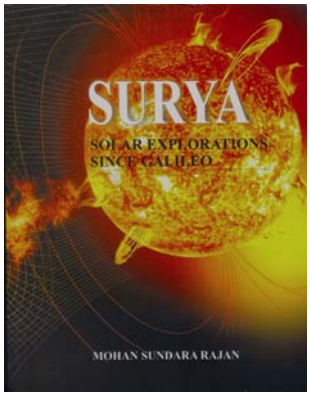


Surya: Solar Explorations since Galileo. Mohan Sundara Rajan. Publications Division, Ministry of Information and Broadcasting, Government of India, Soochna Bhavan, CGO Complex, Lodhi Road, New Delhi 110 003. 2012. 123 pp. Price: Rs 110.

The Sun has been an object of study for several centuries. Its finer details continue to elude us, although volumes and volumes are written about it. The earliest attempt can be traced to the days of Galileo Galilee, when he first saw the spots on the Sun. Larger telescopes and sophisticated instruments have, over the years, helped us to understand the Sun better. The book under review describes our attempts to understand the nearest star.

Apart from Galileo, many others laid the foundation for solar studies. The spots were the main source of attraction. However, their absence from about the time of Galileo's death in 1642, for about 60 years was a big puzzle. It turned out to be almost a retarding agent for solar studies. However, a systematic monitoring of the number and size of the sunspots revealed their periodicity, though the sudden absence of the sunspot cycle continues to be a puzzle. The discussion on this is relevant since the current cycle has presented an unusually long minimum.

Technological advances have brought in a revolution in the field of solar physics. The chapter on 'innovations and limitations' discusses the impact of larger telescopes and sophisticated detectors. The space-borne telescopes have played an important role in understanding the Sun at wavelengths other than the optical – X-rays, UV and IR.

The orbiting observatories like SOHO, YOHKOH STEREO and HINODE have paved the way for robotic telescopes. Their observations stretch to wavelengths beyond the visible. On the other hand, the ground-based telescopes are getting ready with more and more sophisticated instruments. The results combined with space observations are stunning. For example, look at the enigmatic result that the X-ray emission reaches a maximum at sunspot maxima. Another important finding is that there seems to be an overall decrease in the UV emission over the last few sunspot cycles.

The book covers detailed observations from ground-based telescopes and space about the sunspot activity; the importance of radio observations in this context is also discussed.

The history of solar observations in India is traced to a great depth. The origin of the Kodaikanal Observatory and its significant contributions making it to the top third position are described. Its subsequent modernization is sketched. John Evershed (1864–1956) was the Director of the Kodaikanal Observatory. The discovery of radial outflow of the plasma in the sunspot regions, especially the variation from umbra to penumbra regions in the sunspots is known as Evershed effect, whose centenary was celebrated recently. The flow has a period of 10 min. Its connection to the magnetic field has been a subject of study since then. Kodaikanal has other instruments developed to study the magnetic field distribution of the disc of the Sun. The book sketches the efforts for solar observations from the Indian soil starting from Kodaikanal (which now is the field station for the Indian Institute of Astrophysics (IIA), Bangalore) to Nainital and Udaipur. The setting up of the research station at Maitri in Antarctica was another major step.

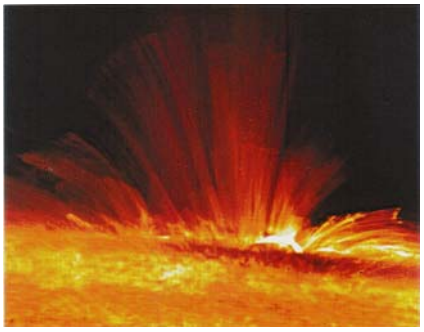
A few words on M. K. Vainu Bappu, the Founder Director of IIA, may not be out of place here. He was instrumental in establishing optical observatories in the post-independence era. He shifted the observatory from Varanasi to Nainital and established another in Kodaikanal. He designed new instruments for solar observation and led expeditions for the observations of total solar eclipses. He planned the observatory at Kavalur (now named after him) and was involved in the planning of the solar observatory in the lake in Udaipur.

Radio observations of the Sun opened a new avenue in understanding the corona. Again here, the early efforts at Gauribidanur are to be noted along with subsequent establishments at Mauritius and Australia. The different types of radio bursts, Types I–III, represent the differences in the mechanism of production. Their association with coronal mass ejections (CMEs) was well known. STEREO recently traced a coronal mass ejection all the way from the Sun to the Earth and beyond. 'Space-weather' is now the keyword for understanding the solar–terrestrial relationship.

Corona and chromospheres can be observed only during total solar eclipses. The spectral features corresponding to the 14th ionization levels in the corona indicated a very high temperature of millions of degrees. The source of coronal heating has remained a puzzle for several decades. Their origin to magnetic jets or to magneto hydrodynamic waves is being debated.

There are several new missions coming up for the study of the Sun. India's first solar satellite, *Aditya*, is one of them. The National Large Solar Telescope on the Himalayas will be another major facility. Others include Advanced Technology Solar Telescope and Solar Probe Plus. The data from *Ulysses*, which went round the polar region of Sun and *Genesis* which brought back some solar wind particles will yield more interesting results.

