विज्ञान प्रसार
VIGYAN PRASAR

VIGYAN VIDUSHI

75 TRAILBLAZERS OF SCIENCE

Kadambini Ganguly Anandibai Gopalrao Joshi. Mary Poonen Lukose E
Chowdhary Asima Chatterjee Kamal Ranadive Anna Mani Rajeshwari Cha
Satyavati Sirsat Archana Sharma Bimla Buti Sudha Gajanan Gangal P Mo
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Preamble

Women researchers in India are witnessing their best times. The policymakers and academia have risen to proactively address issues for women in STEMM and several initiatives have been launched to acknowledge the contribution of women researchers in building the new India. An example of it is the establishment of eleven (11) Chairs in the names of Indian Women Scientists at institutes across the country in 2020. Of special note is the fact that despite the winds of progress flowing in the right direction, we face major blockers impeding the course. The UNESCO Institute of Statistics (UIS) has reported the number of women researchers across the world to be less than 30% of the total workforce; for India, it is somewhere around 15-20%. Thus, to improve these numbers, India needs to devise evidence-based policies and innovative ways to change the society's attitude towards women in science.

The Inception

India is to create exceptional memories in 2022 as it celebrates ***Azadi Ka Amrit Mahotsav*** to mark seventy-five years of its independence. It is dedicated to the people of India who have been instrumental and participative in its evolutionary journey towards becoming an empowered and self-reliant nation. As a part of the celebrations marking AKAM, ***Vigyan Prasar*** conceived the idea of compiling a resource on the contribution of women scientists and researchers in making India shine in STEMM (Science, Technology, Engineering, Mathematics, and Medicine) fields in the form of a book called ***Vigyan Vidushi***.

As the Mahotsav revives the spirit of independence, it is obvious to have a sneak peek into the pre-independence era—to remind us of the beginning of our quest to freedom and desire to build a self-reliant nation. Thus, ***Vigyan Vidushi*** profiles women scientists from pre-independence era and from the seventy five years that have spanned upto post-independence (1947-2022).

Vigyan Vidushi is not just another book but a reflection of how women have progressed in the field of science and have contributed to its development . While a few in government and academia are striving hard to promote women in science, the contribution of society as a whole is still parsimonious. Being a few in numbers does not reflect incompetency or inability on part of women to pursue a successful career in science. Rather, it uncovers deep rooted flaws in our society—the pervasive gender bias, the expectations to abide by socio-cultural norms, conditioning of girls to choose a particular career and so on. Even today, we as a society lag behind in teaching our girls to take risks, make independent decisions and dream big.

Pioneers Who Embraced Difficult Choices and Heavy Compromises

Vigyan Vidushi is an attempt to showcase the life journey of women scientists who have not only championed the cause of science but are also pioneers in many ways—whether choosing to opt for career dominated by males or were the male bastion or deciding to move abroad (Anandibai Joshi) or to choose a subject such as engineering (Rajeswari Chatterjee) or medicine (Kadambini Ganguly); none of which was traditionally meant for women in those times. The book compiles many 'Firsts' in its collection of life journeys.

In their pursuit, ***Vidushis*** broke the traditional socio-cultural norms that were hurdles on their way. Deciding not to marry (Bimla Buti) or not to have children (Rohini Godbole) or living separately from their husbands for the sake of career (a choice made by Neelima Gupte/Rohini Godbole). They are a source of inspiration for young women in science and would keep inspiring generations to come. Their quest to pursue a career in science despite all odds, their propensity to move on against all adversities would certainly inculcate confidence in the young women in STEMM and would give them the courage not to yield or give up to the restrictive socio-cultural norms.

The Backdrop and Early Women Thought Leaders

For a few of these women, the journey started in the exceptional times of British rule, when higher education was restricted to the elite and mostly to men. Scientific enterprise was never a gift to a particular gender. However, we must not forget that during the pre-independence era, the

This book is a reflection of how women have progressed with the nation in the last 75 years and what we must strive to become for 'Women in Science'.

