

Knowledge and Women

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Abstract

Since ancient times, women have been held at an esteemed position in terms of knowledge. This paper tries to address the role of women who have raised the scientific levels to great heights both from the Indian and Western Perspective. From the Indian perspective, Indians have regarded Goddess Saraswatī as the mother of knowledge and wisdom. The intellectual calibre of Indian women has been explicitly stated in the epics and puranas. From the western viewpoint, there has been evidences of Greeks and Romans worshipping Goddess Athena and Minerva, respectively. These characters, albeit mythological portray the essence of the limitless capabilities of women. Starting from the historic times, India have seen remarkable individuals with scientific aptitude. A few of them are Gargi, Avvaiyār and Līlāvati. In the modern times, a few women excelled in the field of mathematics, physics, chemistry and medicine. Similarly, Egyptians, Greeks and Romans have had women professionals in the past. In the recent times, Ada Lovelace and Gracehopper have made breakthroughs in technology. This paper attempts to give a brief outlook of some of these individuals in the field of language, mathematics and science with a focus on knowledge.

1 Introduction

From time immemorial, one of the traits that help to gauge a person is knowledge. The more knowledge a person has, the more respect she gets from the society. This knowledge can be straight away related to expertise in the varied fields, which encompass areas such as language, poetry, mathematics, science, technology, etc.,

Of late Science, Technology, Engineering and Mathematics (STEM) has shaped the world in a dramatic manner. A plethora of experts have worked endlessly and have made a breakthrough in the respective field. Among these experts, there are notable women who have broken the shackles of myth of gender suppression and proved their capabilities. This aspect can be seen worldwide, be it in India, Greece, USA, France or Italy.

This paper lists a few remarkable women who made their way into their respective field of study. First, women in Historical period is described in Section 2. This section includes Indian and western personalities. Section 3 lists a few individuals in the area of STEM, both from India and abroad. Section 4 gives an overview of the different individuals and the respective field of study and Section 5 concludes the paper.

2 Historical Period

In the past, the world has regarded the knowledge as the highest trait and the provider of knowledge is invariably Goddess Saraswatī in India. Similarly other regions also have their Goddesses dedicated to knowledge and wisdom. The mythology also has a number of female personalities personifying the characteristics of knowledge. This section gives a brief account of a few such personalities who excelled in the past. First, Indians are specified, followed by the western individuals.

2.1 Indian Personalities

In Vedic period, three Goddesses namely, **Ila**, **Saraswatī** and **Mahi** have been quoted for the purpose of acquiring knowledge as [1]:

“May Bharati (Mahi) come speeding to our sacrifice and Ila hither awakening our consciousness in human wise, and Saraswatī, — three goddesses sit on this blissful seat, doing well the Work.”

The image of the **Goddess Saraswatī** (Figure 1) portrays a musical instrument called Veena holding in two hands, a book in one hand and a tiny garland in another hand. These represent music, knowledge and inner bliss, respectively.

The Vedic period has seen intellectuals like **Gargi** and **Maitreyi**. Gargi Vachnaknavi, who lived during 700 BC was honored as a great philosopher [2]. The debate between Gargi and Yajnavalkya has been specified in Brihadaranyaka



Figure 1: Goddess Sarawati

Upanishad, in which Gargi puts forth a series of thought provoking questions to Yajnavalkya. A few such questions from this debate are given below.

Yajnavalkya , “ said she, “if all this is pervaded by water, by what, pray, is water pervaded?”
“By air, O Gargi.”, replied Yajnavalkya.
“By what, pray, is air pervaded?”
“By the sky, O Gargi.”
“By what is the sky pervaded?”

These questions clearly indicate depth of thought that Women possess. On a similar front, in the Indian Epic Mahabharatha, there are instances of women empowerment. **Draupadi** is known to have managed the people and wealth in the palace [3].

