Josephine Quest: Multidisciplinary Research Horizons

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Women in Mathematics

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Abstract:

Right from the times of the Greek mathematician Hypatia (who edited the work on the conics of Apollonius, which divided cones into different parts by a plane) whose works were expanded by Isaac Newton, Rene Descartes and Gottfried Wilhem Leibniz to Maryam Mirzakhani who became the first woman to win a Fields Medal, several women have made exemplary contributions to the field of mathematics, even after being subject to societal challenges and gender discrimination. Few of those phenomenal women and their contributions have been discussed here.

Introduction:

What Say the Vedas Regarding Women?

The Vedas describe these women in great detail; they were partners' equals and enhancers. Four names spring to mind when discussing important female characters from the Vedic era: Ghosha, Lopamudra, Sulabha Maitreyi, and Gargi. Numerous hymns contain Vedic wisdom, and 27 women-seers are revealed by them.

Vedic Mathematics: An Overview and Prospects

This amazing technique of computation was discovered in the beginning of the 20th century, when there was a significant interest in ancient Sanskrit manuscripts, particularly in Europe. It was born in the Vedic Age but was buried under centuries of trash. However, because no one could detect any mathematics in some manuscripts known as the Ganita Sutras, which contained mathematical deductions, they were disregarded.

The Discovery of Bharati Krishna Tirthaji

Between 1911 and 1918, the Sanskrit, mathematics, history, and philosophy expert Sri Bharati Krishna Tirthaji (1884–1960) rediscovered Vedic maths from the ancient Indian scriptures. After years of studying these old manuscripts, he was able to piece together a set of mathematical formulas known as Vedic Mathematics (1965), which is regarded as the

foundation for all Vedic math research. It is stated that in his latter years, Bharati Krishna wrote this single book after his original 16 volumes explaining the Vedic system were destroyed.

Creation of Vedic Mathematics

A copy of the book made its way to London in the late 1960s, and Vedic maths was instantly acclaimed as a new alternative approach of mathematics. Jeremy Pickles, Andrew Nicholas, and Kenneth Williams were among the British mathematicians who showed interest in this novel approach. They expanded Bharati Krishna's book's introduction and gave talks on it in London. This was compiled as an Introductory Lectures on Vedic Mathematics book in 1981. Between 1981 and 1987, Andrew Nicholas made several journeys to India, which reignited interest in Vedic maths and led to a newfound respect for it among Indian academics and educators.

The Increasing Adoption of Vedic Mathematics

In the sphere of education, where math teachers are searching for fresh and improved methods to teach the subject, interest in Vedic math is expanding. This antiquated method is reportedly being used by Indian Institute of Technology (IIT) students as well for speedy computations. It is understandable that Dr. Murli Manohar Joshi, the Indian Minister of Science and Technology, emphasised the value of Vedic mathematics in a recent Convocation speech to IIT Delhi students. Joshi also highlighted the significant contributions of ancient Indian mathematicians, including Aryabhatta, who established the principles of algebra, Baudhayan, the renowned geometer, and the saintly pair Medhatithi and Madhyatithi, who developed the fundamental structure for numerals.

Math Research in Vedic

Numerous topics are being researched, including how teaching Vedic maths to kids affects them. Additionally, a lot of work is being done to create easier-to-use and more potent computer, geometry, and calculus applications for the Vedic sutras. On the centenary of Sri Bharati Krishna Tirthaji's birth in 1984, the Vedic Mathematics Research Group released three new volumes.

Advantages

Clearly, there are many benefits to employing a mental framework as flexible, sophisticated, and effective as Vedic maths. Under the Vedic system, students can break free from the constraints of the "one right way" and create their own solutions. Therefore, it can encourage creativity in bright students while assisting slow learners in understanding the fundamentals.

Main Content: Few phenomenal women and their contributions

1. SOFIA KOVALEVSKAYA

Sofia Kovalevskaya is known to be the first woman to receive a doctorate in Mathematics.

She was a Russian mathematician that achieved this feat even after struggling for most of her

adult life to have the same set of privileges to study as men. Her contribution to the field of mathematics was by way of her studies of differential equations, elliptic integrals and a study on Saturn and its rings.

She submitted 3 papers on these respectively, to the University of Gottingen in Germany, while she studied in Berlin, under the tutelage of another mathematician, Karl Weierstrass, who is also known as the father of modern analysis. Kovalevskaya's mathematical results, such as the Cauchy–Kowalevski theorem, and her pioneering role as a female mathematician in an almost exclusively male-dominated field, have made her one of the greatest sources of inspirations for young female mathematicians.

Her work - *On the Theory of Partial Differential Equations* - was even published in Crelle's journal, an outstanding honour for a then unknown mathematician. The journal was founded by August Leopold Crelle, a mathematician himself. It published works of great mathematicians like Carl Friedrich Gauss'.

2. SOPHIE GERMAIN

The Germain Theorem is named after Sophie Germain, a French mathematician born in the year, 1776. In her teenage, she spent her time studying the works of Newton and Euler in detail after she taught herself Latin. Suspecting that her research paper submission would be rejected once the professor came to know that it was submitted by a woman, she wrote under a man's name and continued to do it. The renowned mathematician Carl Friedrich Gauss acknowledged that Germain's works were exemplary.

