technology which I do not agree with. If I think of the fact that the word technology comes from the Greek word *techne* which means practical then women have really contributed a lot. It is just that history and culture has not been fair to women or just that people have been blinded by the patriarchal nature of the society that we do not appreciate the little things around us. The very definition of *science* and *technology* links up with the patriarchal system which is dominant in the system**.** It is true that women were not the first to go to space or to conceive of the idea of an aircraft but why has the name of the first woman to go into ceramics been erased from history books? Or that is not conceded as an invention? Or better still why don't we know about the woman through whose ingenuity hearth was made? What happened to the woman who invented the modern dishwasher, the windshield wiper and the disposable diaper? These are every day mundane objects that we use in our homes. Does it therefore make concrete the saying that "familiarity breeds contempt?"

In an article entitled "Where are your intelligent mothers to come from?..." Melinda Baldwin says that "Although she was one of the most successful female scientists in twentieth-century Britain, the X-ray crystallographer Kathleen Yardley Lonsdale (1903–71) has received relatively little attention from historians of science." Are these not technological enough? These tell us that a lot has been hidden from the world and it is time that women took up the challenge of writing their history, a history that will bring them to the limelight. The attempt made by history to omit women from technological books is made vivid by Durack when she says that "each point out, history in general, and the history of technology in particular have tended to omit the activities of women in part by locating significance primarily in public and political activities and innovations"(37). It is about time women changed *his-story* which does not favor them to *her-story* devoid of biases and prejudices.

As if this is not enough, culture has also not been favorable. The socialization of women does not give way to creation or trying hands on new things. Harding laments that traditional theories have made it difficult to recognize that women can also participate in "social life, or to understand men's activities as gendered." Again according to Harding society finds it difficult to acknowledge the fact that women can be "knowers" or "agents of knowledge" (1986). In Africa for example, it is believed that the proper place for the woman is the kitchen and no other place. It is said that the woman will by all means marry and become the property of the man, if that is the case, then why will parents waste resources on women and take them to study. It is the woman's role to take charge of the home, give birth, take care of the children and make her husband happy so all means of socialization are channeled through this line. Women usually work longer hours. Women have more varied task and sometimes performing more than one task at a time. Work for the family is done by women. Men's work is usually outside the home. Men have more leisure time. Men are more involved in decision making.

In order to be confident in the hands-on world of science and math problems, boys are often much better prepared for what lies ahead than girls, well before they even start at pre-school. By the time they reach the lab, hands-on type of environment, many boys have had years of experience playing with building blocks, Legos, cars, video games and other technology which involves problem solving, whereas many girls have played games which emphasize growing up and relationships, playing with dolls, playing 'house', or drawing and painting. Girls are, therefore, much less well equipped to manipulate problem solving tools and equipment. This can put them at a real disadvantage at the start, and make them feel uncomfortable and unable to compete with the boys in such an environment. In effect the public sphere has been allocated to men and the private sphere to women.
Scholars like Stanley (mother xxviii-xxix) contend that during the industrial revolution, women contributed to the development of machines but their absence from patent books can be attributed to the fact that:

a) Patents require disposable income and time, both resources of which women historically have had less than men
b) Married women in the United States and Britain could not own their innovations or patents until after the Married Women's Property Acts passed (first in New York in 1848 and 1860; in Britain in 1870 and 1882)

c) The technical and mathematical training necessary to build models of inventions and patent them was not available to women because of gender-segregated education
d) Cultural stereotypes discourage women from claiming credit for their achievements

Christine Macleod (1987) also makes us aware that, before 1700, patents were not about people who invented but about those who provided financial backings. This period also coincides with the industrial revolution which saw major economic and mechanical developments. This period saw men taking part in a lot of economic activities because they worked in the factories and engaged in other economic gains. This was also a period that saw capitalist domination which feminist think did not favor women. As a result of this development men gained the financial resources that qualified them to appear in patent books. Women's inventions therefore were credited to their husbands.

