WOMEN IN SCIENCE AND TECHNOLOGY

- Sumeeta Chanda, Eng. Lit. SJU- Bangaluru

THE SCIENTIFIC Revolution took place during the 16th and 17th centuries. This brought drastic change in scientific thought. The Greek view had dominated the scene for almost 2,000 years, but with the advent of the Scientific Revolution, a new view of nature emerged, which replaced the Greek view. Science came to be regarded as having utilitarian goals. Science became an autonomous discipline, distinct from both philosophy and technology. By the end of the Scientific Revolution (1687), science had replaced Christianity as the focal point of European civilization.

Out of the unrest of the Renaissance (15th and 16th centuries) and Reformation/ Protestant Reformation (16th century), there arose a new view of science. This new view of science or the Scientific Revolution, brought about the following transformations:

1. Abstract reasoning took precedence over common sense.

2. Quantitative view of nature substituted the qualitative view of nature.

3. Nature came to be viewed as a machine rather than as an organism.

4. An experimental, scientific method was developed. It sought to define answers for questions that were expressed in a particular way within the framework of specific theories. According to the scientific method conceived in the 17th century, systematic experimentation was slowly accepted as research tradition by the scientific community. This systematic experimentation included both natural and artificial circumstances. The philosophy of using an inductive approach to obtain knowledge started to be used. Inductive reasoning is the kind of reasoning in which a general rule is drawn from particular examples to obtain knowledge. Making assumptions was abandoned and it was encouraged to observe with an open mind. The earlier, Aristotelian approach was of deductive reasoning, by which analysis of

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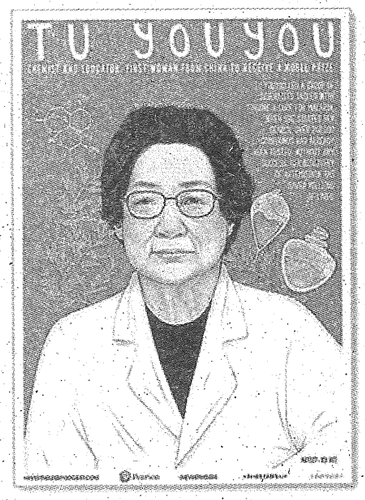

known facts produced further understanding. In practice, many scientists and philosophers believed that a healthy mix of inductive and deductive reasoning was needed. It was required to have the willingness to question assumptions, and yet also to interpret observations assumed to have some degree of validity. By the end of the Scientific Revolution, the qualitative world of book-reading philosophers had been changed into a mechanical mathematical world to be known through experimental research. Although Newtonian science was not like modern science in all respects, it conceptually resembled ours in many ways. Many of the hallmarks of modern science, especially those with regard to its institutionalization and professionalization, became a standard in the mid-19th century.

5. It brought about the acceptance of a new criteria for explanation of things, by stressing the "how" rather than the "why" that had characterized the Aristotelian search for final causes.

The Enlightenment era:

The Enlightenment (1637/87-1804), which came after the Scientific Revolution, literally called the "century of the Enlightened" was a European intellectual movement of the 17th and 18th centuries. Their ideas concerning God, reason, nature, and humanity were combined into forming a worldview that became widely accepted in the West. It caused to happen or begin revolutionary departments in art, philosophy, and politics. The main idea of the Enlightenment thought was the use and celebration of reason. Reason is the power by virtue of which humans understand the universe. Reason is the power by which humans improve their own living conditions. Rationalism, the belief that opinions and actions should be based on reason rather than on religious belief and emotions, was favoured. The goals of rational humanity were knowledge, freedom, and happiness. This emphasis on reason grew out of discoveries made by prominent thinkers. These included the astronomy of Nicolaus Copernicus (1473-1543) and Galileo (1564-1642), the philosophy of Rene Descartes (1596-1650), and the physics and cosmology of Isaac Newton (1642-1727). Many of such thinkers/scientists preceded the Enlightenment (1637/87-1804).

Some scholars date the start of the Enlightenment to the publication of Rene Descartes' *Discourse on the Method* (1637), which contains his famous saying, "I think, therefore I am." Other scholars date the publication of Isaac Newton's *Principia Mathematica* (1687) as the start of Enlightenment, and end of the Scientific Revolution. Many historians date the start of 19th century as the end of Enlightenment, with the death of Immanuel Kant in 1804.

