

FEATURE ARTICLE

8th March is International Women's Day. Here's celebrating woman power in the area of space science with some sterling examples.

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Ecstatic ISRO scientists after a successful mission

Unsung Heroes: *Women Pioneers of Space*

'BEHIND every successful man is a woman' goes a popular saying, signifying the equal, competent, yet silent role some women play in a given success story.

This dictum appears to hold good in the field of Space Science as well. In the sixty plus years of space technology and development, a close look reveals that it is predominantly a male bastion. The lack of an equal number of women in this area is reasoned to social disparity, non-recruitment of women as pilots, fears that women physiology may not be suitable for microgravity, and many more debatable outlooks.

Upon closer scrutiny, what comes to the fore is, even in times when women were not considered in the field of space science, a few enterprising and bold women were playing their part to bring about a change in this outlook. Thanks to their silent efforts, the scenario is fast changing now.

In the initial days of human space travel, a group of women enrolled in the experimental studies, though they were aware that they would not be considered for the actual mission. They had to fight their way through the system to even enrol for studies in the chosen field of aviation and space technology. Their task was to prove that women were equally capable of space travel and the limitations existed only in the mind of the system. Valentina Tereshkova's successful trip to the space station facility and back disproved inhibitions, opening the door for other women to follow.

While the difficulties faced by women to enrol as astronauts were a visible one, the plight of ground-based engineers was no better. Here too it was considered and believed that women were 'not competent enough' or capable of enduring and sustaining the challenges of this science. Simply put, a career in space technology was not on offer for women.

Despite these hurdles, a few women, driven by intrigue and passion for the field, stood up to challenge the disparity meted out to them. They questioned the existing setup, laws, and opportunities in the area of space technology. The only way they could enter the arena was to shine in their chosen academics, take any available chance and come to the fore. Soon they were proving their mettle in experimentations and ground-based studies.

As women enrolled for technical positions, in many cases their capability and authority were found to be more reliable than their male counterparts. They were playing key roles behind the scenes. Holding critical positions as ground-based engineers, consultants and technical experts, they helped in shaping the progress of space technology.

While astronauts have to be ready for intense physical and psychological endurance, the demands from ground-based engineers are no less. They play a critical role in designing schedules, monitoring the activity of the machinery and astronauts,

coordinating communication between the various interfaces, and also making path-breaking changes to the existing system. In this department too women have played a vital role, all the while remaining behind the scenes. Their contributions are no less as they are shaping the way the world approaches space explorations.

Here I showcase the stories of some of the women who spearheaded space exploration by their unique contributions. Their role was an indispensable one and many missions — which the world witnessed as path-breaking — would not have received the accolades they do today without the undaunting and silent contributions of these brave women.

This presentation is an ode and a salute to all the unsung heroes who have and continue to be a part of the triumphs of space missions, whether mentioned or not. While the list is a long one, limitations in space and scope of the column compel me to limit myself to a few names; many women continually toil away to put people and machinery into the realms of space.

United in Space

Whatever may be the political differences and divisions between countries on earth, they appear to be non-existent in space, don't they? It is evident that major powers and nations of the world work harmoniously for space missions: launching of satellites, space explorations and training of personnel, and other shared activities.

Isn't it interesting to know that a woman spearheaded this peacekeeping agenda, transforming the world's outlook on space? She envisaged Space as a region of a useful resource for humanity rather than a battleground. The iconic personality is Dr. Eilene Galloway, called the 'Matriarch of Space Law' and affectionately as 'the Grande Dame of Space'.

Around 1957, Dr. Galloway was working as a congressional researcher, National Defense Analyst and later Senior Specialist in International Relations (National Defense) with the Legislative Reference Service of the Library of Congress in the US. She was in charge of writing House and Senate documents including those of military importance.

When Russia launched its first satellite Sputnik, in 1958, it worried the US and the world at large, as it was perceived as a potential missile and warfare technology. The then US Senator Lyndon B. Johnson proposed the formation of the National Aeronautics and Space Agency (NASA) as a countermeasure. In this regard, he sought the help and expertise of Dr. Galloway to investigate and help in framing the necessary document to pass the bill.

