

**PARTICIPATION, BARRIER, AND COPING STRATEGIES: A STUDY OF
GENDER AND SCIENCE IN ACADEMIC INSTITUTIONS IN BENGAL**

**Dissertation submitted to University of Hyderabad in partial fulfillment of the requirement
for the award of the degree of**

MASTER OF PHILOSOPHY

IN

GENDER STUDIES

BY

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I hereby declare that the work embodied in this dissertation titled *Participation, Barrier, and coping strategies: A Study of Gender and Science in Academic Institutions in Bengal* has been carried out under the supervision of Dr. Ratheesh Kumar P.K, Department of Anthropology, University of Hyderabad, is a bonafide research work which is also free from plagiarism. I also declare that it has not been submitted for any degree in part or in full to any other university or to this university for award of any degree or diploma, I hereby agree that my dissertation can be deposited to Shodganga/ INFLIBNET.

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This is to certify that the dissertation titled "*Participation, Barrier, and Coping Strategies: A Study of Gender and Science in Academic Institutions in West Bengal*" submitted by Malay Mandal in partial fulfillment of the requirements for the award of Master of Philosophy in Gender Studies is a bonafide work carried out by him under my supervision and guidance which is a plagiarism free thesis. The dissertation has not been submitted previously in part or full to this University or any other University or Institution for the award of any other degree or diploma.

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Acknowledgement

First and foremost I would like to extend my gratitude to my supervisor Dr. Ratheesh Kumar P. K, for his intellectual suggestion, constant encouragement and cooperation to give this dissertation and motivating me to work with dedication. I feel myself most fortunate for getting opportunity to work with him.

I also convey my sincere thanks to Dr. Sunitha Rani and Dr. DeepaSrinivas for their constant suggestions and motivations. I also extend my gratitude to Dr. NaziaAftar for her valuable suggestions.

I also thank to the staffs of IGML library, University of Hyderabad, for making available all the required materials for the study.

It would be unfair if I do not recall the help and support I got from my friends and classmates. Particularly Ishani, Master shifu, Rizzu, Uttam, Abhi, Tatha, Rik, Soniya for the encouragement and suggestions, and guiding me in right way.

I would like to acknowledge my parents, uncle and aunty who gave have always encouraged and supported me in each and every step of my life for achieving my goals and contributed immensely not only for the development my thoughts, behavior which gave strength to go ahead in my life. I acknowledge everyone who directly or indirectly encouraged and supported me throughout my research work. For any laps and weakness in this study, however, only I am responsible.

Malay Mandal

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Chapter 1

Introduction

Science and engineering have traditionally been seen as the enterprise of men. Throughout its long history, science has been populated almost exclusively by men always. Women's presence in engineering and science is unequal. Both of these professions are considered as men dominated professions. Women's entrance in these professions used to be considered as an attempt to cross the sex boundary. Even in the extreme developed world like U.S.A. has unequal participation of men and women where monstrous improvement in science and technology has taken place and the quality of employment in this profession is expansive.¹The issue of 'Women in Science and Technology' has increased the attention since the International Women's year in 1975.

In Sociology of Science the awareness, there has been gender recognition and the participation of women in science oriented profession, is a matter of particular concern. Numerous international conferences since international women's year in 1975 have focused on the need of formulating new policies to enable better accessibility, interest and participation of women in science. Why do women have unequal participation in science? To find out the answer of this, extensive investigations have been done among many industrial countries. However, the uneven participation of women in science genre is not a homogenous issue for western countries. So, it would be ideal to say that it is a common concern for social scientists throughout the world

¹ H. A. Edgerton, "Science Talent: Its Early Identification and Later Development," *The Journal of Experimental Education* 34, no. 3 (1966): 90-96. accessed July 30, 2014, <http://www.jstor.org/stable/20156833>.; H. Zuckerman, and Jonathan R. Cole, "Women in American Science," *Minerva* Xii, no.1 (1975): 82-102, accessed October 3, 2015, <http://www.jstor.org/stable/41827212>.

where the feminist perspective regarding these questions varies from region to region or country to country.

Is science discipline an unequal space for women professionals? Numerous social researchers have contended that science is disciplinary space where women have unequal participation. The question of whether uniformity obliges all women being treated the same as men, regardless of their disparities, or whether fairness obliges that contrasts between women and men be acknowledged and provided for, stays key question to feminism and to gender studies. Why this disparity? Numerous social researchers have discoursed about “disparity” through the idea of “androcentricism”.² In feminist scrutiny, most social orders, past and in the present, display androcentric propensities whereby their culture, way of learning, organizations, and institutions imitate and produce the dominance of men.

Numerous scientists and social researchers have revealed that there is no such distinction in cognition and IQ between boys and girls. However, a close observation can easily point out that that women’s participation as professional is lower than men. Indeed, even in employment progression men’s position is higher than women. However, modern day’s sociologists have accused the cultural environment and androcentricism whereby women are representing asymmetrical position as “other”. Certain level gender expectations produced by gender norms in family, institutional, and organizational level are causing women’s passivity in science.

Countries, for example, India likewise have the in inclination of lower presence of women in science genre. Numerous researchers have spoken of science from feminist point of view. However the viewpoint of the west contrasts from Indian setting. By evaluating western theories

of women in science social scientist Carol C. Mukhopadhyay argues that Indian cultural models of family, gender, and schooling interact with macro structural features of Indian society frame academic decision, producing a gender-stratified scientific community.³ According to her, “India has very different cultural setting and social structure which makes gender-gap in science education. As example she mentions “patrifocal” family structure and ideology. Within the context of the patrifocal family model, educational decisions, whether for sons or daughters, are framed by their projected impact on the collective family welfare. Families have traditionally viewed boys’ education differently than girls’. Because sons have traditionally obligation to care for natal families, investments in son’s education benefit the family directly. Daughters are expected to marry, leave the family, and acquire obligations toward their husband’s family.

Girls are not only exposed to stratification or inequalities in the early stage of science education. Indeed, in professional level the disparity can be seen in different science disciplines. Some scholars such as Nilaam Kumar, Krishnaraj have contended that the Inequality or lower participation is a product of socio-cultural environment in which science is practiced, professional environment and socio-cultural setting are closely linked together.⁴

This study is located in West Bengal because of its historicity and uniqueness of women’s participation in modern education and science. West Bengal, the cradle of Indian renaissance and the national freedom movement, is the land of intellectual awakening. One of the most prosperous territories of British Empire, Bengal had been an operational hub of insightfulness and human qualities where numerous modern movements in art, education,

³Carol C. Mukhopadhyay, “A feminist Cognitive Anthropology: The Case of Women and Mathematics,” *Ethos* 32, no. 4 (2004): 458-492, accessed July 12, 2014, <http://www.jstor.org/stable/3651895>.

⁴Namrata Gupta and Arun K. Sharma, “Women Academic Scientists in India,” *Social Studies of Science* 32, no. 5/6 (2002): 901-915, accessed June 4, 2014, <http://www.jstor.org/stable/3183058>.

science and industry were started. West Bengal, the homeland of eminent scientists such as Jagadish Chandra Bose, Ashutosh Mukherjee, and Satyendranath Bose, was among the first to inaugurate a university and a medical college for science education based on Western ideas.⁵

Bengal's entry in modern science education can be traced back in the equivalent journey of modern science education in colonial India. One of most groundbreaking initiative can be found in sec. 43 of the charter act of 1813 for the sanction of one lakh rupees to be spent on education was introduction and promotion of knowledge of the science among the inhabitants of British India. It is historically true that science came late into the educational scheme. According to Depak Kumar, "purely scientific education did not fit into the exigencies of the colonial ruler but the need was felt to have a class of hospital assistants, surveyors, mechanics to serve the fast growing medical, and public works department."⁶ Training native youth was obviously much cheaper than getting technical personnel from abroad. So, as a result most of the research on perception and reception of modern science in nineteenth century India focused on the Bengal province and north India. However, it does not mean that other regions did not participate in welcoming science and higher education. Bengal at that time was the capital of British imperial power and got the opportunity to flourish its intellectual strength. Calcutta medical college was opened by British raj in 1835, and in 1843 an engineering class was opened in Hindu college (now Presidency University).

⁵SatpalSangwan, "Science Education India Under Colonial Constraints, 1792-1857," *Oxford Review of Education* 16, no. 1 (1990):81-95, accessed December 12, 2014, <http://www.jstor.org/stable/1050143>.

⁶Deepak Kumar, "Science in Higher Education: A Study in Victorian India," *Indian Journal of History of Science* 19, No. 3 (1984):253-260, accessed September 11, 2014, http://www.new1.dli.ernet.in/data1/upload/insa/INSA_1/20005abd_253.pdf.

In the beginning women were not allowed to take science education. But West Bengal witnessed an important phase of women's entry into science education when 'Kadambini Devi'⁷ broke the masculine stereotype of scientific education and became first woman doctor. A foremost discussion (debate) went on the equal participation of boys and girls in modern education with the equal syllabus. In Britain, there was rising debate on suitable sorts of education for girls. The impact of physical and biological sciences, and to be précised, that of Charles Darwin, led to debates on differences in capabilities of two genders (sex). The idea of such contrasts was to demonstrate that women's physical characteristics caused inferiority in intelligence to men. It was a common belief that men's characteristics are more variable than women, accordingly, they have a wider range of aptitudes. As a result more and more western educated intelligentsia called 'bhadralok' produced an influential body of opinion cautioned against the granting of equal education to boys and girls. However, Bengal witnessed a radical change in women's participation from *zenanainstruction* to public education by the efforts of many intellectuals such as PanditGourmahanVidyalankar, Raja Radhakanta Dev, Ram Mahan Roy, Inswar Chandra Vidyasagar, DwarakanathGanguly (husband of KadambiniBasu)etc.⁸

From the inception of scientific education in India one section of Bengali intellectuals engaged themselves for promoting women's equal participation in science. Nonetheless, "more enlightened sections of Hindus at that time advocated a limited education for girls who would serve the major purpose of making women intelligent companions for emergent *bhadralok*

⁷MalavikaKarlekar, "Kadambini and the Bhadrakok: Early Debates over Women's Education in Bengal," *Economic and Political Weekly* 21, no. 17 (1986):WS25-WS31, accessed August 9, 2014, <http://www.jstor.org/stable/4375594>.

⁸Poromesh Acharya, "Bengali 'Bhadralok' and Educational Development in 19th Century Bengal," *Economic and Political Weekly* 30, No. 13 (1995): 670-73, accessed August 9, 2014, <http://www.jstor.org/stable/4402564>.

(English educated middle class) and better mother for the next generation”.⁹As example, Keshub Sen (one of the pioneer face of ‘AdiBrahmoSamaj’) was strongly against of higher education for women. He also committed to the idea of a separate, special education for women, one that would develop their uniquely feminine nature. According to him, there is no need for women to learn manly subjects as geometry, philosophy, natural science. He argued, instead of learning science, they should study domestic skills that would fit them for their future work as wives and mothers.

Keshab Sen’s perspective were drastically inverse to those of the radical Brahmos (AdiBrahmoSamaj got divided by two groups) who thought that there should be same open door for women in the field of education as was available to men of the general society. DwarakanathGanguly and other radical Brahmos such as AnadamahanBasu, Durgamohun Das, SivnathSastri formed ‘Samadarshi Party’ and started a journal called by the similar name. With the baking of the Samadarshi Party, the BangaMahilaVidyalaya was inaugurated in June 1876. The Samadarshi Party thrived on changing the general sentiment by the thought that Indian women would stay disadvantaged of western health care if individuals of their own sex were not provided with the medicinal teaching. The thought turned into the pioneer way for women to venture into science education. KadambiniBasu turned into the first woman medical practitioner in colonial India. In later period West Bengal, former Bengal, has produced many eminent women scientists such as AshimaChaterjee who got Bhatnagar award for her contribution in organic Chemistry. AshimaChaterjee is also known as the first woman who earned Ph.D in

⁹MalavikaKarlekar, “Kadambini and the Bhadrakalok: Early Debates over Women’s Education in Bengal,” *Economic and Political Weekly* 21, no. 17 (1986):WS25-WS31, accessed August 9, 2014, <http://www.jstor.org/stable/4375594>.

chemistry and became the first lady scientist to be elected as the General President of the Indian Science Congress Association.

Significance of the Study:

Until the twentieth century, science was populated almost exclusively by men, and so the phrase ‘men of science’ was almost equivalent to non-sex linked tag “scientists”. Even today the situation has not drastically changed. In the recent few years alone, we have seen the start of over fifty new universities, and institutes of higher learning and research in various areas of science and technology in India. Despite the increasing number of women in education and research in science, their participation in higher levels of science is “pitifully low”.¹⁰ Why is this? Many scholars such as Nilam Kumar, Carol C. Mukhopadhyay, and M.S. Sundaram have developed multiple intellectual dimensions to analyze the issue. However, their research only holds pan Indian perspectives such as cultural and institutional dimensions which do not include the micro level studies to understand the dynamism behind women’s lower representation. This study focuses deeply on micro level study which will bring brief analytical views on the issue.

Another particular importance of the study is to present the status of women scientists within the framework of socio-cultural ambience in West Bengal because no research such as this had previously been conducted. The study places great emphasis on women’s representation in science and tries to find possible reasons or facts which are creating the representation. The study is not only spotting the barriers for women it also tries to understand their coping strategies as possible way to manage gender related barriers in science.

¹⁰ D. Balasubramanian. “How to Stop Women Scientists from Dropping Out?,” *The Hindu*, January 27 (2011). <http://www.thehindu.com/todays-paper/tp-features/tp-sci-tech-and-agri/how-to-stop-women-scientists-from-dropping-out/article1128815.ece>.

This study will be a significant endeavor in understanding participation and present status of women scientists. This study will also be beneficial to the students who are willing to take science as career in future. The current study is trying to comprehend the present status of women in science in West Bengal. The study is attempting to explore imbalances and barriers for women in science which exist in science establishments. It additionally manages to explore disproportionate participation of women in science and their adapting techniques (coping strategies) which they take into the discipline in order to conquer the gender boundaries.

Theoretical Framework

The study stands upon feminist understanding gender issues in sociology of science. To comprehend feminist exchange in science we have to rely on previous scholars work and their theories. The scholarship on feminism and science begun in the late 1960s and 70s has widened in the 1980s to a continuous stream of books and articles in journals expressing new scholarship. The work of feminist science scholarship is less voluminous and less theoretical than other feminist scholarship like humanities and social science because of its recent entry into academic discourse.

The lens of feminist discourse brings into focus certain questions of the scientific enterprise or a potential dilemma. The scope of their evaluation is expansive. With the improvement of sociology of science, feminist scholarship has turned its considerations towards “normal” and “hard science” which concentrates on the profoundly established methodology that delivers objectivity, reasons and mind as men, and subjectivity, feeling and nature as women. This separation has prompted the exclusion of women from practice of science. It has additionally influenced the very terms in which science has been scrutinized. The dissection is in

charge of two eminent exclusions in most social investigations of science. Initially, the inability to notice that science has been created by one and only portion of human race i.e., the men and furthermore, it has advanced under the particular ideal of masculinity which was said by the establishing fathers of modern science. Just science is not a purely cognitive endeavor, once again it is personal and also an activity.

The ‘gender and science discussion’ which the feminist viewpoint follows, leads us to ask how philosophies of gender and science notify each other in their mutual construction and how that construction functions in our social arrangements and how it affects men and women, science and nature. In 1997 Dona Haraway said that, scientific facts and technological artifacts are treated as simultaneously semiotic and material. Such as expansive thought of technoscience (science and technology) as a culture allows us to recognize how our relationship to technology is essential to the constitution of subjectivity for both sexes. Despite the fact that all feminist have asserted that science symbolizes a strong androcentric bias, the implications connected to this charge change generally. However, perceiving the intricacy of the relationship between women and technoscience, by the 1980s feminists were investigating the gendered characters of technology itself. According to Sandra Harding’s (1986) words, feminist criticism of science evolved from asking the ‘woman question’ in science to asking the more radical ‘science question’ in feminism.¹¹ Rather than asking how women can be impartially treated within and by science, the question became how a science apparently so deeply involved in specifically masculine projects can possibly be used for emancipatory ends.¹² Feminist investigations of “science and technology” were flowing from women’s access to technoscience to analyzing the

¹¹ Sandra Harding, *The Science Question in Feminism* (London: Cornell University Press, (1986): 30-58.

¹² Judy Wajcman, “Feminist Theories of Technology,” *Cambridge Journal of Economics* 34, (2010):143-152, accessed January 7, 2015, <http://cje.oxfordjournals.org/content/34/1/143>.

very processes by which technology and science is produced and utilized, as well as those by which gender is constituted or established. Both socialist and radical feminists initiated to examine the gendered nature of technical proficiency, and put the limelight on artifacts themselves. The social components that shape different technologies came under investigation, especially the way technology mirrors gender division and disparities.

For radical feminism, women and men are fundamentally different and women's power, culture, and pleasure are regarded as having been systematically controlled and dominated by men, operating through patriarchal institutions. In short, it is patriarchy and its man-centeredness which perpetrates all other forms of oppression such as racism or economic exploitation. On the other hand, socialist feminism is an optimistic political tendency because theoretically it contains the potential for change.¹³ Socialist feminists reject any biologically determined sexual division of labor. They argue that the differences between women and men are not pre-givens, but rather are socially constructed and therefore socially alterable. Socialist feminists do not believe that women's oppression can end without a transformation of society; they have to confront the contradictions of being what they are in a capitalist society characterized by male domination. However, both socialist and radical feminists have been criticized for their utopianism and separatism. For socialist feminism the criticism leveled at them by black women in Britain who have argued that their feminism is ethnocentric and who have accused them of racism because in promoting the notion of sisterhood, they have not recognized the structural power they have as white women over black women in Britain.¹⁴

¹³ Michelle Friedman, Jo Metelkamp and RosPosel, "What is Feminism? And what kind of Feminism Am I?," *Empowering Women for Gender Equity*, no. 1 (1987) 3-24, accessed November 26, 2014, <http://www.jstor.org/stable/4547903>.

Liberal feminism contends that women have the capacity to rival men on equivalent terms such as professional and political worlds, and in the labor force. Liberal feminist anxiety is the unequal and unfair employment practices in the workplace. Liberal feminism was preceded by the perception that almost all scientists are men. It is absolutely a political criticism which asks for an equal society. It can be supported by those who are in favor of equal opportunity. Notwithstanding the fact, that to a great extent they have overlooked other social elements which are bringing imbalances in industrialist social orders. It can be upheld by the individuals who are in support of an equivalent open door for all sexes. But the idea of 'equality of opportunity' has been condemned as meaningless for the inability to comprehend that our society is fundamentally unequal in its socio-economic structure.

In this manner established Marxist feminism takes a gander at the state of women just in relation with capitalism through an economic perspective- either their participation or their prohibition from it. Marx himself did not pay consideration to the question of gender. But he made an intense apparatus to depict and scrutinize contemporary western society that, capitalism. For him, the distinctive character of capitalist society is the division and conflict between capitalists and working class, exploitation and struggle. Later on Engels amplified Marxist thought and perceived the mediocre position of women and attributed it to the institution of the private family. Engels contended, in middle class families women had to serve their husband as master and they had to be monogamous and produce heirs who would inherit the family's property.

¹⁴ Ibid, 3-24.

According to Mulkay (1979), natural science, like capitalism itself, was the liberating force, setting men free from superstition and the ideological confusion of religious thought. But in due course science necessarily became an exploitative resource for bourgeoisie, particularly, within the realm of industrial revolution.¹⁵Wacjman extends Cockburn's (1983) argument by saying that women's exclusion from technology is a consequence of the male domination of skilled trades which developed during the industrial revolution, as a result, industrial technology from its origin reflects men's design, and is a defining feature of masculinity.¹⁶Marxist feminists' researchers have exposed that the capitalist division of labor is intersected with sexual divisions within the society. Through Marxist feminist point of view, one can effortlessly point out that in 'gender and science' arrangement women always relegate as proletariat and their barriers/constraints toward equal participation in science are deeply rooted in gender related customs and expectations.

Despite the diversity of feminist perspectives, there is one perspective which is fundamental to the thinking to them i.e., the process of morale argument presupposes the principle that every individual should be treated similarly and science should have equal participation of men and women. The belief derived from the idea that there is no ethical legitimization of treating individuals differently because of their sex, gender and intelligence

¹⁵ Michael Mulkay, *Science and Sociology of Knowledge* (London: George Allen and Unwin (Publishers) Ltd., 1979), 6.

¹⁶ Judy Wajcman, "Feminist Theories of Technology," *Cambridge Journal of Economics* 34, (2010):143-152, accessed January 7, 2015, <http://cje.oxfordjournals.org/content/34/1/143>.

Statement of the Problem

The study “participation, Barrier, and coping Strategies: A Study of Gender and Science in Academic Institutions in Bengal” empirically analyses the socio, cultural, economic and organizational aspects that influence the role of women scientists. The study analyses the participation of women scientists in various institutions and their respective departments. It also shows the participation women scientists in academic productivity. The study examines the barrier of women scientists which interrupt the equality of women in science. It is also trying to find out the strategies that women scientists take into the profession to cope with burdens which they face in multidimensional aspects.

Research Questions

1. What kind of participation women have within the science community and institutions in West Bengal?
2. Do women scientists face any obstacle or barrier to practice science?
3. Is there any possible way to cope with the barrier?
4. How gender identity plays an important role to shape women’s career as scientist?

Rational of the Study

The main objectives of this study are:-

1. To understand the patterns of representation of women in studied institutions in West Bengal.

2. To analyze the conditions of women scientists and scholars who are having multiple gender disparities and burdens which dictate the unequal representation in science.
3. To find out the strategies of women scientists which they take into science profession to cope with the burdens.

Methodology

As the overall objectives of this study was to investigate women's representation, barriers and coping strategies in science profession and practices, quantitative and qualitative design are both useful to explore research questions deeply. The present study is both qualitative and quantitative in nature. The research is descriptive in nature and uses quantitative as primary data gathered in field work by the researcher from previously selected universities and institutions of West Bengal. Qualitative research is a multi-method in focus, involving an interpretative approach to its subject matter. The Participants were selected using simple random sampling technique.

Data were gathered through employing multiple methods of data collection. Thus in-depth interview, focus group discussion, survey, direct observation and document analysis were applied to triangulate the validity of data. In addition different probing question were raised for clarification and discussion. The interview was also conducted in one session (sometimes two sessions) for each participant. The time of duration of interviews was different from mild to profound depending on their experience and availability of time.

