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EDITORIAL

A TRIBUTE TO PIONEER WOMEN SCIENTISTS OF INDIA



Most Indians are aware that they have a great heritage, but few would include science in it. They believe that science is an import from Europe. Before the birth of Christ, people of the Indian subcontinent had acquired knowledge of science which can only be described as amazing. Relics

of the Indus Valley civilization at Harappa and Mohenjodaro (now in Pakistan) indicate that their cities were well-planned, with excellent water supply and drainage systems. The progress achieved in agriculture, brick-making, craft and industry was remarkable. Their clothes were made of cotton. It is still unknown that this civilization decayed and was lost.

The era from Aryabhatta to Bhaskara II (5th to 12th century C.E.) saw India enjoying a state of science that was advanced compared to other countries of the world. The golden age of science in India was from the fourth century B.C. to the sixth or seventh century A.D. With the prosperity of land, science flowered. There were renowned universities at Nalanda (the world's first residential university), Vikramshila and Taxila (now in Pakistan). India is famed for its rich contribution to the field of science and mathematics. In fact the concept of 'Zero' as a number and decimal system were inventions of brilliant mathematicians of ancient India (Bakhshali manuscript: 224-383 CE). Outstanding contributions were made to not only in mathematics but also in astronomy and medical science. A major benefit to Indian science during British rule was the spread of education in English, the language of modern science. The learning of science got a fillip in **1857 when three universities were created**

at Calcutta, Bombay and Madras. In 1876 a rich physician, Dr. Mahendra Lal Sircar, set up the first scientific research institution in Calcutta, known as the Indian Association for the Cultivation of Science, which became the focus of scientific activities in pre-independence India.

A new page was opened in the history of science in India when the country became independent on **August 15, 1947**. There was a remarkable expansion of facilities for scientists and the research began and prospered in many fields. India is now a member of (i) the nuclear club, (ii) the space club, and (iii) the Antarctica exploration club. It has the world's third largest pool of trained technologists, next only to the USA and the Soviet Union, though it is still a developing nation. Now it is the role of Indian scientists including the women members to do much more to catch up with the advanced countries.

A society would advance ahead of others if it has an all pervasive scientific spirit receiving and assimilating the new scientific inventions and make the best use of them. The scientific spirit is the bedrock of any perceptible progress. Unfortunately, in a traditional society like ours, we are yet to create an effective and vibrant scientific temperament for science graduates. It is our fervent hope that **our** college students understand the evolution of science and the arduous path of the scientist so that they would be inspired to be scientific in their outlook and be receptive to new inventions and innovations.

Contributions of Women Scientists:

Women have made significant contributions from the earliest times. Women contributed the science of alchemy in the first or second centuries AD. The eleventh century saw the emergence of the first universities where women were excluded from university education. The attitude of educating women in medical fields in Italy appears to have been more liberal than in other places. The first woman

in the world to receive an academic degree from the University of Padua (founded in 1222) and in **1678** became the **first woman in the world to receive Doctor of Philosophy (D.Phil.) degree was Elena Cornaro Piscopia from Italy** (1646-1684). The first known woman to earn a university chair in a scientific field of studies was eighteenth century Italian physicist/scientist, Laura Bassi. **Bassi (1711-1778) was awarded a D.Phil (science) in 1732 at the University of Bologna (established in 1088, the oldest and first university in the world). She became the second woman in the world to earn doctorate degree but first in Science. She was the first female university Professor in Physics at a University in Europe.**

The Nobel Prize by Women Celebrities :

The Nobel Prize and the Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel have been awarded to women 59 times and men 888 times between 1901 and 2021. Only one woman, Marie Curie has been honoured twice, with the Nobel Prize in Physics 1903 and in Chemistry 1911. From India only one woman **Mother Teresa** from Kolkata, was awarded Nobel Prize in Peace in 1979.