The respect and applause for the Indian women in science can never be confined to a quantifiable number or a list of names. It goes much beyond and is rather qualitative and subjective. Initially, ***Vigyan Prasar*** screened the names of more than two hundred and fifty (250) women scientists for selecting the final seventy five (75). Selecting the 75 was an arduous task, and thus ***Vigyan Prasar*** followed the criteria approved by the advisory committee for picking out a set of women luminaries for ***Vigyan Vidushi***. We are mindful that a single compendium is never enough to bow in reverence to praise the efforts of all ***Vidushis*** of the Indian soil.

Future Hopes

Towards the end, we have included snapshots of about 36 future hopes — the younger lot, who entered higher education in the 21st century. These women have captured the nerve of the new-age advancements in science education, research, and innovation and represent the 'New and changed India'. The scientific legacy of our 75 icons is passed on to the current generation of women, who are doing a great job of nurturing it. For example, Anindita Bhadra received an award in the name of Janaki Ammal, whose biography is showcased in this book.

Further, many of these women are members of Indian science academies—which is a huge leap from the past, for if one maps the first four-five decades after independence, the representation of women in science academies was significantly low.

Most of these 36 women have been conferred awards that were instituted after the year 2000. For example, Gitanjali Yadav and Sharmistha Sinha have won the 'SERB women Excellence Awards'. It highlights the changes in the Indian scientific set-up ,where special awards have been instituted for promoting women in science.

On the contrary, Niti Kumar and Mahalaxmi Radhakrishnan have bagged highly competitive fellowships such as Swarnajayanti fellowships and DBT Wellcome Trust India Alliance Fellowship, respectively. This suggests that competence can never be gendered in any manner.

Our upcoming leaders such as Rohini Garg and Shalini Arya are members of contemporary vibrant academies such as 'Indian Young Academy of Sciences' (INYAS, 2014) and Global Young Academy, Germany (GYA, 2010), respectively. Thus, women scientists are driving fresh institutions that reflect the changing needs of academia and research.

These young women are certainly redefining the status of disciplines traditionally not ventured by women, such as engineering. The example that Rajeswari Chatterjee sets in by becoming the first female professor of engineering in IISc is alive and kicking in young brigades. For example, Neeldhara Misra holds the prestigious INAE Young Engineer Award, and Ruchi Sanghvi became the first female engineer to be hired by Facebook.

There is another crew of interesting women who started as researchers but have now established novel domains such as research management (Savita Ayyar) and intellectual property consultancy (Lipika Sahoo) and whose work have been endorsed and supported by S&T policymakers.

These 50 women have touched most disciplines in S&T and are not only expanding what their predecessors had initiated, but creating new horizons for our young generations to progress forward.

Concluding Message

More than the offices of policymakers, S&T leaders, and other decision-making bodies, this book must aim to enter common house-holds to sensitize the society on the pride and global success that we have achieved as a nation from the contribution of ***'Women in Science'***. It took more than half a century post-independence for the Government of India to acknowledge the ***'collective contribution'*** of women in all fields including S&T with the year 2001 being marked as Women Empowerment Year. In fact, many of the compilations, articles, and books on ***'Women in Science'*** were published in the first two decades of this millennium. 'Lilavati's Daughters' (2008), published by the Indian Academy of Sciences, Bengaluru being the most noted and revered. Major scientific bodies such as INSA and DST took charge and published several reports on women in science and their career progression.

This book showcases these enabling aspects subtly mixed in the background of career journeys of women researchers and science leaders. It is better explained with an analogy, ***"The farmer is informed, the soil fertile, the seeds well produced, the climate conducive—the harvest is going to be magnificent like never before"***.

Young women students are like seeds that are groomed in the best of academic institutions. Their foremothers (established women researchers) have painstakingly prepared a fertile ground for them to flourish. The farmer is the academic, scientific, and political leader who is well informed of the 'problems of the practice' and has resolved to channelize resources accordingly. The climate represents the active global efforts for promoting women in science. Through such a message provided in this book we aim to reach out to our young girls and infuse them to rise above self-doubt, tackle the fear of hostile biases, and take charge not only to seal the leaky pipeline but to escalate to upper echelons of scientific leadership. •

Nawab Faizunnesa Choudhurani, is an advocate and activist of female education, social worker and poet. With her own funds she established Schools and hospitals in Bengal. She was honored with the title 'Nawab' as a reward for her noble deeds.