The data collection procedures were followed by different steps. First, by asking permission from previously selected institutions, the participants were contacted physically, through mails and phone calls. Then having the consent of the participants and administration,

the interview and survey was held. The interviews were conducted through structured or semi structured questionnaires according to the specificity of the study. Further, in order to capture ideas and views at all stages of the data collection process, field notes and tape recording were used.

The data collected from primary and secondary sources were being analyzed and interpreted in line with the research questions. The data were coded and analyzed qualitatively. First the raw data was summarized and coded according to the themes of the study in order to manage the data appropriately. In the process, the researcher examines, compare, conceptualize and categorize the data in scientific fashion. Next, the data were interpreted as specifically as possible to fulfill the objectives of the study. The used methods not only facilitate the description of the phenomenon being studied, but also it was comfort to create conceptual framework by bringing bits of data together.

Chapterization

After having presented introduction the first chapter deals with extensive literature review. The literature review contains recent debates on innate aptitude and cognitive abilities, the terminological evolution of gender and sex, sociology of science, and gender roles in participation of women in science. After giving critical insight into the debates the chapter is also looking into the historical trends of women invisibility in science in the world and broad over view of Indian scenario. The second chapter gives a present scenario women's participation in science in West Bengal. The chapter is clearly bringing multidimensional aspects and status of

women participation which contains women participation in institutional atmosphere, recognition and award, and productivity. The third chapter is about the barriers and coping strategies of women scientists in Bengal. The chapter is elaborately discussing the obstacles/barriers for women scientists which they face with feminist point of view. It also points out the possible strategies they take into the profession to cope with gender-related burden.

Chapter 2

Literature review

This chapter contains extensive literature review contains the foremost debate regarding women's inferiority in cognition and innate aptitude, sociology of science, and women's representation within the scientific community. The discussion also extends the general overview on women's representation in scientific community and related research in Indian social and institutional dynamics. It also presents the rationales behind choosing few selected institutes in West Bengal to study women's representation, barriers and coping strategies in science and scientific community.

Regarding women's representation in science many scholars such as Francis Galton, Anne Moire, and David Jesselin earlier stage inferred that women are less in science because of their biological difference and intellectual inferiority. It was pointed out that women's IQ is lesser than men. But in later stage some scholars such as Diane F. Halpern and Mary L. LaMay have argued that regarding the IQ question we really cannot conduct sex neutral test. In later period many scientists as Linda Birke have pointed out that there is little bit difference between boys and girls in terms of ability in science but these biological traits in cognitions are responsive to training. They have also pointed out that not sex but gender which plays an important role to women's access in science.

However, there is an ongoing debate regarding sex and gender. As indicated by numerous scholars, the term gender and sex came through many permutation and combination. As example Myra J. Hird argues that the change from gender to sex or sex to 'gender' as a term was achieved through a slow epistemological and political shift-not in the body itself, but the in the meaning

attributed to this body. Gender is the main variable which shapes the women's participation in science. The representation includes participation, recognition, productivity etc.

Debate on Innate Aptitude and Cognitive Abilities

The smaller numbers or fall out of women in science and technology has larger connotations. While we are saying asymmetrical existence of women in science, there is extensive debate on the issue. Such as on January 14, 2005, Lawrence Summers, President of Harvard University, stated at a conference on women and minorities in science (organized by National Bureau of Economic Research) that man and woman are different biologically, and because of that men are dominating science and technology. He argued that difference in availability of aptitude at the high end has greater impact than social factors and discrimination on the representation of women.¹ Even before Lawrence Summers, in 1973, another scholar Dr. Robert Lehrke hypothesized that "a number of genes related to intellectual ability reside on the X-chromosome and that, because of that chromosomal inheritance, men exhibit greater variability in intelligence."² Another scholar like Linda Birke also showed that there is a slide difference between male and female brains in terms of spatial ability. She doubted that the differences in spatial ability might be the reason for lower presence of women in science.³

¹ Ellen Daniel, introduction to *Every Other Thursday: Stories and Strategies from Successful Women Scientists* (London: Yale University Press, 2006), xxi.

² Elizabeth Potter, introduction to *Feminism and Philosophy of Science: An Introduction* (New York: Routledge), 1.

³ Lynda Birke, "In Pursuit of Difference: Scientific Studies on Women and Men" in *Inventing Women: Science Technology and Gender*, ed. Gill Kirkup and Laurie Smith Keller (United Kingdom: Polity Press, 1992), 81-102.; Doreen Kimura, *Sex and Cognition* (United States of America: MIT Press, 2000), 1-5.; Simon Baron-Cohen, Svetlana Lutchmaya, and Rebecca Knickmeyer, *Parental Testosterone in Mind: Amniotic Fluid Studies* (United States of America: MIT Press, 2004), 13-19.

Moir and Jessel start their assessment with the work of Francis Galton and make a surmising that women are mentally sub-per compared to men. They indicate that noteworthiness of sex distinction in favoring men in mathematical capacity, spatial capacity, and pragmatic capacity in science. As indicated by them, the certainty of the male's predominance in spatial capacity is not in question. It is affirmed by truly end of diverse scientific studies.⁴Dr. D. Wechsler's IQ test methods, in 1950s, additionally affirmed the predominance of male sex over female. However, it is extremely uncertain to say that young men and women have distinctive IQ. Since, as per Wechsler's statement, it is unrealistic to direct a 'gender neutral' experiment.

Numerous researchers have attested that there is no probability of 'gender neutral' test on intelligence. For example Diane F. Halpern and Mary L. LaMay said that the substance of the inquiries has been much of the time over-looked in audits of intelligence tests. In intelligence experiment it ought to be clear that scores on intelligence tests rely upon the set of question asked by the researcher. These researchers have scrutinized the general data which is characteristic of intelligence. By and large, women and men have somewhat fairly diverse values, hobbies and engagement in distinctive levels of information about distinctive branches of knowledge. In intelligence testes it is hard to discover sex-neutral occupations and exercises.

Real sex contrasts in ability appear to lie in examples of ability instead of general level of intelligence (measured as IQ). A few analyst, for example Richard Lynn have contended that the presence of little IQ contrast favoring men. Case in point a few individuals are particularly great at verbal abilities, for example, utilizing words, while others are better at managing outside jolts, for example, recognizing questions in a different direction rapidly. Within the same level of

⁴ Anne Moir and David Jessel, *Brain Sex: The Real Difference between Men and Women* (New York: Dell Publishing, 1991), 5-21.

general intelligence two individuals may have varying cognitive abilities. According to Doreen Kimura, women do better than men on mathematical calculation tests, but on the other hand, men tend to do better than women on the tests of mathematical reasoning.⁵

We can't guarantee that the brain has sex difference in "cognitive abilities". Here I will bring some other researcher's work with a specific end goal to demonstrate "different innate aptitude" can be addressed. Presently researchers have officially proven that definitely there is natural biological contrast between men and women, yet to the extent that the topic of cognition and innate aptitude, there is no distinction between men and women in science. Lynda Birke points out that "the evidence of sex difference in spatial abilities is not found in all human societies. It largely disappears, moreover, if girls and boys are taught science in ways that encourage initiative and appropriate cognitive skills."⁶

Numerous researchers state that gender contrasts in cognitive abilities explain differential profession access. In 1974, Maccoby and Jacklin, in an examination, presumed that gender differences exist in three structures, for example spatial ability, verbal ability, and quantitative ability.⁷ Nonetheless, meta-analyses have exhibited that gender differences are not consistent pattern within these categories, and procedures examinations have raised more particular portrayals of areas where differences emerge.⁸

⁵ Doreen Kimura, *Sex and Cognition* (United States of America: MIT Press, 2000), 1-5.

⁶ Lynda Birke, "In Pursuit of Difference: Scientific Studies on Women and Men" in *Inventing Women: Science Technology and Gender*, ed. Gill Kirkup and Laurie Smith Keller (United Kingdom: Polity Press, 1992), 81-102.

⁷ E. E. Maccoby and C. N. Jacklin, review of *The psychology of Sex Differences*, by Carol Anne Dwyer, *American Educational Research Journal* 12, no. 4 (1975): 513-516, accessed March 2, 2015, <http://www.jstor.org/stable/42642465>.

⁸ Marcia C. Linn and Janet S. Hyde, "Gender, Mathematics, and Science," *Educational Researcher* 18, no. 8 (1989): 17-19, accessed March 13, 2015, <http://www.jstor.org/stable/1176462>.

Hyde and Linn (1988) have analyzed their research work by amalgamating meta-analysis and process analysis on gender differences in verbal, spatial, quantitative abilities and finalized that these classes give no confirmation to demonstrate gender differences in science and mathematics. They additionally state that these shorts of capacities are receptive to training. That implies distinction in verbal, quantitative, and spatial abilities (mechanical reasoning, calculation, mental rotation etc.) vanishes with training. Indeed, even differences like confidence, aggression, and interests are receptive to instructions. As indicated by them, environment is the fundamental variable inside which gender performs and sustained in distinctive way which drives the position of women in science and technology.⁹ Diane F. Halpern and different researcher have reasoned that the past encounters, biological factors, scholarly institutional strategies, and social setting influence the follower (women and men) of advanced study in science.¹⁰ That implies an extensive variety of sociocultural strengths add to sex differences in science, accomplishment and ability-including the impact of family, neighborhood, school impacts, and cultural practices

Inside of the sexes technical skills and domains of expertise are partitioned as Francesca Bray has argued in his work. The areas of mastery over a work are formed by the concern masculinities and femininities of human being. Men are viewed as having a natural affinity with technology, whereas women fear or dislike it. Men actively engage them with machines, making, using, tinkering with, and loving them. Women may have to use the machines, in the work place or in the home, but they neither desire nor seek to understand them. Women are considered

⁹Ibid., 18.

¹⁰ Diane F. Halpern, Camilla P. Benbow, David C. Geary, Ruben C. Gur, Jannet S. Hyde, and Morton Ann Gernsbacher, "The Science of Sex Differences in Science and Mathematics," *Psychological Science in the Public Interest* 8, no. 1 (2007):1-51, accessed October 25, 2015, <http://www.jstor.org/stable/40062381>.

passive beneficiaries of the inventive flame. The modernist association of technology with masculinity translates into everyday experiences of gender, historical narratives, employment practices, education, and the distribution of power across a global society in which technology is seen as the driving force of progress.¹¹

Sex and Gender

A considerable amount of research has been devoted to understanding the factors associated with women's less participation in science and professions which are related to science. Two of these qualities are biological sex and gender role. Past researches and investigations has reliably demonstrated that men all the more frequently improve position in science profession than women. This marvel has been credited to internal and external boundaries restricting women rising in science. Be that as it may, late sociological examination proposes that there have been moves in expert acknowledgement of women in science. Researchers now utilize the term sex to allude to biologically based distinctions in the middle of the sexes and the term gender to allude to the social development of contrasts in between women and men.¹² Yet there is still perplexity encompassing the ideas of sex and gender.¹³

¹¹ Francesca Bray, "Gender and Technology," *Annual Review of Anthropology* 36, (2007): 37-53, accessed September 9, 2014, <http://www.jstor.org/stable/25064943>.

¹² Margaret Mooney Marini, "Sex and Gender: What Do We Know," *Sociological Forum* 5, no. 1 (1990): 95-120, accessed January 17, 2015, <http://www.jstor.org/stable/684583>; Russell L. Kent and Sherry E. Moss, "Effects of Sex and Gender Role on Leader Emergence," *The Academy of Management Journal* 37, no. 5(1994):1335-1346, accessed November 19, 2014, <http://www.jstor.org/stable/256675>; ShaheenBorna and Gwendolen White, "Sex" and "Gender": Two Confused and Confusing Concepts in the "Women in Corporate Management" Literature," *Journal of Business Ethics* 47, no.2 (2003):89-99, accessed May 3, 2015,<http://www.jstor.org/stable/25075129>.

¹³ Carol M. Worthmann, "Hormones, Sex, and Gender," *Annual Review of Anthropology* 24, (1995): 593-617, accessed April 19, 2015, <http://www.jstor.org/stable/2155951>; ShaheenBorna and Gwendolen White, "Sex" and "Gender": Two Confused and Confusing Concepts in the "Women in Corporate Management" Literature," *Journal of Business Ethics* 47, no.2 (2003):89-99, accessed May 3, 2015,<http://www.jstor.org/stable/25075129>; Myra J. Hird, *Sex, Gender, and Science* (New York: Palgrave Macmillan, 2004), 17-24.

In the course of recent decades, the ascent of feminism brought discuss over the epistemological status of sex and gender. Biological anthropologists utilization ‘sex’ to gender status (e.g. “the sex of a child is female or male”), sort people by sex, compose of sex contrasts, and utilize the expression ‘sexual behavior’ (male are strong, hard, uproarious and so forth female are delicate, passionate, and so on.) to mean sex as defined character. The mental refinement and based on whether sexes produce egg cells (females) or sperm cells (males); ownership of anatomical structures suited to the generation of eggs or sperm (primary sexual characteristics); or hereditary qualities, gonads, morphology (genitalia, breasts and secondary sex characteristics). Sex as per cultural anthropologists in the social sciences, the meaning of ‘sex’ changes in dynamic counter position to ‘gender,’ as feminist researchers endeavor to adroitly withdraw the ‘determinism’ of science from the ‘constructivism’ of society. .

Early feminist scholarship criticized the essentialization of gender roles and statuses that appeals to biological ‘givens’, and limited the definition of sex to the biologically separated status of male or female. In any case, all the more as of late the status of sex as biological given has been addressed as questions and the role of social molding through daily performs, in the development of biological sex differences has been proposed.¹⁴ According to Worthmann, sex is neither universal nor uniform across life forms, and may adopt different forms within species. Sex differences in morphology and behavior vary in kind and degree. Males of some species might take alternative bio-behavioral phenotypes that support alternate reproductive strategies, such alternate phenotypes, found among vertebrates and invertebrates, can be fixed or plastic, that is, males may develop into one alternate phenotype only, or switch phenotypes in adulthood.

¹⁴ Carol M. Worthmann, “Hormones, Sex, and Gender,” *Annual Review of Anthropology* 24, (1995): 593-617, accessed April 19, 2015, <http://www.jstor.org/stable/2155951>.

Factors affecting choice or switch among alternate forms include parental condition, access to resources, or social experience¹⁵

Then again, many researchers have expressed their queries to refer 'sex' as the morphological and biological differences between men and women, and gender as cultural distinctive. According to Myra J. Hird, in pre-modern society, sex did not hold such foundational status. She augments her concept through Londa Schiebinger's argument: "sex before the seventeenth century..... was still a sociological and not an ontological category". In reality, what we understand as 'sex' today all the more nearly looks like what, amid the pre-enlightenment period, we would term 'gender'. The shift from gender to sex or sex to gender as a term was accomplished through a gradual epistemological and political shift-not in the body itself, but the significance credited to this body. These changes were made conceivable by the rising disciplines of science, and biology more particularly.¹⁶ Researchers like ShaheenBorna and Gwendolen White have arrived at a contention based on their surveys of literature pertinent to 'gender' and 'sex'. They recognized couple of conceivable reasons for perplexity in compassing the terms 'gender' and 'sex' : (i) quick development of idea of gender, (ii) deceptive nature of the terms 'sex' and 'gender' (iii) gender as etymological phenomena.¹⁷ According to Judith Butler, "with the terms of culture it is not possible to know sex as distinct from gender because the reproduction of the category of gender is enacted on a large political scale, as when

¹⁵Ibid., 610.

¹⁶ Myra J. Hird, *Sex, Gender, and Science* (New York: Palgrave Macmillan, 2004): 17-24.

¹⁷ShaheenBorna and Gwendolen White, "'Sex' and 'Gender': Two Confused and Confusing Concepts in the 'Women in Corporate Management' Literature," *Journal of Business Ethics* 47, no.2 (2003):89-99, accessed May 3, 2015, <http://www.jstor.org/stable/25075129>.

women first enter a profession or gain certain rights, or are reconceived in legal or political discourse in significantly new ways.”¹⁸

The concept of gender, as we now use it came into common parlance during the early 1970s.¹⁹ It was utilized as an analytical category to draw a line of boundary between biological sex and differences and the way these are utilized to advice practices and capabilities, which are then doled out as either masculinity or femininity. Scott defines gender as follows: the core of the definition rests on an integral connection between two propositions; gender is a constitutive element of social relationships based on perceived differences between the sexes, and gender is a primary way of signifying relationships of power.²⁰ Gender is an analytical tool for understanding social process which indicates culturally set of characteristics to identify the social behavior of women and men, and the relation between them. Gender, therefore, refers not simply to women or men, but to the relationship of them, and the way it is socially constructed.²¹

The typical convection to depict science as masculine and with the understanding of masculine as a cultural instead of that as a biological term; In these kind of understanding gender plays an important role which ties issues of women in science more extensively and how they go through the cultural transmission by birth itself.²²n 1970s the concept gender was created to

¹⁸ Judith Butler, “Performative Acts and Gender Constitution: An Essay in Phenomenology and Feminist Theory,” *Theatre Journal* 40, no.4 (1988): 519-531, accessed February 3, 2015, <http://www.jstor.org/stable/3207893>.

¹⁹ Jane Pilcher and Imelda Whelehan, 50 key Concepts in Gender Studies (New Delhi: Sage Publications, 2004): 56-59.

²⁰ Joan W. Scott, “Gender: A Useful Category of Historical Analysis,” *The American Historical Review* 91, no. 5 (1986): 1053-1075, accessed December 1, 2014, <http://www.jstor.org/stable/1864376>.

²¹ Neelam Kumar, “Gender and Stratification in Science: An Empirical Study in the Indian Setting,” *Indian Journal of Gender Studies* 8, no. 5 (2001):51-53, accessed May 17, 2015, <http://ijg.sagepub.com/content/8/1/51>.

understand the social inequality of indifferences between men and women as it had a motivation to create a space in which socially interceded contrasts can be investigated separately from biological contrasts.²³

To promote in a specific way to emphasize process over structure Judith Butler played a leading role. In her work, gender categories are not given but rather show up as the result of the emphasized social execution in which they are. According to Butler, gender, sex and the self are the effects of socially regulated performances.²⁴ Social rules and desires regulates performances. Indeed, parental desires distinct from young men to young women. In 1965 Alice Rossi surmised that one of the reasons why couples of women are spoken to in science is the distinction in the cognitive style in men and women. Thus the after effect of difference in the way young women are raised contrasted with young men. The number of women at the entrance of science can be raised by encouraging them in analytical and mathematical abilities that science requires and in this way more women can fix themselves in the frame of the field of science not as science teacher but scientist as well.²⁵ According to Harding an initial challenge for feminism was to demonstrate that the enduring identification between technology and manliness is not inherent in biological sex difference. Feminist researchers have exhibited how the binary oppositions in western society have favored masculinity over femininity, in between culture and nature, and

²² Henry Etzkowitz, Carol Kemelgor, and Brian Uzzi, introduction to *Athena Unbound: The Advancement of Women in Science and Technology* (New York: Cambridge University Press, 2003), 1-5.

²³ Jane Pilcher and Imelda Whelehan, *50 key Concepts in Gender Studies* (New Delhi: Sage Publications, 2004): 56-59.

²⁴ Judith Butler, "Performative Acts and Gender Constitution: An Essay in Phenomenology and Feminist Theory," *Theatre Journal* 40, no.4 (1988): 519-531, accessed February 3, 2015, <http://www.jstor.org/stable/3207893>.

²⁵ Alice S. Rossi, "Women in Science? Why So Few?," *Science* 148, (1965):1196-1202, accessed September 26, 2014 <http://www.jstor.org/stable/1716182>

hard and soft.²⁶To comprehend this wonder extravagantly we have to take a gender perspectives at the sociology of science itself

Sociology of Science

According to Joseph Ben-David, Sociology of science deals with social conditions and effects of science, and with the social structures and process of scientific activity; science is a cultural tradition which is preserved and transmitted from generation to generation partly because it is valued its own right and partly because of its wide technological applications.²⁷ The rise and development of sociology of science can be tracked back in World War II. May be more unmistakably than ever had sometime recently, science demonstrated its huge social significance at the time of world war two. According to Bernard Barber (1987), postwar competition among the powers on the industrial and military fronts led to new institutions for the support of science and to the emergence of organizations and studies in science policy in the hope that they could more effectively guide such support. As a result, in the late 1950s, a number of important intellectual developments contributed to the development of the sociology of science and science policy.²⁸

As we all know the ‘founding fathers’ of sociology like Durkheim, Marx, Manheim, Merton etc. played an important role in the considerable growth and diversification of the sociology of science. Early sociology of science was produced inside of the philosophical civil

²⁶ Sandra Harding, *The Science Question in Feminism* (London: Cornell University Press, 1986), 30-58.

²⁷ Joseph Ben-David and Teresa A. Sullivan, “Sociology of Science,” *Annual Review of Sociology* 1 (1975): 203-222, accessed January 13, 2015, <http://www.annualreviews.org/doi/pdf/10.1146/annurev.so.01.080175.001223>.

²⁸ Bernard Barber, “The Emergence and Maturation of the Sociology of Science,” *Science and Technology Studies* 5, no. 3/4 (1987):129-133, accessed February 14, 2015, <http://www.jstor.org/stable/690434>.

arguments with respect to the way of science and social basis of learning as a rule.²⁹ Concerning philosophy of science Emile Durkheim's focal case is that the development in the size of human social orders and their dynamic inside separation progressively free savvy action from social obliges. For him scientific believed is a result of this freedom and its discussions are, hence, similarly unaffected by direct social impacts.³⁰ As indicated by his thoughts, a sociological investigation of science is possible however in a more restricted structure than is the situation of different territories of scholarly attempt. For him genuine sciences, such as astronomy, physics, and biology, are taking into account detectable actualities about the physical world. The outcomes of these sciences are gotten from the facts, as opposed to being forced upon them. Science speaks to phenomena not regarding culturally unforeseen thoughts but rather as far as their natural properties.³¹

Marx's point of view on science as social phenomena emerges is a piecemeal fashion in the course of his wide ranging examination of consciousness, ideology and modes of production, whereas, Durkheim's judgement with respect to science is relatively explicit. Marx goes more distant than Durkheim and offers moreover a dynamic record of social procedure which can be utilized to portray a percentage of the connections in the middle of science and society. He emphasizes on that social orders are made out of generally unmistakable groupings, the individuals from which have restricting interest and in addition an unequal limit or controlling others. Science similar to capitalism itself, was a freeing power setting men free from superstition and the ideological disarrays of religious however. Yet at the appointed time course

²⁹ Randall Collins and Sal Restivo, "Development, Diversity, and Conflict in the Sociology of Science," *the Sociological Quarterly* 24, no. 2 (1983):185-200, accessed September 24, 2014, <http://www.jstor.org/stable/4106228>.

