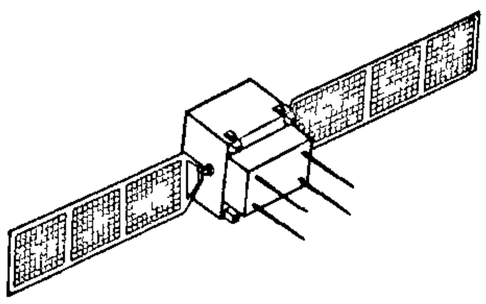


Special Issue on:
Remote Sensing for National Development

Those who made it possible

One of the proudest moments for Indian science and technology was when the Indian Remote Sensing Satellite IRS-1A, made entirely in India, was launched in 1988. This satellite uses a technology that matched the best in the world at that time, comparable with the USA's LANDSAT or France's SPOT. It is a matter of some satisfaction that IRS-1A, is still functioning, much beyond its designed life. The images received are of high quality (as one can see from the photographs reproduced in this issue). The ground-support system and the turn-around time for supply of images to users are also on par with those of LANDSAT or SPOT.

On the eve of the launch of the IRS-1B satellite, it may be worthwhile for us to look back on the saga of the origins of the remote sensing programme in India and contemplate on "who" and "what" made all this possible.

In 1960-61 the harassed US Army faced the critical problem of distinguishing khaki-clad Vietnamese soldiers from the green forests in which they were hiding or moving about. The problem was solved by using false-colour photographic film specially developed for aerial photography. The green vegetation, which reflects infrared copiously, was recorded as red, while the visible light reflected by the khaki uniforms came out blue. The peacetime applications of this military development to forestry and agriculture became immediately obvious.

Back from England at the age of twenty, Vikram Sarabhai commenced his researches on cosmic rays, working with C. V. Raman at the Indian Institute of Science. Homi Bhabha too returned to India after the outbreak of World War-II and was a Reader at the same institute. The two met there and, although Bhabha was older, they became good friends, both socially and intellectually. It was then that Bhabha thought of starting an atomic energy programme in a big way. When Sputnik was launched Vikram dreamt of taking India into the space age. Homi Bhabha gave all the support to this vision of Vikram Sarabhai on space activity. Indeed, these two are truly the initiators of the Indian Space Programme.

But Sarabhai had a greater cross to bear as he had to agonise over the goals to be given to the activities in space. It was only two or three years since the launching of Sputnik, there were practically no precedents, and there were no proven possibilities or technologies at that time. He had the unenviable but unique opportunity of being forecaster, assessor and decision maker. He narrowed down the choice of problems to communication, satellite television, meteorology and remote sensing – every one of them of great utility to India; for Sarabhai was convinced that wherever possible science and technology must be harnessed for practical use.

Sarabhai was keen that these technologies should not be obtained merely as "bought-out services". So he went about laying the foundations for relevant technologies for sustaining these applications in both the technical and the economic sense. Satellite and satellite-launch-vehicle technologies therefore became a part of the Indian Space Programme.

For remote sensing he was constantly on the search for someone to lead the group. In 1967, accompanied by Philip Morrison, he heard a lecture by the meteorologist P. Rama Pisharoty. Vikram knew then that the search was over and that he had found the man. Remote sensing activity in India

started immediately thereafter. Pisharoty organised the first successful mission of early detection of coconut wilt root disease by remote sensing using a Soviet aircraft, US equipment and Indian scientists. Being now an octogenarian, he can be called the grandfather of remote sensing in India. The next step was to convince the then Prime Minister, Indira Gandhi, that remote sensing is essential for the future of India as a mission in the Indian Space Programme.

Then came the tragic and untimely death of Sarabhai in December 1971. Many thought that his ambitious space programmes might be derailed. Fortunately the services of Satish Dhawan, a brilliant student of von Karman, a distinguished aeronautical engineer, and one who had built many wind tunnels in India, were available. The mantle of carrying forward the visions of Bhabha and Sarabhai thus fell on Dhawan.

In a country where the ethos of team work and organisational commitment for completing the task envisaged by someone else are weak, Satish Dhawan totally committed himself to realising the Sarabhai (1970-1980) profile. Dhawan too had the foresight to get the help of a rather unique and wise personality, Brahm Prakash, who had to leave the Atomic Energy Department. These two inspired a large number of young engineers into a magnificent team effort which not only realised the profile but also went farther, exceeding its targets.