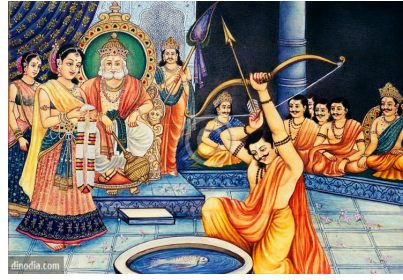


Figure 2: Draupadi

In South India, around First or Second Century A.D. there was a Tamil Poet called **Avvaiyār**. In one of her poems, she specifies about the information of energy of an atom as

“aNuvaith thuLaitththu Ez kadalai puguththi”
Energy of seven seas within a pierced atom

This line indicates the level of scientific thought process in those days.



Figure 3: Avvaiyar

Līlāvati was the daughter of Bhaskara (during 1150 A.D), who was one of the pioneers in Indian mathematics. The tale goes like this: Līlāvati was an intelligent and inquisitive child and Bhaskara had always kept an eye on this nature

of hers. However, when Bhaskara analysed her horoscope, he was shocked to see that her marriage will be short-lived. To circumvent this issue, Bhaskara prepared a perfect device that could calculate the auspicious time for her marriage. Līlāvati's curiousness drew her close to the device (when her father was not near) and while examining, the pearl that she was wearing fell into the device. The calculations went awry and the auspicious time was missed. Eventually, Līlāvati got married, but as feared it was short-lived. Soon after this incidence, Līlāvati was extremely upset and was not able to lead her regular normal activities. In order to overcome her worries, Bhaskara posed a lot of arithmetic puzzles which made her busy. These questions later on helped her to be the greatest mathematicians of all times [11].

2.2 Western Personalities

According to the Greek Mythology, **Athena** is the embodiment of wisdom and power. Various poems written for her by Odysseus G. Osborne spot light the depth of powers that the Goddess has.



Figure 4: Goddess Athena

One of the many poems written on Athena in relation to Wisdom as [4]:

*Marshal of Wisdom
give the gift as you resolve,
As a Lance of Glory,
Heralding your puissant strike!
Or like a silent owl
A glide on the Nights wind
With talons wide!
Mighty Athena! Let me be re-born of your thunderbolt!*

Minerva was the Roman Goddess of Wisdom and war. She is believed to be the inventor of numbers and musical instruments. She was later equated with the Greek Goddess of Wisdom, Athena. She was called as the “goddess of thousand works” by Ovid, a Roman poet. She was being worshipped on the Capitoline Hill along with Jupiter and Juno as the Powerful triad of Gods.

Mythologically According to Homer, **Agamede** was a Greek physician acquainted with the healing powers of all the plants that grow upon the earth.

Merit-Ptah is believed by Egyptologists to be the first-ever named Physician. She is most notable for being the first woman known by name in the history of the field of medicine, and also the first named woman in all of science as well. She practiced medicine nearly 5,000 years ago, and was immortalized by her son on her tomb as “the chief physician”[5].



Figure 5: Merit Ptah

Agnodike was the first female Athenian physician, midwife, gynaecologist. She studied in Alexandria under the great Herophilos, the first anatomist.



Figure 6: Agnodike

Maria the Jewess are the first female alchemist and is credited with the invention of several chemical apparatus.

Hypatia was a Greek mathematician, astronomer and philosopher in Egypt. She was the head of Neoplatonic school of Alexandria. Her contributions are considered as invention of the hydrometer used to determine the relative density (or specific gravity) of liquids. She worked collaboratively with her father on many works.

3 Modern Period

Notable women have shown the expertise in medicine, physics, botany, chemistry, mathematics and technology. This section provides a description of such women who excelled in the fields of STEM from India and abroad.

3.1 Scientific women personalities from India

Janaki Ammal Edavaleth Kakkat (4 November 1897 – 7 February 1984) was the botanist whose works are considered to be one of the most important breakthroughs in the research of sugarcane and eggplant. Having born and brought up in Kerala, she pursued school and college education in her home town and Chennai, respectively. She then went to USA to receive the doctorate during 1931. She is considered to be the first woman to obtain a Ph.D in botany from USA. A flower has also been named after her as 'Magnolia Kobus Janaki Ammal' [12].