Consulting engineers, scientists and experts, Dr. Galloway concluded that space had more potential to benefit humankind — like telecommunication, meteorology, travel, exploration and scientific experimentation — rather being confined to military activities.

She was not in favour of the creation of an 'Agency' which would speak of boundaries and differences. She put forth this proposal to the senator recommending that NASA should be an 'Administrative' body with international authority rather than a military 'Agency'. Seeing the impact of worldwide peace in her recommendation, Johnson immediately made amendments to the Bill and reformed NASA.

Soon after, Dr. Galloway helped create the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS). In his speech to the UN assembly, Senator Johnson said: "Today outer space is free. It is unscarred by conflict. It must remain this way. We know the gains of cooperation. We know the losses of failure to cooperate ... Men who have worked together to reach the stars are not likely to descend together into the depths of war and desolation." In these famous words were hidden Dr. Galloway's farsighted peacekeeping intentions.

Soon, all the other nations were convinced by the far-reaching benefits of this proposal and by consensus joined together to work united.

Human Computers

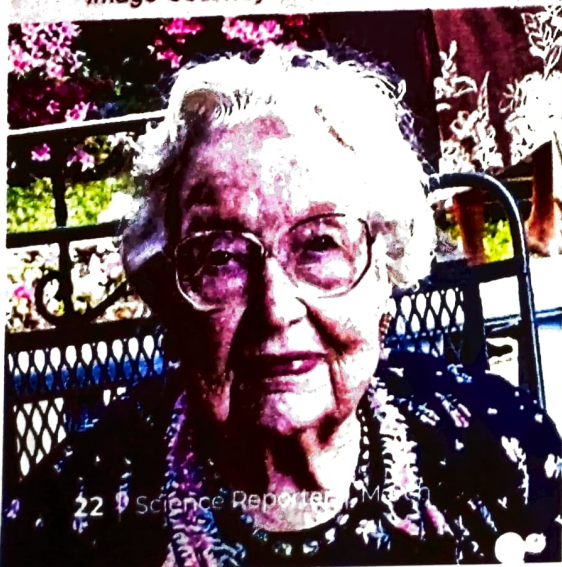
During the 40s and 50s, the Langley Memorial Aeronautical Laboratory provided the primary technical support to the National Advisory Committee for Aeronautics, NACA (later called NASA). Computers were not as evolved as we know them today, and many critical calculations were dependent on human mathematicians, called 'human computers'.

These aerospace technologists had to process all the data coming from instruments placed inside test facilities, wind tunnels and flight tests. Their task was to compute the values accurately using mechanical calculators.

During this time, breaking many social barriers, a group of three African-American women — Katherine Johnson, Dorothy Vaughan and Mary Jackson — joined the Space Task Force, to form a computer pool,

Dr. Eilene Galloway died in 2009 at the age of 102. Until her end, Dr. Galloway took a keen interest in Space law and contributed many essays.

Image Courtesy: www.iislweb.org





Katherine Johnson, the human-computer, was the first African-American woman to break the barrier at the Langley computer pool (Source: www.nasa.gov)

initially, recruited on an experimental basis. However, their prowess proved them to be indispensable in their field. Soon the engineers depended on them. They worked rapidly and accurately; the organisation is quoted to have admitted that these girls could do the work more efficiently than their male counterparts.

Evidently, they played a crucial role in the Mercury Mission — USA's mission to send the first man into space. Space historians quote that John H. Glenn, the first astronaut to fly on this mission, was wary of the actual calculations made by computers — machines of that time. As the world focused on his historic attempt, the astronaut looked up to Katherine Johnson. Before finalising his flight, he insisted that she run through the computations and check the results. Johnson's girl computer pool ran the calculations, calculated the trajectories and verified the algorithms that the instruments were expected to perform, putting Glenn at ease.

While researching for her book, author Margot Lee Shetterly compiled many such incidents of women mathematicians of that time into *The Human-Computer Project*. Delivering a talk Shetterly once said, "This is a really strong example of how women rise to the occasion in a very high-pressure scientific endeavour. All eyes were on this man as he is going into space and this is the woman who stood behind the man and checked the numbers. You cannot have a better example of what women are capable of doing in a scientific organisation."