To the Indian remote sensing programme Dhawan made an important contribution. It was owing to his perception that the second Indian satellite Bhaskara was oriented to be an Earth Observation Satellite, with a television camera and a microwave equipment for remote sensing.

Dhawan, with his intuitive feel for and knowledge of engineering, knew that an assiduous accumulation of experience is essential for technological success. The sensor technology acquired through Bhaskara-I and Bhaskara-II and the stabilisation technology acquired through APPLE spacecraft paved the way for the achievement of IRS-1A.

Dhawan attempted yet another difficult task through a process of consensus. He worked out, along with a young colleague of his scientific secretariat (whom he often used as a sounding board for crystallising his ideas), the processes for the establishment of a National Natural Resources Management System (NNRMS). The scientific work done for defining NNRMS was published in the *International Journal of Remote Sensing* in 1985. To establish NNRMS it was necessary to bring together two distinct organisations with completely different modes of working – the National Remote Sensing Agency (NRSA), which did the operational work (in DST), and the Space Applications Centre (SAC) of ISRO. They had eminent directors but ones with strong views. The integration of these two by Brahm Prakash may be seen as part of the success story of remote sensing in India.

There was another unexpected side of Dhawan – his acumen for "business management". He developed and nurtured the market for remote sensing well in advance by working with potential users. This required educating them and bringing about a scientific awareness in the user agencies and government. These forums ISRO created have matured so much that they not only provide an excellent feedback but, when several configurations are presented to them, actually help to define the IRS satellites.

Through NNRMS the application of the remote sensing technology has now been fully linked to the governmental system – state and central. Remote sensing has also become a part of Indian industry and there are several small-scale entrepreneurs who make world-class equipment.

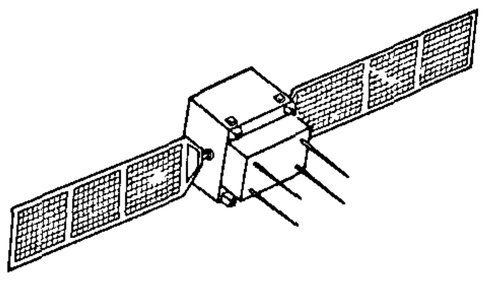
We now come to the present day. Many of the participating scientists have written articles in this special issue. It would embarrass them if we wrote more about them. But one cannot end the story without mentioning the dynamic role U. R. Rao has played. He pioneered satellite technology in the country through Aryabhata, subsequently headed the ISRO Satellite Centre, and is now Chairman of ISRO. He is now actively spearheading the operational programmes for development.

With specific references to remote sensing satellites, K. Kasturirangan has been the Project Director from the very first Indian satellites for earth observations (Bhaskara-I and Bhaskara-II) to IRS-1A. One cannot but admire the traditions he has maintained – of project leaders not only contributing scientifically and technically but also preserving a humane approach to project management.

Less than three months ago we conceived of having a special issue of *Current Science* on ' Remote sensing for national development '. To whom should we dedicate this issue: to Homi Bhabha (it is 25 years since he died); to Vikram Sarabhai (it is 20 years since he died); to Rama Pisharoty (for his having seen 1008 moons); to Satish Dhawan (who has just completed the biblical three score and ten years); to U. R. Rao (who will shortly be 60)? And the list could go on and on. Yes, we think of all these men with gratitude for making remote sensing a part of our lives.

But remote sensing technology is a complex business. All over India inside ISRO and scores of organisations outside, thousands of young men and women have had to toil hard, and work with precision and dedication to build our satellites, to design and fabricate the equipment that go into them, and to obtain the data and finally to interpret the imagery so painstakingly acquired. These are the ones who really made it all possible. To them we dedicate this issue.

