‘One Earth, One Family, One Future’—India’s Historic Landing on the Moon

by Janet G. West

August 23—The *Hindustan Times* proudly reported today that over nine million people tuned in to the live stream to witness the success of the first mission to land on the South Pole of the Moon—the Chandrayaan-3 mission’s lander—at 6:04 pm IST. The live stream showed an explosion of clapping, cheering and laughing personnel in Mission Control—many of whom were women and young people—as the lander touched down. As of mid-day August 25, the official ISRO telecast video had garnered over 76 million views.

The *Economic Times* quoted the Indian Space Research Organization (ISRO) Project Director of the Chandrayaan-3, P. Veeramuthuvel, “It’s a great moment of happiness. On behalf of the team it gives me immense satisfaction on achieving this goal as the Project Director of the mission. The entire mission operations right from launch till landing happened flawlessly as per the timeline.”

‘This Success Belongs To All Humanity’

Prime Minister Narendra Modi was also shown on the live stream as he, too, watched the historic landing from South Africa, where he was attending the meeting of the BRICS. As he watched the successful landing, he smiled broadly, and waved the Indian flag.

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A happy Narendra Modi, Prime Minister of India, watched his country’s Chandrayaan-3 spacecraft’s historic landing at the Moon’s South Pole. From the BRICS Summit in Johannesburg, South Africa, he addressed ISRO scientists: “This success belongs to all of humanity.”

PM Modi addressed the ISRO center scientists immediately after the successful landing, from South Africa:

> Friends: On this joyous occasion, I would also like to address all the people of the world, the people of every country, and region. India’s successful Moon mission is not India’s alone. This is a year in which the world is witnessing India’s

G-20 presidency. Our approach of "One Earth, One Family, One Future" is resonating across the globe. This human-centric approach that we represent has been welcomed universally. Our Moon mission is also based on the same human-centric approach. Therefore, this success belongs to all of humanity. And it will help Moon missions by other countries in the future. I am confident that all countries in the world, including those from the Global South, are capable of achieving such feats. We can all aspire for the Moon and beyond.

He made other comments in Hindi; these are machine-translated here, and therefore may not communicate the full import of his comments:

My dear family, When we see such history being made in front of our eyes, life becomes blessed. Such historical events become the living consciousness of national life. This moment is unforgettable. This moment is unprecedented. This moment is the victory cry of a developed India. This moment is the triumph of the new India. This moment is about crossing the ocean of difficulties. This moment is about walking on the path of victory. This moment holds the capability of 1.4 billion heartbeats.… This is a moment of new energy, new faith and new consciousness in India. This is a moment of invocation for India's emerging destiny…. We made a resolution on Earth, and realized it on the Moon [also translated as "what we dreamt on Earth, we implemented on the Moon"]…. Today, we are witnessing a new flight of new India into space….

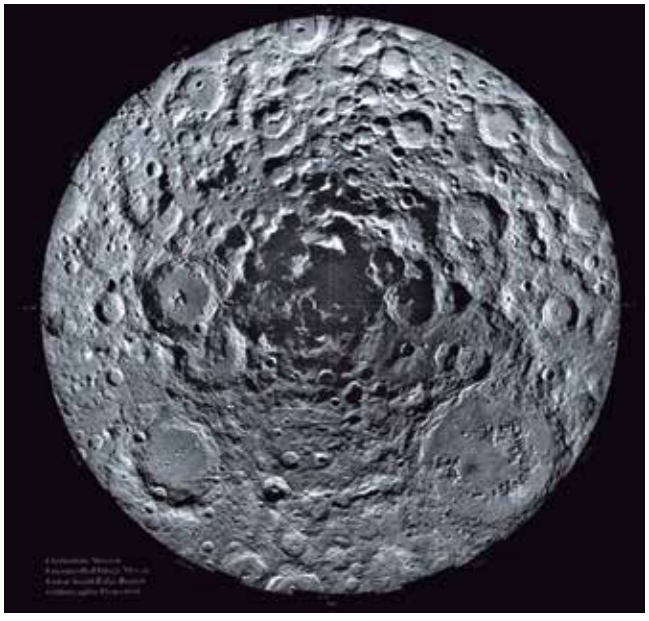
Due to the hard work and talent of our scientists, India has reached the South Pole of the Moon, where no country in the world has been able to reach till today. From today onwards, the myths associated with the Moon will change, the plot will also change, and the proverbs will also change for the new generation. In India, we all call the Earth, Mother Earth, and the Moon as Moon Uncle [Chanda Mama]. It was once said that Chanda Mama is very "far away." Now a day will come when the children will say, Chanda Mama is just a "tour."

