more inclined to label Argentina in the early 2000s, for example, as a 'deficient democracy', because of its limited controls on executive power — something that is perhaps reflected in how Bevacqua's story played out.

Regardless of such nuances, how might such machinations be nipped in the bud? The authors examine two political attempts in mature democracies to make it more difficult for politicians to manipulate official statistics: the establishment of the United Kingdom Statistical Authority (UKSA) in 2007 and of France's *Autorité de la statistique publique* (Authority for Public Statistics, ASP) in 2009. Both bodies have the power to make authoritative judgements about the validity of official statistics, and to withhold the title of official statistics from data that they find to be methodologically suspect or flawed.

The UKSA's power is mainly reactive: the body does not initiate investigations, but can only respond to requests. These can come in subtle ways: for example, in a 2022 public exchange of letters between a representative of the UKSA and the chief executive of the fact-checking organization Full Fact, in which the two agreed that then-prime minister Boris Johnson's interpretation of employment statistics left much to be desired.

The ASP, by contrast, is required by law to investigate whether statisticians attached to individual French government ministries are conducting work to an appropriate standard. Billig and Marinho's case studies of the agencies explore the effects of using an extremely limited set of tools to combat manipulation of official statistics. What neither agency can do is silence a politician determined to skew the numbers to their own advantage. The part of the bogeymen is played in these two cases by Johnson and current French justice minister Gérald Darmanin: their repeated run-ins with their respective statistical authorities make them the other two politicians whom the authors deem worthy of their own chapters.

In covering the origins and nature of statistical abuse by those in positions of power, this book sets high expectations. It is, ultimately, a fascinating read, weaving together stories of individuals and systems around the globe. In this post-truth world, to understand how numbers are manipulated is a necessary — if not sufficient — step in nipping the consequences in the bud.

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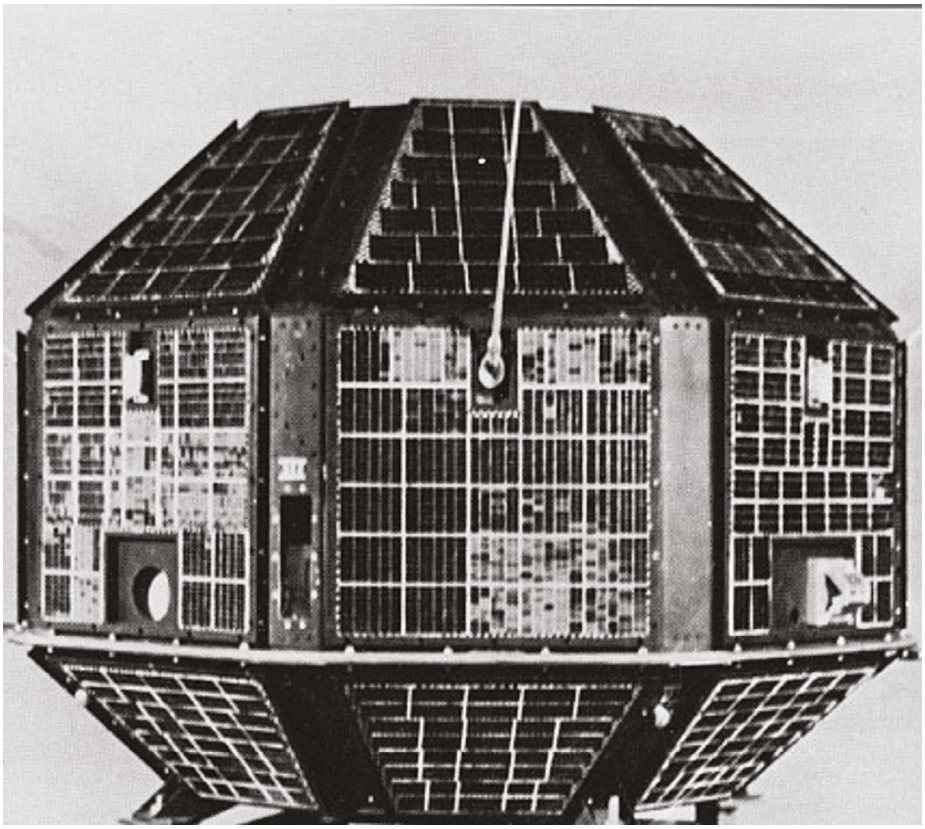

NASA/ALAMY

The satellite, Aryabhata, provided a huge boost to India's space programme.