When the French Academy of Sciences announced a contest to explain the underlying mathematical law of a study on the vibration of elastic surfaces, Germain became the only entry in the contest. In 1813, she received an honourable mention for her work on Theory of Elasticity by the French Academy of Sciences but did not end up winning the prize. In 1816, for her paper titled, *Memoir on The Vibration of Elastic Plates,* she won it. After this accomplishment she published several such memoirs, most importantly the ones that dealt with the *Nature, Bounds and Extent of Elastic Surfaces.*

She became the first woman who was not a wife of a member to attend the Academy of Sciences' sessions. She did this with the help of Jean-Baptiste-Joseph Fourier, another French mathematician who is best known for and is associated with Fourier Transform. The Institut de

France inviting Germain to attend their sessions was another remarkable achievement in her career, as this invitation was highest honour that this institute conferred on a woman, during that time. Sophie Germain died at the age of 55, before receiving an honorary degree which was recommended by her mentor Gauss. The Germain Theorem was a result of her extensive work on Number Theory.

Today, she is one of the prominent figures in mathematical physics and her contributions to the field of elasticity, thanks to her undying passion to learn despite prevailing gender prejudices, is inspirational for generations.

3. KATHERINE JOHNSON

Katherine Coleman Johnson was born in White Sulphur Springs, West Virginia, in 1918. An expert in complex manual calculations, at the age of 18, Katherine Johnson graduated with the highest distinction. In 1953, she accepted a job offer from The National Advisory Committee for Aeronautics (NACA), which was a United States federal agency founded to undertake, promote, and institutionalize aeronautical research.

This agency later became what the world famously knows today as NASA (National Aeronautics and Space Administration). She worked for NASA until she retired as an aerospace technologist in 1986. Katherine Johnson made stellar contributions to the United States space program, that included celestial navigation calculations for the missions of John Glenn and Alan Shepard, the Apollo 11 flight to the moon, and the Apollo 13 lunar flight that returned safely home after having to be aborted.

Hence, Johnson played an influential role for the first spaceship and the first Americans land on the moon. Johnson was included on the BBC's list of 100 Women of influence worldwide. In a 2016 video, NASA stated, "Her calculations proved as critical to the success of the Apollo Moon landing program and the start of the Space Shuttle program, as they did to those first steps on the country's journey into space."

Being a woman and that too of an African-American race, she broke stereotypes and refused to let any pressure from society shake her and remained a strong and assertive person with

exceptional technical brilliance. She became one of the very first African-American to work as a scientist for NASA.

4. SHAKUNTALA DEVI

One of the stories that was rarely talked about until recent times was that of an Indian woman, who earned the moniker of a "Human Computer" and rightly so. She was the legendary mathematician, Shakuntala Devi. She did not receive any formal education as a child.

Her spectacular ability of calculating and memorising numbers was discovered age of 3, thanks to her father, who worked as a circus artist. When she was born on the 4th of November, 1929, it would be fair to assume that little did her father know about the grand circus of numbers that his daughter would build in her mind. Some of the books she authored include – *Puzzles to Puzzle You*, *Figuring The Joy of Numbers, Awaken The Genius In Your Child* and *In The Wonderland of Numbers.*

Particularly known for her ability to quickly and accurately complete difficult mental computations, one of most remarkable of her many achievements was in 1977, in the USA, where she competed with a computer to calculate the cube root of 18,81,32,517. The Human-computer won. On June 18, 1980, the Human-computer, Shakuntala Devi demonstrated the multiplication of two 13-digit numbers 7,686,369,774,870 × 2,465,099,745,779 picked at random by the Computer Department of Imperial College, London. She answered 18,947,668,177,995,426,462,773,730 in 28 seconds which is correct. This event is mentioned in the Guinness Book of Records.

With the ability to calculate the cube root of 61,629,875, and the seventh root of 170,859,375 without writing it down or using a calculator, Shakuntala Devi's abilities were studied by Arthur Jensen, a professor of psychology at the University of California, Berkeley in 1988.

He wrote in his report that the calculation was done and answers given even before he wrote the answer in his notebook. The findings were published in the academic journal, Intelligence, in the year 1990.

Shakuntala Devi was successful in making mathematical concepts more entertaining and fun to learn for wider audiences. The world remembered this unparalleled mathematician once again, in the year 2020, when a Hindi-language movie was made on her life.

5. MARYAM MIRZAKHANI

In 2014, the Iranian mathematician Maryam Mirzakhani created history by becoming the first woman to be awarded the Fields Medal (named after mathematician John Charles Fields), the highest award given in the field of mathematics. She was a professor at Stanford University

and held a Ph. D from Harvard University.

Her work solved several problems and answered questions about hyperbolic surfaces and resulted in three papers published in the top journals of mathematics.

In 2006, she was recognized as one of Popular Science's "Brilliant 10" extraordinary scientists. In 2008 she joined the faculty at Stanford University as a full professor of mathematics. Her contributions to the *study of the dynamics and geometry of mathematical objects called Riemann Surfaces and their moduli spaces*, earned her the invaluable Fields Medal. It is not an exaggeration by any means to say that she was one of the greatest mathematicians of this generation.

In 2016, she was made a member of the National Academy of Sciences (of the United States), making her the first Iranian woman to be officially accepted as a member of the academy. Maryam Mirzakhani passed away at the age of 40, in 2017, while battling breast cancer. It was at the World Meeting for Women in Mathematics in Rid de Janeiro in 2018, that the delegates voted to recognise 12th of May as an annual global Celebration of Women in Mathematics on Maryam Mirzakhani's birthday.

CONCLUSION

These female mathematicians are only a few among a great list of names that have given solutions to innumerable complex mathematical problems, despite all the challenges that came with being a woman. The duty relies upon us, today, to take note of their contributions and life stories and pass it on to the generations to come and encourage them, which can only take them to greater heights, help them gain inspiration and recognise their potential.

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