The society has also been brought to acknowledge the fact that men are good at science and women at reading subjects (humanities, and other social sciences). Science makes us aware that the male brain is different to that of the female, making it more spatially aware which is critical for math and science problems. From the above, one would agree with Wajcman when she says that "technical competence is central to the dominant cultural ideal of masculinity and its absence a key feature of stereotyped femininity" (159) and that the work of women "is often deemed inferior simply because it is women who do it"(39). We are made aware from the ongoing discussion that society recognizes what is technology to be the things men engage themselves in. Stanley tells us that the basis of this lies in the fact that cultural views which are predominantly masculine

- Deny women's identities as inventors and women's work aids as "tools"
- Deny women access to knowledge necessary for inventing and protecting tools and ideas
- Diminish the significance of women's technological skills in areas they are expecting to have expertise
- Define women's unpaid labor as "not work"
- Define traditional women's work as not "technological" (qtd. in Durack, "Gender, technology, and Technical Communication" 39).

It can be realized from the above that women have not been treated fairly both by history and society. Therefore women need to be compensated so that they can achieve good representation. It is heartwarming to note that societies, families and nations have realized that they really need to compensate women. Nations have come to the realization that the struggle to attain good representation is not only for women but a call to all humanity. Nations, societies and families have embraced this idea and are doing all they can to bridge the gap between men and women in the society and more importantly in the field of science and technology. People have come to know that the woman is not a passive citizen but an active one and that when given chance can rub shoulders with men. Women are now seen as co-partners in development and not just a mere subject to be ordered about. Many policies and interventions have taken place in many counties and societies all in the name of helping or supporting women in the struggle. As a result I have taken my time to discuss some of the interventions that are put in place by governments of nations and societies.

INTERVENTIONS

Many interventions are ongoing. Countries have set for themselves targets to help bridge the gap between men and women in the field of science and technology and the society in general. In Ghana for instance, the ministry of women and children affairs was established in 2001 to initiate and coordinate and Monitor gender responsive issues. The Ghana version of the 2011 international women's day was celebrated under the theme: "Equal access to education, training and science and technology: pathway to decent work for women." In Ghana, women are encouraged to take up leadership positions. Presently, we have women occupying these positions; the Chief Justice, the Speaker of Parliament and the Minister of Science and Technology, the Sports Ministry and Tourism. We also have 19 female Legislators. In our traditional setup, women hold final authority in determining the successor of chiefs.

In accordance with its multi-year program of work for 2010-2014, the Commission on the Status of Women (CSW) will consider 'Access and participation of women and girls to education, training, science and technology, including for the promotion of women's equal access to full employment and decent work' as its priority theme during its fifty-fifth session in 2011.

In 2009 the government of the United States department of Agriculture announced the Norman E. Borlaug International Science and Technology Fellows Program (Borlaug Fellows Program) for Women in Science for female citizens of Ghana, Kenya, Malawi, Mali, Mozambique, Nigeria, Niger, Uganda and Zambia.

The program which is funded by the United States Agency for International Development and administered by the United States Department of Agriculture, Foreign Agricultural Service in cooperation with the Forum for Agricultural Research in Africa aims at

- Providing female agricultural research scientists, faculty and policymakers with an opportunity to work one-on-one with U.S. experts in the fields of agriculture, forestry and natural resources at a U.S. institution or CGIAR center;
- Providing scientists, faculty and policymakers with practical experience and exposure to new technologies that can enhance their own research endeavors;
- Fostering increased collaboration and networking between African and U.S. agricultural scientists and policymakers to improve agricultural productivity and food security;
- Facilitating the transfer of new science and agricultural technologies to strengthen agricultural practices;
- Addressing obstacles to the adoption of technology such as ineffectual policies and regulations; Providing leadership skills training.

These are but a few of the many interventions that are put in place to help bridge the gender gap. But the question is, are these working? In Ghana for instance I can say that there is still more work to be done because we still have a few number of women in science and technology. Women and feminist scholars in their small ways are also adding up to what governments and other societies are doing to help bridge the gap. Gender activists in their quest to achieve their aim, have made it their concern to encourage their fellow women to pursue science and technology. To counter the negative image that women are passive citizens and that have no technological knowledge, activists have decided to publish the achievement of women in science and technology to serve as a means of encouragement for other women. Durack for instance names some women and what they have done in her article *Gender, Technology and the history of technical communication.*