How India's first satellite redefined space missions

Fifty years ago, the nation reimagined what a low-income country could achieve. **By Pranav Sharma**

In the early hours of 19 April 1975, the mood at the Soviet military launch site of Kapustin Yar — a space test facility north of the Caspian Sea — was heavy with anticipation. Scientists and engineers moved with brisk deliberation, the pre-launch silence was punctuated only by the rustle of paper, the clicking of relays and the careful exchange of words in thick Russian and Indian accents.

The Indian engineers, most of whom were less than 35 years old, had arrived at this remote enclave in what is now southern Russia to hurl their nation's first satellite, named Aryabhata after an ancient Indian astronomer, into space, with the help of a Kosmos-3M launch vehicle. The relatively light satellite — a 358-kilogram payload packed with scientific instruments — had been flown halfway across the continent in a custom-built shockproof container padded with helical springs, designed to shield it from any forces it wouldn't be able to endure.

When Aryabhata arrived at the Kapustin Yar cosmodrome, its constituent parts — bottom shell, instrumentation deck and top shell — were reassembled and carefully inspected. Soviet scientists meticulously checked the satellite's shock resistance, thermal cycles and vibration. To their surprise, it passed the tests with flying colours.

At the time, the Indian Space Research Organisation (ISRO) was still a young agency with limited experience. For many of the 200-odd scientists and engineers at what was then the ISRO Satellite Centre in Bengaluru, India, the moment marked their first real encounter with orbital space flight. Although they had previously worked on sounding rockets and small collaborative projects, nothing matched the scale or importance of this mission. The modest polyhedral satellite was about to redefine what a low-income country could accomplish.

When the Kosmos-3M rocket roared to life, it carried not just circuitry but also the dreams of a nation not even 30 years free from colonial rule. The launch was a success. As Aryabhata hurtled through layers of piercing cold Soviet air, a space programme destined to become the envy of the world, for its ability to operate on a shoestring budget was quietly born.

Fifty years on, ISRO provides launch services to other low- and middle-income countries, nurturing the space ambitions of many African and Latin American nations. With private for-profit enterprises increasingly dominating the space industry, Aryabhata's legacy offers a valuable counterpoint.

India's space programme showcases the value of public investment in science. The nation's space-related technology has contributed to the development of ultralight-weight artificial limbs, health-care devices and water-purification systems, for instance. Perhaps Aryabhata's more immeasurable impact, however, is the boost it has given to national confidence — inspiring a generation of scientists and engineers. It wouldn't be an exaggeration to say that Aryabhata did not just orbit Earth, it orbited India's imagination.

ANSHUMAN POYREKAR/*HINDUSTAN TIMES* VIA GETTY

India's space scientists continue to expand their programme and inspire the next generation.

Scientific modernity

Aryabhata was never meant to dazzle as a payload. Its purpose was humble but profound: to provide hands-on experience in designing, building and operating a spacecraft to a team of young Indian scientists. Its solar panels were modest, its instruments sparse and its spin-stabilization system rudimentary. Yet, all of the spacecraft's components, from its telemetry boards to its thermal insulation, were made in India.

The decision to go low-tech was intentional. U. R. Rao, the project's director, had convinced ISRO's leadership that developing operational communications and remote-sensing satellites was impossible without building experimental ones first. The mission served as an orbital classroom. Its main purpose: training a new generation of space technologists and validating home-grown hardware.

The name of the satellite — Aryabhata — was chosen deliberately. During the initial days of the project, it was called ISRO Satellite-1, or IS-1, internally. The idea to rebrand the spacecraft emerged when then-ISRO chair Satish Dhawan sought then-prime minister Indira Gandhi's input, because the satellite neared completion and its public launch was imminent. Both ISRO and the government wanted a name that embodied India's national pride and cultural heritage.