The 18th century European science was a process designed to create entitlement, or give a right to the European science to know all of nature. They did so by using 'othering' or the concept which we know today as the "Subaltern." The Oxford English dictionary defines "other" as "a person or thing different from one already mentioned or known, or those not already mentioned," meaning those that are not mentioned. The subaltern or the other is any person who is omitted, silenced, or who lives in the margin of any given situation (women, the illiterate, the peasants, the tribals, the lowest strata of the urban sub-proletariat (proletariat are those to earn their living wages by working because they do not own property)).

Period of the European Science:

This period mainly introduced the idea that it was not only possible, but also necessary to investigate and understand all of nature. They were going to replace medieval superstition by a complete body of knowledge backed by science. This was to be done by the process of taxonomy – the act of naming and ordering all biological things. Taxonomy became the epitome of the 18th century science, and Linnaeus' taxonomical system was to become the biological standard.

This system consisted of a descriptive system designed to classify all plants and animals on

earth, known and unknown, according to the characteristics of their reproductive parts. They set out to invent a system which would cover the unknown, as well as the known. This act of naming plays the part of the power of the Divine. The enlightenment scientists considered this naming process as a process to define or classify nature in the biblical sense, rather than to know the inner being of a plant, animal or mountain. Linneaus was a Swedish Lutheran, who did not believe in hypocrisy. He was perfectly aware of the biblical nature of his taxonomy. Linneaus referred to himself as the second Adam, the 'eye' of God, who could give real or actual (in accordance with fact) names to things. The 'balance of nature' was maintained partly by the role of the new 'man' who would see clearly and name accurately (who could draw realistic, intricate drawings of biological things, and label them, as is done in taxonomy). This man who could see and name accurately was an important identity during the 18th century European expansion. This identity was that of the modern authorial subject – one who writes the history – and the object of other being the 'other' or the 'subaltern.' Writing taxonomy about the object gives assurance of dominance or mastery. The first Adam was given all Earth to rule, whereas the second Adam aspired to dominance of Earth, or to be a ruler of the Earth. However, in order to rule, a ruler needs someone to rule on.

The development of European 'science' required the development of an 'other,' which would embrace all attributes of Satan in their minds. The unconscious assumption in all these ideas was that God had created man 'in His Image' which was the image of the biologist. The peoples who did not conform to the self-image of the scientist were much lower on the scale of good and evil, that is, those who did not look like the biologist (European male) were on a much lower scale of good and evil, including European females.

The physicist, Madame du Chatelet wrote in 1735, "I feel the weight of the prejudice which so universally excludes us from the sciences... there is no place where we are brought up to think... I would reform an abuse that retards so to speak one half of the human race... I am convinced that many women are either unaware of their talents for lack of education, or that they bury them... for lack of intellectual courage. I experienced this myself, which confirms it. Chance made me acquainted with men of letters who became my friends... I started then to believe that I was a being with a mind."

There was relatively little participation of women in science until the 17th century. There were few exceptional female scientists in ancient and the medieval period, and that was a pattern. The question is "Did women have a Renaissance?" If so, who were these women and what were their contributions to science?

Back in those days, science was called "natural philosophy." The crafts and inventions based on empirical findings and research, also fell under the same category of "natural philosophy." Scholars have shown that during that period, theory and production worked together. That is, with 'mindful hands.' One had to be good at using one's hands, for example, one had to be able to draw well, as well as being good in analytic thinking. For example, Leonardo Da Vinci was one such person. The age-old head/hand binary connects the learned and the worker, the scholar and the craftsperson. That is, one had to be a learned person and a worker at the same time.

Women were denied access to universities and academics, so they did science in domestic spaces – kitchen and dining tables. They improvised dissecting rooms, salons, private studios, stores of people who

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Women were denied access to universities and academics, so they did science in domestic spaces – kitchen and dining tables. They improvised dissecting rooms, salons, private studios, stores of people who

prepared and sold medicines, workshops and laboratories. Therefore, our search for women's science must include such spaces. We also must include alchemy, which was understood as an all-encompassing approach to natural knowledge or natural philosophy.

Which ideas got attention, whose studies of the natural world were heard and approved? Throughout history, the custodians of scientific knowledge and activity have excluded women. It was believed that women's knowledge did not count. Michel Foucault called this space as the "subjugated knowledges." Socialist Ruth Watts shows that the most of the subjugated knowledge was that of women, whose scientific activities and findings were systematically ignored.