Sarala Ray a great social reformer and educationist, founded the

Readers would be able to appreciate the fact that most of the women researchers received unflinching support from their families, colleagues, and mentors.

ROHINI GODBOLE

Being The Light

- **1992** Elected Fellow of the Indian Academy of Sciences
- **2009** Fellowship of Academy of Sciences of the Developing World, TWAS
- **2019** Padma Shri for Her Contributions in Science and Technology
- **2021** Ordre National du Merite by the French Government

Her passion for science is not ordinary, for even in her 70's, she keeps telling to herself every day, when she wakes up in the morning that "it's a new day!" A celebrated theoretical physicist, a Padma Shri awardee (2019) and a recipient of French 'Order of Merit' (2021) in recognition of her research and contribution in promoting the cause of 'Women in science', Rohini was born in a family of intellectuals who valued girl education in that era, when women literacy was neglected. In her school, girls were taught home science, as that was what they were supposed to learn. She studied in a vernacular medium, with no science till the eighth grade. Thus, a young Rohini had no idea of what learning science would be. It was because of her sheer dedication—choosing research over any other thing and not getting distracted by indulgences of life—that she made it to the 'High Energy Physics Advisory Panel' of the United States. Rohini worked very hard, day in and day out to reach the pinnacle of success and establish herself as a stalwart in high energy physics.

Rohini had a desire to compete for middle school state merit scholarship exam, but she needed science lessons to succeed. One of her teacher's husband, Mr Sohani pitched in to help Rohini with science lessons on Sundays. He introduced her to a Marathi science magazine 'Shristi Gyan' and both would bicycle to the office of 'Shristi Gyan' every Sunday to get old issues of the magazine. For Rohini, these 'Sunday Science Outings' were her early exposure to science.

While her mother would discuss Sanskrit texts and her father would read interesting topics from the Sunday science supplement of 'The Times of India'; Mr Sohani intrigued Rohini for science. She became the first girl from her school to have cleared the scholarship test.

Rohini shares, "In my senior school, I thought of doing a PhD in Sanskrit or Mathematics; a part of young me knew that I was going to lead the life of a scholar". Rohini was a rank holder in SSC examination and her elder sister persuaded her to appear for the National Science Talent Scholarship (NSTS)—a scheme launched in 1963 to promote basic sciences.

Rohini attended summer schools at IIT Delhi and Kanpur as an NSTS scholar during her BSc She decided to pursue her career in theoretical physics while pursuing her MSc at IIT Bombay. She completed her PhD from State University of New York at Stony Brook in 1979 and returned to India to join TIFR as a research fellow. Later she joined the University of Bombay and soon took a long leave for her post-doctoral research.

Rohini talks about her visits to CERN that houses the Large Hadron Collider (LHC), the world's most powerful particle accelerator. It was at CERN, that she received international recognition for her research work from the particle physicist community. She says, "The cornerstone of my science is that I am a particle physics theorist but I work closely with experimental physicists".

Rohini devised strategies for collider searches for important particles, like the top quark. Her work on an unexplored corner of the theory of strong interactions pointed out how to use collider experiments, to gain information on effective hadronic interactions that a high energy (100's of giga electron volt) photon can have. Interestingly, this seemingly academic exercise turned out to have important implications for the background for experiments at the planned electron-positron colliders and hence for designs of these colliders.

Rohini Godbole receiving Padma Shri

Godbole says that the scientific ability and excellence of women may stop men from gendering but there are still many barriers for women to cross. She cites her parents support who realized that settling in science was more important to Rohini than domestic settlement. For a girl, travelling abroad alone was not a socio-cultural norm and considered scary, yet her parents stood steadfast and inspired Rohini to follow her choices, become independent and stay fearless.

Rohini was never interested in administration, however, she chaired several academic committees and influenced policy decisions in S&T, especially for 'Women in STEM'.

Rohini points out that sometimes women scientists make decisions to not to have children so as to navigate their research path better. She believes that a woman needs a huge dose of luck to have a successful career, a happy marriage and a family of their own, while men do not. She waits for the day when our society creates enabling systems where women no longer require that dose of luck to have a successful career and a happy family. •

— Adita Joshi

Travelling abroad alone was not a socio-cultural norm and considered scary, Rohini followed her choices and stayed fearless.