³⁰ Michael Mulkay, *Science and the Sociology of Knowledge* (London: George Allen & Unwin Ltd, 1979), 2-5

³¹.ibid, 4

science essentially turned into an exploitive assert for bourgeoisie. The bourgeoisie has been the one gathering in capitalist society ready to deploy surplus economic product to produce new experimental information specifically important to its own goals.³²

Mannheim received Dilthey's idea of methodological differences in between the knowledge of natural sciences and cultural sciences.³³ According to Collins and Restivo, specifically Mannheim was not interested in science. His work mainly reflected in sociology of Knowledge rather than sociology of science. According to them, Mannheim actually exempted science and mathematics from sociological explanation, he derived his idea from the traditional idea that mathematics is a self-evident exemplar of pure knowledge.³⁴ But Mulkay's reading of Mannheim suggests that he does not abandon science entirely as a subject for sociological investigation. In few pages of *Ideology and Utopia* he interprets the rise of science broadly along with Marxist lines. According to Mulkay, Mannheim argues that the methodology adopted by the advanced science was a by-product of particular philosophy (*weltanschauung*) of ascendant bourgeoisie.³⁵

Robert K. Merton took continued interest in empirical and analytical investigation of science since 1930s. Merton in his analysis of science has relied on Mannheim and his

³²Ibid., 6.

³³ David Kaiser, "A Mannheim for all Season: Bloor, Merton and the Roots of the Sociology of Scientific Knowledge," *Science in Context* 11, 1 (1998):51-87, accessed November 29, 2014, <http://web.mit.edu/dikaizer/www/Kaiser.Mannheim.pdf>.

³⁴ Randall Collins and Sal Restivo, "Development, Diversity, and Conflict in the Sociology of Science," *the Sociological Quarterly* 24, no. 2 (1983):185-200, accessed September 24, 2014, <http://www.jstor.org/stable/4106228>.
Dick Pels, "Karl Mannheim and the Sociology of Scientific Knowledge: Toward a New Agenda," *Sociological Theory* 14, no. 1 (1996): 30-48, accessed April 29, 2013, <http://www.jstor.org/stable/202151>.

³⁵ Michael Mulkay, *Science and the Sociology of Knowledge* (London: George Allen & Unwin Ltd, 1979), 13.

rationalistic philosophy of knowledge. But Merton's review of Mannheim brings some criticism, where, he argues that Mannheim did not pay careful attention to different types of knowledge. Merton continued with the critic on Mannheim's *Ideology and Utopia* by stating that the work suffered from a 'serious confusion of essentially different spheres'. The issues with such perplexity were that the sociological analyses which may be correlated for one domain of learning may not permit simple speculation. As indicated by Merton, we all know that the social procedure enters into the viewpoint of a large portion of the spaces of information, yet Mannheim's contention ('the content of formal knowledge is unaffected by the social or historical situation.') is making a vague position for himself. Merton is bringing up that Mannheim's ought to have cleared the 'formal knowledge' as a logic or mathematics or formal sociology. As indicated by Merton, such immunity (the unaffectedness of formal knowledge by social or historical situation) is delighted in by the 'exact sciences' yet not by the 'cultural sciences'. For Merton, if Mannheim had deliberately and expressly elucidate his position, he would have been less disposed to expect the physical sciences are completely invulnerable from extra-theoretical impacts and, correlatively, less slanted to urge that the social sciences are particularly subject to such impacts. Merton would not have liked to see the physical sciences expelled totally from sociological analysis.³⁶

The study of science by Merton is kept to the social and moral regulations controlling the scientist and scientific group. Now a days science is a real movement in the glove. Relative examination in diverse social orders would demonstrate particular nature of the structure and association of science, values and rules controlling exploratory exercises and connection between

³⁶ David Kaiser, "A Mannheim for all Season: Bloor, Merton and the Roots of the Sociology of Scientific Knowledge," *Science in Context* 11, 1 (1998):51-87, accessed November 29, 2014, <http://web.mit.edu/dikaizer/www/Kaiser.Mannheim.pdf>.

science from one perspective and on the other social, economic and political power structure. As asserted by Merton, there is very much catheterized and overriding social objectives that is, the augmentation of certified knowledge. He says science is social establishment which develops checked information. The institutional objective, that oversee scientific community are known as the “Ethos of Science”³⁷

Merton’s “Ethos of Science” are- “(i) the norm of communism, (ii) disinterestedness, (iii) organized skepticism, and (iv) universalism.” For Merton, “communism” refers to collective ownership of products. Likewise communism underpins the thought of common sharing of investigative information from one viewpoint and the substantive discoveries of science are allocated to the property on the other. According to Merton, “the communism of scientific ethos is incompatible with the definition of technology as private property in a capitalist economy”.³⁸

Merton’s concept of “disinterestedness” in ‘ethos of science’ guarantees quit far, that the pressure of individual interest is controlled. The researcher ought to be candidly unbiased by doing scientific work, that is, the checking of individual inclination. Thus, the researcher ought to be altruistic not prideful while performing the scientific experimental work. “Organized skepticism” is an institutional and methodological mandate requires a supervision of judgement until the social affair of conformation is finished for Metron.³⁹

“Universalism”- scientific truth is subjected to Universalism. In Merton’s words “Universalism finds immediate expression in the canon that truth claims, whatever their source,

³⁷ Robert K. Merton, the Sociology of Science: Theoretical and Empirical Investigations (Chicago: Chicago University Press, 1973) 268-270.

³⁸Ibid., 273-75.

³⁹Ibid., 272-73.

are to be subjected to pre-established impersonal criteria: constant with observation and with previously confirmed knowledge”.⁴⁰ As such, truth ought to be confirmed dispassionately. The acknowledgment or dismissal of scientific claims is subjected to the individual and the social properties of the scientist. That implies there ought to be judgement of scientific knowledge by impersonal criteria regardless of race, religion and gender. For Merton’s universalism demands that career ought to be to the deserved person “career should be opened to talent.

Merton has focused on the Universalism of science in the “Ethos of Science”. Though different scholars have shown that women are intensely under-spoken to science and profession related to science but this phenomenon serves to emerge one question that is to what extent science is universalized. Mertonian paradigm is scrutinized by Micheal Mulkay, in “science and sociology of knowledge”. As per Mulkay to accomplish universalism in science, those proposed by Merton in practical life is troublesome. According to him, the Mertonian paradigm is based on couple of suppositions, for example- “(i) the aim of science is the extension of knowledge, (ii) the recognition is made according to the originality and contribution, (iii) recognition depends on productivity, and (iv) productivity is constructed by gifted scientists.” He has given a critique to all of these presumptions. He thinks that, the aim of science is to expand certified knowledge, is true, but the ambition behind original contribution is not to earn recognition only. He states that, behind the pure contribution of a scientist recognition is not the only criteria which pushes the scientists to fulfill his work satisfaction. To perform the job of a scientist, there might be many other motivating factors to make them do so.

Merton’s theory says, inequality is based on recognition and rewards on productivity. According to him, scientists should be judged on the basis of his productivity of scientific

⁴⁰ Ibid., 270

knowledge. Mulkay on the other hand says that it is only scientific knowledge where universalism is applicable but the scientists should be given equal opportunity to produce knowledge in terms of resources which is generally not possible. According to him, all scientists do not get the same opportunities to produce scientific knowledge and get recognition. The person who has more recognition gets more and more. Thus we can say that, in practical setting, we cannot apply Merton's formulation of universalism. As of now we can say that, one does not find the norms of universalism in science, if one agrees with Mulkay's criticism. "If question comes about the relevance of Mertonian concept of universalism in science, then the answer is Mertonian thought of universalism creates a powerful tool to set a vision of gender equity in scientific community and production." When we compare men and women entering into scientific profession, non-universalism (inequality) in science is very much visible.

Merton left his mark on the history of the sociology of science by putting forward a model that gave rise to new research and many discussions. It is customary to associate Merton with a 'tradition' of which he is the founder. This tradition has been initiated institutional sociology of science. Merton's sociology met with considerable success in 1960s. His notion of scientific ethos is considered as a model to analyze sociology of science. It was not until the start of 1960s Merton gathered several researchers such as Harriet Zuckerman, Jonathan R. Cole, and Stephen Cole around him. These were the people who had been trained by him and drew their inspiration from his analyses. They worked on the social system of science on the functional interactions within the scientific community. But sometimes their works invalidate Merton's theories. Harriet Zuckerman's work in 1977 shows that the elite members of scientific community have specific types of behavior such as the scientific ultra-elite tend to have more discussion among themselves than with ordinary researchers. Even the best researchers come out

of the laboratories that are already headed by famous scientists. According to her, a hierarchy is established inside the scientific institution and imposes strata among the individuals, laboratories, and universities.

Merton engaged the sociology of science in a study of the way institution of science worked. From this, he put forward a theory whose ingredients were the normative structure (scientific ethos) of science. His work resulted in a better understanding of institutional mechanism and the effective functions of norms, at times more ideological and rhetorical than normative. At the end of 1960s, scientific ethos as descriptive notion was sharply criticized. In 1966 Norman W. Storer suggested that the normative structure does not go far enough to explain how different parts of scientific community are integrated to form a whole science. Not only science as an institution but also social dynamics has to be taken into account too. It comes to a serious scrutiny when gender plays an important role within scientific community to make barriers and stratified representation of women in science.

Gender Roles and Women's Participation in Scientific Community

Science has been both characterized as the most universalistic institutions and debated as an institution in which universalistic standards hesitate to reach its target. A substantial body of research in the sociology of science has involved an assessment of the operation of universalistic standards in process of stratification in science. According to Alan Gewirth, "Universalism can be defined as the doctrine that all persons ought to be treated with equal and impartial positive consideration for their respective goods or interest."⁴¹ Additionally science has the same universalistic approach which has been designed by Robert K. Merton. Universalism defined by

⁴¹ Alan Gewirth, "Ethical Universalism and Particularism," *The Journal of Philosophy* 85, no. 6 (1988):2003-302, accessed May 25, 2014, <http://www.jstor.org/stable/2026720>.

Merton in “Ethos of Science” demands two related requirements. Firstly, scientist’s contribution to scientific knowledge and the assessment of the validity of that knowledge by scientific community should be subjected to impersonal criteria and second requirement is that scientists should be fairly rewarded for contributions to the body of scientific knowledge. As Merton’s summarization describes “careers should be open to talent”.⁴²

While debate continues about the scientific community’s adherence to Merton’s ethos of science, it is unquestionably true that science is an institution in which enormous disparity exists. As Zuckerman and Cole’s “triple penalty” defines the basis of inequality in science institutions.⁴³ According to them, inequalities exist in employment, ranks and award, and promotion and recognition etc. Long and Fox describe science as an institution with immense inequality in career attainment. Both of them argue that women as group have lower level of participation, position, productivity, and recognition than do men.⁴⁴ Lower participation of women in professions and in the high status positions is a logical consequence of women cultural

⁴² Robert K. Merton, *The Sociology of Science: Theoretical and Empirical Investigations* (Chicago: Chicago University Press, 1973), 268-270.

⁴³ Harriet Zuckerman and Jonathan R. Cole, “Women in American Science,” *Minerva* 13, no. 1 (1975): 82-102, accessed October 3, 2015, <http://www.jstor.org/stable/41827212>, “Triple penalty”, described by Zuckerman and Cole, suggest that women encounter three major barriers to becoming productive scientist. First, Science is culturally defined as an inappropriate career for women. Second, existing women scientists continue to be hampered by the belief that women are competent than men. And third, there are some evidences of actual discrimination against women in the scientific community. Namrata Gupta and Arun K. Sharma, “Women Academic Scientists in India,” *Social Studies of Science* 32, no. 5/6 (2002):901-915, accessed June 4, 2014, <http://www.jstor.org/stable/3183058>. Gupta and Sharma also accused “dual burden’ as a barrier for women in profession. According to them, Women in any profession have to manage their careers and families. They observed that professional women do larger share of house hold work than men.

⁴⁴ J. Scott Long and Mary F. Fox, “Scientific Careers: Universalism and Particularism,” *Annual Review of Sociology* 21 (1996):45-71, accessed December 5, 2014, <http://www.jstor.org/stable/2083403>.

mandate which prescribes that their primary allegiance be to the family and that men be its providers of both economic means and social status.⁴⁵

According to Londa Schiebinger, “when looking at women’s opportunities in science, one focal fact emerges: women have never fared well in official institutions of science—past or present.” She further extends her argument as “women simply do not hold senior positions in science from which they can guide the future course of science.”⁴⁶ Numerous scholars have contended that women in science profession do not hold senior position on the ground that it is a cultural mandate of women as kin to be soft and unable to fit in administrative profession. Bernadine Healy asserts that “women in science eventually hit the mommy track or a glass ceiling.”⁴⁷ After extensive research in Indian setting Namrata Gupta suggests that women’s lower participation is interlinked between organization of academic science and the socio-cultural systems such as family and society reproduce social relation at the institutes.⁴⁸ Social milieu is important since science and educational institutions are embedded in the social context. The practice of academic science and its interaction with gender always governed by social norms and social backgrounds of the people involved in science.

⁴⁵ Rose Laub Coser and Gerald Rokoff, “Women in the Occupational World: Social Disruption and Conflict,” *Social Problems* 18, no. 4 (1971):531-554, accessed November 14, 2014, <http://www.jstor.org/stable/799727>.

⁴⁶ Londa Schiebinger, “The History and Philosophy of Women in Science: A Review Essay,” *signs* 12, no. 2 (1987): 305-332, accessed September 30, 2014, <http://www.jstor.org/stable/3173988>.

⁴⁷ Bernadine Healy, “Women in Science: From Panes to Ceiling,” *Science, New Series* 255, no. 5050 (1992):1333, accessed August 26, 2013, <http://www.jstor.org/stable/2876356>; Norman Stockman, Bonney Norman, sheng Xuewen, review of “Women’s work in the East and West: The Dual Burden of Employment and Family Life,” by Jinjoo Chung, *Sociology* 30, no. 4 (1996):828-830, accessed April 5, 2014, <http://www.jstor.org/stable/23746009>.

⁴⁸ Namrata Gupta, “Women Research Scholars in IITs: Impact of Social Milieu and Organizational Environment,” *Sociological Bulletin* 56, no. 1 (2007):23-45, accessed January 22, 2015, <http://www.jstor.org/stable/23620703>.

Numerous researchers have blamed social standards as the inventor of gender norms which makes a “leaky pipeline” for women in science. Lower participation and barriers are interlinked variables where, women participation is a phenomenon caused by gender barriers in science. Gender plays a critical part in molding science profession for women. David Bloor argues that science and technology shapes society as much as society shapes science and technology.⁴⁹ Scholar Neelam Kumar says “it became clear that not only gender influenced technology, but one fundamental way in which gender is expressed in any society is through technology. Women kept away as it was considered ‘masculine’ and at the same time ‘masculinity’ was being defined in terms of man’s use of technology and its tools.”⁵⁰ Significant forms of social division deeply rooted in gender division of the society. The socio-political and economic settings of gender are significant in the context of the hierarchical structure of the social environment in which we live. In 1978 the term gender and science first made its appearance by Evelyn Fox Keller. She clarifies the significance of exploring the ways masculine norm, taken as universal norms, have been drenched into the practice itself. She questions the hetero-normative relationship between men and science where women are consigned to the position as ‘other.’⁵¹

Women in both higher education and career are required or expected to attend equal opportunity in science. But, primarily, they are seen as women who are made to feel out of place

⁴⁹ David Bloor, introduction to *Knowledge and Social Imagery* (London: University of Chicago Press, 1991), xi.

⁵⁰ Neelam Kumar, ed. introduction to *Gender and Science: Studies Across Culture* (New Delhi: Cambridge University Press India Pvt. Ltd., 2012), xv-xxviii.

⁵¹ Evelyn Fox Keller, “Feminism and Science,” *Signs* 7, no. 3 (1982): 589-602, accessed March 23, 2015, <http://www.jstor.org/stable/3173856>.

and treated differently by patriarchal structure of our society.⁵² Male colleagues undermine the women professionals' identity by putting their gender first. This could take the form of, for instance, sexual jokes etc. In work place three major problems faced by women scientists in science due to gender identity: (i) general male dominance in work environment; (ii) feeling isolation; and (iii) experience of conflict between being a woman and a scientist.⁵³ Along these lines, we can say women professional's latent presence as a particular identity creating them passive "other". However, the scenario is changing day by day as more women are coming into science profession.

Gender question became an important issue in relation to women's profession, organization, etc. has attracted the attention of scholars' through-out the world. As indicated by Gould, discrimination is very much reported custom in the histories of women scientists. The lower participation of women in various institutions demonstrates that gender does play a significant role in shaping women's career in science. It is commonly argued that in the field of science women do not receive recognition in the same degree as men for similar contribution.⁵⁴ Even in advanced education (research level) a woman scholar faces various complications such as difficulties for publication, cooperation from guide, decent facilities from institution etc.⁵⁵.

⁵² Ruth Carter and Gill Kirkup, "Women in Professional Engineering: The Interaction of Gendered Structures and Values," *Feminist Review*, no. 35 (1990):92-102, accessed February 24, 2015, <http://www.jstor.org/stable/1395403>.

⁵³ Namrata Gupta and Arun K. Sharma, "Women Academic Scientists in India," *Social Studies of Science* 32, no. 5/6 (2002):901-915, accessed June 4, 2014, <http://www.jstor.org/stable/3183058>.

⁵⁴ Jonathan R. Cole, *Social Stratification of Science* (Chicago: University of Chicago Press, 1979), 27.

⁵⁵ Neelam Kumar, ed. introduction to *Gender and Science: Studies Across Culture* (New Delhi: Cambridge University Press India Pvt. Ltd., 2012), xv-xxviii.

Indeed, even in academic productivity likewise turned into a genuine concern among social scientists all through the world. Numerous scholars have asserted that in academic productivity such as participation in various projects funded by external funding agencies and publication women's participation is much lower than men.⁵⁶ Numerous studies have found that women scientists' participation in publication is lower than men scientists. Together Xie and Shauman initiated their assessment in this regard from Cole and Zuckerman's term 'Productivity Puzzle'. For the first time Xie and Shauman identified differences between women and men in personal characteristics, structural position, and facilitating resources that account for women's lower productivity. As indicated by them women scientists publish fewer papers than men because women are less likely than men to have the personal characteristics, structural position, and facilitating resources that are conducive to publication.⁵⁷ In 2006 Erin Leahey concocted new thought that "women have lesser participation in publishing because their lesser research specialization."⁵⁸

Numerous researchers have attracted attention on the idea that women have lesser publication or productivity because of their other responsibilities such as child bearing and rearing, household responsibility etc. However, Steven Stack approached with a conclusion that "children are not the strong predictor of productivity, but the influence that they do have followed a gendered pattern." In later period few scholars have pointed out that women's less

⁵⁶ Steven Stack, "Gender, Children and Research Productivity," *Research in Higher Education* 45, no. 8 (2004):891-920, accessed January 24, 2015, <http://www.jstor.org/stable/40197370>; Erin Leahey, "Gender Differences in Productivity: Research Specialization as a Missing Link," *Gender and Society* 20, no. 6 (2006):754-780, accessed May 30, 2014, <http://www.jstor.org/stable/27640933>.

⁵⁷ Yu Xie and Kimberlee A. Shauman, "Sex Differences in Research Productivity: New Evidence about an Old Puzzle," *American Sociological Review* 63, no. 6 (1998):847-870, accessed April 24, 2013, <http://www.jstor.org/stable/2657505>.

⁵⁸ Erin Leahey, "Gender Differences in Productivity: Research Specialization as a Missing Link," *Gender and Society* 20, no. 6 (2006):754-780, accessed May 30, 2014, <http://www.jstor.org/stable/27640933>.

participation in publishing is not only for gendered pattern it is also reciprocal to women scientists' position in professional hierarchy. Jean Anderson Eloy and couple of different researchers have contended that men have higher academic productivity rates at earlier points of their career than women do. The productivity rates expanded and rose to those of men later in their professions. By using 'h-index' method they have inferred that women's productivity rates are reciprocal to women's position in profession.⁵⁹ There is strong evidence of women's presence in science since its inception. However, the patriarchal notion of the society has historically curved their presence from scientific community and practices

Historical Trends of Women's Invisibility in Science

Gender and Science relation cannot be seen as isolated issue from larger historiographical framework. Historically, science has developed within an ideological framework emphasizing masculinity and patterned a 'male scientific ethos'.⁶⁰ From the very beginning of the history, women were excluded from science. Women's participation in science is not new in science. In fact since ancient period we have example of women participation in science. According to Margaret Alice, from the earliest times women contributed to the development of scientific knowledge, yet we think of the history of science as history of men. One of the earliest women in science in the west was the mathematician and astronomer Hypatia in A.D. 370. According to

⁵⁹ Jean Anderson Eloy, Peter Svider, Sujana S. Chandrasekhar, Qasim Hussain, Kevin M. Mauro, Michael Setzen, and SolyBaredes, "Gender Disparities in Scholarly Productivity within Academic Otolaryngology Departments" *American Academy of Otolaryngology- Head and Neck Surgery*, (2013):215-222, accessed January 23, 2013, <http://oto.sagepub.com/content/148/2/215>.

⁶⁰ Neelam Kumar, "Gender Imbalance in Science: Cultural Similarities and Differences," in *Gender and Science: Studies across Culture*, ed. Neelam Kumar (New Delhi: Cambridge University Press India Pvt. Ltd., 2012), 21-22.

many scholars, she was killed by mob in Alexandria.⁶¹ Because religious oriented society did not allow women to practice science individually. Evelyn Fox Keller's 'Reflection on Gender and Science' argues that the term 'scientists' itself related to masculine idea. She pointedly insists on the pronoun "he" when referring to scientist. According to her, when we refer a scientist it automatically means 'male' bodied human being. So until very recently women were not considered as scientists.

During the emergence of modern science in 17th century, the institutional base of science shifted. But the institutionalization of science resulted in the women marginalization in science. World's major scientific academics were found in 17th century such as the Royal Society of London in 1662, the Parisina Academie Royal der Sciences in 1666, the Akademie des Wissenschaften in Berlin in 1700 etc. The prestigious Royal Society of London which was established in 1662 did not allowed women till 1945. Marie Curie was also rejected by the French Academy of Science. It took till late nineteenth century to open the doors of universities, scientific societies, and research laboratories for women.⁶²

The evidence of women being discouraged from entering into the world of sciences has been seen all over the world. In eighteenth century the notion was reinforced by the belief that men and women had radically different natures, so, only men could be scientists. Women who did receive an education, either at home or in boarding schools, followed curricula that emphasized music and fine arts, reflecting the belief that their nature differed from the male nature; males were taught a curriculum that include science. Many historians suggest that

⁶¹ A. W. Richeson, "Hypatia of Alexandria," *National Mathematics magazine* 15, no. 2 (1940): 74-82, accessed April 6, 2015, <http://www.jstor.org/stable/3028426>.