Scholars such as Margaret Rossiter, Carolyn Merchant, Londa Schiebinger, Dorinda Outram, and Ludmilla Jordanova have theorized the barring of women from the ranks of science because of gendered assumptions. Many scientific women operated independently. Who and where were these scientific women, and what were they doing?

We know the most about women scientists of the Americas and Western Europe. There is still much work to be done to trace the scientific women in Eastern Europe, in the Muslim world, in India, and in China.

Some women were evidently active in Slovenia since medieval times. In the 15th century, the Ukranian-born wife of the powerful Suleiman the Magnificent, named Hurrem Sultan or Roxelana, was known to have supported science, and to have built hospitals and schools. Turkey is also important because it was there that Lady Mary Wortley Montage, in the 1720s, first observed women performing vaccination against smallpox – a practice she later brought back to England. Gunpowder, the compass, paper, printing, and system of numbers were invented in China and India respectively, and helped to awaken the West. But it has not been possible, so far, to know the role of women, if any, in such inventions in China or India. Recent scholarly written study, articles, and collection of facts on the subject have therefore been focussed on the Western world. This scholarship has brought attention to women scientists whose contributions to science and technology deserve attention.

Colonial Period

During the colonial period in North America (1607-1776), women made strides in agronomy (the science of soil management and crop production) and botany. Jane Colden Farquahar wrote letters, and in her botanical journal, disagreed with Linnaeus. She made the first illustrated catalogue of the flora of New York State, with intricately accurate drawings. Margaret Rossiter called her "America's pioneer (and only) woman scientist for almost ninety years." But there were more.

Eliza Pinckney developed a technology for cultivating a strain of indigo that was capable of surviving in difficult conditions. She also developed a technology to make dyes from indigo. Martha Logan wrote the first American work on the science of gardening. Sybilla Masters was an inventor, who in around 1715, developed a pulverizer to refine Indian corn on the plantations. Her invention's patent had to be registered in her husband's name instead because the British court did not allow a patent to be registered in the name of a woman.

In the southern regions of the USA (New Spain or Mexico), Sor Juana de la Cruz defended women's ability to reason in the mid-17th century. She studied spirals by experimenting with how tops spin. She was aware of and was inspired by the mathematics of Tycho Brahe and Johannes Kepler, and used their mathematics in her study of the spirals.

In South America, there are several written accounts about the extraordinary German-born Maria Sibylla Merian. She took her daughter with her to Surinam in order to study plants and insects. She especially studied the behaviour and reproduction of insects. She made breathtakingly realistic illustrations (drawings) of her research subjects and sparked interest in the ecology of the rainforest, and in entomology, the study of insects.

In Europe, the Swedish Queen Christina famously invited Descartes and many other scientists to teach her. Another Swede, Eva Ekebald was an agronomist (agronomy is the science of soil management and crop production). She made flour and alcohol from potatoes and became the first woman member of the Swedish Royal Academy of Science.

The Danish scientist, Sophie Brahe, despite her family's general disapproval, collaborated actively with her more famous astronomer brother, Tycho Brahe, who greatly admired his sister's "determined mind." She also worked in horticulture, chemistry, and medicine.

Especially in Germany, there were many female astronomers. In the 17th century, Maria Cunitz simplified Kepler's tables. Elisabeth Hevelius, helped her husband in his research and published a star catalogue. In the 18th century, Maria Winkelmann Kirch, though very accomplished, was nonetheless refused admission to the Berlin Academy because, it was said, "mouths would gape." Caroline Herschel assisted her brother who took her from Germany to settle in England and find comets and nebulae. Caroline was more fortunate than other women scientists because she received salary for her science, and her work was published by the Royal Society.

Margaret Cavendish, duchess of New Castle, wrote six books on natural philosophy, undeterred by her critical nickname, "Mad Madge." Lady Anne Finch Conway's work on monads probably influenced Leibniz. Katherine Jones, Lady Ranelagh, Robert Boyle's elder sister, was a fine scientist in her own right.