My family members, This achievement of Chandrayaan Maha Mission [Great Mooncraft Mission] will take India's flight beyond the orbits of the Moon. We will test the power of the limits of our solar system, and must also work to realize the infinite possibilities of the universe for humans. We have set many big and ambitious goals for the future. Soon, ISRO is going to launch Aditya L-1 Mission for detailed study of the Sun. After this, Venus is also one of the goals of ISRO. Through Gaganyaan, the country is also fully prepared for its first human spaceflight mission. India is proving time and again that sky is not the limit. [The Gaganyaan project, according to the ISRO website, "envisages demonstration of human spaceflight capability by launching crew of 3 members to an orbit of 400 km for a 3 days mission and bringing them back safely to Earth, by landing in Indian sea waters."]

Friends, Science and technology is the basis of the bright future of the country. Therefore, the country will remember this day forever. May this day inspire all of us to move towards a bright future. This day will show us the way to the fulfillment of our resolutions. This day is a symbol of how to win by learning from defeat. Once again, many congratulations to all the scientists of the country and best wishes for the future mission! Thank you very much.

'Dreamt on Earth, Realized on the Moon'

The South Pole of the Moon has drawn an increasing amount of interest from space scientists and researchers, primarily because there are portions of it which are in constant darkness. Scientists have hypothesized that there could be pockets of frozen water in these shadow lands, and some measurements have indicated that there is potentially a total mass of ice of around 6 trillion kg (6.6 billion tons), according to data collected by the Lunar Reconnaissance Orbiter and the Chandrayaan-1 Moon Mineralogy Mapper. Lunar water could offer rocket fuel and breathable oxygen (by breaking it down into its components, hydrogen and oxygen), as well as potable water for astronauts, potentially revolutionizing space missions. There is also evidence of rich mineral deposits in this region, making it very attractive as a site for future colonization.



NASA/ARC

A promising site for human colonization on the Moon is its south polar region, thought to have pockets of frozen water and mineral deposits. Imaged from the Lunar Prospector spacecraft in 1998.

The Chandrayaan-3 spacecraft (**Figure 1**), launched on July 14, 2023 by ISRO's Launch Vehicle Mark 3, was successfully inserted into lunar orbit on August 6, and the Lander Module detached from the orbiter on August 17.

The four-step landing process (**Figure 2**) was precise—during the first phase, the spacecraft was traveling at a speed of 1.68 kilometers per second, and then the "rough braking" began, slowing the craft to 370 meters per second. When the lander was about seven kilometers above the lunar surface, the "fine braking" began, while the spacecraft slowly began to tilt, and was slowed still further; gradually, through braking and tilting of the lander, it was brought into a position with the legs pointing downward. Sensors and camera images from the lander assisted in the final maneuvers aloft for a few kilometers to locate a prime landing site for a successful soft landing. Only hours later, the Pragyan ("wisdom") rover rolled out and began surveying the area.

India's President, Droupadi Murmu, congratulated the ISRO team when Pragyan was successfully deployed. She said, "Its rolling out a few hours after the landing of Vikram ["Valor"] marked the success of yet another stage of Chandrayaan-3. I look forward with excitement, alongside my fellow citizens and scientists, to the information and analyses that Pragyan will acquire and enrich our understanding of the Moon."

The Indian website, *Republic World,* explains some instruments of the lander and rover:

> The Vikram lander is equipped with four instruments, one of which is built by NASA—the Laser Reflector Array (LRA) to measure the distance between the Earth and the Moon. The other three instruments are the RAMBHA-LP to measure the near-surface plasma density on the Moon, ChaSTE to carry out measurements of thermal properties of the lunar surface, and ISLA to measure seismicity around the landing site.
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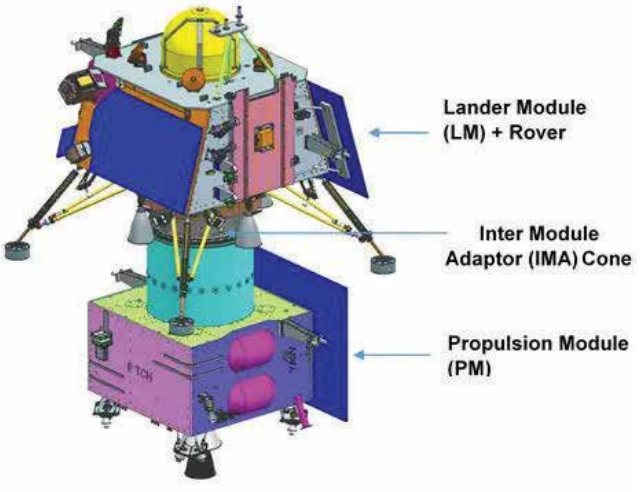
> The Pragyan rover is equipped with two instruments—the Alpha Particle X-Ray Spectrometer (APXS) and the Laser-Induced Breakdown Spectroscope (LIBS). The APXS will be used to derive the chemical composition and infer mineralogical composition to further enhance our understanding of the lunar surface, whereas the LIBS will determine the elemental composition of lunar soil and rocks around the lunar landing site.