Celebrated Women Scientists of India:

1. Kadambini Ganguly (1861-1923): The first Indian woman to receive her degree as a Medical doctor in 1886 and the first female graduates of the British Empire and South Asian female physician trained in western medicine. First studied in Calcutta Medical College. She was also **one of the earliest working women in British India.**



Kadambini Ganguly

Kadambini was one of the first two graduates from Bethune College in 1883 along with Chandramukhi Basu, in the entire British Raj. 1886 marked her record as one the first Indian women physician eligible to practice western medicine alongside Anandi Gopal Joshi. She received her GBMC (Graduate of Bengal Medical College) degree, allowing her to practice. She even left for the United Kingdom in 1892 to get more experience in her field and received various certificates from Edinburgh, Glasgow, and Dublin. After returning to India, she worked for a short period in Lady Dufferin Hospital and started her private practice later. Kadambini organized

the Women's Conference in Calcutta for solidarity and served as its **President** in 1908. She died on 7th October 1923. As a champion of women's education and rights, Kadambini Ganguly may have long gone, but she will never be forgotten!

2. Janaki Ammal (1897-1984): A world-renowned botanist and cytologist paved the way for a lot of young



Janaki Ammal

woman to embrace science and progress in the 20th century. Janaki did her B.Sc. degree from Presidency College in 1921. She taught at Women's Christian College, Madras. After receiving the Barbour Scholarship, she moved to the University of Michigan from where she obtained her Master's degree in 1925. Again after receiving the first Oriental Barbour Fellowship she obtained her Ph.D. in 1931 (**India's first woman doctorate**) and D.Sc (honoris causa) in 1935 from the same university. After returning Janaki joined the Sugarcane Breeding Station at Coimbatore. Janaki's research in this field led to identifying hybrid varieties of high-yielding sugarcane. In 1935, CV Raman, the famous scientist and Nobel laureate founded the Indian Academy of Sciences and selected Janaki as a research fellow. But she left for London as an Assistant cytologist in the Innes Horticultural Institute. She also co-authored The Chromosome Atlas of Cultivated Plants with renowned biologist CD Darlington. Janaki relocated to India in 1951 when Prime Minister Jawaharlal Nehru personally invited her. She restructured the Botanical Survey of India (BSI) and served as the Officer on Special Duty in Calcutta in 1954.. Janaki was awarded **Padma Shri in 1977** by the Govt. of India and passed away on February 7, 1984 at the age of 87.

3. Irawati Karve (1905-1970): A pioneering Indian



Irawati Karve

Anthropologist, educationist from Maharashtra. She obtained Masters degree in 1928 in sociology from Bombay University. Then moved to Germany to have her doctorate degree working at the Kaiser Wilhelm Institute of Anthropology, Human Heredity and Eugenics. Returning to India she

worked at the SNTD Women's University in Bombay, Deccan College, Pune as the head of the Department of Sociology and Anthropology and finally she founded the Department of Anthropology at the Poona University. She made significant contributions in the field of anthropometry, serology, Indology and palaeontology as well as collecting folk songs and translating feminist poetry. She was the **President of the Anthropology** Division of the National Science Congress held in New Delhi in 1947.

4. Kamala Sohonie (1912-1998): First Indian woman biochemist took 14 months to complete her Ph.D. degree



Kamala Sohonie

from the Cambridge University in 1939 having thesis in 40 typed pages on 'Cytochrome C' which plays an essential role in the electron transport chain found in plants, human and animal cells. Returning from England she joined the department of Biochemistry at the Lady Hardinge Medical College, New Delhi

to work on nutrition research. Later she moved to Bombay to join the Royal Institute of Science as Professor of Biochemistry. She worked on the nutritional aspects of legumes. She was finally become the first Lady Director, Institute of Science, Bombay. She was awarded the Rashtrapati Award for her research work. She was also felicitated by the Indian Council of Medical Research (ICMR), New Delhi. The topper of Bombay University was refused admission by Sir C.V. Raman – India's Nobel Laureate. *"I am not going to take any girls in my institute" (1933). Kamala was to later recount —Though Raman was a great scientist, he was very narrow-minded. I can never forget the way he treated me just because I was a woman. Even then, Raman didn't admit me as a regular student. This was a great insult to me. The bias against woman was so bad at that time. What can one expect if even a Nobel Laureate behaves in such a way.*