⁶² Neelam Kumar, "Gender Imbalance in Science: Cultural Similarities and Differences," in *Gender and Science :Studies Across Culture*, ed. Nelaam Kumar (New Delhi: Cambridge University Press India Pvt. Ltd., 2012), 21-22.

women did not begin to receive education in science until the women's colleges and public land-grants institutions were established.⁶³ Women achieved access to institutions of higher education in US 1833; Germany in 1908; and Japan in 1913. In India the first graduate degrees were granted to women in 1883.

Women and Science in India: an Overview

History of Science and Technology education in India has witnessed huge expansion in the post- Independence era. But women's lower enrollment patterns in science education have historical roots since the inception of science education in India. The advent of modern science was linked to the introduction of modern education in the beginning of 19th century.⁶⁴ Men were the early beneficiaries of such education. Because traditionally too, women in India have been members of a stratified society, characterized by the ideology and practice of inequality. It was only in the Second World War that Indian women entered into colleges in sizable numbers. But in the case of science education, the proportion of women was unequal. As Sundaram's description of the pattern in Indian universities for the year 1941-42 shows that the total number of enrolled for under graduate course in science is 903 in comparison to 11,217 boys. Only 83 girls were enrolled for a postgraduate course in science in contrast to 1,321 boys. While in medicine their number was 778 against 6,093 boys, in engineering only one was enrolled along

⁶³ Sue V. Rosser, ed. introduction in *Women, Science, and Myth: Gender Beliefs from Antiquity to the Present*(United States of America: ABC-CLIO, 2008), ix.

⁶⁴ E.S., Amrik Singh, Rais Ahmed, Madhulika Rakesh, NupurAwasthi, and SreyosiKanta. "Science in Indian Universities," *Minerva* 30, no. 1 (1992):51-100, accessed December 24, 2014, <http://link.springer.com/article/10.1007%2FBF01096396>.

with 2,718 boys.⁶⁵Over the years, women's enrollment has shown significant increase due to various efforts by government bodies to enhance women's access to scientific careers.

Many science and technology related agencies are providing special amenities to encourage women in access science as career. The department of science and technology (DST), for example runs a program call entitled "Women Scientist Schemes (WOS), for providing opportunities to women scientists. DST also provides opportunities for women who have suffered a break in career to return to a science career. NCERT (National Council of Educational Research and Training) runs few programs such as special scholarship for girls studying in government schools to take up science. University Grants Commission (UGC) has started role model program to encourage more women in science. It has also initiated short term research projects, special leave with pay, and other many amenities to reduce gender imbalance in the sphere of science and technology.⁶⁶By the 1970s, there was a growing awareness that gender is an important social category, which needs to be addressed in developmental planning. The women's debate in India began in 1975 with an official report of the Committee on the Status of Women in India. The *Report of the Committee in the Status of Women* (1974), better known as *Towards Equality Report*, set clear guidelines on the aims of women education.

According to University Grants Commission report, "There has been a phenomenal growth in the number of women student's enrollment in higher education, since independence. The women enrollment which was less than 10 percent of the total enrolment on the eve of Independence has risen to 43.28 percent in the academic year 2012-2013, i.e. the number of

⁶⁵ M.S. Sundaram, "Education in British India," *The Journal of Negro Education* 15, no. 3 (1946):513-525, accessed August 23, 2014, <http://www.jstor.org/stable/2966117>.

⁶⁶ INSA (Indian National Science Academy), *Science Career for Indian Women: An Examination of Indian Women's Access to and Retention in Scientific Careers* (New Delhi: INSA, 2004), 1-67.

women enrolled per hundred men registered more than five times in 2012-2013 (76.31 women per hundred men) as compared to 1950-1951 (14 women per hundred men). Women enrolment in science education has also witnessed growth in recent years. Official data suggests that percentage of women enrolment increased to 19.07 percent (1775319) in science, and for engineering and technology it increased to 10.55 percent.

Women enrolment has been increased in recent decades but still in professional areas of science and engineering still witness a severe imbalance and women's participation which has been limited and confined to junior positions as far as science careers is concerned. The constitution of India assumes equal opportunity for girls and boys. Girls study same curriculum as boys, take the same examination and many cases obtain better result than boys. It is unfortunate that in India this equality of opportunity available in the educational set up. But girls cannot avail the choice of their own because of socio-economic and cultural impulses. Even in professional sphere they relegate as inferior and hold smaller proportion of participation. According to Neelam Kumar, "only few women could make it to senior decision-making positions and get recognition." Many scholars have pointed out that lack of women in decision making position is interrelated to masculine ethos of scientific institutions and its exhibition of hierarchical segregation in terms of gender. As a reason they have argued that on the one hand a family structure gives a precedence to men over women, and characteristics of Indian society act as determining factors behind women lives including their educational access and preferences.

Studies on Indian women in science have emerged only since the 1970s. For instance, in early 1970s, a survey of women scientists at Bhabha Atomic Research Centre (BARC) by Roshan Begum and Kamala Balaraman (1975) found that, due to socialization in a patriarchal culture and a lack of childcare facilities, women have to work harder than men. According to

Gurunani and Seth (1984), women scientists felt that the male colleagues and superiors do not accept women professionally. In 1986 Chakravarthy reported that very few women scientists hold senior posts in central research institutions. Many scholars have noted that women scientists also suffer career interruption as a result of having move because of the husband's job. As example, Martin and Irvin noted that one of the major reasons for relative lack of success of women astronauts in England is career interruption because of such movements. In India women scientists who are married generally finds there husband in the same fields or in the other fields holding equal position or better than their own. Many scholars also have emphasized the role of prejudices as, lack of infrastructural support, and dual burden for women scientists.

Over few decades, development in India has served to enhance the opportunities for women in every sector. But large number women from under privileged class still have extremely lower representation in science discipline. The complex stratification system in India give rise to a multiplicity of social categories often obscured the relative status of women and men within more disadvantaged segment of the population. Scholar like Dana Dunn has pointed out that women within schedule groups have far more limited access to both educational and employment resources.⁶⁷

Contemporary studies have revealed gender differentiation in Indian scientific institutions through multiple perspectives. Carol C. Mukhopadhyay has accused the cultural and social context as contributors of gendering science.⁶⁸ According to Gupta and Sharma, the prevailing

⁶⁷ Dana Dunn, "Gender Inequality in Education and Employment in the Schedule Caste and Tribes of India," *Population Research and policy Review* 12, (1993):53-70, accessed November 17, 2014, <http://www.jstor.org/stable/40229787>.

⁶⁸Carol C.Mukhopadhyay, "A feminist Cognitive Anthropology: The Case of Women and Mathematics." *Ethos* 32, no. 4 (2004): 458-492, accessed July 12, 2014, <http://www.jstor.org/stable/3651895>.

socio cultural systems in India result in a 'triple burden' for women in academic and scientific careers.⁶⁹ Many studies have indicated that women in all professions perform a double role of managing job and household responsibilities, which has been commonly considered as 'dual burden'. Many scholars have accused the lack of clarity on the purpose of women's education in educational planning. According to Veena Poonacha, all the important education commissions such as National Council for Women's education (1959), National Committee on women's education (1970) were hesitant in defining the aims of women's education, and seem to be caught in contradictory value systems while defining the purpose of female education. Many scholars have argued that although women in science education have expanded yet imbalance and inequalities continued to exist.

To understand the imbalance and inequalities in science the present study is concentrating in West Bengal. The present study has been conducted among three universities and three institutions in West Bengal. West Bengal is a state situated in the eastern region of India and it is nation's fourth most populous state. It is also the seventh most populous sub national entity in the world with over 91,347,736 populations as per 2011 census. Maximum GDP of the state depends on agriculture. Among the total populations males and females are respectively 46,927,389 and 44,420,347. In West Bengal sex ratio is 947 females per 1000 males. As per 2011 census total literacy rate is 77.08 percent and female literacy rate is 71.16 percent. According to UGC report, West Bengal has 40.75 percent women enrolment in universities and colleges. Due to unavailability of proper data we cannot find out the exact ratio of women enrolment in science education.

⁶⁹Namrata Gupta and Arun K. Sharma, "Women Academic Scientists in India." *Social Studies of Science* 32, no. 5/6 (2002): 901-915, accessed June 4, 2014, <http://www.jstor.org/stable/3183058>.

Chapter 3

Women's Participation in Science: Study in West Bengal

This chapter elaborates the marginal participation of women in science. Prevailing interpretations are based upon the idea that cultural prejudice, namely role stereotypes, inhibits women from aspiring to scientific careers. Existing literature suggest that not only do fewer women than men undertake a scientific career and proportionately more women than men move out from science study in research level. Not only obtaining higher degrees in science but also women face inequalities in gaining positions and other rewards of success. Many scholars such as Jonathan R. Cole, Harriet Zuckerman, and Steven Stack have pointed out that women have proportionately lower participation in scientific productivity. The productivity in terms of publishing articles, books etc. It is visible that proportionately lesser (compare to men) rate of women scientists can gravitate from research into teaching and administrative positions.

What is it that has brought about and perpetuated this dismal situation? Scholars have argued that existence of gender prejudice and its impact causing lower visibility of women in science. It seems that the image of women pressed into the fringe areas of science by prejudice and the image of women staying away from the 'masculine' and competitive hard sciences are overdrawn. Indeed, none of the explanations are anchored in any fundamental understanding of either the dynamics of science as a social institution or of the usual processes of women's self-screening that effect their career choices, their research preferences, and their professional advancement, factors that ultimately produce the pattern of lower participation and marginality.

Recent statistical data regarding women's enrollment in scientific disciplines shows that the number of women participation is increasing but it is still lower than male participation. As indicated in 2004 INSA (Indian National Science Academy) report, during the academic year 2000-2001 there was increase in in the proportion of women studying science at PG level compared to graduation level but some decline occurred at the level of Ph.D. The percentage of Ph.D enrollment was 37.2.¹ This study takes INSA report as latest statistical data because of unavailability of recent data regarding Ph.D enrollment. Year wise data from UGC annual report show that overall enrollment of women in science at UG and PG level is increasing but in full time employment at research is really lower than the male participation.

In recent decades many government organizations are taking initiatives to bring gender parity in the field of science and technology by creating leadership positions, different schemes etc. Recently, the Ministry of Human Resource Development announced a fresh scheme titled KIRAN (Knowledge Involvement in Research Advancement through Nurturing) which will create leadership position for women as they are so few in science. The Department of science and Technology under Ministry of science declared another scheme which provides opportunities for those women scientists who have suffered a break and desire to return to mainstream science and work as bench-level scientists. Women are still minority in practicing science despite all the initiatives over recent decades by Indian government. Dr. Jyoti Sharma, principal scientific officer in-charge, science and technology based Societal and IPR Research Fellowship for women scientists, reveals that the percentage of women in full-time employment

¹ INSA (Indian National Science Academy), Science Career for Indian Women: An Examination of Indian Women's Access to and Retention in Scientific Careers, (New Delhi: INSA, 2004),9

at research and development is only 17%.² Another work of K.C Garg and S. Kumar mentions that “although, women have earned 37% of all science Ph.Ds awarded by Indian institutions, the ratio of women scientists entering the workforce is still very less and women constitute only 15% of the total manpower engaged in R&D (Research and Development) in science and technology.”³

Women not only represent lesser proportion in enrollment they also have lesser proportion in academic productivity in terms of publications and projects. According to K.C Garg, it is found that of 9957 life science papers published during 2008-2009 academic years but women scientist were sole contributors in just 3.4 per cent of them. They also represent lower proportion in joint contributions. As Garg pointed out that woman scientists have 47 percent joint contribution in life science.⁴ During the study it is been observed that women also have lower participation rates in decision making, mentoring, top positions as administrators etc. For study in West Bengal this study cannot produce exact proportional figure of women scientists and their enrollment because systematic official data do not exist. Although, it can be said that West Bengal’s position is far lower than the other states in India. 2004 INSA report mentioned that few states such as Goa, Kerala, Punjab and Pondicherry have more 50% women enrollment in science. On the other hand few states such as Arunachal, Bihar, Orissa and Rajasthan which have less than 35% women enrollment in science. The report did not mention West Bengal in the

²Poulomi Banerjee, “The Missing Women of Indian Science,” *Hindustan Times*, Updated: Sep 14, 2014, accessed January 5, 2015, <http://www.hindustantimes.com/india-news/the-missing-women-of-indian-science/article1-1263846>

³ K.C. Garg and S. Kumar, “Scientometric Profile of Indian Scientific Output in Life Sciences with a Focus on the Contributions of Women Scientists,” *Scientometrics* 98 (2014):1775, accessed January 27, 2015, <http://link.springer.com/article/10.1007%2Fs11192-013-1107-4>

⁴ Ibid, 1779

list. So we can carry forward an argument that West Bengal has lesser percentage of women enrollments in science.

Science has been catheterized as the most universalistic institutions in which universalistic standards hesitate to reach its equality. While debate continues about the scientific community's faithfulness to Merton's ethos of science, it is arguably true that science is an institution in which massive inequalities exist in career attainment. The essential link between the ethos of science and inequality in science is seen in the distinction between inequality and inequity. Therefore, to what extent is the inequality in science equitable or inequitable? Can the inequality be explained by normatively justifiable, universalistic characteristics as opposed to unjustifiable particularistic characteristics? According to Jonathan Cole, in this way stratification has been regarded as a "strategic starting point" for into the social system of science. This chapter deals with the participation of women in selected institutions. The chapter is trying to capture the current status of women's participation on the basis of entry into science education, position, recognition, and academic productivity. The chapter helps to understand women's marginality in science while considering the meaning and measurement of universalism in comparison with particularism. The chapter is also analyzing the causes of differential participation with a view toward assessing evidence for violations of universalism of science.

Profile of the Studied Institutions

The profile of the selected institutions contains three universities and three institutes. The rationale behind choosing these institutions is wide-ranging. Firstly, these are the best institutions for science and engineering studies. According to NAAC report these are the extremely popular institutions for higher studies and better placement. Secondly, these

institutions are almost nearby with each other with heritage value and international academic excellence. Among the selected institutions three (IACS, BESU, and PU) were established in British colonial period and have much importance in contributing modern science education. Among the other three, Jadavpur University was established from the spirit of national movement to create a space for science and engineering education under national control. The IICB and SNIP are the most leading institutes in country for research as international level of excellence. So, it is very important to search for present status of women in science atmosphere among the selected institution. It will help to understand the present scenario of women's participation in West Bengal.

IICB (*Indian Institute of Chemical Biology*): is one of the major laboratories in India which initiated, right from its inception, multidisciplinary concerted efforts for conducting basic research on infectious diseases. The institute was established in 1935 as the first non-official center in for biomedical research and was included with in the aegis of CSIR (Council for Scientific Industrial Research) in 1956. CSIR- IICB today is engaged in research on disease of national importance and biological problems of global interest. The scientific staff has expertise in variety of areas including chemistry, biochemistry, cell biology, molecular biology, neurobiology and immunology which promotes productive interdisciplinary interaction.

SINP (*Saha Institute of Nuclear Physics*): Research in basic sciences, performed as institutes like the Saha Institute of nuclear Physics, epitomizes the country's international stature in the global quest for scientific truth at the most fundamental level. This institute is keeping the legacy of Professor Meghnad Saha since its inception in 1950. It has many contributions in scientific research throughout the world. Major achievement have been accomplished in various fields of sciences like magnetic properties as low temperature, semiconductor based quantum

structures the study of nuclear and high energy physics through work done in the campus. SINP has developed an Indian beamlines for x-ray scattering research in Photon Factory synchrotron, KEK, Japan and this facility is being used by many institutes.

IACS (Indian Association for the Cultivation of Science): IACS was founded by Dr. Mahendra Lal Sircar on July 29, 1876. It is the oldest institute in India which devoted to the pursuit of fundamental research in the frontier areas of basic sciences. Till today the IACS is one of the best autonomous research Centers in India where higher research in Physical Sciences can be carried out. Many distinguished scientists of modern India had carried out research here. S Bhagavantam, L Srivastava, N. K. Sethi, C Prosad, M N Saha and a host of other eminent Indian Scientists worked here to enrich the research culture of the IACS. Professor C.V Raman worked at IACS during 1907-1933 and discovered the Effect which brought him prestigious Nobel Prize in Physics in 1930. This institute is still producing end number of remarkable scientists throughout the world.

BESU (Bengal Engineering and Science University): Bengal Engineering College, commonly known as B.E College starts its journey as the Civil Engineering College on 24th November in 1856. At the time of its inception the university was called Calcutta Civil Engineering College. This university situated in Shibpur, Howrah, in the state of West Bengal. It is the country's second oldest institution for engineering education. The university has produced thousands of students in both engineering and science discipline. It is popularly call Bengal Engineering and Science University since it is under state government of West Bengal. It is classified as an institution of national importance by Government of India since 2014.

PU (*Presidency University*): The '*Hindoo College*', established in 1817, was transformed into the '*Presidency College of Bengal*' in 1855. From very beginning the Presidency College aimed at a liberal scientific and secular education and stood for modern, western education in the English medium. The college was borne out by the contribution of the students of the college to Bengali literature, language, mathematics, chemistry and some other science subjects. The pioneering discoveries of Jagadish Chandra Bose and Prafulla Chandra Ray in Physics/plant Physiology and Chemistry were made in the laboratories of the college. The students like M.N Saha, P.C Mahalanabish made world-class contribution in the field of science. In recognition of its heritage of academic excellence the legislature of West Bengal honored the status of a University on Presidency College on 7th July of 2010. The Presidency University has no Ph.D. courses because of its new recognition. The following data are presenting the status of women faculties who are engaged in various scientific researches in different departments.

JU (*Jadavpur University*): To trace the History of Jadavpur University is to trace a part India's freedom movement, at least from the Swadeshi Movement onwards. It was 1905-1906. The hegemony of the British establishment had to be challenged. Education had to play a new role in this changes scenario. It had to become a new form of resistance through which the emergent nationalist spirit could be propagated. With this in mind the National Council of Education (NCE) came into being. Its primary aim was to impart education-literacy, scientific and technical on national lines exclusively under national control. The foundation of the NCE was made possible by the munificence-scholarly as well as monetary –of the likes of Raja Subodh Chandra Malik, Brajendra Kishore Roychoudhury of Gouripur as well as Sir Rash Bihari Ghose (first president of NCE), poet Rabindranath Tagore and Sri Aurobindo Ghosh.

In 1910 the society for the Promotion of Technical Education in Bengal which looked after Bengal Technical Institute (Which later became College of Engineering and Technology, Bengal) was amalgamated to NCE. NCE henceforth looked after the College of Engineering and Technology, Bengal which by 1940 was virtually functioning as a University. After Independence, the Government of West Bengal, with the concurrence of the Govt. of India, enacted the necessary legislation to establish Jadavpur University on the 24th of December 1955. Now Jadavpur University has successfully established itself as foremost Indian University with a vast repertoire of courses offered, an enviable list of faculty members and has come to be known for its commitment towards advanced study and research.

Participation of Women in Career Attainment

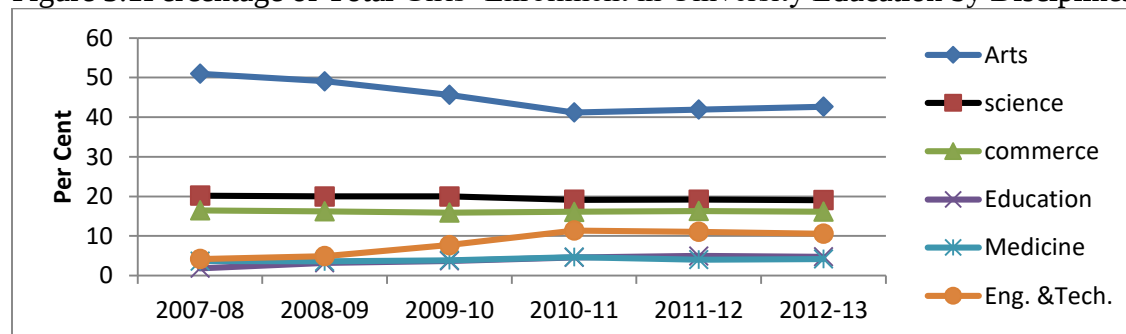
In the study of gender and society, science is a strategic research site. This is because of the hierarchical nature of gendered relations, generally, and the hierarchy of science, particularly. Relations of gender are hierarchical because women and men are not simply social groups, neutrally distinguished from each other; rather they are differently ranked and evaluated, usually according to standards of masculine norms and behavior. Science, in turn, is fundamentally hierarchical.

As we know science connects with powerful social institutions, especially education and state. The state, in turn has a strong stake in science and the shaping of scientific research, and scientific attainments have been taken as gauges of national resourcefulness and prestige. But finally and in keeping with its hierarchical character, science is marked by immense unequal participation in academic enrollment, work force, recognition, and rewards for women who practice it.

In the study of women and science, this study focuses on academia. Assessing women's status in academic science is critical to an analysis of women and science in India because of unavailability of elaborate data regarding these issues. While there are significant number of studies on various aspects of gender and science originating from the Western countries, it is relatively neglected area of research in India and its regional parameter. Various scholars and institutions devoted their time and energy in studying the status of and position of women in India and exploring ways through social research for their betterment. Yet status of women in profession precisely in science has still neither drawn attention properly nor focuses in micro (regional basis) study. More precisely, this study is looking at women's participation in different institutions according to status and positions in West Bengal.

The most basic and invariably the first question asked in gender and science research is related to the statistical participation of women in science and scientific professions. Almost all the studies have done in India in the field of gender and science highlight the fact that the fast improving yet minority positions of women in science.⁵ Figure 3.1 is showing that throughout various years girl's enrollment in science is lower than the arts discipline.

Figure 3.1 Percentage of Total Girls' Enrollment in University Education by Disciplines.



Source: UGC, Annual Report (Various years).

⁵ArpitaSubhash, "Women and Science: Issues and Perspectives in the Indian Context", In Gender and Science: Study Across the Cultures. Ed, Neelam Kumar (Delhi: Cambridge University Press India Pvt. Ltd.), 272.