In spite of its proximity, the Sun has left many questions unanswered. The origin of 11 year/22 year cycle, the mechanism dictating CME, and the possibility of forecasts of space weather are some of them. Temporal changes in the Sun like the small decrease in UV output and small increase in its equatorial diameter are all questions that need answers. The book discusses these aspects in great detail.



Coronal arches: Fountains of hot gases stretching 480,000 km above the solar surface. They heat up as they rise, flow along magnetic lines and then slide down into the surface.

The author has studied the upcoming solar missions in great detail and presented the same in simple language.

The book concludes with a description of the forthcoming projects on solar observation and the search for other Suns (other planets, quite naturally). The chapter on the Sun and black hole does not fit into the flow of thoughts. It stands out isolated since there is no direct relevance to the Sun.

The book serves as a good resource material for students and teachers. The author needs to be congratulated for having put in efforts in visiting the establishments for understanding the details to present the best picture to the readers. The coverage on the Indian efforts, which generally is not available for an average reader, deserves special appreciation.

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A Brief History of Rocketry in ISRO. P. V. Manoranjan Rao and P. Radhakrishnan. Universities Press (India) Private Limited, Hyderabad. 2012. 369 pp. Price not mentioned.

In the years since independence, the country has made significant achievements in many areas of technology. Generally speaking, technology procured under licence essentially ended up in assimilation and adaptation; it did not add much to innovation or improvement. However, key science and technology departments set up during this time, thanks to the vision and farsightedness of their leaders, chalked up significant achievements. Such achievements were a result of essentially the confidence in Indian capabilities – which could be brought to bear even under adverse conditions of tight budgets, import restrictions and technology denial regimes. The fact that India has notched up significant capability in the area of space – one in the building of application and scientific satellites and the other to launch them into the desired orbit – is due to a large measure to the inspirational leadership the space programme benefitted from in its formative years. Within four years of the launch of *Sputnik* by the Soviet Union in 1957, the seeds for the Indian space effort were sown with the Department of Atomic Energy under Homi Bhabha's stewardship assuming the responsibility. Bhabha strongly believed that science and technology provided the very basis for the future of the country and space was a strong contender. In Vikram Sarabhai (who was asked by Bhabha to chair the newly formed Indian National Committee on Space Research to guide India's space effort), Bhabha found the ideal foil. Sarabhai generated a wide canvas for space research involving development, experimentation and facility generation. Satish Dhawan steered the space programme after Sarabhai's death and consolidated the space effort technologically and organizationally to what the Indian Space Research Organisation (ISRO) represents today – a technology development-oriented and goal-focused organization equipped with the necessary human and infrastructure resources.

In India, where written histories of departmental technological achievements are few and far between, the authors of this book, Manoranjan Rao and Radhakrishnan have done yeoman service in chronicling the development of rocketry in India. The book provides an anecdotal narrative starting from the Indian response to the International Geophysical Year and the birth of the Indian National Committee of Space Research, and takes one to the current status of the launch vehicles. The book is a veritable treatise on India's space odyssey and captures in fair detail not only the history and development but also the trials, tribulations and outstanding successes of ISRO, which had the good fortune of being fathered and fostered by some of the greatest scientists and human beings (a rare combination indeed) the country has produced.

The chapter giving the background reiterates the strong impetus Jawaharlal Nehru provided to science and technology. The space programme benefitted from his early encouragement; the programme has without exception been strongly supported by all Governments since independence; and the programme, as a rule has consistently enjoyed the backing and support of Indian parliamentarians of all political perceptions. The background chapter illustrates this by quoting the questions asked in the Indian Parliament in January 1963 relating to the establishment of the rocket launching station in Kerala and the answer provided by Lakshmi Menon on behalf of the Prime Minister. The authors have neatly stitched the description of phenomenon of equatorial electrojet, the then prevailing interest of the international scientific community in investigating the electrojet and the consequent sitting of the rocket launch facility at Thumba and its sponsorship by the United Nations. The two-stage rocket *Nike-Apache* took to the skies on the evening of 21 November 1963 with sodium vapour payload, heralding the first ever rocket launched from Indian soil for scientific purposes.

Sarabhai's thought processes were wide-ranging. Procurement of sounding rocket technology from abroad served the purpose of meeting the needs of the national and international scientific community for flying their experiments. Sarabhai simultaneously set up the mechanism for indigenous capability and capacity building, first towards sounding rockets and then towards the satellite launch vehicle. The authors have touched upon the rather chaotic working practices prevalent in the early years with more than one team involved in rocket development activities. Sarabhai's mind had already gauged the positive societal gains of satellite-based communication and resource management. It was therefore no surprise that while his scientists at Thumba were still experimenting with sounding rockets and associated technologies, he set in motion the development of the satellite launch vehicle, SLV-3.

Two consecutive failures of the Augmented Satellite Launch Vehicle (ASLV) called for serious introspection and failure analysis. The authors have stressed the transparency and rigour of the review systems that became established at ISRO; how the constitution of two independent failure analysis teams helped nail the problem; the recommendations which emerged for overcoming the design inadequacies, and the successful achievement of the mission with these modifications. The ASLV flight failures and their analysis had an overarching impact on the design practices, simulations and checks introduced for the subsequent launch vehicles. The successful operation of a score of PSLV launches bears testimony to the positive fallout.