

News

Workshop on Importance of Eclipses in the History of Astronomy

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A workshop on 'Importance of Eclipses in the History of Astronomy' was held on March 3, 2018, at the Jawaharlal Nehru Planetarium, Bengaluru. As is well known, one of the challenges of the astronomers of yester years faced was the prediction of eclipses. It began with the systematic observations and the recognition of periodicities. Thus we find a wealth of records from many observatories all over the world. This workshop was aimed at the contribution of these records towards the study of long period variations in the orbital parameters of the earth and the moon.

B V Sreekanthan, Visiting Scientist, National Institute for Advanced Studies and Former Director, TIFR, in his opening remarks, highlighted the importance of maintaining observational records. He described several early experiments on cosmic rays that were carried out in India. He also remembered with gratitude the pioneering efforts of Homi Bhabha and Vikram Sarabhai which laid the foundation to the development of technology in independent India.

Kiyotaka Tanikawa from National Astronomical Observatory of Japan, delivered a talk entitled 'Short-term variations of Delta T and climate changes'. This was an introductory lecture explaining the definition and geometry of Delta T, which is the imprint of perturbations in Earth's rotation. The variations of Delta T are the result of the variations of the inertial moment of the Earth. We interpret the latter variations as coming from the sea level changes which are the direct

consequences of climate changes, which may have time scales of the order of one hundred years or less. The records from ancient observatories, therefore gain importance in understanding climate change in historical time scales. During ice ages, the earth rotated faster and conversely when the sea level rises the rotation is bit sluggish. The values of Delta T, can be deciphered from ancient eclipses. Scientists infer the changes in the sea level from geochemical measurements of radioisotopes derived from ice cores, sediment / rock cores, coral growth rings and tree rings; the eclipse records take us back to about thousand five hundred years. Tanikawa and his team have been determining the value of Delta T since 2001. From the beginning, they have monitored the nature of variations of Delta T and the relation to climate changes at different time scales. The talk mainly emphasised the method of determining the value of Delta T using basically the solar eclipses by imposing two conditions on the data: (1) eclipses should be deep (total or annular) and (2) there are contemporaneous eclipses observed during less than say, ten years. He showed many examples using this technique.

B S Shylaja's lecture on 'Stone inscriptions as Sources of astronomical events' was based on an extensive survey of stone inscriptions in South India and it explained the wealth of data that can be mined from these unconventional sources. The inscriptions record solar and lunar eclipses as well as astronomical phenomena like

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solstices, equinoxes and occultation of bright stars like *Rohini* (Aldebaran) by the Moon, although they were written for non astronomical purposes like release of a grant or donation. They provide information on different types of calendars, different methods of notations of numerals. They are seen all over India and extends from about 3rd Century BCE to about 1800CE. She showed that the solar eclipse inscriptions in South India with a special mention on totality have contributed to the understanding of the small changes in the rotation speed of earth. By comparing the predicted path with the observed sites we can infer the minute differences in the motion of Earth. The study extended to all over South Asia, to include countries like Cambodia, Srilanka, Indonesia, Nepal and Myanmar from 3rd Century BCE. It throws light on many new aspects such as evolution of calendars apart from the influence of Indian system. Many interesting records of planetary conjunctions are available.

Balachandra Rao, Honorary Director, Gandhi Centre of Science and Human Values, Bharatiya Vidya Bhavan, described the records of eclipses from many texts of the medieval period in his talk entitled 'Eclipse Dates from Literary Sources'. He also explained the difficulty in the interpretations since different parts of the country followed different types of calendars. He cited many examples of eclipses, mainly in the commentaries of major Sanskrit texts, by the medieval Indian astronomers; he explained how the circumstances of these are worked out using improved Siddhāntic Procedures. The eclipses considered are from the works of Pṛthudakasvāmīn (c.862); Mallikārjunasūri (c.1178), Parameśvara (c.1360-1455); Nīlakaṇṭha Somayāji (born 1444); Yallaya (c.1472); Sumatiharṣa (c.1600) and Viśwanātha Daivajña (c.1610) and many others.

Mitsura Soma also from National Astronomical Observatory of Japan, delivered a talk entitled 'Earth rotation determined from occultation records'. He discussed the small changes in the motion of the moon as deduced by

special types of eclipses called occultation. His team has been investigating the variation of the Earth's rotation speed using ancient solar eclipses. Lunar occultation of planets and bright stars were often observed and recorded in ancient times, but visible areas of lunar occultation are usually wide, and therefore they are rarely usable for our studies of the Earth's rotation. He described how the lunar occultation of Venus on 5 August 503 and of Saturn on 22 August 513 recorded in China play an important role for our studies because the former was observed just after the Moon rose in the east and the latter just before the Moon set in the west. The results from the occultation are compared with those from the contemporary solar eclipses. There is also the question on whether or not the Moon's tidal acceleration has been constant from ancient times from solar eclipses and occultation, and we will also show the results about it. The moon is moving away from the earth at a rate of about 3.8 cm per year as we know today. Their study of ancient records of solar eclipses between 198 and 181 BCE in China and in Rome show that the lunar tidal acceleration that is consistent with the current rate.

M N Vahia, TIFR, Mumbai, could not attend the workshop. His talk 'Traditional astronomies and their expression' was presented by Dr Shylaja. It described the impact of astronomy on human culture, which is far more complex than normally understood. Examples were drawn from common astronomical beliefs of various tribes in different parts of India and extended to historical periods where astronomical impressions are traceable in coins and art. Various manifestations of human activity and belief system are projected on the sky. The introduction of the ingenious postulation of Rāhu and Ketu in the skies and their use in astronomical calculations can be considered as a path breaking achievement. It is interesting to see that the astronomical ideas have influenced great artisans and hence the art.

The lectures were well received and followed by rigorous discussions by enthusiastic audience, over seventy, mostly youth.