According to Neelam Kumar, over the years (1950 -2006), women enrollment has shown significant increase from below 10 percent to above 30 percent⁶ but according to the data from last six years showing that women enrollment in science is somewhere stagnant in certain percentage (19 percent to 20 percent) of overall enrollment. INSA (Indian National Science Academy) published a report in 2004 regarding the issue of women access in science mentions that during the index year 2000-2001 there was increased in the proportion of women studying science at PG level compared to Graduation level but some decline occurred at the level of Ph.D.⁷ Data regarding women enrollment from Jadavpur University is indicating that in three major science disciplines have more women enrollment in PG level compare to graduation level during the academic year 2012-13. But during the same academic year women enrollment decreases in Ph.D. level compare to PG level. The scenario seems “leaky pipeline” which has leaks at every joint.

Table 3.1 Women Student Enrollment in Jadavpur University in Various Disciplines and Courses.

Courses	Mathematics		Physics		Chemistry		Total		Total Enrollment	Percentage	
	W	M	W	M	W	M	W	M		W	M
UG	74	164	38	129	57	104	169	397	566	29.86	70.14
PG	73	146	49	93	64	77	186	316	502	37.05	62.95
Ph.D.	7	32	8	17	14	34	29	83	112	25.89	74.11

Source: NAAC Report, 2013

In the 2nd half of twentieth century many scholars such as Harriet Zuckerman, Jonathan Cole, Londa Schibibger, and Evelyn F. Keller etc. who have explored women’s lower

⁶Neelam Kumar, “Gender Imbalance in Science: Cultural similarities and Differences,” in *Gender and Science: Studies across the Culture*, ed. Nellam Kumar (Delhi: Cambridge University Press India Pvt. Ltd.), 29.

⁷ INSA (Indian National Science Academy), *Science Career for Indian Women: An Examination of Indian Women’s Access to and Retention in Scientific Careers*, (New Delhi: INSA, 2004), 9.

participation in science. To explore women participation status in West Bengal this study is taking the most famous analogy such as “career pipeline” from feminist science scholarship.

“Career pipeline” is a liberal feminist concept to improve women’s participation in science. Henry Etzkowitz, Carol Kemelgor and Brian Uzzi have developed the concept to answer the question of women’s lower participation and proposed some solution for the future. According to career pipeline, the scientific career track of a woman, from secondary school to initial employment, has been depicted as a pipeline like those for the transport of fluids and gases such as water, oil or natural gas. The rate of flow into scientific career is measured by passage through transition points in the pipeline such as graduation and continuation to the next education level. However, it is been seen that the flow of women into science is through, a pipe with leaks at every joint along its span, a pipe that begins with high pressure of young women at the source- a large number of smart graduate students- and ends at the spigot with a trickle of women prominent enough to be deans or department heads at major universities or to gain recognition and awards.

More precisely, it can be said that significant numbers of women enter the pipeline and then leave at disproportionate rates or functions less effectively. It is been seen that in studied institutes genders are almost equally represented in the early stage of graduation and they increasingly diverge at the later stages, resulting in a much smaller proportion of women than men emerging from the pipeline. Findings of the study show that girls’ entry in graduation is almost equal. As the degree level increases girls’ participation goes down. In research level women’s participation takes marginality status.

Professional areas of science still witness a severe imbalance and women's participation in workforce. This study is concentrated only faculty level as women's participation in workforce. This study observes that there is decrease in proportion of women at faculty level (academic professions) compare to Ph.D. level (Table 3.2). Among six institutes it is been found that the total number of women's participation as faculty is much lower than the women Ph.D scholars. Among the six institutes women's participation in faculty level is 18.16 percent whereas research scholars constitute 31.70 percent of total enrollment in Ph.D. level.

Women's Position in Academic Profession

Women participation not only decreases in workforce but also limited and confined to junior positions as far as science career is concerned. Only few women hold senior position and get recognition. During the study it is been observed that scientific institutions in studied region carry essentially masculine ethos and exhibit vertical as well as hierarchical segregation in terms of gender. The study found that among the five institutes only few women are holding administrative positions in various departments.

Some previous studies such as Carol C. Perucci,⁸ Rita J. Simon S.M. Clark, and K. Galway⁹ conclude that in American science women tend to hold lower ranks as tenure (Assistant Professor), and very low at tenured positions (Associate Professor). Simon goes on to specify the conditions under which women do achieve equal academic ranks. After analyzing her samples from Science, social science and humanities department concluded that unmarried or

⁸ Carol C. Perucci, "Minority Status and the Pursuit of Professional Careers: Women in Science and Engineering," *Social Forces* 49, (1970): 245-259, accessed April 15, 2015, <http://www.jstor.org/stable/2576524>

⁹ Rita J. Simon, S.M Clark, and K. Galway, "The Woman Ph.D: A Recent Profile," *Social Problems* 15, (1967) 221-236, accessed November 23, 2014, <http://www.jstor.org/stable/799515>

single women were just as likely as men hold high-ranked positions. In 1968, Bayer and Astin argued that academic ranks are apparently controlled by the time women did not spend in the labor force after receiving Ph.D.¹⁰ However, each of these studies presents problems interpretation, since professional age, educational background, types of institutional affiliation, and scientific role performance have not been considered as variables.

Table 3.2 Distribution of Women Faculty according to Their Position

Institute/ Universities	Total Department	Total Faculty	Assistant Prof.		Associate Prof.		Professor		HOD	
			W	M	W	M	W	M	W	M
IACS	7	64	1	16	2	6	3	30	1	6
SNIP	11	101	0	0	5	23	9	56	1	10
BESU	4	43	4	11	2	1	2	19	0	4
PU	4	68	16	36	1	6	0	5	0	4
JU	4	118	8	27	3	37	5	34	2	2
Total	30	394	29	90	13	73	19	144	4	26
Percentage	-----	100%	7.36	22.84	3.30	18.53	4.82	36.55	1.02	6.60

Source: Annual Reports 2013, NAAC Reports 2013, and Websites

The following data is showing that more women faculty is been seen in junior faculty position as assistant professor. As the position goes upward women participation is decreasing. Least participation is been seen in administrative position as Head of the Department. Among thirty departments only four women positioned as Head of the department. Among three hundred and ninety four faculty women are holding 7.36 percent as assistant professor position, 3.30 percent as associate professor, and 4.82 percent as professor.

Despite the fact that marriage and household responsibilities are controller of women's high rank in science, many respondents shared that women get HOD position at the end of their

¹⁰ Alan E. Bayer, and Helen S. Astin, "Sex Differences in Academic Rank and Salary among Science Doctorates in Teaching," *Journal of Human Resources* 3, (1968):191-200, accessed August 18, 2014, <http://www.jstor.org/stable/145131>

profession. Many respondents agreed with the fact that at the end of profession generally women feel free from household responsibilities and put more effort to increase academic productivity such as publications. Not only professional age institutional affiliation also controls the position ladder in science workforce. Same question regarding women's rank was raised in an informal group discussion. Many participants have told that institutional affiliation does matter to get good position. One of the participants revealed that *"foreign good university qualification and publication from good publishers help to get fast recognition within community."* But women are sometimes staying behind than their men counterparts. Group discussion revealed that women's mobility for higher education. One of the interviewees shared *"I got Ph.D. in USA but couldn't go because parents do not want me to go. They do not want me to go so far."* They have discussed that *"good lobby within department helps to get promotion as HOD post or post as Dean."* According to the interviewee *"men are good socializing because they can meet in club, pub, sports complex etc. beyond office hour but women cannot do the same due to their nature."*

During the study it is been observed that women scientist from schedule categories have very lower participation rate within institutional space. Among the studied institutes there was one head of the department who belong to schedule caste categories. Although, she born and brought up within urban spaces. During the study it is been found that only few assistant professors belong to schedule caste category. According to one respondent, *"now women form schedule categories are coming into science due to various governmental policies. Few years back the scenario was not the same."*

Recognition and Awards

Recognition by peers is an important indication of a scientist's contribution to the advancement of science. Recognition serves as a reward for past performance and an influence for the future performance, and in this sense it is important as reinforcement for valued activity. One scientist can be evaluated by his/her peers through the work she/he is doing. In academic science most of the scientists engage themselves in doing different projects funded by different agencies. But while there are few women scientists who have been extraordinarily successful, women as a group are less successful than men on all dimensions that characterize participation and achievement in science. Women's participation is not only hold lower position they usually share lower participation in academic project and funding grants funded by several funding agencies. During the research this study found four hundred and sixty three ongoing projects spread among six institutes. The projects are mostly funded by DST (Department of Science and Technology), UGC (University Grant Commission), CSIR (Council for Science and Industrial Research), DBT (Department of Biotechnology), and DAE (Department Atomic Energy). Beside all these funding agencies there are few others funding agencies such as ICMR (Indian Council for Medical Research), INSA (Indian National Science Academy), SERB (Science and Engineering Research Board) etc.

During the period of study it is been observed that men headed more scientific projects than women. Table 3.3 shows that during the studied period among six institutes within total funding projects women only constitute 13.17 percent of participation. A common tendency has been observed during the study that women participation is higher in research grants among those organizations which have gender sensitive program. As example we can say women grabbed more research funds and projects in DST (Department of Science Technology) and

UGC (University Grants Commission) during the period of study. Women are holding 27.87 percent of total ongoing research projects which is much higher than other funding agencies such as CSIR, DBT, DAE and other small funding agencies.

After investigating this phenomenon it is been found that DST and UGC have more gender sensitive program to improve women participation in scientific research. As example it can ben be mentioned that DST has a program which call WOS (Women Scientists Scheme) which gives opportunities to women scientists for pursuing research in basic or applied sciences in frontier areas of science and engineering. A special provision has been made under this scheme to encourage those women scientists who have had break-in-career. It provides a launch pad for them to return to mainstream science and work as bench level scientists in the field of science and technology. DST has another scheme call “Women Scientists Fellowship Scheme” which provides funds for women to develop their own projects. During the period of study many interviewees who are mostly scientists in their respective fields revealed that women scientists prefer to do small funded projects because of its lesser time consuming factors.

Among the studied institutes it is been found that women’s representation in awards are lesser than men. As example it can be mentioned that in IACS (Indian Institute of Cultivation of Science) ten scientists got “Shanti SwarupBhatnagar Prize” since 1958 to 2012. But surprisingly there is only one woman scientist who has been awarded for the prestigious prize.

Table 3.3 Percentage of Women's participation in Research Projects

Institutes/ Universities	Total Projects		Funding Agencies					
	W	M	DST	UGC	CSIR	DBT	DAE	Others
IICB	13	35	2	-	-	6	2	3
SINP	13	34	3	2	8	0	-	-
IACS	2	57	1	-	0	0	1	0
BESU	2	8	0	1	-	-	-	1
PU	14	82	3	2	0	0	1	
JU	17	186	8	5	2	0	0	2
Total	61	402	17	10	10	6	4	7
Percentage (%)	13.17	86.83	27.87	16.39	16.39	9.83	6.56	11.48

Source: Annual Reports 2013,

Academic Productivity

Sex differences in academic productivity of women scientists have long been attracting the attention of sociologists of science. Numerous studies have found that women scientists publish at lower rates than men scientists, and research efforts to explain this gender have been largely unsuccessful. Cole and Zuckerman's research on 'gender and academic productivity' mentioned that women generally publish fewer papers throughout their careers than men matched for age, doctoral institutions and field. In their classic statement of the problem. Cole and Zuckerman characterized sex differences in research productivity as "the productivity puzzle". Their suggested explanation for the disparity in publication rate focuses on: (i) sex discrimination, (ii) sex related differences in aptitude or behavioral tendencies, and/or (iii) gender differences in parental responsibilities.¹¹

Regarding women's lower participation publication Loehle suggested that women publish less than men because of: (i) discrimination against women in ease of garnering

¹¹ Andrew Sih and Kiisa Nishikawa, "Do Men Really Differ in Publication Rates and Contentiousness? : An Empirical Survey," *Bulletin of Ecological Society of America* 69, No. 1 (1988): 15-18, accessed May 24, 2013, <http://www.jstor.org/stable/20166634>

resources (grant funds, space, students, etc.) and in assigned teaching loads, (ii) behavioral tendencies differences between men and women.¹²Loehle expanded his explanation by mentioning that women are intellectually less aggressive than men which significantly contribute to reduce publication rate. Numerous studies have tried to give proper explanation regarding women lesser participation in academic productivity. Xie and Shauman suggested that sex differences in productivity can be attributed in personal characteristics, structural positions, and marital status. Another scholar such as Steven Stack found that “productivity is relatively low for women with young children”.¹³

Scholars such as Frank Fox, Ward and Grant, and others have identified individual-and institutional level factors that help to explain variation in productivity. Scholar Erin Leahey identified “research specialization as a missing link” between gender and productivity in academic science. Ray Over and others have pointed out that productivity varies with a certain circumstances such as relation between student and supervisor. ¹⁴ This part of the research is trying to demonstrate the representation of women scientists in academic productivity among the studied institutes in West Bengal. To understand productivity and its differences this study quantified productivity in the form of “research output” in a period of ‘exposure’.

Research output is commonly measured by the number of publications by the responded through university websites, personal web page, annual report etc. In general, the publication count did

¹²C. Loehle, “Why Women Scientists Publish less than Men,” *ESA Bulletin* 68 (1987):495-496, accessed September 23, 2014, <http://www.jstor.org/stable/20166604>

¹³Steven Stack, “Gender, Children and Research Productivity,” *Research in Higher Education* 45, no. 8 (2004): 901, accessed January 24, 2015, <http://www.jstor.org/stable/40197370>

¹⁴Ray Over, Jane Over, Ingrid Meuwissen and Sandra Lancaster, “Publication by Men and Women with Same-Sex and Cross Sex PhD Supervision,” *Higher Education* 20 (1990):381-391, accessed October 26, 2014, <http://www.jstor.org/stable/3447220>

not distinguish between sole- authored and co-authored publications. One paper counted as one unit of total publications by a scientist. To simplify the quantitative data this study divided the total exposure of a scientist between two categories (i) cumulative measures, and (ii) short term measures. Cumulative measures refer to an individual's total research output over the complete span of his/her career; short term measures refer to research output during a relatively short interval.

To investigate the productivity rates between women and men the data has been collected among three hundred and thirty eight faculty members. Women's participation is 20.42 per cent of total faculty members. Eight thousand five hundred eighty six publications have been recorded during the study. Among the total publications women contributed only 16.78 percent which is very lower than men's contribution as academic productivity (Table 3.4). However, the study could not reach to a conclusion regarding women's participation in productivity due to multidimensional dispute among variables.

If we look at present scenario of productivity one can easily point out that the women participation is lower and because of that participation in publication indicating as lower than the men. If we see the average rate of publication between men and women it does not indicate much difference between them. During the study eight thousand five hundred eighty six publications were recorded as cumulative measures. Where on the one hand sixty nine women contributed one thousand four hundred thirty two publications and on the other hand two hundred and sixty nine men scientists contributed seven thousand one hundred fifty four publications as research output over the span of their life. Average calculation shows that women's average contribution is near about 20.75 papers per person; on the other hand men's average contribution is 26.59

papers per person. So we can say there is no much difference between men and women in academic productivity.

If the average rate of women's productivity is lower than their men colleague, then what is the fact which affecting then? Does institutional affiliation affect the productivity pattern? Study conducted by Plez and Anrews, in 1966 tried to find the relationship between institutional affiliation and scientific performance among scientists. Their study concluded by refusing general notion that scientists working in only research oriented institutions get more time to do research and therefore publish more peeper. They argued that more the scientist involves himself in diversified activities like the technical, administrative work, teaching more they produce. To examine such notion this study has collected data from five institutions. Out of five institutions three were fully research oriented and two were both research an academic oriented institutions. To find the effect of institutional affiliation on productivity, average publications in each institution was drawn and then comparison was made between the research-oriented institutes and universities.

Table no. 3.4 shows the effect of institutional affiliation on productivity. Measurement was made according to life publications of every respondent who are currently working in respective position. After comparing the number of papers published by both men and women scientists in different institutes which carrying two different categories. The result showed that more publications done by women scientists who are working in only research institutes. Thus it can be said that the institutes where both research and teaching are carried out seem to have lesser participation of women in productivity.

Table 3.4 Women's Contributions in Scientific productivity in Terms of Publications

Institutions / Universities	Total Contributors		Total Pub.	W	M	Average published	
	W	M				W	M
Indian Institutes of Chemical Biology	18	44	2243	612	1631	34	37.07
Saha Institutes for Nuclear Physics	17	84	1975	334	1641	19.64	19.54
Indian Association for the cultivation of science	7	57	2681	222	2459	31.71	43.14
Bengal Engineering and Science University	8	35	1160	119	1041	14.87	29.74
Presidency University	19	49	527	145	382	7.63	7.79
Jadavpur University	-	-	-	-	-	-	-
Total	69	269	8586	1432	7154		
Percentage %			100	16.78	83.32		

Source: Annual Reports, 2013-14. Websites

To understand this phenomenon more precisely this study takes another step where total exposure of a scientist calculated as short term measure. Total publications of a scientist have been divided with in shorter intervals such as 0-5, 0-10, 0.15, and 0-20 from the year of finishing Ph.D degree. The study focused on those faculty members who are positioned as senior professor of various departments and mostly working as an employee for more than twenty years. The study took twelve women and twelve men scientist as independent variables for the analysis.

The study has observed that women have consistently lower participation in academic productivity in term of publications. In the study it is been seen that within five years of finishing Ph.D. degree women published nearly half compare to men publications. More precisely it is been tested throughout shorter intervals among men and women since they finished their Ph.D. degree and the result remain the same. Table 3.5 is showing that from twenty years of finishing Ph.D. women published half amount of what men scientist published. Numerous studies have documented that men scientists show greater scientific productivity than comparable women scientists. However, in contrast to prevailing conventional wisdom, these differences cannot be explained simply on the basis women's commitment to marriage and family.

Table: 3.5 Women’s Productivity according to Short Term Intervals

Women	Men	
Panel A: First five years from finishing Ph.D (0-5)		
Mean	6	11.58
Standard Deviation	3.74	6.10
Total Publications	72	139
Panel B: Ten years from Ph.D (0-10)		
Mean	11.75	22.33
Standard deviations	7.95	12.58
Total Publications	141	268
Panel C: Fifteen years from Ph.D (0-15)		
Mean	18	38.67
Standard deviations	12.92	20.53
Total Publications	216	464
Panle D: Twenty years from Ph.D (0-20)		
Mean	25.25	58.67
Stand Deviations	18.46	35.37
Total Publications	303	704

Source: University websites and personal webpage and bio data uploaded by scientists.

Data collected among 12 women and 12 men scientists within short term interval

The findings of this study show that women scientists have marginality in productivity. To have a closer look some interview were conducted. During the study it has been observe that women scientists in older age produce more papers than young age. Closer look at table 3.5 shows average production rate went high at the twenty years of finishing their Ph.D.

Findings and Discussions

The collected data from the selected institutions shows that women’s entry into science is in early stage such as graduation has no significant asymmetry but as the degree goes upward the proportion is decreasing. It can be identified as very famous analogy from liberal feminist such as Henry Etzkowitz, Carol Kemelgor and Brian Uzzi who have suggested that women’s enrollment in science is like “leaky pipeline” which has leaks at particular joints. Gender proportions are almost equally represented in the early stage of graduation and they increasingly

diverge at the later stages. Women's proportion is not only diverging at later stage of the education in work force they are holding minority position than men. Among the selected institutions it is been found that only few women are holding high position such as HOD or as dean. Women scientists also are lesser recognized in respective institutions in terms of doing projects funded by different funding agencies such as DST, DAE, and UGC etc. They also have lesser proportion in academic productivity in terms publication. It is also been found that women's academic productivity not only lower but also it varies through institutional affiliation. Even in cumulative measurement it has been seen that women are publishing lesser proportion than men but it is increasing at the later stage of their life. In order to understand this asymmetrical participation few respondents were asked to give their opinion and critical insights into the matter. In order analyze the asymmetry of women's participation the careers were viewed as a series of linked processes developing over time.

Education and Training: Conception of the scientific role, styles of work, and standard of performance are very much interrelated to the education and training at the early stage of women's enrollment. According the data it is been seen that men and women proportion in graduation level is almost similar but it is diverging at later stage of the education. Many women cannot go to the higher level of study because of not getting good opportunity to have better educational training.

"I have one very close friend. She and I both grew up in same village and took chemistry in graduation in our nearby collage which was not that sound in academic ranking. As both of us were very good student at that time in our department we planned to come to Kolkata to take admission in good university. But her parents did not want her to come to the city alone. So she remained there. After graduation she did not pursue post-graduation and took a job in a bank. Now she is successful banker but she could have done better than this. I think education from good university helps to have good career in science."

-Assistant Professor, Chemistry Department

“Good academic training helps a lot to future career. I can tell you my experience. I had very good supervisor during my Ph.D. during my doctoral degree I published more paper than my other friends just because of my supervisor. But on the other side it also very difficult for a girl to get good supervisor at the department who can understand and relate on the ground of personal understanding. Sometimes girls are not that free with their men supervisor.”

-Post doctoral fellow, Department of chemistry

One of the consequences women's participation can be found in the educational and training phase of their career. Because gendered identity sometimes act as an important role women in science education. Many women cannot peruse desirable education due to their gender trait which lies into the socio-cultural dynamics. Traditional gender roles and masculine culture of science helps to relegate women as passive beneficiaries of science which ultimately lead to women's lesser participation in science.

Marriage and Family Roles Performance: The loss of time available for scientific work as a result of family obligation is likely to be greater for women, since women are more likely to be the primary caretakers on the families. Therefore, it is possible that the family roles sometimes affect women's scientists' career. During the study many respondents have mentioned that they simply did not choose to take higher position because of family responsibilities.

“As women it is very difficult to hold an administrative position as it is connected with many responsibilities. Maintaining high position, doing research and household responsibilities most of the time do not go together smoothly for a woman scientist.”

-HOD, Department of Mathematics

“Women have marginality in academic production. This may be because of the dual role responsibility that a woman science has to carry. Women usually give much more priority to the family, child rearing, and domestic chores. In present day we can find a slight change in the trend that is, men especially those married to working women sharing domestic chores. Now many husbands who have working wives are taking equal responsibility to look after the family.”

-Scientist, Cancer Biology & Inflammatory Disorder

Though the respondents said that they choose their motherhood by choice not from obligation which ultimately resulted in being lower in position and productivity in science. It can be understood as the desire lies into the deep cultural roots from where they are choosing to become a mother. Our socio-cultural dynamism makes a woman's life such a stereotypical way that they choose family life and those effects on their career in science.