5. Bibha Chowdhuri (1913-1991): She was a gifted particle physicist and the first Indian woman to earn a Ph.D. in Physics. She discovered mesons using nuclear emulsion, identifying new particles by studying their tracks in cloud chambers and on photographic plates and also on Kolar Gold Fields. The only woman student to complete M.Sc. (Physics) degree in 1939 from the University of Calcutta. She joined the Bose Institute and moved to the University of Manchester for her Ph.D. degree in 1949



Bibha Chowdhuri

under the supervision of Sir Patrick Blackett. She conducted research on cosmic rays and air showers. Returning to India she joined TIFR (Tata Institute of Fundamental Research) in 1949 and worked for eight years, then to Physical Research Laboratory in 1957 and finally to Saha Institute of Nuclear Physics, Kolkata in 1960 and continued her research until her death in 1991. The IAU has rechristened the star **HD 86081 as Bibha** (a yellow-white dwarf star in the constellation Sextans south of the celestial equator) after her.

6. Asima Chatterjee (1917-2006): The first woman awarded a Doctor of Science by an Indian University in



Dr. Asima Chatterjee

1944, by the University of Calcutta. She was also the first woman to be elected as the General President of the Indian Science Congress in 1975. She was elected a Fellow of the Indian National Science Academy in 1960 and won several prestigious awards/position such as Premchand Roychand Scholarship of the University of Calcutta,

Khaira Professor of Chemistry (1962-1982, the most prestigious and coveted chairs of the University of Calcutta). the Shanti Swarup Bhatnagar award (1961), the C V Raman award, and the P C Ray award; and is the recipient of the **Padma Bhushan** in 1975, the third-highest civilian award of the Govt. of India, in recognition of her contributions to the field of science. Her area of interest was natural products with special reference to medicinal chemistry. *She published 400 research papers in reputed journals, about 15 books, supervised 60 Ph.D. theses and 3 D.Sc. theses.* She was nominated by the President of India as a Member of the Rajya Sabha from February 1982 to May 1990. Prof. Chatterjee also served ISNA Council for long time and also acted as one of the Vice-Presidents.

7. Kamal Ranadive (1917-2001): She is an Indian biomedical researcher best known for her groundbreaking cancer research and devotion to creating a more equitable society through science and education. She did her



Kamal Ranadive

she joined ICRC, Bombay and for the first time established tissue culture laboratory in India in 1960. She was the pioneer woman scientist in animal modeling of cancer development. For the first time in India she proposed a link to the susceptibility of cancer and hormones and tumor virus relationship. Finally she worked as the Director of the ICRC in acting capacity for a term of 1966-1970. She published about 200 scientific research papers in the field of cancer and leprosy. Dr. Ranadive was awarded the first Silver Jubilee Research Award in 1964 of ICMR, the G.J. Watumull Foundation Prize in microbiology in 1964 and finally she received the **Padma Bhushan** (India's third highest civilian award) for Medicine in 1982 by the Govt. of India.

8. Anna Mani (1918-2001): She was an Indian Physicist and meteorologist from Travancore, Tamil Nadu.



Anna Mani

She was also a former Deputy Director-General of the Indian Meteorological Department, who made significant contributions in the field of meteorological instrumentation. She studied meteorological instruments from Imperial College, London and finally joined the Meteorological Department in Pune after returning to India in 1948. She published numerous papers on solar radiation and wind energy measurements. She also authored two books, "The Handbook for Solar Radiation data for India in 1980 and Solar Radiation over India in 1981. Anna Mani won the **K.R. Ramanathan Medal** in 1987.