Gandhi saw scientific modernity as an extension of India's civilizational legacy. After careful consideration, she proposed naming the satellite after the fifth-century mathematician-astronomer Aryabhata, whose pioneering contributions included postulating that Earth rotates on its axis, calculating the value of π to a remarkable precision and laying the foundations of algebra.

The name carried deep symbolism, reaffirming India's rich history of scientific enquiry and linking ancient intellectual achievements to modern technological progress. Politically, it also provided an alternative narrative to the cold war-era space race between the United States and the Soviet Union by reinforcing India's unaligned stance. The country was not following global trends, it was merely reclaiming its own long-standing intellectual prowess.

Heartbeat of a nation

With symbolism deeply woven into the project, success was crucial. That's why, when Aryabhata started tumbling soon after reaching orbit, the engineers who had clustered around consoles at what was then the Sriharikota Range ground station in India held their breath.

The issue was traced to a faulty valve relay that failed to initiate the satellite's spin, which was crucial for orbital stability. Engineers on the ground sent a correction command and, over four tense days, Aryabhata gathered data on X-ray sources and ionospheric electrons.

By day five of the mission, another snag was detected. A 9-volt power bus, which powered all three scientific experiments (X-ray astronomy, solar γ-rays and aeronomy), had failed. It was then decided to shut down the experiments and operate Aryabhata as a technological test platform. It was a tough but pragmatic decision. The mission's main goal had always been to build capability; the scientific experiments were a bonus. Then, on its 45th orbit, the backup spin system kicked in and the satellite steadied at 50 revolutions per minute. Cheers erupted at mission control. With this, India had not only launched but also controlled its first satellite in orbit. Despite the satellite being scientifically extraneous, it continued to transmit data reliably for the next two years.

Notably, as one of its last demonstrations, Aryabhata relayed an electrocardiogram signal — a recording of a human heartbeat — from Sriharikota to the satellite centre in Bengaluru, some 360 kilometres away. It was a prophetic act, foretelling satellites' potential in telemedicine long before such systems were established. "That day," as Indian physicist Yash Pal would recall decades later, "we heard the pulse of India in space."

The poetic weight of this gesture — a heartbeat bouncing off a machine named after a fifth-century astronomer — could not have been greater.

Legacy and lessons

When news of Aryabhata's launch spread globally, it became both a diplomatic and technological milestone for India. Within two days of the satellite's successful insertion in orbit, the Indian government signed an agreement with the Soviet Union to launch a second satellite. This boosted the confidence of Indian scientists and set the country's space programme on firm footing.

Five decades later, Aryabhata's technical footprint might seem small. Yet, its impact is more enduring than perhaps that of any Indian satellite since. The project demonstrated that a low-income country could design, build, test and operate complex space hardware without relying on outside help or imported blueprints. It was an enterprise in bold imagination, despite prevailing difficulties, including economic hardship, global scepticism and the legacy of colonial subjugation.

The Aryabhata mission offers several lessons for emerging spacefaring nations, such as Nigeria and Indonesia. It shows that even a humble first satellite can catalyse and accelerate an entire programme. The key component for long-term success is not access to unlimited funds but the creation of institutions that support experimentation and prioritize investment in human capital. A set of unglamorous missions aimed at building in-house expertise can lay the groundwork for more ambitious projects down the road.

When India's satellite programme was conceived, the plan was to establish close ties with NASA. But, as the project progressed, the government realized that a partnership with the Academy of Sciences of the Soviet Union would be more fruitful. India's ability to navigate international partnerships while maintaining national ownership of the project during the cold war is a huge achievement. Other spacefaring nations could benefit from developing space-diplomacy programmes that help them to access launch services and position them as meaningful contributors to the global space community.

"Missions aimed at building in-house expertise can lay the groundwork for more ambitious projects."