Cumulative Advantages or Disadvantages: Research introduced by Merton's essay on the Matthew effect has established the importance of cumulative advantage in science. Cumulative involves processes by which initial advantages, however obtained, are used to gain further advantages. Equally, cumulative disadvantage reinforces and magnifies initial disadvantages. The central descriptive idea of cumulative advantage or disadvantage is that the advantage or disadvantage of one individual or group over another accumulates over time. The advantage or disadvantage in question is typically a key resource or reward in the stratification process, for example, cognitive development, career position, and wealth etc. These processes are important to understand women's marginality in science. In initial stage they face difficulties to take science as subjects or to choose to have family which ultimately make women's participation in science lesser than men. The operation of socio-cultural factor has been evident, especially with respect to participation of women in science.

Chapter 4

Mapping Barriers and Coping Strategies

Men domination or lower participation of women in science can be traced back within social structure and institutional backdrop which make consistence barriers for women as scientist or science professional. This study is bringing the gender related barriers women face at the time of entry and success in scientific careers which make asymmetrical participation. According to Henry Etzkowitz, the strong effect of culturally defined gender roles persists in science and other traditionally male professions through the social meanings attached to gender. This study tries to collect personal experiences in terms of social constraints faced by women in scientific career and profession that make asymmetrical participation.

Research on women in science in the West has highlighted the role of socialization and social stereotypes in the under-representation of women in this profession. Many scholars have documented that right from childhood women are discouraged from studying science. Parents have lower expectations from their daughters than sons. Uncooperative spouses and family roles have also affected women's career. The organizational and institutional barriers encountered by women in science have been sometimes referred to as the 'glass ceiling'. Scholar like Holloway has asserted that discrimination in appointment to administrative positions is another hindrance for women professionals. According to Long, "science is an institution with immense inequality in

career attainments.”¹ Women, as an individual or group face barriers that effect in four career attainments such as participation, position, productivity and recognition than men.

Science has been both characterized as the most universalistic of institutions and debated as an institution in which universalistic standards falter and fall short.² This part of the study focuses directly on the question of barriers/obstacles faced by women in science. The study is not only throwing light on the barriers but also blending theoretical insight with empirical data and findings. The exploration is also providing an understanding the nature and characteristics of ongoing changes in the status of women scientist. The study is also giving insights into coping strategies taken by successful women to cope with the barriers.

Barriers of Women scientists: Sociological Perspective

In sociological scholarship many scholars have discussed that gender is an individual property which assigned in particular body. Moira Gatens makes a point “that male body and the female body have quite different social value and significance cannot help but have a marked effect on male and female consciousness.”³ She also mentions that male body itself is imbued in our culture with the mythology of supremacy, of being the human ‘norms’. A number of feminist theorists argue that gender is a feature of social structure which has relation with social norms encoded in gendered identity, and women’s agency. According to Diana T. Meyers, gender is internalized dimension of women identities which are gendered in patriarchal culture does impede women’s ability to function as self-determining agents. Many scholars have suggested

¹J.Scot long, and Marry M. Fox, “Scientific Careers: Universalism and Particularism,” *Annual Review of Sociology* 21 (1995): 45, accessed December 5, 2014, <http://www.jstor.org/stable/2083403>

²Ibid., 47

³Gatens M. *Imaginary Bodies: Ethics, Power and Corporeality*, London: Routledge, 1996, p-9

that identity is a particular form of social representation that mediates the relationship between the individual and the social world. Its functions are to inscribe the person in the social environment. Xenia Chryssochoou argues that through their active participation in social world, individuals construct a set of knowledge about the world and themselves: their identity. To protect from, provoke or respond to changes to this knowledge people act in the name of identity. Thus, identity constitutes the social psychological context within which worldviews are constructed, through worldviews are communicated.⁴

Talcott Parsons contributions to functionalism in his general theory of action give an overall picture of how societies are structured and fit together. His analysis includes four systems such as the cultural system, the social system, the personality system and the behavioral organism as system. According to Parson “a social system consists in a plurality of individual actors interacting with each other in a situation which has at least a physical or environmental aspect, actors who are motivated in terms of a tendency to the ‘optimization of gratification’ and whose relation to their situations, including each other, is defined and mediated in terms of a system of culturally structured and shared symbols.”⁵ Parson’s reference to ‘culturally structured and shared symbols,” which define the way actors interact. He refers to “individual actors” whose motive is self-gratification because of the nature of their personality system. He brings it in a “physical or environmental aspect,” which sets limits around this situation where interaction between actors is itself a function with the involvement of behavioral organisms. In behavioral

⁴Chryssochoou Xenia. “Studying Identity in Social Psychology: Some Thoughts on the Definition of Identity and Its Relation to Action,” *Journal of Language and Politics* 2, 2 (2003):225-241, accessed December 16, 2014, <http://pandemos.panteion.gr:8080/fedora/objects/iid:685>

⁵ Ruth A. Wallace and Alison Wolf, *Contemporary Sociological Theory: Continuing the Classical Tradition*, (USA: Prentice-Hall, 1991), 30.

organism the basic unit is the human being in its biological sense i.e, the physical aspect of human person, including the organic and physical environment in which the human being lives.

Parsons view of socialization elaborates that at birth we are simply behavioral organism; we gain any personality when we develop as individuals. Duveen illustrates that the “individual or person or agents come to have a sense of who they are through a recognition of their position within the symbolic space of their culture.”⁶ Parson describes that individuals internalize the values of a society; i.e, they make the social values of the cultural system their own by learning from other actors in the social system. They learn “role expectations” and so become full participants in society. The work of Lloyd and Duveen on the acquisition/ construction of gender identity present an example to these considerations. The question rose by their research concerned how the children, born into a world where meaning already exists, became participants in this world. Before it is even born a child is the object of representations, expectations, beliefs and images of his/her parents and of the community in which she/he will be born. Once born the child is named and categorized into familiar frameworks. One of these frameworks is gender. ⁷

Studies have shown that adults would propose different toys to six months old infants depending on their assumption about the child’s gender. Thus, the child’s world is structured in terms of gender at very early age. According to XeniaChryssochoou, the actions and representation of others guide the knowledge that children acquire about themselves. Research of Lloyd and Duveen have shown that children as very young age use objects to construct their

⁶G. Duveen, “Representation, Identity, Resistance,” in *Representation of the Social*, ed. K. Deaux and G. Philogene (Oxford: Blackwell, 2001), 258.

⁷Xenia Chryssochoou, “Studying Identity in Social Psychology: Some Thoughts on the Definition of Identity and Its Relation to Action,” *Journal of Language and Politics* 2, 2 (2003):225-241, accessed December 16, 2014, <http://pandemos.panteion.gr:8080/fedora/objects/iid:685>

identities within the socially marked framework.⁸ Since long time sociologists and psychologists have tried to explain the lesser participation of women in science. Most of the scholars have come to a point that the determinism of gender leads to a stereotypical image of girl child which affects the presence of women in science. Contemporary researches have shown that negative stereotypes about girl's abilities in math can indeed measurably lower girl's test performance. "Researchers also believe that stereotype can lower girl's aspiration for science and engineering careers over time."⁹

Regarding the issue of lower Participation of women in science we can refer Alice Rossi's classical paper "women in Science: Why So Few?" given at the 1964 Massachusetts Institute of Technology conference of women and science posed a question. Rossi asked, "are the Social and psychological influences [that] restrict women's choice and pursuit of careers in science?" Her research shows that girls' unwillingness to major in science in college has deep cultural roots- ranging from the kinds of toys they play with to the kinds of study they receive. Studies show that erector sets and chemistry sets help children develop different skills and aspiration than do Barbie doll because until the age of thirteen boys and girls have equal skills in mathematics and other subjects.¹⁰

⁸Ibid.,231.

⁹ Hill Catherine, Christianne Corbett and Andresse St. Rose, *Why So Few? : Women in Science, Technology, Engineering, and Mathematics* (United States: AAUW, 2010), Xiv.

¹⁰LondaSchiebinger, "The History and Philosophy of Women in Science: A Review Essay," *Signs* 12, No 2(1987): 305-332, accessed September 30, 2014, <http://www.jstor.org/stable/3173988>

More precisely, “Evelyn Fox Keller used ‘object relation theory’¹¹ to explain that having women as primary caretakers for most children in our society may result in the encouragement of more boys to be separate, distant, and autonomous from the female caretaker from whom the boys are distinguishing their gender identity, compare to girls who are permitted to remain closer and more dependent. More men than women will feel comfortable with scientific approaches and careers because of this socialization.”¹²

More elaborately we can say actions or agency is very much linked with the social structure. Many sociologists define social structure as patterned social arrangements in society that are both emergent from and determinant of the actions of the individuals. In sociological scholarship, the term “social structure” is itself heavily loaded with connotations as many sociologist discussed with different views. One of the major views is ‘institutional or cultural vision’ of social structure. From this point of view, the basic elements of social structure are the norms, beliefs, and values that regulate social action of individuals. As Talcott Parsons’s functionalist theorization imagined that a social system within social structure made up of differentiated roles that maintained structured relations among themselves. Each role is defined in the value system shared by the individuals who are form the society, so that the society is

¹¹ “Object relation theory is not actually a theory, because it refers to the work of many writers who do not belong to any particular or given schools of thoughts. The theory is the term that has come to describe the work of a group of psychodynamic thinkers. The theory is based on the belief that all people have within them an internal, often unconscious world of relationships that is different and in many ways more powerful and compelling than what is going on in their external worlds of interactions with real and present people. It focuses on the interaction that individual have with other people, on the processes through which individuals internalize those interactions, and on the enormous role these internalized object relation play in psychological life. The terms objects relations thus refers not only to ‘real’ relationship with others, but also to the internal mental representation of others and to internal image of self as well.” [Laura Melano Flanagan, “Object Relation Theory”, In *Inside Out and Outside In: Psychodynamic Clinical Theory and Psychopathology in Contemporary* , by Joan Berzoff, Laura Melano Flanagan, Patricia Hertz (United Kingdom: Rowman& Littlefield Publishers, 2011), 118-157]

¹² Sue V. Rosser, introduction to *Women, Science and Myth: Gender Beliefs from Antiquity to the Present*, ed. Sue V. Rosser (California: ABC-CLIO, 2008), vii-xvii.

ruled by cultural norms who from the society. According to psychoanalytical perspective actors or individuals or agents internalize these roles in their infancy: they learn to behave and to relate to others according to cultural models.

As feminists analysis shows patriarchy and gender as structure of male domination. In other word we can see patriarchy or gender as a source of constraints for women as social independent actors or agents. According to Nancy Julia Chodorow, “gender difference is not determined by biology and is not immutable. It must be understood as a ‘relational construction’ and the key to understanding gender difference is the process of ‘separation-individuation’- the process through which as infant who is cognitively and emotionally fused with its mother comes to understand itself as a distinct individual.” Using psychoanalysis Chodorow argues that within social structure gender asymmetry arises because “mothers or other women are primarily responsible for child care and, as a result, boys must gain their gender identity by negating femininity rather than by positively identifying with a masculine figure.” Many feminist theorists hold that masculine personalities lead to social structures that institutionalize women’s subordination and also that hierarchical duality in which masculinity is privileged over femininity establishes a pattern of thought and action that is replicated in social domination, subordination and discrimination.

Many scholars have accused social norms as the creator of gender norms which provides a leaky pipeline for women in science. Women’s lower participation and burdens are interlinked variables, where, women participation is a phenomenon caused by gender barriers in science. Gender plays an important role in shaping science careers for women. David Bloor argues that science and technology shapes society as much as society shapes science and

technology.¹³ Scholar Neelam Kumar says “it became clear that not only gender influenced technology, but one fundamental way in which gender is expressed in any society is through technology. Women kept away as it was considered ‘masculine’ and at the same time ‘masculinity’ was being defined in terms of man’s use of technology and its tools.”¹⁴ Gender is one of the most important forms of social division. The socio-political and economic construct of gender is significant in the context of the hierarchical structure of the social environment in which we live. The term ‘Gender and Science’ first made its appearance in an article published by Evelyn Fox Keller in 1978. Keller clarifies the importance of exploring the ways masculine norm, taken as universal norms, have been immersed into the practice itself. She interrogates the normative relationship between men and science when women are relegated to the position of ‘other.’¹⁵

Women in both higher education and career are required or expected to attend equal opportunity in science. But, primarily, they are seen as women who are made to feel out of place and treated differently by patriarchal structure of our society.¹⁶ Science has traditionally been seen as the enterprise of men. Throughout its long history, science has been populated almost exclusively by men. Women’s entry into this profession used to be considered as an attempt to cross the sex barrier. The scenario has been changed a bit but still women face prejudices discrimination with this profession which can be considered as hidden barriers. This section of

¹³David Bloor, introduction to *Knowledge and Social Imagery* (London: University of Chicago Press, 1991), Xi.

¹⁴Neelam Kumar, introduction to *Gender and Science: Studies Across Culture*, ed. Neelam Kumar (New Delhi: Cambridge University Press India Pvt. Ltd., 2012), xv-xxviii.

¹⁵ Evelyn Fox Keller, “Feminism and Science,” *Signs* 7, no. 3 (1982): 589-602, accessed January 13, 2015, <http://www.jstor.org/stable/3173856>

¹⁶Ruth Carter and Gill Kirkup, “Women in Professional Engineering: The Interaction of Gendered Structures and Values,” *Feminist Review*, no. 35 (1990):92-102, accessed February 24, 2015, <http://www.jstor.org/stable/1395403>

the study is an attempt to understand the gender barriers which lead to prejudices and discriminations of women scientists in Bengal. Broadly the discriminations and prejudices against women can be divided into forms- the socio-cultural and organizational or institutional. The socio-cultural discrimination is the basis that stems from the structure and functioning of the prevailing socio-cultural norms, values, and institutions which exist in the society itself. They are the reflection of the total socio cultural setting in which women are assigned lower status or inferior role. The organizational/institutional discrimination is formal in nature and originates from the purposive action of the organization. They can be further divide into two types-covert and overt. The covert discrimination is a manifest form of discrimination which deliberately made to prevent women from joining particular job. The covert type of discrimination is latent and less obvious. When women high official are not given due recognition or assigned lesser responsibilities and inferior occupational roles, the covert discrimination may be said to be in practice.

Profile of the Scientists Studied

The exploration of the barriers among women scientists begins with the construction of the profile of the respondents.

Sex Status: The sample of present study consist 45(62.5 percent) women and 27(37.5 percent) men.

Age: the below table shows that the majority of respondents are relatively young in age

Sex	20-29	30-39	40-49	50+	Total
Women	24	4	8	6	45
Men	13	6	5	3	27
Total	35	10	14	13	72

Age wise distribution of the respondents

Marital Status: Among the respondents 35 are married and 39 are unmarried. Among married respondents proportion of married men and women were almost same.

Sex	Married	Unmarried	Total
Women	18	27	45
Men	15	12	27
Total	35	39	72

Marital Status of the Respondents

Occupational Status: The occupational status of women and men are important to understand socio-cultural discrimination and inequalities among women scientist in the respective area of study. The following table is showing the occupational distribution of men and women respondents.

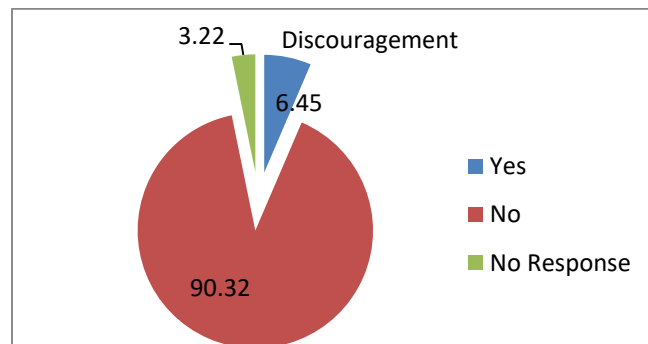
	Scientific officers/ Research Associate/	Senior Scientific officer/ Senior research associate/	Scientists/ Lecturer	Senior Scientists Professor
Sex	JRF	SRF	Associate Professor	Senior Professor
Women	25	7	12	3
Men	15	4	5	3
Total	40	9	17	13

Occupational Status of the Respondents

Early Stage of Discouragement

Among the many forces working against women's participation in science is the masculine image of the scientific role that frequently has taken hold by early stage of girl's education. This is often followed by neglect and discouragement of girls from doing science in school in concert with parental perception of science as difficult and non-essential for their daughters. In 1965, Alice Rossi noted that "a young girl with high intelligence and scientific interests must come from a very especial family situation and must be far rarer person than the young boy of high intelligence and scientific interest." During the study a survey was conducted among research scholars to understand their response towards discouragement. Fig. 3.1 majority of the scholars responded that they did not feel discouragement during their secondary education but some of them choose not to response. Some of the respondents clearly mentioned that they faced discouragement in the time of secondary education.

Fig 4.1 Percentage of Discouragement among Respondents



Personal interview was conducted among the respondents who have felt discouragement in early stage of education. Some of the interviewees felt discouragement within their home, particularly from their mothers due to have male sibling. In our society educational decision are

mostly family decisions. The decision to invest family resources on expensive science and engineering degrees is less inclined in favor of daughters, specifically if the resources are limited. This is due to the assumption that after marriage, benefits of their higher education would accrue to their husband and his family. It happens because of patriarchal social dynamics where boys are prioritizing as the only bread earner and security for the family.

Some of the interviewee mentioned that most of time discouragement happened in class room. During the class boys and girls were treated differently. By treating boys and girls differently, teachers gave extra attention to boys for their mathematical skill and girls were given less importance for the same. Therefore, it can be said that girls are at a disadvantage position in school due to gender stereotyping. Scholars like Myra and David offer many instances of teachers who believe girls equality and are surprised to discover that boys dominate class discussions and teachers attention. Boys' domination and gaining teachers attention lies in the gender facts of stereotyping of gender and gender identity. Nancy Julia Chodorow says "gender difference is not determined by biology and is not immutable. It must be understood as a 'relational construction' and the key to understanding gender difference is the process of 'separation-individuation'- the process through which as infant who is cognitively and emotionally fused with its mother comes to understand itself as a distinct individual. Using psychoanalysis Chodorow argues that within social structure gender asymmetry arises because mothers or other women are primarily responsible for child care and, as a result, boys must gain their gender identity by negating femininity rather than by positively identifying with a masculine figure. It is a socialization process which gives boys' a positive vive. In sociology, the concept of socialization refers to the process whereby individuals learn the culture of the particular society. Research with in gender studies has examined the presence of gender

stereotyping in the key agencies of socialization such as education. Studies of reading materials as textbooks in schools have been shown to contain gender stereotypes such as all the character in school math books (ex. West Bengal board math books) depict male characters. Stereotypical image of girls' cognitive ability also leads to class teacher's unconscious bias. Recent Study by Victor Levy and Edith Sand's work "On the Origins of Gender Human Capital Gaps: Short and Long Term Consequences of Teachers' Stereotypical Biases"¹⁷ shows that unconscious/conscious bias against girl's mathematical abilities leads to lower participation of girls in science. The bias of teachers on girl's mathematical ability comes from stereotypical image women's inferiority within patriarchal society.

Extensive interview has revealed another dimension such as discouragement of girls is deeply rooted in caste class parameter of the society. It is been seen that those who have come from schedule categories got more discouragement from her surroundings. According to a respondent *"It was not so smooth for me to reach this position today. I had to struggle a lot to get this position."* The data was not quantified because of some difficulties. The thought behind this decision was that the women scientists are already in certain social position where asking caste/class position might be counted as demeaning. The researcher identified their caste by the name. Girls are not a homogenous category, yet nowhere do they enjoy a status which equal to that of men. In their case, the dimensions of rurality, class, caste and tribe, religion, and disabilities are further complicated by the contemporary socio-economic forces to create cumulative disadvantages. In education particularly in science SC/ST girls are in more vulnerable position than others. Broadly they come into two larger segment (i) gender, and (ii)

¹⁷Victor Lavy and Edith Sand, "On the Origins of Gender Human Capital Gaps: Short and Long Term Consequences of Teacher's Stereotypical Biases," *National Bureau of Economics Research* no. 2099 (Cambridge: Massachusetts):2015, accessed March 13, 2015, <http://www.nber.org/papers/w20909.pdf>

caste/class. Feminist scholars worked to salvage gender and women's issues from being subsumed by class analysis, and sought to extend the Marxist understanding of labor to include domestic production, and highlighted the marginality and vulnerability of women in workforce and education.¹⁸ The stereotypical image of caste and girls both make outsized barriers for SC/ST girls in science. More precisely it can be said that gender hierarchy takes shape with the class and caste factor in science when the science is itself elite practice. In recent feminist scholarship, Josephine Beoku-Betts showed that how racial (caste in Indian context) bias effect on women in science at the stage of education. According to him "while racial bias was perceived as a critical factor affecting how most of the women experienced their exclusion or differentiated from other graduate student, several were also aware of how the interconnections between their racial identity as Black and their gender identity as women positioned them as "outsiders"."¹⁹

Entry Level Constrains: Education and Workforce

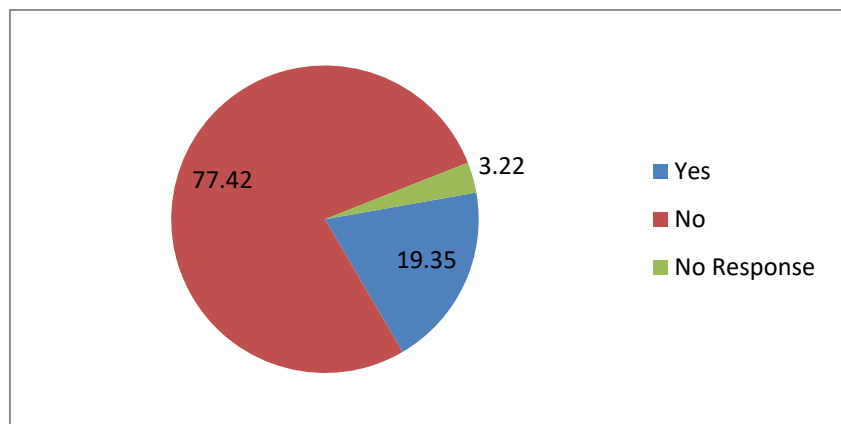
This part of the discussion is divided into two segment (i) entry level constrain in higher education and (ii) constrain to enter work force. In-depth interview and group discussion revealed that women faced discrimination to enter in research position and job. Fig 3.2 is showing that 19.35 percent of respondents were faced difficulties to obtain research position. While the majority said they did not feel any constrain. In-depth interview has shown that

¹⁸Susie Tharu and Tejaswini Niranjana, "Problems for contemporary Theory of Gender," *Social Scientists* 22, no. 3/4 (1994):93-117, accessed May 25, 2013, <http://www.jstor.org/stable/3517624>

¹⁹Josephine Beoku- Betts, "African Women Pursuing Graduate Studies in Sciences: Racism, Gender Bias, and Third world Marginality," *NWSA Journal* 16, no. 1(2004): 116-135, accessed January 26, 2014, <http://www.jstor.org/stable/4317037>

during the selection through interviews women face difficulties to obtain the position. According to one respondent *“if there is not more women panelist in the interview board it is very difficult for women to get research position”*. She mentioned again that if the women student from same Institution attending interview the scenario will not be the same. Personal interview has revealed that *“sometimes men supervisor hesitate to take women research student thinking that she will not finish her research because of marriage.”* Another respondent commented that *“it is not that men doctoral or post-doctoral fellow leave the institution without completing the course, but women examples are specially relegated to a particular image.”* It clearly indicates the presence of double standard against women. In social life, behavior is governed by informal norms and rules, as well as formal laws. In feminist analyses, men power define the content of formal and informal behavioral cultures means that the criteria or standards used to evaluate and regulate women often differ to those used for men. In other words, rather than a single standard of behavior for all, there exist two-fold, or double standards, one relating to men and the other to women. In the context of an androcentric culture, double standards most often benefit men than women.

