

Next stop the Moon



The two Moon landing attempts of the Luna 25 and the Chandrayaan-3 missions in close succession are symbolic of the renewed international push to go back to the Moon on a more consistent basis, which is shaping up to be one of the main space exploration narratives of our time.

Writing this editorial at the end of August 2023, it is easy to see why the 2020s could be called the decade of the return to the Moon. In the space of two days, two ambitious missions similar in scope tried to land on the surface of our satellite. Luna 25, part of the Russian Luna-Glob programme, consisted of a lander carrying a comprehensive payload with a wide scientific reach. The Indian Chandrayaan-3 had a more complex configuration of orbiter-lander-rover. The relevance of these missions is beyond just scientific advancement. The Russians wanted to show continuity with the glorious Soviet programme of Moon exploration and prove that they could still be able to have an independent space programme after the failure of Mars 96 in 1996 and Fobos-Grunt in 2011. India wanted to prove that they had the technology to become the fourth nation to soft-land on the Moon and forget the failure of Chandrayaan-2's lander in 2019. National pride and promotion were also a fully integrated part of the equation that made the double event especially well-followed and thrilling. And the summer excitement hasn't finished yet, as the Japanese lander Smart Lander for Investigating Moon (SLIM) is planned to be launched in the coming days, at the time of writing.

Even a cursory look at the timeline of Solar System exploration shows that the Moon hasn't always been a popular destination. After the Cold War-induced frenzy of the 1960s, which saw more than 60 launches to the Moon and ended with the first walk of humankind not on terrestrial ground, dedicated missions fell quickly to zero after the first half of the 1970s and stayed very close to that level for three decades. The reasons for this rather abrupt shift are complex,

involving multiple factors including budgetary constraints, a feeling of completion of the space race after the crewed landing, waning public interest and a shift of scientific focus to other targets. Possibly unfairly, the seemingly static Moon landscapes were not considered to be as interesting as the dynamic nature of Mars and other planetary bodies. The situation has progressively changed in the past 15 years. The numbers again provide an immediate indication of the resurgence of the Moon as a prized destination: 11 missions in the 2010s, already 14 (including the 6 Moon-focused CubeSats onboard Artemis I) between 2020 and August 2023. The future also looks bright with around 30 missions planned or proposed up to 2030. By the end of the decade, if everything goes in the most optimistic way possible, we will have a circumlunar base (the Lunar Gateway), at least three crewed visits to the surface (all within the NASA Artemis programme) – including the first woman and the first person of colour visiting the Moon – and we will be on the cusp of the first crewed Moon landing beyond the Americans, by China.

This second phase of Moon exploration has rather different characteristics from the first one. Of course, the international context is different. It is no longer a race between two superpowers probing a totally unexplored environment. Even though the United States are leading, this time the landscape is more inclusive, with China, India, Japan and even less-prominent spacefaring nations like South Korea, Israel and the United Arab Emirates participating. It is indicative that all soft or hard landings (impactors excluded) since the end of the Cold War have been from Asian nations (including Russia in that tally). Another significant difference is budgetary. We will not see the increase that brought the NASA budget to account for 2–4% of the total US federal budget between 1963 and 1969: the level will not evolve significantly from the ~0.5% allocated in recent years. And there are no indications that suggest that other nations will behave differently. The involvement of a totally new actor, the commercial sector, is partly a consequence of these budgetary constraints and partly a natural evolution of space exploration. But above all, the main 'philosophy' of the endeavour is different. As

NASA has repeated multiple times, this time, we're going to stay.

Of course, any kind of human presence, especially a permanent one, needs resources. This is why – and that is another difference compared with the 1960s – this new lunar era has a specific geographic target: the south pole. It is there that orbital measurements have found evidence of water in some form within the regolith, the shallow subsurface or even possibly at the surface in permanently shadowed craters. And that is why both Chandrayaan-3 and Luna 25 aimed at being the southernmost lander ever on the Moon, with their target latitude of -70° S (compared to the previous record of Chang'e-4 at 45° S). Other planned landings will target the polar region proper and some of them will also carry technology demonstrators for resource extraction and utilization. This push for the south pole has created some concern of a 'wild west' rush for lunar resources, particularly considering the relative lack of regulations. International accords such as the [Moon Agreement](#) have been dead on arrival and other forms of governance, such as the series of bilateral agreements between the US and (at the time of writing) 28 countries under the umbrella of the [Artemis Accords](#) or the China-led International Lunar Research Station Cooperation Organization ([X. Wu, *Space Policy* 65, 101537; 2023](#)), are rather vague concerning space resources. As Chandrayaan-3 and Luna 25 have shown, we are getting close to making the concept of lunar resource utilization at the south pole a reality, and it is time to lay down a path towards a fair and sustainable use of lunar resources.

Considering all these circumstances, it is easy to frame the events under the idea of a 'new space race'. While there are some elements of it in the current and near-future events, it is a rather facile narrative. The effort is both individual and collective, with a substantial attention to science besides mere resource acquisition. International cooperation is fully part of the dynamics: European astronauts will fly under the Artemis programme, and China wants to open to international partners in its planned south polar outpost. Most of all, this new lunar venture reminds us of the peaks and valleys of

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space exploration and that “space is hard”. All the attempts to soft-land on the Moon since Luna 24 in 1976 ended up in failure, except for the Chinese Chang’e programme and now Chandrayaan-3 (see the [N&Vs](#) in this issue),

including the ill-fated Luna 25. When a scientific mission crashes, there is not a winner and a loser as in a race; we all lose. The stakes will only increase when we send people. Only a concerted effort will avoid rash

decisions and endangering humanity’s first realistic attempt to move beyond the Earth’s boundaries.

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