Figure 7: Janaki Ammal

Aseema Chatterjee (1917 - 2006) was a notable Indian chemist in the area of organic chemistry and phytomedicine. She received M.Sc in the field of Organic Chemistry in 1938 and D.Sc. from the same university in 1944. "She made significant contributions in the field of medicinal chemistry with special reference to alkaloids, coumarins and terpenoids, analytical chemistry, and mechanistic organic chemistry". [13]



Figure 8: Aseema Chatterjee

Dr. Anandi Gopal Joshi (1865 - 1887) was the first female to obtain the medicine degree from USA. It was during the time of when Britain ruled India and hence Indians had an awareness of science from the west. As a regular practice those days, children were married at an early age and Anandi was not an exception. Her Husband Gopal Joshi encouraged Anandi to pursue education. She gave birth to a boy while she was fourteen years. But due to the non-availability of medical facilities, the baby could not survive beyond 10 days. This prompted her to pursue medicine and her husband helped her to send to USA for a medical profession. Despite her challenges of poor health, she successfully completed MD in 1886. She returned back to India on 1887 and wanted to open a medical college for women in India. But her health declined and died in 1887 [14].



Figure 9: Anandi Gopal Joshi

Shakuntala Devi (1929 - 2013) was the arithmetic prodigy of the century. She is known as the “human computer”, since she could calculate even a 13×13 digit multiplication in 28 seconds. Her father was a working in a circus and had taught her card tricks, which enabled him to discovered the mathematical trait in her. She did not have a formal school education because of financial constraints. However, it does not deter the spirit of Shakuntala Devi to pursue the love for numbers. She travelled across widely to Europe and USA and exhibited her talent. Her calculation approach was appreciated by the scholars worldwide and her multiplication of 13×13 number was recorded in Guinness Book of Records [15].

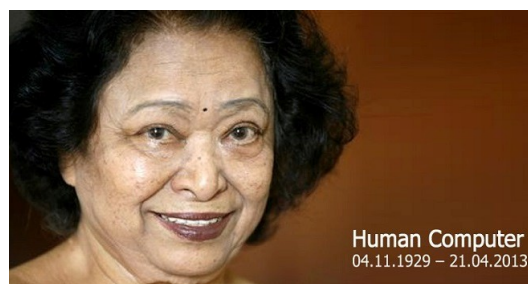


Figure 10: Shakuntala Devi

Anna Mani (1918 - 2001) was a physicist and a meteorologist, who made important contributions in meteorological instrumentation. She was influenced in her younger days by Gandhian movement and vowed to wear khādi, a typical variety of cloth made by Indians. She initially wanted to pursue medicine, but shifted her career to physics since it appealed her more. She pursued her degree from Presidency college and did research under Sir.C.V. Raman. Since she did not have masters degree, she could not get Ph.D at that time. She then proceeded to Imperial college, London for a degree in meteorological studies and then returned back to India. She was the deputy director of Indian Meteorological department and authored a number of papers in the area of meteorological instrumentation. [16]



Figure 11: Anna Mani

Dr. Muthulakshmi Reddy (July 1886 – 22 July 1968) was one of the pioneers in India to be the first in many sectors: “first female student to be admitted into a men’s college, the first woman House Surgeon in the Government Maternity and Ophthalmic Hospital, the first woman legislator in British India, the first Chairperson of the State Social Welfare Advisory Board, the first woman Deputy President of the Legislative Council, and the first Alderwoman of the Madras Corporation Avvai Home” [17]. Despite the pressure of stopping the education citing gender as a reason, Dr. Muthulakshmi stood against odds and completed the degree of medicine from Madras Medical College. She did not stop there, but entered into political career and also was a social reformer. Her proof of success stands today as Adayar Cancer Institute, which she initiated for the benefit of masses. This reform is presently headed out by another female physician namely, Dr.Shantha [18].