Fig 4.2 Difficulties Faced by Student to Obtain Research Position



Women not only face prejudice at the time of entering research position they also face difficulties in getting first job. One of the major areas of discrimination and unequal treatment to women lies in the field of recruitment of jobs. Studying into this aspect, respondents have been asked to give their opinion. Table 4.1, is showing that almost half of the respondent said that they felt difficulties during their first entry into job. Was the job selection process fair enough for every one? To inquire in this issue respondents were told to give their opinion about the fairness in recruitment to their first jobs in comparison to other men and women scientists and engineers.

Table: 4.1 Women scientists experienced difficulties in getting first job

Experience of difficulty	Scientist	Percentage
Yes	19	42.22
No	22	48.89
No Response	4	8.89
Total	45	100

Responses from all the participants

The data pertaining to the perceptions of men and women have been given in Table (a) and (b) respectively. From the following data in can be seen that when the comparison in made along the same sex, the grievance regarding recruitment is minimal, but when it is made between the sexes it becomes very pronounced. However, the grievance of men against women is not as glaring as the grievance of women against men. Men too are unhappy with the fairness in the selection process but their displeasure is not related to sexed base factor, instead they are related to prevailing politico –social factors like departmental policies, nepotism and favoritism

Table 4.2 (a) Perception of Men Regarding Fairness in Selection Process

Responses	As compare to men	As compare to women
scienctist	Scientists	
Fair selection	14 (51.85)	21(77.78)
Not fair selection	9 (33.33)	4(14.81)
No response	4 (14.81)	2 (.7.41)
Total	27 (100)	27(100)

Figures in brackets indicate percentage.

Table 4.2 (b) Perception of Women Regarding Fairness in Selection Process

Responses	As compare to men	As compare to women
Scientist	Scientists	
Fair selection	17 (37.78)	31 (68.89)
Not fair selection	26 (57.78)	10(22.22)
No response	3 (66.67)	4(8.89)
Total	45 (100)	45(100)

Figures in the brackets indicate percentage.

So it can be said that patriarchal structure of science institutions and stereotypical image of women making barrier for them to enter into job force. The patriarchal social dynamics are unconsciously/consciously discriminating them to enter in workforce particularly in science. The “gendered” character of science (as it is depicted as men dominated subject) molded with “gendered” identity creates partiality during selection process. In simple terms, something is ‘gendered’ when its character is either masculine or feminine, or when it exhibits patterns of difference by gender. According to Reskin and Padavic, “Gendered” is a concept which signifies

outcomes that are socially constructed and give men advantages of women.²⁰ Lisa Adkins' study describes "gendering" is a process through which power relations between men and women in employment are constituted, and how "advantages and disadvantages, exploitation and control, action and emotion, meaning and identity are patterned through a distinction between men and women."²¹

Institutional Practices and Work Compatibility

Barriers against women professional in science can be understood from various dimensions. One of the major dimensions is institutional practices and work compatibility. Such study would facilitate satisfaction with working hours, satisfaction in facilities in jobs. The study also helps to understand men-women differences in terms of barriers/obstacles and justifies it with recent feminist scholarship. Science is an institution/organization which can be viewed as number of internally structured practices. These practices sometimes are not gender friendly. Though science is an elite practice of knowledge but it has certain characteristics which act as barrier of gender equality or gender mainstreaming. Theoretical insights on gender development sought to establish gender neutral infrastructure to benefit women and men equally. Men and women, however, have different roles, responsibilities, constraints and priorities, which results in gender –based differentials in demand for and use of infrastructure facilities and services. The development effectiveness and sustainability of the infrastructure sector could increase significantly by addressing gender differences in demand and utilization. This involves

²⁰ B. Reskin and I. Padavic, *Women and Men in Work*, (CA: Pine Forge Press 1994), 6.

²¹ Lisa Adkins, *Gendered Work* (Buckingham: Open University Press, 1995), 1.

incorporating a gender perspective in selecting and designing infrastructure interventions and work characters.

Satisfaction with Working Hours

One the major areas which affect the job of a worker in various ways is related to working hours. On the one hand, it may inferred that with the domestic responsibilities of the individual especially women, and one the other, it may intervene in his/her other social obligations. If the worker happens to be a woman then many areas of conflict may arise because of her long and busy work schedule. Certain other obstacles such as distance of work place, availability of transport facility are also related to it. Overstay in office, extra work on holidays and inconvenient shifts also affect the female employees more adversely than male employees. Such as during interview one of the respondents replied *“every day I travel almost 45 kilometer to attend office. Sometimes it gives me dissatisfaction.”*

Table 4.3: Satisfaction with Working Hours

Sex	Fully Satisfied	Partially Satisfied	Not Satisfied	Total
Women	14 (31.11)	20 (44.44)	11 (24.44)	45(100)
Men	11 (40.74)	10 (37.03)	6 (22.22)	27 (100)
Total	25 (34.72)	30 (41.67)	14(19.44)	72(100)

Figures in the bracket indicate percentage

The data collected from in this regard and displayed in Table 4.3 reveal significant differentiation in level of satisfaction between men and women scientists. Among the fully satisfied, the proportion is higher than the women. Partial satisfaction is more pronounced among

women. Similar to this, dissatisfaction with the working hours has been expressed by higher proportion of women scientists than men

Satisfaction with Facilities at Work Place

Adequate facilities at work place are important not only for the satisfaction of the workers but also for the proper performance of work roles. These facilities range from simple amenities like light arrangement, official set up, seating accommodation, etc., to the sophisticated ones like instruments, gadgets, apparatuses, etc. Therefore, the respondents in the present study have been asked to state their opinion about the congeniality of the facilities provided to them at their work place. It was assumed that since all the studied institutions hold international standard of education, women in such institutions will be satisfied by the facilities. However, the data collected in this regard exhibited in Fig 3.3 do not prove such assumption. It was found that majority (51.61 percent) of respondents are not satisfied with the basic infrastructure of the institutes. Near about one fourth of women scientists feel unsatisfied with the facilities and infrastructure provided by respective institutions.

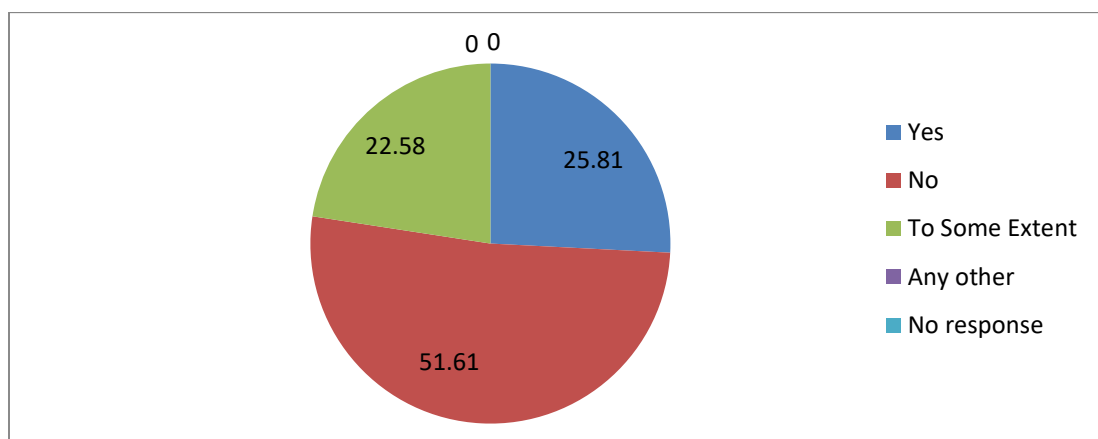


Fig 4.3 Percentage of Satisfaction with Basic Infrastructure Provided by Organization

In-depth interview and group discussion unfolded the anxieties among respondents of studied institutes. Many women scientists noted that university/institute should provide more gender oriented facilities. Such as many institutes have no crèche system for new mothers. Even in for newly mothers there should be separate place to feed their baby. Those institutes have crèche system it is not workable all time. So newly mother has to arrange babysitter in home or dependent of other family members. One senior respondent said that *“I was appointed in my department there were no toilets for women, so, we had to go to other buildings to use basic necessities. Now the situations are changing but still the needs are not fulfilled properly.”* One of the faculty members shared her experience *“the work I am doing right now it needs a separate office but administration is not providing.”*

Stereotype, Prejudice, and Discrimination

This part of the study is an attempt to depict the discrimination and unequal treatment as barriers experienced by the respondent scientists. As discrimination is the result of many socio-psychological and cultural factors, therefore, an attempt has been made to find out the persistence of sex based prejudices and stereotypes which exist among the scientists who are otherwise trained for applying rational and objective outlook both, in their respective specialties and in social problems as well. Prejudices and discrimination against women in modern profession is vastly complex and multi-faced phenomenon.

Different treatment because of gender or sex is another trait for women in science profession. Fig 4.4 is showing the percentage of respondents who have experienced different treatment at work place because of their gender. It is been observed that 22.58 percent of

respondents have faced different treatment in their work place. Group discussion has been revealed that few respondents were sometimes felt that they are getting different treatment because of her gender. Many scholars noted that sometimes supervisor hesitate to give them task. Sometimes even the behavior of technical staffs in lab is not sophisticated enough towards women research scholars. One of the senior professors in Jadavpur University, said that *“when I was recruited in this department my official colleagues were not enough friendly with me, even our departmental librarian, who is a man, repeatedly denied my instruction.”* It is been observed that few faculty members who are coming from long distance they are not getting suitable sif for their work. One of the faculty member noted that *“I am working for one year and I travel long way to come here but departmental administration did not say anything about shifting my work time.”*

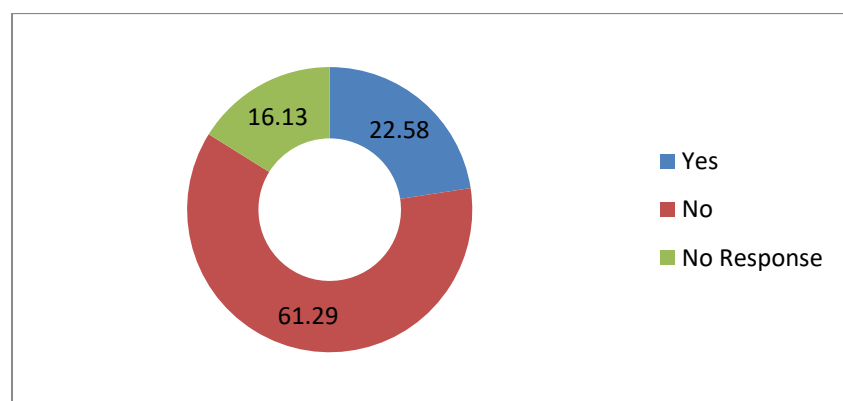


Fig 4.4 Experiencing Differential Treatment Because of Gender

Interview with scientists and focused group discussion with research scholars revealed quite a bit gender related barriers. Some of the comments are follows. *“If you are practicing science and you are fashionable they do not take you seriously. Older men are condescending. But if you challenge them then they become hostile.”* Another comment is *“if a woman is really*

good in her field, her growth is suppressed.” It is been observed that tiny number of women are in higher position as departmental head and others. Some of the respondents were shared their feelings that “though tiny number of women in higher position but time is changing more and more women are coming to the surface.”

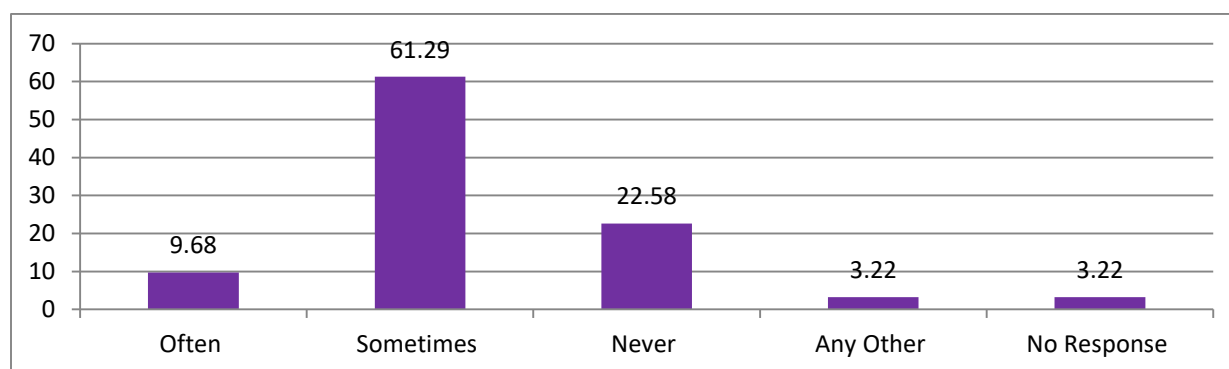


Fig 4.5 Women Scientists have to Assume Duties which are not Part of their Profession

Fig 4.5 is showing the percentage of women scientists undertook duties which are not part of their profession. Many women scientists noted that sometimes they had to bear with uninvited sexual attention while work in the lab. Many students expressed the problem of personal safety as a problem regardless of where they were-library, or the lab, or during field work, half of their energies were expended in ensuring personal safety. This is indeed a matter of concern needing institutional safeguard.

Students expressed difficulty in obtaining a research position as supervisors would impose conditions or just plainly refuse women students. While most students did not have gender preference for supervisors, where gender preferences were indicated, slightly higher percentage preferred woman as supervisor compared to male supervisor. Women teachers did not perceived much difficulty in students approaching them.

Structured questionnaire identified few difficulties and the response among women scientists. Data form field is showing that they have faced multiple difficulties such as gender discrimination in rules and practice, non-cooperative colleagues, lack of freedom in professional practice, and lack of facilities and technical practice etc. According to one of the senior professor from Illumination Science department *“when I joined this department my all colleagues were male and senior than me, I faced many obstacles that time, even some times the situations were more hostile to me.”*

Allotment of Work/ Responsibility

One of the major aspects of differential treatment relates to the allotment of work responsibility. Men are generally considered as more aggressive, independent, competitive, objective and have better ability to solve the problems. In other words, men are better suited to handle managerial and administrative post. Conversely women are stereotyped as more gentle, passive, non-competitive, submissive and dependent, or less suited to responsible position. Therefore, women are selected to these professions are assigned relatively lower positions where the responsibilities are comparatively lesser important. Men and women posted in similar positions are allotted work with differential value. It is a general assumption that women with marriage and children do not accept any such assignment which carry heavy responsibility and complicated in nature.

Table: 4.4 (a) Men Respondent's Opinion on Differential Treatment in the Allotment of Work/Responsibility

Responses	Comparison with men in the same position	Comparison with women in the same position
Inferior	10 (37.03)	6 (22.22)
Similar	12 (44.44)	14(51.85)
Superior	5 (18.51)	7 (25.92)
Total	27 (100)	27 (100)

Figures in the brackets indicate percentage

Table: 4.4 (b) Women Respondent's Opinion on Differential Treatment in the Allotment of Work/Responsibility

Responses	Comparison with men in the same position	Comparison with women in the same position
Inferior	18 (40)	6 (13.33)
Similar	22 (48.89)	23(51.11)
Superior	5 (11.11)	16 (35.55)
Total	45 (100)	45(100)

Figures in the brackets indicate percentage.

Studying into the differential treatment being given to men and women scientists, the respondents have been asked whether they have been allotted similar work and responsibility in comparison to other men and women working on similar job positions. Responses of men and women respondents are given in Table 4.4 (a) and Table 4.4 (b). It is clear from the table that the complainant about differential treatment in allotment of work or responsibility is relatively more

pronounced among the women when they evaluate their allotment or work in comparison to men who are working in similar job positions. In interview one respondent stated that *“allotment of work or responsibility is more favorably disposed towards men because of common perception about women as inferior, less mobile, less strict, and less competent to their work.”*

Satisfaction with the Placement in Job

Organizational practice and work compatibility is also relate to the placement of incumbents in their job position and satisfaction. In the most of the institutions, it is been seen that persons with same designation and pay scale are expected to perform different types of functions in different job positions. Some of these positions are highly valued in term of power, prestige and other fringe benefits while other possess relatively lesser amount of power, prestige and related benefits. According to one respondent *“even some of the job positions can be considered as punishment posting where authority, special prestige and other benefits are less.”* Similarly, some of the job positions provide good opportunities for overtime allowances, travelling allowances and other pecuniary benefits. Thus, it is not necessary that all positions with the same designation and same pay scale may have similar benefits.

The placement on job has got significance too; it is an area where discrimination and favor can be showered upon the employee, particularly women. According to an interviewee, *“in this profession men may be given highly prestigious, extremely powerful and more paying job positions, while women with equal rank and pay scale may be put in such job positions which are less-valued, less-rewarding or even sometimes punishing.”* Another respondent commented that *“I am taking some classes which I am not supposed to take, neither they are compatible with my work schedule and designation.”* Therefore, an employee’s satisfaction with the job is dependent

upon his/her placement in the job which may either be rewarding or disappointing to him/her. Data in this regard are contained in Table 4.5 which reveals that full satisfaction with placement in job has been expressed by a high proportion of men than women. It is significant to note that partial satisfaction and dissatisfaction are more pronounced among women than men, which can be considered as barriers/ obstacles. The placement women in job are always embedded with the practice of academic science and its interaction with gender. It always governed by social norms and social backgrounds of the people involved in science.

Table 4.5 Satisfaction with the Placement in the Job

Variables	fully Satisfied	Partially Satisfied	Not Satisfied	Total
Women	8 (17.78)	17 (37.78)	20 (44.44)	45 (100)
Men	13 (65)	8 (40)	6 (30)	27 (100)
Total	19 (26.38)	23 (31.94)	23 (31.94)	72 (100)

Figures in the brackets indicate percentage.

Analysis of the data depict that occupational segregation in science is visible but it is not overt all time. According to feminist analysis occupational segregation by sex is extensive in diverse religious, social and cultural environments. Feminist or gender theories mainly concerned with non-labor variables which economist take as given. A basic premise of gender theories is that women's disadvantaged position in the labor market is caused by the reflection of patriarchy and women's subordinate position in society and the family. Gender theory makes a valuable contribution to explaining occupational segregation by sex by showing how closely the characteristics of "female" occupations mirror the common stereotypes of women and their supposed abilities. So it can be said that the above mentioned two distinct characteristics

(gaining reward/punish) within science happen because of women's two different stereotypes (i) positive, and (ii) negative. The positive stereotypes represent a caring nature, skill and experience in household-related work, greater manual dexterity, greater honesty and attractive physical appearance. On the other hand the negative stereotypes such as disinclination of subversive others, lesser willingness to travel, lesser physical strength, low ability in science, and lesser willingness to face physical danger and to use physical force. These stereotypes are the main contributors of women's gaining reward or getting 'punished' by the institution.

Denial of Instructions by Men Subordinates

Sometimes, women officers or are not taken seriously by men working under them. The respect and the fear of women high officials are found missing among their subordinates particularly among men subordinates.²² The power attached to a position and the person holding such position are two types; if the person happens to be a woman then the power attached to that position is not likely to have much impact as it would have when the same position is held by a man.

Table: 4.6 Denial of Instruction by Men Subordinates

Scientists	Yes	No	can't say	Total
Women	25(55.55)	15 (33.33)	5(11.11)	45 (100)
Men	7 (25.92)	17 (62.96)	3 (11.11)	27 (100)
Total	32 (44.44)	32 (44.44)	8 ((11.11)	72 (100)

Figures in the brackets indicate percentage.

²²PreranaRane, "Women Engineers: A Strange New Species." *Science Age*, (1985):47-49, accessed June 23, 2013, <http://www.jstor.org/stable/4316039>.

In the present study, the respondents were asked whether they faced or have heard of any case where decisions taken by a woman have not been taken seriously or not followed simply because they emanated from a woman. During interview one senior respondent told that sometimes she felt denial of instruction of her subordinate when she first joined in the department as an assistant professor. According to the respondents “*sometimes our lab attendant does not follow my instruction.*” This statement can be interpreted as masculine social practice and cultural representation in workplace. Masculinities can be understood as the effects of the interpretations and definitions on bodies, on personalities and on the society’s culture. Masculinity always occupies a higher ranking than femininity in the gender hierarchy characteristics of modern societies.

To understand the issue data were collected from various respondents to understand it more precisely. Maximum number of respondents replied in favor of denial by men subordinates. It can also be seen from the Table 4.6 that maximum number of men’s opinion pronounced against the denial of women official by their men subordinates.

Hostility from Colleagues

In the traditional Indian society, sex segregation has been practiced to a very large extent. Modern work organizations, on the other hand, present a different picture where men and women work together. The persons working within the same organization are expected to have normal and congenial interpersonal relationship. But, in fact, the relations among the colleagues are not always smooth. Achievement orientation, competition for better status/rewards and sex related prejudices may result in unhealthy and hostile relationship among the colleagues. To inquire into

this dimension, the men and women respondents have been asked to state the presence of any hostility of strained relationship with their colleagues.

Table: 4.7 (a) Men Respondents Perceptions of Hostility from Colleagues

Responses	Hostility from men Colleagues	Hostility from women Colleagues
Yes	12 (44.44)	8 (29.62)
No	15 (55.55)	14(51.85)
Can't say	NR	5 (18.52)
Total	27(100)	27(100)

Figures in the brackets are percentage.