The Force behind Cassini

Linda Spilker stoically watched as Cassini took gravitational assist from Titan and made the final plunge into the plumes of gas and dust of Saturn. It was an emotional moment for her, for, she had been an integral part of the Cassini mission from its inception to the grand finale.

Around 1980-81, the Voyager probes passed-by Saturn and beamed back valuable data of the gas giant. During this time, Spilker joined the Jet Propulsion Laboratory as a scientist. The scrolls of data from Voyager were handed over to her group. Mesmerised by it, she poured over the data to study the rings of the planet.

Running through the data for information, it occurred to her, "What if NASA sent an exclusive probe to Saturn to study these rings?" However, in those days and with their then available technology, it was a far-flung idea for NASA. Undaunted Spilker championed for a flagship mission to Saturn. It was

not until a decade after that the voyage was approved and realised.

It was a proud moment for this planetary scientist as she watched the launch and the flawless arrival of Cassini at the gas giant. Spilker was also responsible for designing the famous Cassini's dives through Saturn rings.

With Cassini's final plunge, the expedition is wrapped up at NASA, but not for Spilker. Now 62, she is busy rooting for another voyage to Enceladus: Saturn's moon which holds the promise of life. Her able assistant and fellow woman scientist Morgan Cable will be taking over from Spilker.

India's Rocket Women

ISRO is not far behind in able women scientists who play prominent roles in bringing its space activities to success. The Mars Orbiter Mission (MOM) or Mangalyaan was a path-breaking achievement for India. It was one of the missions that was given a public eye:

Linda Spilker with the Voyager team in the 1980s (Credit: Nasa/JPL-Caltech). Spilker was the force behind the Cassini Mission — from its inception to the disintegration.





Clockwise from top left: Ritu Karidhal, Anuradha T.K., Nandini Harinath, Minal Sampath, Kriti Faujdar, Moumita Dutta and Lalithambika V.R.

creating Facebook pages and updating the progress thus involving the public to peek into the work that was underway.

Through this publicity came forth the vital role played by women in the mission. They held critical positions and worked relentlessly balancing their work, life and social pressures.

With just 18 months to realise the project, Anuradha T.K., senior Program Director, lead the task with a firm hand. Aply supporting her were Ritu Karidhal and Nandini Harinath, both Deputy Operations Directors, who had their hands full on the MOM. Also on board were Minal Sampath, Moumita Dutta and Kriti Faujdar, Systems Engineers.

The team put in 12-hour work days all through the week. When the launch date drew close, they worked through the nights as well. With a short time frame, they plunged into the mission co-ordinating, conceptualising, designing, functioning and troubleshooting the

algorithms on the machinery. The team had to think quickly on their toes, brainstorm sessions, and provide solutions to various technical aspects. Of course, it demanded extensive hard work which they adeptly handled proving that women are indispensable in the field of science and technology.

The smooth launch and success of the mission that the world witnessed is a testimony to their hard work.

Lalithambika V.R., Deputy Director at the Vikram Sarabhai Space Centre (VSSC), Thiruvananthapuram, heads the team that works on fuel optimisation for rockets, autopilots, software development for onboard computers and the hardware to integrate with the equipment. The latest feather in her cap is the smooth launch of 104 satellites by the PSLV-37. It was no mean task as the satellites' orbits needed careful calculation and each one of them had to be positioned without colliding with each other.

True to their humble outlook, these women choose to remain grounded and do not stop by to bask in the glory. Instead, they are currently occupied with their next missions: Mangalyaan 2 and Chandrayaan 2.

The stories of these women only show the foundational contributions they have made. Today they have set an example to many young girl aspirants to look up to the skies not just in admiration but be a part of the task force that can reach up to them. They have set an indelible mark that women are equally skilled and reliable in the high-pressure scenario of space science. Their contribution proves that women are not only capable of doing intensive technical tasks but also can manage the work well.

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