In her search for women achievers she mentions women like Harriet R. Strong who built the storage and the reservoir as a container for kitchen debris and Madeleine Vionnet who invented the bias cut in dressmaking (37). Stanley Autumn also mentions women inventors like Becky Shroeder, Bette Graham and Patsy Sherman. He also makes us aware that the cotton grin, the sewing machine, the small electric motor, the McCormick reaper and the Jacquard loom (forthcoming) were all invented by women. Judy Wajcman mentions names of writers like Evelyn fox and Anne Sayre who have written biographies of female achievers in the field of science and technology in their books. Recovering the history of women's achievements has become an integral part of women in a wide range of discipline. Women are setting for themselves role models for other young women to emulate.

It is good to know that policies are enacted by societies and nations to encourage the woman to further a career in science and technology. But these interventions fail to answer a broader question of how science and technology will be reshaped to accommodate women. The field of science and technology has been populated by men and feminists think everything has been shaped to favor men. Harding (1986) points out that the equal opportunities recommended by policy makers make the woman forfeit her gender identities. She laments that the current career path dictates intensive study and research which do not give room for childcare and domestic responsibilities. Crafts were made for men and are to be used by them. For example Wajcman draws our attention to the "phallic symbols in the shape of missiles," and in *The City in History* Lewis Mumford also says that "…with the development of the city '[m]ale symbolisms and abstractions now become manifest: they show themselves in the insistent straight line, the rectangle. The firmly bounded geometric plan, the phallic tower and the obelisk…'" (1961: p. 27).

One question that Judy wajcman poses in *Feminism confronts technology* is should science and technology be "based on women values?"This is an interesting question and must be answered tacitly. What are women's values, and how can science be based on these values, if so how effective will it be to solve societal problems? Some scholars believe that women by nature are endowed with qualities such as humanism, pacifism, nurturance and spiritual endowment, procreation, warmth and creativity. Some believe that these qualities are non exploitative as compared to the exploitative and dominant nature of patriarchal science as we have it now.

Some feminist scholars think that when science and technology is based on the peaceful nature of women then the world will be a peaceful place to live I have my doubts anyway but when I consider the number of violence going on in the world, what is happening in Libya, Egypt and the exploitation of the environment by the ends of science and technology then I am tempted to believe their assertion. In all these violence you can barely count the number of women involved. But I wonder how science can be based on these values. Probably this is where women should investigate and start working on. My stake on this issue is that we should desist from the deterministic view of science and technology and concentrate on the participatory aspect of science or a science that is more embracing than science and technology based on values. In as much as we have men who are violent, we have men who are non violent and as much as we have women who are non violent, there are some who are violent. People like Harding are however skeptical about this because they believe that the feminine qualities reflect the social experience of all women as their experience is divided by class, race and culture.

Perhaps the best way to do this is to make science and technology appealing to girls. Robots for instance should not always be exploding monsters or cars but rather by using robots involved in performing arts, for example, can make it a much more interesting topic for the girls in the class. It is believed that girls are interested in how the technology is used, whereas boys are more interested in how big the hard drive or the engine is, and how fast the processor runs. These are some of the concerns that policy makers should turn their attention to if they really want to bridge the gap and make the working environment favorable for women. It will be unfair on my part or better still a lack of accomplishment to only discuss the problems of women and how unfavorable history has been to them without suggesting ways that will help policy makers and women activist in their quest to bridge the gap between men and women. I will therefore urge that you proceed to the way forward for women. No problem comes without a solution, once we have been caught up in the web of helping women to bridge the gap what is there to be done?

THE WAY FORWARD

Having traced the history and the causes of the differences between men and women in the field of science and technology, what then can be done to help bridge the gap? It is true that many policies have been put in place but it seems that the process of empowering women has been slow. What then can be done to move the process faster?

Talented and gifted programs are to be organized. It should be an area of concern for parents, teachers and nations to organize programs that will see girls take part in programs that will enable them showcase their gifts and talents. Good or creative acts can be taken up. In Ghana for instance there is the organization of the "Brilliant Science and Maths Quiz" that brings students from all corners of the country together to compete. In this case students are exposed to other sections of the field that they are not exposed to. Though it is not solely for girls, girls' schools take part in it. Girls are therefore given the chance to compete with their male counterparts. One interesting thing to note about this initiative is that the host is a female. This host who is well versed in the field of science becomes a role model for other females to aspire to.