9. Rajeshwari Chatterjee (1922-2010): She is the first woman scientist to pioneer the field of Microwave Engineering and Antennae Engineering in India. She was a very bright student securing First class First in B.Sc.(hons.) and M.Sc. Examinations in Mathematics in



Rajeshwari Chatterjee

1943, Then she joined IISC, Bangalore as a research student and after a short spell moved to USA and again took MS degree in 1949 from the department of Electrical Engineering and Ph.D. degree availing a Barbour scholarship in 1953 from Michigan University. She was the only Woman on the faculty in the Indian Institute of Science, Bangalore around 60 years ago. She mentored 20 PhD students, published about 100 research papers and authored seven books and finally retired as Professor and Chairperson of the Department of Electro-Communication Engineering, Indian Institute of Science, Bangalore. Dr. Chatterjee was awarded **J.C. Bose Memorial Prize** from the Institution of Engineers, **Mountbatten prize** from the Institute of Electrical and Radio Engineering(UK) and **Ramlal Wadha Award** from the Institute of Electronics and Telecommunication Engineers.

10. R. Rajalakshmi (1926-2007): A biochemist studied at McGill University, and worked at the University of Adelaide on a



R. Rajalakshmi

of Adelaide on a **Rockefeller ICMR** postdoctoral fellowship before retiring as the Head of the Department of Biochemistry at Baroda University in 1986. Both her children are scientists, too. **In 2009, her son, Venktraman Ramakrishnan won a Nobel Prize in Chemistry.** Rajalakshmi passed away two years before this. Rajalakshmi's most important work was her book *Applied Nutrition*, which made the principles of nutrition relevant to Indian diets — keeping in mind available grains, vegetables, herbs, etc.

Rajalakshmi held classes on language and nutrition for children from marginalised caste backgrounds. She encouraged children of all castes to share in the cooking and eating. Rajalakshmi acknowledged that sharing meals across castes was a "violation of unwritten codes and very much went against convention." Her attitudes towards nutrition, and building community across caste-lines were unusual in her time; they remain relatively rare even today.

11. Archana Sharma (1932-2008): A renowned Indian botanist, cytogeneticist and cytotoxicologist. She



Archana Sharma

had her M.Sc. (1951), Ph.D. (1955) and D.Sc. (1960) degree from the University of Calcutta. She was the second woman to be awarded D.Sc. degree from C.U. She joined the Department of Botany at C.U. as a faculty in 1967, and remained there till her retirement. Archana was a pioneer in studying chromosome structure and developed techniques for chromosome labelling. Her book with A.K. Sharma "Chromosome Techniques- Theory and Practice" is a standard reference book for chromosome staining worldwide. She published 400 research papers, 8 books, supervised 70 Ph.D. theses. She was a founder of the cytology journal *Nucleus*, and remained its editor until 2007. Additionally, Archana was actively involved in many policy-making bodies, and various committees of UGC, CSIR, ICAR, ICMR, DST, DBT and DOEn. In recognition of her contributions she won many awards like the **Shanti Swarup Batnagar Prize** (1976) by the Council for Scientific and Industrial Research, and the **Padma Bhushan** (1984) by the Govt. of India.

The Ministry of WCD, Govt. of India, has instituted Chair Professors in the name of Indian Women Scientists at Institutes across country to recognize and honour Indian Women Scientist's contribution to the field of science.

The progress of research being conducted by Indian women scientists in physical, biological, medical and pharmaceutical sciences and other allied disciplines are also commendable. Besides, it is also very pertinent to focus on the social and cultural issues of women scientists in the present society. Now we are paying our respectful homage and tribute to the celebrated Indian women scientists who brought name and fame to Indian science. The women scientists will lead the proper and the most significant pathway to proceed in right directions in the 21st century.

Here we have discussed about a few of the greatest Indian women scientists of all time. These women scientists changed the world through their talents and innovative ideas. They have made groundbreaking discoveries that have contributed to the betterment of human kind. Their lives are role models for all girls who aspire to make a mark and achieve excellence in STEM. □

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