S. Ramaseshan



Acknowledgements

Current Science wanted to bring out an issue featuring the magnificent imagery from our remote sensing satellite to inspire our young men and women and make them aware of what can be done in India. This special issue, ' **Remote Sensing for National Development** ', is a collaborative effort between the Department of Space and the *Current Science* and Indian Academy of Sciences. I thank all who participated. I would like to mention specially:

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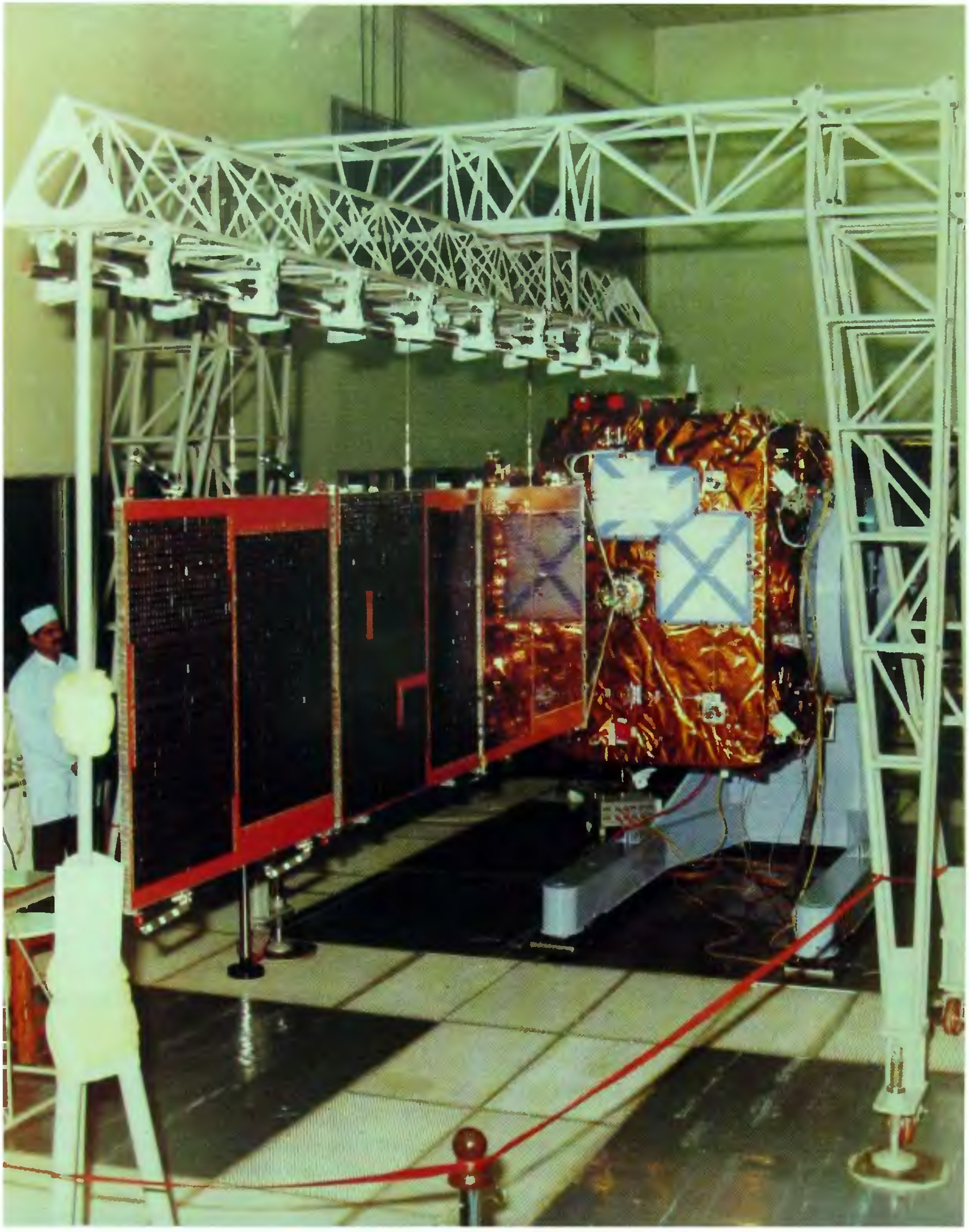
★ I finally thank **U. R. Rao, Chairman, Space Commission**, for graciously agreeing to the idea of a special issue. Without the unstinting support from him and many members of his organisation this special issue would not have been possible.

S. Ramaseshan



Solar panel deployment test on IRS-1B spacecraft.