Women need to support one another. The most difficult thing to know is to encounter problems alone. Women should come together to support one another. Through the organization of workshops, symposiums etc. women will be able to share their experiences. They will also be able to educate, motivate and inspire professional and student scientists and engineers by openly discussing the victories and challenges of working in the traditionally male-dominated field. When this is done women will be able to figure out how to go about their obstacles. They should come to the realization that it will take a concerted effort to bridge the gap rather than individual efforts. The saying that "unity is strength" should be their guiding principle. For example on the 22nd of March 2011, there was a ceremony to celebrate women into IT by a society called Women into Science, Engineering and Construction (WISE).

The aim of this was to create more female role models, and to encourage more businesses to improve the prospects available to girls in IT careers. At this program Her Royal Highness presented two prestigious awards namely; the Breaking the Mould Award, which celebrates entrepreneurship amongst young girls, and the CWT everywoman in Technology Award which recognizes women who have already entered the profession. The presence of the princess royal alone serves as a means of motivation to encourage young girls to take up careers in science and technology. These are some of the things all women organizations should aim at doing.

Girls must be made to believe in their intellectual growth. It will be important to let girls know in their prime age that their intellectual abilities equal that of boys and that whatever the boy can do the girl can also do better. Girls should be encouraged to do things that will make them think and increase their intellectual capacities. The stereotypical notion that males are better than females should be eradicated at the initial stage of their socialization process. When this is done the confidence level of girls will be boosted and they will be encouraged to take up challenges in the field of science and technology. Girls should be made aware that passion, self improvement and dedication are contributing factors in the success of an individual in every field and in the field of science and technology. Children should be made to play with constructing toys like their male counterparts. In effect, girls should be made to cultivate the interest in science and technology early on in life. The Women into Science, Engineering and Construction (WISE) collaborates with industry and education to encourage UK girls of school age to value and pursue STEM (Science, Technology, Engineering and Mathematics) or Construction-related courses in school or college and move on to related careers. Members of this organization listen to the concerns of girls and make sure organizations hear the voices of the girls. Models, tools and ideas are provided to help them challenge traditional approaches and demonstrate equal involvement for girls.

Added to the above is the fact that girls should be exposed to the achievement of women scientist by parents. This will encourage them to take up good role models that will inspire them to attain higher feats in the field of science and technology. Parents and teachers should encourage girls to attend science related programs where they can talk to women achievers and even men who are ready to encourage girls into science and technology. The best way to teach a child is to let the child experience the thing. If girls are made to experience and participate in science related programs, their interests will be boosted. The notion that science and technology is for men and other social sciences for women can be bridged when parents encourage their female children to take up science related courses. Parents should build the confidence of female children by encouraging them to practice with their hands on techniques which are traditionally assigned to men. Meaning parents should help them build the spatial skills that are crucial to success in many math- and science-related fields, such as physics, engineering, architecture, geometry, topology, chemistry, and biology. Research suggests that spatial skills, on which boys have typically outperformed girls, can be improved through specific types of training. Judy Wajcman will tell parents to "take the guns from the boys."

Colleges and universities should not be left out in this campaign. Colleges can attract a lot of female students into the field by making the environment conducive. As part of their information, colleges should increase the awareness of women about the opportunities in the science and technology departments. There should be scholarship packages set aside for girls who are ready to enter the science departments. I am yet to see any university brochure that highlights the opportunity of girls or that sets aside a page for special attention that is paid to women in the field of science. At least I know that there is a graduate hostel for men in this institution but none for girls and this is also a science institution. It goes to make my point concrete that institutions do not support females. Introductory courses that appeal to students with different levels of preparation should be organized for students.

CONCLUSION

The above arguments point to the fact that "the history of technology represents the prototype inventor as male." Women are barely mentioned or recognized as inventors or creators of scientific and technological artifacts. This has been possible because the society in which we find ourselves has been biased towards women. The thinking has always been that the proper place for the woman is the home and not a public place. This notion has had a toll on the development of women psychologically, socially, economically and politically. It has therefore limited the woman and has made her aware that the man is always the head. This has made them subservient both in the home and the work place.