Table: 4.7 (b) Women Respondents Perceptions of Hostility from Colleagues

Responses	Hostility from men Colleagues	Hostility from women Colleagues
Yes	19 (42.22)	27 (60)
No	22 (48.89)	15(33.33)
Can't say	4 (8.89)	3(6.67)
Total	45(100)	45(100)

Figures in brackets indicate percentage.

The data received in this regard have been presented in Tables 4.7 (a) and (b), which reveal that strained or hostile relationship with in same sex is more pronounced than between the sexes. This may be due to the competition among the colleagues for better rewards, status and achievement. Moreover, the presence of hostility among men colleagues and among the women

colleagues is almost equal in proportion. This data rejects the popular stereotype that women are relegated to hostility in workplace where maximum workers are men.

To look at the issue more closely respondents were asked to give their responses. The respondent had told her experience when she was recruited one of the selected institutes.

“I do not know how to put this. But when I was recruited in the department I was the only woman who got the job. My colleagues were very nice to me at the initial stage but after sometimes I have experienced really very bad. After taking the post I started to get project from different funding agencies. So I got one project. I thought I will prepare by own laboratory. The day I can remember I was in a meeting outside the campus. When I came back and saw my lab is close from outside but inside was completely vandalized. Immediately I called police and they came but neither police nor administration took any action. Few months back I got to know who are behind the incident. I did not take any action against them.”

-Professor, Illumination Science

The narration indicates that women are discriminated by hegemonic masculinity and patriarchal culture of our society. Masculinity is the set of social practices and cultural representation associated with being man. It can be said that femininity is always subordinated to masculinity. It also connects with the idea of power where women sexuality always relegates as subordinate from men sexuality. It also connects with gendered identity politics where masculine gender suppressing the feminine gender. E The narration also gives an insight the women in science has evolved from very lower position to the surface level. The degrees of hostility which may not be physical but mental have changed within science and society together.

Dual Burden

Women in every profession have to manage their careers and families. It has been observed that professional women who work outside the home do a larger share of household work than men. Such work includes child bearing, cooking and cleaning, among other tasks. The double demands of the career and home lead to a double burden, which has been observed in many national contexts and is variously referred to as the “dual burden”, “second shift” or “dual role syndrome” or “dual role syndrome”.²³ Dual burden is more visible among women scientists because of their lab oriented work and experimentations. Many respondents have told that “*lab work has no time limit.*” Data in this regard were collected from various respondents. It is been seen that certain amount of scientists think that household responsibility make obstacles in research level. On the other hand few women scientists revealed that for research they cannot fulfill household responsibilities. It was told to the respondents to write some responsibility which they perform in house hold. One of the respondents wrote “*a woman usually play many role as a daughter, wife, mother, daughter-in-law etc. and it is quite difficult to maintain or balance their family life and career. I am a homemaker too, where I have to take care of my son, in-laws, husband, and parents.*”

Interview with women scientists revealed that women found the responsibilities of marriage and family to be an impediment in their science careers. Combining career and household responsibility was difficult, and only privileged women who received support from their families were able to cope with dual burden of home and work. One of the respondents said:

²³Namrata Gupta and Arun K. Sharma, “Women Academic Scientists in India”, Social Studies of Science 32, No. 5/6 (2002) :901-901, accessed June 4, 2014, <http://www.jstor.org/stable/3183058>

“I love my child and my family, so, I cannot name it as difficulties that are hindering my career. But to some extent it is true that my family related responsibilities are stopping me to go far. I cannot leave my family therefor cannot move to better option outside the city or cannot go for post doctorate in abroad. I had to leave good job due to long working hours and distant location. There is no specific duration of research work for a day. But I had to stop my work at certain time so that I can reach my home within comfortable time to take care of my child and other household responsibilities.”

-Post Doctoral Fellow, Chemistry Department

Fig 4.6 is showing that large amount of respondents feel household responsibilities as barrier for science profession. But the majority of respondents said that they do not feel household responsibilities as barrier for profession. To inquire this issue interviews were taken. The interview results were not satisfactory as the opinions were mixed. Most of the senior respondent told that marriage motherhood, living in a joint family, and managing household constitute dual burden and have an impact on the career. On the other hand, interview with younger respondents reveal that being married or having children are not hindrance for career as such. According to one respondent *“I don’t think having family is a problem in women’s career growth.”*

Fig 4.6 Household Responsibilities are Barrier for Profession

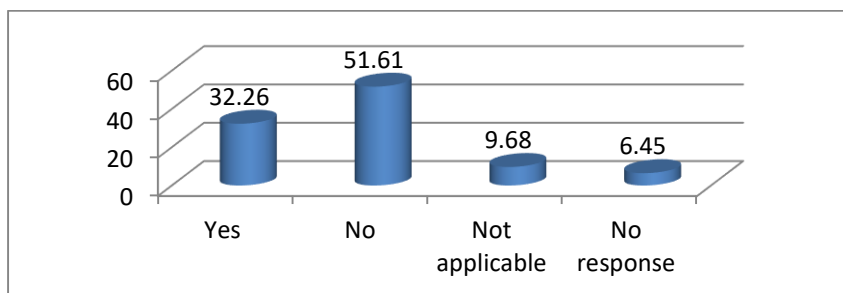


Table 4.8 Perceptions on Household Responsibility as Barrier for Career.

Responses	10-15 years of working	0-5 years of working or Ph.D scholars
Yes	11 (78.57)	8 (29.63)
No	3 (21.43)	19 (70.37)
No response	NR	NR
Total	14 (100)	27(100)

Figures in the brackets indicate percentage.

To understand the core of the above discussed contradiction the survey papers were sorted into two distinct groups. One group was constituted by 14 senior professional who are working for 10- 15 years in respective institutions and the other group was constituted by 27 mostly young professionals who are working for 0-5 years and newly joined research scholars. Four survey papers were rejected as some respondents choose not to respond. The data contained in Table 4.8 reveals that majority of young professionals gave their opinion against the concept of dual burden while the senior professional feels that dual burden makes hindrance for career. The possible explanation can be the social and cultural changes in family or household dynamics. In an interview one responded said that *“the concept of traditional joint family and wife’s role is decaying.”*

Coping Strategies as Invisible Resistance

Historical participation by women in science has been persistent but inconsistent pattern because of the social, economic and intellectual obstacles that have stood their way. From 20th century history of women in science we have seen many women who stood as icon in first world for their great contribution in science. The most famous women in the 20th century by nearly any measure were Marie Curie, Barbara Mcklintok, and Maria Goeppart Mayer who have contributed a new era in their respective field. Life history of Marie Curie says she was a mother, wife and world famous Nobel Prize winner scientists. Even when Maria Goeppart Mayer won the Nobel Prize the local San Diego news-paper headline announced that ‘San Diego Mothers wins Nobel in physics.’ Within the first two paragraphs, readers also learned that she was a red-haired college professor and mother of two. So it is a clear perception that Maria Goeppart Mayer balanced her family life and career. Even from the writing of Evelyn Fox Keller we can see the life of Barbara McClintock, geneticist Nobel Prize winner, ‘who met no man she liked so well as her work’. A significant number of well-known scientists were married and had children even as they conducted good careers.

Gender inequality and segregation have characterized science for centuries. Gender biases have been shown in science in terms of its nature, style, content and practices since its inception. Various ideological constructions of gender through different eras have served as barriers for women’s access and progresses in sciences. But it is historically proved that from the beginning of 20th century women started entering into science as professional and many of them became icon of their time. So it can be said that they must have had some kind of strategies in their live to cope with the barriers which helped them to stay into the profession and choices.

Measuring workload of Women scientists

Several techniques were implemented to understand coping strategies of women scientists. 45 respondents were selected to share their opinion. Firstly respondents were divided into two distinct groups to understand work load they are sharing within family. Among 45 respondents 18 were married. Among married women scientists 14 scientists are having children with family and 15 are in joint family. Among 27 unmarried women scientists 7 scientists live in rented house (PG) where they have to share some family work with roommates. To measure the work load questionnaire was given to score their work load which they are performing. Each and every question had selective marks. High score was considered as high workload they are sharing with in family. The questionnaire is available in appendix i. The result is displayed at Table 4.8.

Table: 4.9 Measuring Work Load among Women Scientists

Social Variables	High	Medium	Low	Total
Married	11(61.11)	4(22.22)	3 (16.67)	18 (100)
Unmarried	6 (22.22)	15 (55.55)	6 (22.22)	27(100)
Total	17(37.78)	19(42.22)	9(20)	45(100)

Figures in the brackets indicate percentage

On basis of above classification, it was found that married most of the respondents share medium level of work load. The data also reveal that married women always share larger amount of work load with in family. The data from men's perspective is not included in this regard as it was assumed that they usually give lesser time for family work. Mental stress measurement was not conducted as it is been proved by Arun K. Sharma and Namrata Gupta that degree of exhaustion are highly pronounced among married women. The degree of tire due

to pressure of being scientists and a homemaker has multidimensional faces such as physical, emotional, and mental etc.²⁴

Strategies to Maintain Professional and Personal Life

For a sincere research scholar or professional in science one needs to manage her personal and professional life very well. For some respondents, family responsibilities and career stress have direct effect on career growth of woman scientists. Sometimes women scientists leave their profession due to gender related stress between work personal lives. During the study respondents were asked to give their opinion about gender related stress in work place. Many of them mentioned that gender related stresses are strongly present at their work place. As a woman professional they are managing both of their careers and families. Many scholars' work such as Usha Rani Rout, Sue Lewis has mentioned that professional women who work outside the home do larger share of household work than men. Such work includes child bearing, cooking among other tasks.

During the study respondents were asked whether they have any strategies to cope with the obstacles they are facing. According to one respondent "I have one child but I don't feel that much stressed because of my parents-in-laws. They usually look after the baby all time." Again she mentioned that "as I live in a joint family it's some way the other benefiting my career." To inquire the issue respondents were asked to give their opinion about baby sitting at home. The result displayed at Table 4.9 which shows that most of the women prefer themselves as best baby sitter while majority of men preferred either housemaid or older family members of their family. On the other hand, some respondents told that since they live in small family structure they take

²⁴Namrata Gupta and Arun K. Sharma, "Women Academic Scientists in India", *Social Studies of Science* 32, No. 5/6 (2002) :901-901, accessed June 4, 2014, <http://www.jstor.org/stable/3183058>

full time “paid help” (in terms of house maid or other organization such as crèche) to look after their child and other family related works. But it is not satisfactory all time. In such cases they took different strategies such as negotiating with the career or finding other alternative. Many respondents mentioned that they have negotiated with their career because “it was too hard to maintain both.” In an interview one respondent said that “I got administrative position but I left it.” She also mentioned that such strategy helped her to stay in the profession. So it can be said that the stress of the work environment and dual burden on the women academics in science has let them to redefine success as different strategies.

Table: 4.10 Perceptions about Baby Sitting

Variables	Self	Older member	house maid	other	Total
Women	22(48.89)	13(28.89)	7 (15.56)	3 (6.67)	45(100)
Men	9 (3.33)	8 (29.63)	6(22.22)	2 (7.41)	27(100)
Total	31 (43.05)	21(29.16)	13 (18.55)	5 (6.94)	72(100)

Figures in the bracket indicate percentage.

Due to gendered work environment, harder work is required by women scientists to establish themselves in the initial years of their careers. Most of the respondents noted that family constrains in the initial years are the reasons for a delayed career peak. Few respondents revealed that they had to postpone their research because of family pressure of marriage. Even after marriage one woman has to take a break for maternity purpose. It is been seen that the women faculty members seem to reach a peak of their research activity only in their later age. Data was collected to enquire the issue regarding perception about taking a career break because

of parenting which is displayed at Table 4.10 (a). Surprisingly majority of women pronounced against taking break at the time of parenting while almost all the men were against it. To explore the issue more deeply respondents were asked to give their opinion on women participation in parenting by both men and women together. The result was astonishing which is displayed at Table 4.10 (b). During the study it is been found that majority of men think women should take a break because of parenting while women rated themselves against it. So it can be said that compromise with career or year break not only a strategy to stay out of work stress or to save energy for coming back to the profession with full energy, it is male oriented social values that women perform.

Table: 4.11 (a) Perception of Taking Break because of Parenting

	Yes	No	No Response	Total
Women	11(24.44)	26(57.78)	8 ((17.78)	45(100)
Men	NR	24 (88.89)	3 (11.11)	27 (100)
Total	11 (15.28)	50(69.44)	11(15.28)	72(100)

Figures in the brackets indicate percentage.

Table: 4.11(b) Perception of Men and Women about Taking Break by Women because of Parenting

Responses	Men's perception on taking break	Women perception of taking break
Yes	20 (74.07)	12(26.67)
No	5 (18.51)	29(64.44)
No Response	2 (7.40)	4(8.89)
Total	27 (100)	45(100)

Figures in the brackets indicate percentage

It is difficult enough for one professional to secure a job in an organization, institution, or community, let alone two. Matching vacant posts in science to a specialist's skills and interests usually requires that one be free to move. When a choice has to be made between a partner and a job that best suits their training and abilities, it is more often women who put the priorities of personal life before professional goals. It is interesting to note that women in science commonly end up in partnership with other scientists. Though, there are many exceptions. One of the respondents said that "getting spouse from science field is good because he is familiar with this profession." Some respondents have noted that spouses from same field can create better understanding between husband and wife. "It is an added benefit of access to an informal, cost-free, research consultant with whom to share and develop ideas." To inquire the issue respondents were asked to give their responses which are displayed at Table 4.11. The shows that majority of women scientists prefer spouse from science background. But interestingly data on men's preference shows that majority of men want to get spouse from same qualified but not from science field. The most possible explanation is that women prefer spouse from same field because of gender based obstacles which they face at their work place.

4.12 Preference of Getting Spouse

Social variables	Science	Not Science	Others	Total
Women	26 (57.78)	9 (20)	10 (22.22)	45(100)
Men	7(25.92)	16 (59.25)	4(14.81)	27(100)
Total	33(45.83)	25(34.72)	14(19.44)	72(100)

Figures in the brackets indicate percentage

During the study respondents were asked to give possible solution to maintain both work place and family. Some respondents have said that they shifted in suitable location near work

place. Generally long distant from work place is a problem for working women. As they are maintaining both family and professional life, many of them choose to settle near the institutes/universities. According to on the respondents, “after getting first job I had to travel long way to come to the work place. Now I have shifted near university and it saves time and energy. I can reach home in comfortable time and give my child good care.” It is been observed that those professors are engaged in mentoring students they usually live near universities/institutes. According to one of the respondents ‘I have few numbers of research students. I choose to live near university because if they need me I can reach at the lab in short time.”

Concluding Remarks

Science is an institution with immense inequality in career attainment where women as minorities have lowered level of participation, recognition and productivity in science education and profession. The main objective of the part of the study was to investigate the nature of women’s barrier into science which though to be men dominated profession. During the study it is been seen that women’s discrimination or inequality starts from early education where either by the consequences by surrounding or biasness of teachers they start moving into different profession or education. The discrimination does not end at the beginning of their science education it continues to higher level of study where women’s access to science further makes discrimination. Women massively face discrimination at the time of selection into higher education. The selection itself follows masculine ethos and carries into profession too. The stereotypical image of women contributes to the limited accessibility of women’s job participation. Even in work place women face discrimination by the socio-cultural image of hegemonic masculinity which hold the women scientist either in subordinate position or different

allotment of work/ responsibility. It is a social stigma that women are naturally soft, passive, not aggressive which contribute to women subordination in scientific community. Even institutional infrastructure acts as a social barrier for women. Here I want to argue that to certain extend women does not need equality they need equity. Equality in infrastructure sometimes does not give women right opportunity to flourish in their respective field. The study also significantly found that the discrimination in science is changing. The perspective and experience between two groups (senior scientists and contemporary scientists) have distinctively found that science is not that oppressive space now a day as it was once for women.

Chapter 5

Conclusion

The main objectives of designing the present study had been to investigate and delve deep into the exact nature and extent of women's participation in the field of Science, and therefore identify the barriers, and coping strategies used by them in what has been conventionally looked upon as the 'men domain'. One of the natural assumptions that the thesis works upon have been that prejudices and stereotype ideology thrust upon women in general has worked strongly even in an age where we talk about women progress, liberation and empowerment. What is ironical and unfortunate then is how women have been forced to take the path of negotiation even in their pursuit of profession where only merit and ability should only be the criterion of determination. The very early social mind-set that still sips through, coupled with the perceptions about 'women profession' and the subtle ways of discriminations that is strategically placed upon the women when she makes choice to undertake 'study' of a subject and occupation affect the entry, development, and mobility of women specially in scientific professions. Through an exploration of women's asymmetrical participation in professions relative to science, the attempt of the present study is to identify the barriers that cause it. The study is confined to the women scientists working under the discipline 'science' in three leading Universities in the country and in three research institutes of West Bengal. The comprehensive analysis of the data and the interpretation made in the preceding chapters of the thesis bring us to the following conclusions:

The present study interestingly found that women's entry and development in the field of Science is naturally at a certain phase wherein at the first entry level the proportion of men and

men involved are almost same. It is thereafter that things go different pathways, women are not visible as participants in the higher grade of education or profession related to science thus the women: men ratio look unhealthy. The reality is that only few women scientists are sitting in high positions. This uneasiness spills to academics – in terms of productivity and recognitions women scientists have significantly lower participation, publishing lesser research papers than their counterparts. Also to be noted is the fact that publication rate is dependent on institutional affiliations! Women scientists who work in research institutes publish more papers than their women counterparts from the Universities. Will it then be wrong to suggest that institutional structure also affects women scientists' productivity? It had been duly noted that women's participation in projects funded by different funding agencies happens to be significantly lower than men. Co-incidentally, most women scientists when involved in projects did concentrate only on smaller projects. When asked, many of the respondents stated that smaller projects meant less time to give to it. Conclusively, such an attitude of the women scientists can be traced to her family obligations as a mother, wife, that is as the primary caretaker of the family that does not allow to give time to her career as much her male counterpart. The study also realized that the women's participation in science is affected by gender prejudices almost right at the beginning of their career. Many such informal social practices regarding giving science education to women end up isolating women, giving them an initial disadvantage; hence, opening up a social capital gap that creates the sense of negativity in her perusal of science as a career. This in effect means fewer women available as supervisors or educators and the vicious cycle becomes self-engulfing. Negotiation and cultural stereotype becomes a stumbling block. It has been noted that sometimes male supervisors are not keen to take up girls students. The sense of 'othering' that begins in academic sphere translates into professional zone. Even in the class rooms, women are

hapless victims of partial teaching. Many women scientists have acknowledged that they have faced some level of discrimination in their course of study and career. The study also nailed the fact that science education and career particularly if pursued by women were those who belonged to upper castes and sound economic background. The participation of women in science is effectually related to geographical mobility and specific gender obligations. Many women failed to pursue science as career because family constrains who were hesitant to spend on her education or give her mobility to achieve such education. It is well known that most of the good institutions happen to be located in urban areas such as in the city of Kolkata, West Bengal. Many women scientists complained that often the girl child was not allowed by her parents or family members to go away in the city to avail such education - such a prejudice of social mobility reaches its zenith where some women leave working towards their doctoral thesis.

It is not that women find a smooth road if they can overcome the initial hindrance of achieving their education, the trial continues even as women students who have pursued science look for jobs. Obviously the reason behind this dismal situation is masculine hegemony in science and allied practices – it cannot be easy as women try break into this male battalion. So her challenge is if she wants a pie of her share, she needs to be more talented and hard-working than her male counterparts. Victim to such double standards, women have known such informal norms and rules and formal laws posing a barrier for her growth. Feminist criticism sees ‘men power’ defining the content of formal and informal behavioral cultures that in simple version suggests that the criteria or standards of evaluation or regulation are different women vis-a-vis men. The layered texture of rules forced women to look at priority differently and not take much liberty with her education. Science is rational. Science is experiment based. It is time consuming and intruding in the sense that it demands a large level aggressive concentration. All very

unfeminine sensibility, thus her participation in such scientific venture is also a challenge to masculine hegemony. This cycle brings us back to where we began – women's entry and survival in the sphere of scientific projects is ridden with challenges of myriad hues. It is well known that long hours of laboratory work and experimentation needs good infrastructure and also an ambience of gender neutrality and such a balance is oft not achieved. Again during the study, it has been noted that most of the women are not satisfied with the 'working hours' of their institutions. The lack of infrastructure can make for a dismal situation for a new mother who happens to be a scientist too. Aggressive bias is deep rooted to the extent that institutions are not gender friendly enough to give a comfortable ambience to the women scientist to pursue her goal in a project.

Science itself has masculine tag and that means women are not welcome entry. The study found that negative labelling against women scientists means male scientists continue to be considered as more aggressive, independent, competitive, objective and having better ability to solve the problems – a case of judgment even before the case can be argued. Men then are better suited to handle managerial and administrative posts. Conversely women are more gentle, passive, non-competitive, submissive and dependent, thus less suited to responsible position. Therefore, women who manage to be selected to the profession related to science get relatively lower positions where the responsibilities happen comparatively to be lesser important. Also, men and women posted in similar positions are allotted work with differential value. Thus the cycle seems unbreakable and posits a challenge that the study hopes will be enlightening the path towards breaking the stereotype.

Another of the key barriers for women in science is the dual burden wherein women fall prey to dual role syndrome. For a working women scientist, she has to shoulder the responsibility

of family and profession work together. Eventually the non-conducive atmosphere slows down the women scientists' career track and contributes to gender-related stress. To cope with the stress and career challenges, women scientists take adopt many coping strategies such as a number of women scientists have been found to be taking career break to raise their children properly. The study found that the perception of taking career break for child bearing and rearing lies deep into social stigma where most men think women should take break from work to take care of the child. It is the dictate of the patriarchy that make women perform the balancing act between career and family. Women not only take break from their scientific career but also sometimes change their professional goal which ultimately leads to constructing a new career graph for them.

The experience of women scientists begin and end with the consequences of social exclusion in an activity, which necessitates, perhaps demands, community. All too frequently the consequences of social stigma and otherness have been attributed to inherent deficit within women themselves. The argument has been that they lack human capital for physically demanding and mathematically intensive scientific work, whether by 'nature wisdom', which has divided the gene pool, or by self-selection into softer field that permit greater attention to the family. Sadly but that is the truth that the experience of separateness and stigma make for the tendencies of lower participation, discrimination, and role performances in the sphere of science education and profession.

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