Figure 12: Muthulakshmi Reddy

3.2 Scientific women personalities from the western world

Christine de Pizan is a fifteenth-century writer in France. She is the author of the Book of the City of the Ladies. She was an early feminist who challenged her culture’s stereotypes of women. She wrote love ballads, books supporting and extolling the powers and virtues of women (including a response to Jean de Meun’s Roman de la rose), and a work about Joan of Arc.[6]



Figure 13: Christine de Pizan

Maria Sibylla Merian was a Naturalist, an Entymologist and a Botanical Illustrator. She published collections of engravings of plants in 1675, 1677, and 1680. She collected and observed live insects and created detailed drawings to illustrate insect metamorphosis.[7]



Figure 14: Maria Sibylla Merian

Maria Gaetana Agnes was the first woman to write a mathematics handbook and the first woman appointed as a Mathematics Professor at a university. She is credited with writing the first book discussing both differential and integral calculus and was a member of the faculty at the University of Bologna[8].



Figure 15: First Page of the Book Agnesi wrote

Laura Bassi was an Italian scientist and the first woman professor to be appointed at a European university.. Bassi contributed immensely to the field of science while also helping to spread the field of Newtonianism through Italy[9].



Figure 16: Laura Bassi

Charlotta Frolich became the first of her gender to be published by the Royal Swedish Academy of Sciences with three books in agricultural science depicting her own experiences and suggesting various inventions in agriculture. The only other female to be published by the Academy of Sciences during the age of liberty was Eva Ekeblad[10].



Figure 17: Charlotta Frolich

Marie Curie discovered two new chemical elements – radium and polonium. She carried out the first research into the treatment of tumors with radiation, and she was the founder of the Curie Institutes, which are important medical research centers.

She is the only person who has ever won Nobel Prizes in both physics and chemistry.[19]



Figure 18: Marie Curie

A gifted mathematician, **Ada Lovelace** is considered to have written instructions for the first computer program in the mid-1800s.

Ada showed her gift for mathematics at an early age. She translated an article on an invention by Charles Babbage, and added her own comments. Because she introduced many computer concepts, Ada is considered the first computer programmer.[20]



Figure 19: Ada Lovelace

Grace Hopper was one of the pioneers in the early days of electronic computers. She and her team invented A-0, the world's first compiler. Then, determined to make programming accessible to more people, she replaced mathematical symbols in programming with everyday English words. Her English-language-based FLOW-MATIC was the bedrock of the 20th century's most widely used computer language COBOL (Common Business-Oriented Language)[21].



Figure 20: Grace Hopper

Hedy Lamarr was an actress during MGM's "Golden Age." She starred in such films as Tortilla Flat, Lady of the Tropics, Boom Town, and Samson and Delilah, with the likes of Clark Gable and Spencer Tracey. Lamarr was also a scientist, co-inventing an early technique for spread spectrum communications—key to many wireless communications of our present day[22].



Figure 21: Hedy Lamarr

4 Analysis

The biographies of each of the aforementioned individuals provide the proof of the accomplishment in varied fields. An analysis in terms of the field and the challenges that they faced are provided in Table 4.