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In the 18th century, the chemist, Mme Marie-Genevieve-Charlotte Thiroux d'Arconville, was a never tiring writer. She published all of her many works anonymously. For over a decade, she devoted herself to understanding scientifically, the border between life and death. She strove to find an effective antiseptic that could stop the putrefaction (rotting and foul smelling) of the flesh. She weighed and measured hundreds of samples as they decomposed, and recorded the results in lab notebooks, charts, graphs, and tables. In 1766, she published the first full treatise on putrefaction, 'Essai pour server a l'historie de la putrefaction.' She correctly concluded that something in the air must be causing the putrefaction. She explained her findings a century before Louis Pasteur discovered the invisible microbes that actually cause fermentation and decay. She realized that she needed to make her experiments reproducible by others, and therefore she documented with extreme detail and precision. She criticized male scientists if she was unable to obtain the same results as they did, for not documenting that work with precision. Her's was a sophisticated and modern way to understand the scientist's need to document lab findings. She requested in her will that her body be given to 'science,' that she be "opened up."

19th & 20th Century development...

In Africa, in the 20th century, technology usually meant technical solutions to problems that were defined in areas which ignore women's needs, and are biased towards the Western cultures. Thereby, women are poorly represented in the science and technology sector. The norm was to prevent women students from entering the traditionally 'unfeminine' professions. For black women, missionary education and gender-biased formal education policies, caused cultural barriers to women who wanted to enter technology, engineering and science fields. As a result, women have been unable to leave their mark on these fields. Because of their absence from science, black women have been unable to question research agendas and oppose gender-bias and racism in 20th century science and technology. Also, the then technological solutions did not fit

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women's environment and needs. The technology sector in Africa would hold many possibilities and potential if they took women's environment and needs into consideration.

Debates around women and technology have been conducted, and now, in South Africa, new opportunities are being provided to women in order to broaden women's horizons. Women are not venturing into areas which were previously closed cue to culture, unjust laws, and tradition. The important questions to now ask are, 'What does technology mean to women in different parts of the worlds in terms of race and class?,' 'What are the environment and needs of women that technology could make life easier for women?,' and 'Where are the women in technology?'

The technology and engineering professions are dominantly male. It is not an easily or quickly achievable goal to transform this male face of science and technology. Technology is divided into distinct areas or parts, and these processes have gender-specific impacts. Women need to ensure that these processes are relevant to them, that they have application to their needs, such as job creation and non-traditional skills training.

In France, since the 1980s, the history of medicine has gone through a major renewal of its approaches, subjects, and narratives. Women's history, gender history, and history of sexualities have all been expanding rapidly. In the same period, these changes have significantly impacted the renewal of history of medicine by focusing on medical sources that had been earlier ignored by traditional history of medicine.

This positivist attitude spread starting from the 19th century. The history of science and history of medicine, has produced a series of narratives about the progress of knowledge. They recorded the progress made by great men, major discoveries of scientifically-recognized truths. However, they shunted mistakes, and ignored obscurantism and obsolete theories pertaining to women. Such narratives did not bear many references. Social, political, and ideological influences were woven into and informed scientific discourse. Such narratives focused on the epistemological advances made possible by progress in theoretical thinking of technology. Epistemology is the branch of philosophy that deals with knowledge, and when women's concerns or women's knowledge is kept out on the side-lines, the narrative or study can only be incomplete and skewed.

Since 1953, due to a range of factors, traditional history of medicine was replaced by a social and cultural history of sickness and health. These factors are challenges to medical authority, and critiques of the history of science by sociologists, anthropologists and philosophers.

In the Islamic world, there is only one known scientific treatise dedicated to a woman. It is the pre-modern al-Biruni's book, 'Book on the Understanding of the Elements of the Art of Astrology.' It was composed in the early eleventh century. Al-Biruni dedicated the book to the princess Rayhana, daughter of al-Hasan of Khwarazm, a region of Persian Empire. The life of Rayhana is shrouded in myth because al-Biruni's dedication to her is the only evidence of her existence. The editor of the modern edition wrote in 1934, "she is marked out among oriental women by her craving for scientific knowledge and by the rare distinction of having a book dedicated to her."

Scholarship on women in science in the pre-modern Islamic world has advanced very little if at all. This writing on Rayhana was done in 1936.

A handful of names have come to the light in recent studies conducted during the early 21st century, but they all date to the 10th century. Sutaya al-Mahamali of Baghdad and Labona of Cordoba were known for their mathematical abilities. Mariam al-Ijliya and Fatiman al-Majritiya were said to have built astrolabes.

Certain Western cultural prejudices and misunderstandings of women in the Islamic world exists for all periods. The problem of women in science has been

made worse by the fact that after the 11th century, the prevailing Islamic science was undergoing decline and stagnation. However, recent scholars have shown that this is not true, or is at the very least, questionable. However, the notion that Islamic science had declined is popular among historians and in popular culture. Such misperceptions have largely contributed to a lack of scholarship in this field, but the sources are also difficult to track down, and there are no obvious starting points for research.