A multipolar world offers more opportunities for flexible partnerships without strategic entanglements. Aryabhata provides a compelling precedent that scientific cooperation need not be ideologically determined, and that technical sovereignty is achievable. Countries developing their first satellite can structure partnership agreements in such a way that they emphasize knowledge transfer and joint development of technology, rather than focus on service delivery. This would entail choosing collaborators who are willing to invest in local skills and infrastructure.

With space becoming increasingly commercial, contested and crowded, Aryabhata reminds us that the most meaningful missions are not the loudest. Aryabhata was not a Sputnik satellite or an Apollo mission. It did not push the frontier of what was possible in space. It did not seek to impress. Instead, the mission focused on instilling a long-term vision of the value of science in a young nation, and that's what makes it enduring.

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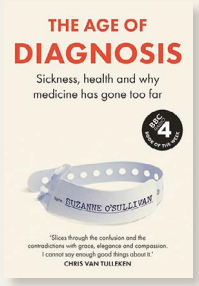
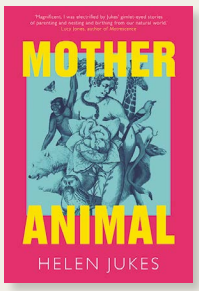
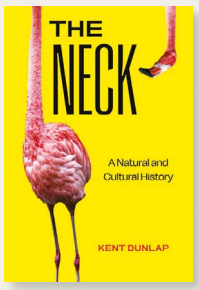
Books in brief



The Age of Diagnosis
Suzanne O'Sullivan *Thesis* (2025)
In 2019, the UK health secretary praised a direct-to-consumer genetic test that revealed his 15% risk of prostate cancer, and planned its widespread use. This diagnosis was not significant — the average lifetime risk for men is 18%, notes neurologist Suzanne O'Sullivan. Her riveting book argues that new technologies often lead to overdiagnosis, which both doctors and patients often welcome. "New diagnostic criteria need to be measured more by their ability to make quality of life better — not by how many patients they can find."

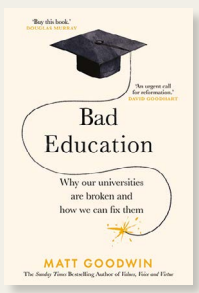


Mother Animal
Helen Jukes *Elliott & Thompson* (2025)
Her first pregnancy and childbirth inspired Helen Jukes to investigate motherhood in a variety of other species, from polar bears to burying beetles. In her intimate and personal second book, the leader of creative-writing workshops warns that "if there are grounds for alarm" in the book, "I hope there is also much to inspire wonder". For example, labour in humans takes many hours longer than in other primates, requiring the baby to rotate so that its head can — just — pass safely through its mother's tilted pelvis. Not all babies fit through.



The Neck
Kent Dunlap *Univ. California Press* (2025)
The human neck is the "ultimate multitasker", writes biologist Kent Dunlap. "It flexes, senses, vibrates, transports, and secretes every second of our lives", using bones, muscles, cartilages, cords, tubes, nerves, glands and nodes. Ironically, he researches the neurobiology and behaviour of (neckless) fishes. The book shows Dunlap's fascination with the neck, ranging from anatomy to Indian dancing, opening with a medical drawing from Henry Gray's classic *Anatomy* (1858), showing the neck's tortuous inner complexity.

Waste Wars
Alexander Clapp *Little, Brown and Company* (2025)
Books about waste disposal inevitably bristle with horrendous descriptions, appalling statistics and nefarious human activities. They document "toxic terrorism" and "garbage imperialism", to quote a US congressman speaking at a hearing in 1989. Journalist Alexander Clapp's vividly written book — which stems from two years spent roaming five continents — explores "the strange, evasive, unbelievably massive business of globalized garbage". Oddly, it doesn't include a single illustration.



Bad Education
Matt Goodwin *Bantam* (2025)
Growing disillusionment with academia led political scientist Matt Goodwin to resign from his UK university professorship in 2024. Through a mixture of his and others' experiences, he argues that UK and US universities have betrayed long-standing conventions of academic freedom by expanding their bureaucracy and embracing a "sharp shift to the left". Scientists disturbed by the US government's ongoing attack on research and equity efforts might find this right-wing perspective thought-provoking. **Andrew Robinson**