In spite of the fact that many policies and initiatives have been put in place to help the women move away from this cultural and historical setback, women are still lurking behind or better still not well represented in the field of science and technology. The goal of this project is to suggest possible ways that can help the woman rise up to the task. Some of the suggestions outlined postulate that the fight for fair representation is not to be seen as a fight for only one section of women but it should be a concerted effort and a challenge to all women and well wishers of women. For this to be realized, women should always come together as a group to share their problems together and suggest solutions and ways to move forward.

Again institutions, that is, schools and workplaces should be made conducive and that will enable the woman to prosper and contribute. It is about that institutions realized that women are co-partners in development and not just subjects to be ordered and controlled. It is important for parents to also realize that they need to create conducive atmosphere at home for girls to participate in decision making and issues of grave importance.

It is a major task of parents because they are the first contacts of children and socialization begins first and foremost in the house. Whatever attitude the girl child will build will mostly come from how well they are psyched by parents. They should be encouraged, praised and feel that they belong. Parents are to take active interests in the wellbeing of their girls and let them know that the study of science and technology is not a difficult task.

One thing would also want to do is expand the definition of the term science and technology and tracing the origin of what women are good at and what they have done so that they younger generation of girls will be well informed about the feats that women have attained in the field. This will encourage girls and let them know that women are also creative and can innovate or invent. I therefore commend the good works of Durack, Fox and Wajcman for the mention of names that hitherto are not mention in the field. This I will say is a good start and will go a long way to help boost the morale of girls.

Further, there has been a call that science and technology should be redesigned based on the values of women. This I will say is a radical move because I don't know how this will work. However I would call for more participation of women in the designing process. Instead of redesigning to suit the values of women, I would rather say that science and technology should be women centered. This means less influence of men's interest that affects the development of artifacts. Feminine values are themselves distorted and dictated by the patriarchal society in which they find themselves. Technology should be constructed around completely deferent set of values that are neither feminine nor masculine.

It is also worthwhile to mention that the concept of socialization that prevents women from doing stuffs with their hands should not be encouraged. Women are as creative and innovate as men so they should be given the maximum support from all aspects of the social fabric. It is about time we realized that the woman is a co-partner in development and not just a subject. Men should be made aware from the onset that they also have a part to play in the home. In this way women will get enough time to do other things. Lack of time on the part of women is also one of the issues. If men help their wives in house chores and taking care of children, women will be less burdened by the mores and responsibilities that prevent them from taking up their careers. A female lecturer in Ghana, Prof. Henrietta Mensah-Bonsu was asked during an interview what her greatest challenge was in her quest to achieve her goals she said 'trying to be a good mother, a good wife and a good professional.' This tells you how difficult it is for career women to manage their homes in addition to their work which they are committed.

Governments of nations, the UN and all other world governing bodies should still keep up the fight to encourage women to take up science and technology courses. Initiatives, policies and incentives should go into this sector of their plans. I would even wish that more scholarship packages be offered to women who show interest in taking up careers in this field.

Stereotyping, prejudice and biases are some of the forces that are bedeviling the development of women in this field. In as much as we are trying our best to get rid of these forces we should be aware that these are not done consciously. It is an unconscious act to be bias towards someone. I say that these are unconscious because these traits are hardly articulated. These are preformed judgment about individuals or a group of people. This will make it very difficult but people should be made aware of how detrimental it is towards the development of an individual. The only principle that can subdue this canker is the application of fairness in all we do and wherever we find ourselves.

It is not an easy task bridging the gab between men and women in the field of science and technology but I believe that it is tenable. When all sectors come to the realization that it is about time that women are encourage to take up careers in the field and work towards achieving this goal it will work. I acknowledge the fact that a lot is going on, but the process is slow. I believe that when stake holders follow the path that I have charted, it will go a long way to accomplish our dreams. Though it seems difficult, we must all realize that "a journey of thousand miles begins with a single step." I am very optimistic that one day men and women will rub shoulders (I believe it is ongoing) and the world will be a better place for us all.

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