Table 1: Analysis of a few female personalities

S.No	Name	Period	Area of Excellence
1	Merit-Ptah	Third Dynasty of Egypt - 2700 BCE	Physician
2	Agnodike	4th Century BCE	Gynaecologist
3	Agamede	Twelfth Century BCE	Physician for plants
4	Maria the Jewess	First - Third Century AD	Alchemist
5	Hypatia	Fourth Century AD	Mathematician
6	Janaki Ammal Edaaleth Kakkat	Nineteenth - Twentieth Century AD	Botanist
7	Aseema Chatterjee	Twenty-first Century AD	Chemist
8	Dr. Anandi Gopal Joshi	Nineteenth Century AD	Doctor
9	Shakuntala Devi	Twentieth Century AD	Mathematician
10	Anna Mani	Twentieth Century AD	Physicist and Meteorologist
11	Dr. Muthulakshmi Reddy	Twentieth Century AD	Political Leader
12	Christine de Pizan	Fifteenth Century AD	Writer
13	Maria Sibylla Merian	Seventeenth Century AD	Botanist
14	Maria Gaetana Agnes	Eighteenth Century AD	Professor
15	Laura Bassi	Eighteenth Century AD	Scientist
16	Charlotta Frolich	Seventeenth Century AD	Author
17	Marie Curie	Twentieth Century AD	Scientist
18	Ada Lovelace	Nineteenth Century AD	Programmer
19	Grace Hopper	Twenty-first Century AD	Programmer
20	Hedy Lamarr	Twenty-first Century AD	Scientist and Actress

5 Conclusion

This paper has provided a list of few intellectual women who were successful in their field of study. The enormous struggles and hardship that these women have faced cannot be accounted in a single article. With limited resources and support, the women went on to become pioneers in their respective field. For example, Dr. Anandi had faced difficulties in multiple dimensions - in terms of gender, money, health and religion. But these factors do not deter her towards her goal. Same is the case with other women personalities. In the present scenario, given the choices of facilities and technology, there is no limit to reach great heights in STEM. With this little background, we hope that this paper will act as an inspiration to the present generation female individuals.

References

- [1] <http://www.universityofhumanunity.org/biblios/Sarasvati>
- [2] Ahuja, M.L. 2011. Women in Indian Mythology Rupa Publications
- [3] Kisari Mohan Ganguli The Mahabharata of Krishna-Dwaipayana Vyasa Translation from original Sanskrit Text <http://sacred-texts.com/hin/maha/index.htm>
- [4] <https://sites.google.com/site/shrineathenapromachos/prayers-poems>
- [5] <http://www.ancient.eu/article/49/>
- [6] <http://historymedren.about.com/od/cwho/a/Christine-De-Pizan-Quotes.htm>
- [7] https://en.wikipedia.org/wiki/Maria_Sibylla_Merian
- [8] https://en.wikipedia.org/wiki/Maria_Gaetana_Agnesi
- [9] <http://www.sciencemuseum.org.uk/broughttolife/people/laurabassi>
- [10] <https://alchetron.com/Charlotta-Frolich-1083211-W>
- [11] Retrieved from <http://4go10tales.blogspot.in/2012/06/lilavati.html>
- [12] Retrieved from https://en.wikipedia.org/wiki/Janaki_Ammal

- [13] by S C Pakrashi. Asima Chatterjee, Retrieved from http://www.ias.ac.in/public/Resources/Initiatives/Women_in_Science/Co
- [14] Dall, Caroline Wells Healey, The life of Dr. Anandabai Joshee: A kinswoman of the Pundita Ramabai Roberts Brothers (Boston, Mass.), 1888
- [15] Shakuntala Devi, 'Human Computer' Who Bested the Machines, Dies at 83, The NewYork Times', Retrieved from <http://www.nytimes.com/2013/04/24/world/asia/shakuntala-devi-human-computer-dies-in-india-at-83.html>
- [16] Retrieved from <http://www.thebetterindia.com/83063/anna-mani-scientist-meteorology-ozone-wind-energy/>
- [17] Retrieved from https://en.wikipedia.org/wiki/Muthulakshmi_Reddi
- [18] Retrieved from <http://health.economictimes.indiatimes.com/news/hospitals/interview-dr-v-shanta-chairperson-cancer-institute-wia-adyar-chennai/49182834>
- [19] <http://www.famousscientists.org/marie-curie/>
- [20] <http://www.biography.com/people/ada-lovelace-20825323synopsis>
- [21] <https://www.famousscientists.org/grace-murray-hopper/>
- [22] <http://www.biography.com/people/hedy-lamarr-9542252>