Vikram has also activated three of its four onboard science experiments, including a thermal probe which

FIGURE 1



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Chandrayaan-3 lander, rover, and propulsion modules.

will go into the lunar soil, and measure its temperature and other properties. Another instrument will study the ionosphere—a tenuous "atmosphere" of the Moon, formed primarily of electrons and ions formed as a result of solar radiation; scientists want to know if the density changes, and how it's affected by sunlight.

The mission duration is for one lunar day—one rotation on its axis with respect to the Sun—approximately two weeks on Earth.

The successful landing was especially exciting and rewarding to all scientists, engineers, technicians, and others involved in the mission because of earlier failures.

ISRO

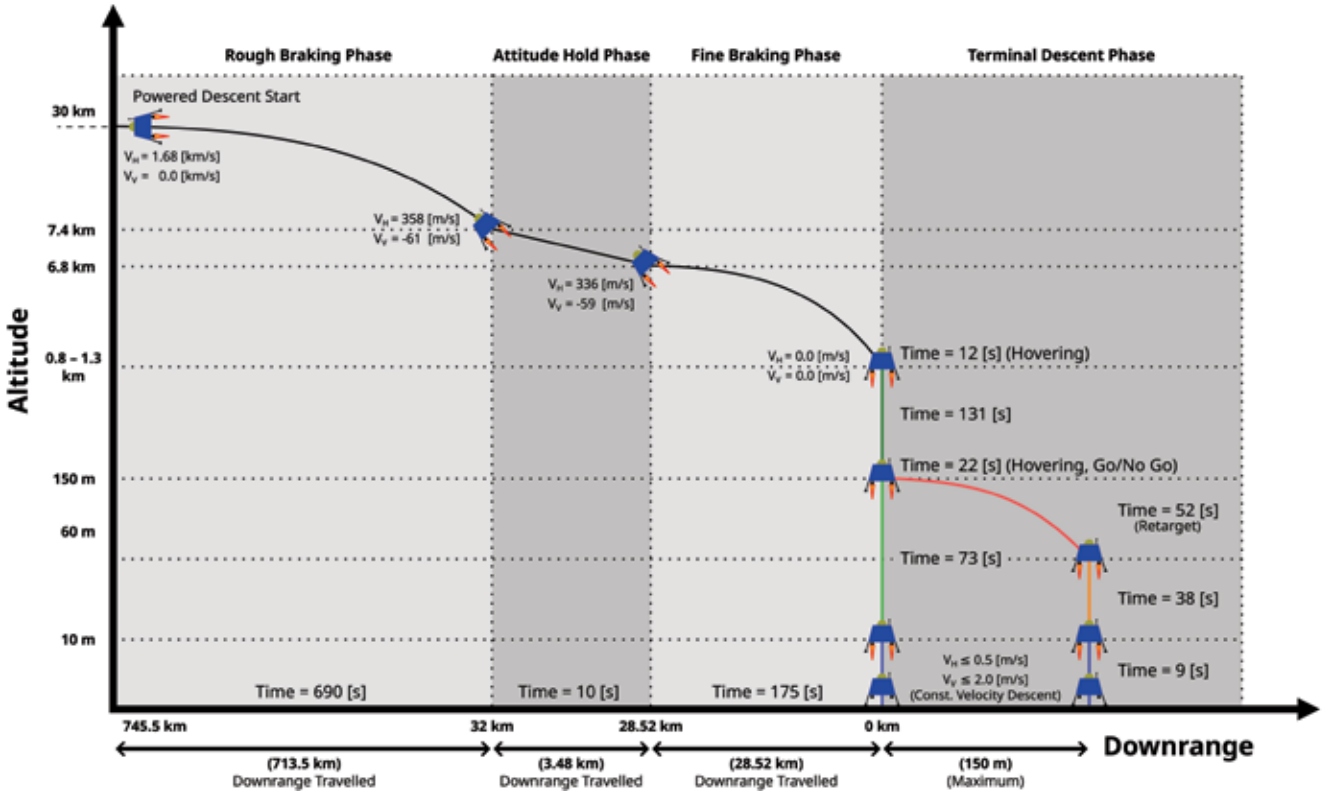
Artist's depiction of Chandrayaan-3 making a fully autonomous Moon landing.