In this scenario, no women are known to have authored scientific or philosophical texts, and no woman's name appears in any of the scientific texts subjected to historical examination. But most historians realise that women were there. It is just a matter of knowing which kinds of questions to ask and where to look. How have historians of women in science in early modern European contexts tackled such questions, and did they ask such questions? Can the same methods be applied to the Islamic context?

In the Islamic world, it has been said that there had been a decline in scientific activities. How did this belief undermine the efforts to understand the nature, locales, duration, and general assessment of scientific practice? How would this information be useful to direct our inquiries regarding women? Can the survey of general literature on women in the early modern Islamic world be used to form a framework within which we might study women's participation in Islamic science and technology?

Historians of early modern science in the European contexts have been faced with very similar challenges when attempting to reconstruct the role of women in science. The fact that in the 17th century, women authored and published their own writings, has made the situation little less challenging. In an attempt to include a broader spectrum of women who have authored scientific texts, historians have adopted a range of sources and methodological approaches. This helps them to understand better how early modern European participated in the science and technology. These sources include images and paintings of women in science, private libraries, and especially correspondence (personal letters). The personal letters have been very fruitful in determining the status of women in science. These letters were exchanges between women and famous scientific figures, such as Descartes or Galileo. Dedications have also indicated the interest of elite women in science and philosophy. However, such sources have not yet been fully exploited.

The pool of potential sources has increased. The scope of what historians (a historian is an expert in history) consider "science" has also widened to include alchemy and astrology. These new areas of inquiry have given the most insights into women's history. Historians have made great strides in the past several decades, decades preceding 2016, on unearthing women's history of science in the early periods. However, these great strides are often overshadowed by publications that focus on "women in science" as a special category.

Gender also has been absent from studies on Islamic science, especially from the early modern era. This means that gender would be a useful category to analyse the work of women in Islamic science. Just as with women's history in the Islamic world, questions pertaining to women's contributions to Islamic science have not been asked. One of the most obvious area of Islamic women's involvement with science was in the field of medicine, and particularly in their role as midwives.

Rally

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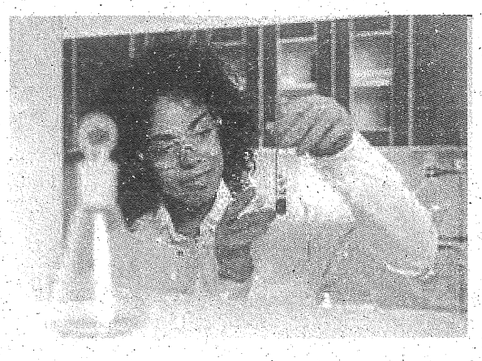

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Sea (She) of Hope

Sr. Dr. A. M. Jansi FSAG
Aicuf N W C Coordinator

WOMEN who create the world,
Both, small and great in ages old,
Stronger than the earth possess,
Who are brighter than the stars.

The sun and the rivers of power
Flow within us all through ever,
She is more than anyone's guess,
Never swap anything as a mess.

She, deserving the highest respect.
Of her beauty and smartness correct,
She is enshrined with love perfect;
An enkindling light of sparkle yet.

Her heart bears pains all kinds,
Turns into renewed strength so bind,
Her love enveloping her dear family,
Hiding her dreams and wants willingly.

Giving up her freedom for no gain,
All for chance, making it light to begin,
Let the tide rise only to fall as hope,
Twilight darkens, but the sunrise pops-up.

The night settles giving room for dawn,
Never allow her pains to wear out and gone,
Her beauty and potential are not to flatter,
Give no choice to hurt her rights matter.

Sunshine comes to reclaim its ray,
Dreams galore, are brought here to lay,
No bitter storm there to wash away,
Mysterious passionate eve supreme.

Right time has ripened for her to bloom,
Breaking the bonds from doomed gloom,
Comes, an end for an alien cage in plight,
Her desires in grace climbing on height.

Her super minded computer in technology
Knit her identity with nano-technology
Digital era takes a lead in speed and spy
Its platform for all to take wings and fly

Digital era is a boon or bane for women,
Face book and Whats APP cheating omen,
Privacy of women is at stake all the while,
Only vigilant women can win over this evil.

Rally