Chandrayaan-1, which launched in 2008, comprised an orbiter and the Moon Impact Probe. The Probe successfully impacted the Moon in a controlled strike to create ejecta so that the chemical composition of the regolith could be studied in depth. However, after a year of operation, technical issues caused the orbiter to shut down, and the ISRO declared that the mission was officially ended.

Chandrayaan-2, launched in 2019, failed when its lander crashed into the Moon due to a software glitch, much like what happened to Russia's Luna-25, which the head of Roscosmos, Yury Borisov, explained was due to an engine shutdown sequence malfunction, which caused it to

FIGURE 2

Chandrayaan-3 Lander's Powered Descent Profile



crash. Like India, Russia will learn from the mistakes, and is looking forward to future missions of Luna-26, 27, and 28.

The Next Historic Mission

The next mission—for India and for mankind—includes an Earth-bound component and an outer space component.

During the BRICS Summit in South Africa, PM Modi called for the creation of a new collaboration among nations, calling it the BRICS Space Group:

> We are already working on the BRICS satellite constellation [for remote sensing]. Taking it a step further, we can consider creating a BRICS space-exploration consortium. Under this, we can work for global good in areas like space research [and] weather monitoring.… We must make our societies future-ready to make BRICS future-ready.

About a month ago, the director-general of Russia's space agency, Roscosmos, offered to dedicate a specialized module for the BRICS countries at the Russia Orbital Station (ROS), enabling space agencies in those countries to participate in low near-Earth orbit scientific studies, and this proposal would complement that of Prime Minister Modi. This kind of collaboration could also inspire the fledgling space agencies of several African countries, such as Botswana, Nigeria, and South Africa.

The second, outer space component is the next launch planned by ISRO, Aditya L1. Its scheduled launch date is currently Saturday, September 2, 2023 at 4:00 AM (UTC).

The ISRO website describes it:

> Aditya L1 shall be the first space-based Indian mission to study the Sun. The spacecraft shall be placed in a halo orbit around the Lagrange point 1 (L1) of the Sun-Earth system, which is about 1.5 million km from the Earth. A satellite placed in the halo orbit around the L1 point has the major advantage of continuously viewing the Sun without any occultation/eclipses. This will provide a greater advantage of observing the solar activities and its effect on space weather in real time. The spacecraft carries seven payloads to observe the photosphere, chromosphere, and the outermost layers of the Sun (the corona) using electromagnetic and particle and magnetic field detectors. Using the special vantage point L1, four payloads directly view the Sun and the remaining three payloads carry out in-situ studies of particles and fields at the Lagrange point L1, thus providing important scientific studies of the propagatory effect of solar dynamics in the interplanetary medium.
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> The suites of Aditya L1 payloads are expected to provide most crucial information to understand the problem of coronal heating, coronal mass ejection, pre-flare and flare activities and their characteristics, dynamics of space weather, propagation of particles and fields, etc.

Some of the scientific objectives include:

- Study of solar upper atmospheric (chromosphere and corona) dynamics
- Physics of solar corona and its heating mechanism
- Magnetic field topology and magnetic field measurements in the solar corona.

Looking back a bit in history for today's inspirations, we find that in 1937, Jawaharlal Nehru—who was to become India's first Prime Minister after its independence from British colonial rule—expressed his vision for the future in addressing the Indian Science Congress:

> It is science alone that can solve the problems of hunger and poverty, of insanitation and illiteracy, of superstition and deadening custom and tradition, of vast resources running to waste, of a rich country inhabited by starving people.… Who indeed could afford to ignore science today? At every turn we have to seek its aid … the future belongs to science and those who make friends with science.

When women and men of good will step forward to advance science for all humanity, then we can, indeed, move mountains—including the Mountains of the Moon.

For Further Review

ISRO official telecast
Rover deployment