Yukio Ôhashi (1955–2019)

Yukio Ôhashi is a name well known to students of history of Asian astronomy, Indian astronomy in particular. His exhaustive study of the astronomical instruments used by Indian astronomers before and after the influence of Persian astronomy renders him an authority on the subject.

He was born in the Shibuya ward of Tokyo on 13 March 1955 and completed a B Sc in Physics at Saitama University (Tokyo) in 1979. His varied interest led him to take up a completely different subject and he completed his MA in Chinese Culture in 1981. His desire to learn ancient astronomy brought him to India. He was very fortunate to get the guidance of Kripa Shankar Shukla (1918–2007) who was already known as an authority on the history of Indian mathematics and astronomy. During 1983–1987 he studied the history of Indian astronomy and recollects this as the best part of his life[1]. Again, he was fortunate as this period covered the great event of the IAU meeting held in New Delhi, during 13–16 November 1985. Though he was not yet a PhD, not a member of the IAU, he presented his paper in the first ever conference on History of Indian Astronomy which was conceived by Shukla himself. His paper brought to light a hitherto unknown aspect of Indian astronomy – on the instruments.

Almost all astronomy texts – commentaries of the medieval period and still earlier treatises – do have a chapter on instruments. However it had not attracted scholars for a very detailed study. There are several reasons – the change in the mode of education during the colonial period, dearth of students to take up studies of traditional mathematics and astronomy, the grip of astrology and also a deprival of means of livelihood for the traditional scholars because of political disturbances and so on. The advent of European astronomy with telescopes acted as a permanent barricade to the traditional scholars whose number was already dwindling. The added difficulty is the style of narration with very crisp phrases and hardly any illustrations.

Thus Ôhashi had a huge task ahead of mastering the language, the fine details of the grammar and most importantly the 'assumed' knowledge on the part of the reader. He mastered the technique and therefore his papers are the sole authorities on this subject today.

After his tenure as a visiting scholar, Ôhashi returned to Tokyo (without a PhD, because of some administrative hurdles) and registered for a PhD in Social History; but gave up midway for pursuing the subject of his interest back in India[1]. One of the reasons was an inspiring lecture by Hideo Hirose (1909–1981), a former Director of Tokyo Astronomical Observatory. Yukio was awarded PhD in 1992 by the Lucknow University. He continued his studies on ancient astronomy widening his area to include Tibetan astronomy and China. By 2004 he had included most of East Asia like Vietnam, areas of SE Asia apart from Japan into his area of study.

Starting from his classic papers published in the *Indian Journal of History of Science* (*IJHS*)[2,3], all his work centered around astronomical instruments, calendars and the impact of China and India on the development of astronomy in SE Asia. As Orchiston puts it, his recent diversion into Taiwanese ethnoastronomy, and of Phillippines would have produced lot more interesting results. He was successful in obtaining the necessary expertise in the languages like Sanskrit, Thai and Chinese.

Here is an example describing one instrument called *toya yantra*[3]. It was described by Burgess and Whitney as given in *Suryasiddhānta* as 'By water instruments and stringed sand-receptacles, one may determine time accurately'. The word *reṇu* (dust particle) in the original verse, was interpreted to mean a sand clock. Ôhashi studied the original source, which was a version prepared by Ranganātha in 1603. He looked up the other earlier version of Paramesvara of 1432 to find a very important difference; the word was *veṇu*, a bamboo with a hole for flow of water. Thus the description was of a water clock and not sand clock.

One of the instruments invented by Bhaskaracharya II is called the *Phalaka yantra*, which is distinctly different in the procedure. One has to measure the shadow and use a graph to infer the time. The rationale for this and the drawing also were prepared by Ôhashi. This is one example for his efficiency in transforming crisp, short phrases into an elaborate description with very apt drawings.

His exposure to other works of literature by virtue of his mastery on the language brought out many astronomical concepts concealed in texts of other disciplines. For example, a simple formula to find the time of the day with shadow described in the *Arthashastra* of Kautilya was deciphered for the latitude by him. Another example is the verse in *Mānasāra*. The shadow length had another small supplementary explanation with a word *apachāyā*, which gave the corrections to be applied for every ten days throughout the year, resembling a sinusoidal variation from –4 to +8. This was interpreted as 'zig zag variation', 'reduced shadow', 'shadow which is wrongly placed' and so on, by various scholars. The fact that the correction was not zero at equinoxes posed a big problem for any explanation. Ôhashi rightly deduced that to be a small correction for the shadow resulting from a small change in the declination from dawn to dusk. Depending on the northern or southern movement of the sun the correction can be positive or negative. Further, he extracted the hidden dependence on latitude and showed that it was applicable for a latitude of 18 N.

When I sought for some references on instruments used in India, his contact was kindly provided to me by Prof. S. M. R. Ansari almost a decade ago. Though that e-mail did not yield any response, I was fortunate to get involved in a very useful conversation which started with an apology for having abandoned that e-mail id. Subsequent exchange of e-mails was very helpful for me trying to understand the observational records from India. I got an opportunity to meet him in 2017 during a conference organized at NAOJ, Mitaka, by Profs Tanikawa and Soma. The meeting turned out to be very eventful giving me an opportunity to discuss the observations of stars and planets from India. His expertise on astrolabes, their construction and observational details helped me in my pursuit. His small back of the envelope sketch to explain the difference between the *yāmya* and *soumya* astrolabes (southern and northern) displayed his skill in drawing and his beautiful handwriting. The route map he prepared for a location in Shibuya was perfect down to the details of stations for change of train, platform and direction (indicated by the name of the next station).

Yukio was active in Commission C3 of the IAU for history of astronomy. He also was a member of the Executive Committee of the International Conference on Oriental Astronomy (ICOA), and he served on the Editorial Board of *Journal of Astronomical History and Heritage*. He was practically involved in every effort at the international level related to studies of astronomy in South East Asia. Orchiston has compiled a long list of his publications which include important papers in the international meetings on Indian astronomy[4].

Ôhashi was dedicated to reply to requests and meeting deadlines and to his educational commitments to the day before his death in October 2019. The small group of Indian astronomy enthusiasts will miss him for the expert comments as well as a good unassuming friend. We have also lost his authoritative book on *Classical Indian Astronomy* which was about to be finalized[4].

1. Ôhashi, Y., *Studies in Indian Mathematics and Astronomy, Selected Articles of Kripa Shankar Shukla* (eds Kolochana, A., Mahesh, K. and Ramasubramanian, K.), Hindustan Book Agency, New Delhi, 2019, pp. 3–22.
2. Ôhashi, Y., *Indian J. Hist. Sci.*, 1994, **29**(2), 155–313.
3. Ôhashi, Y., *Indian J. Hist. Sci.*, 1997, **32**(3), 199–295.
4. Orchiston, W. and Nakamura, T., *J. Astron. Hist. Heritage*, 2020, **23**(1), 209–217.

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Sundaresan Naranan (1930–2019)

Prof. S. Naranan belonged to the first generation of scientists in TIFR who pioneered development of Experimental Cosmic ray Physics that laid a solid foundation for the growth of experimental cosmic ray studies and investigations in high energy physics, for which TIFR came to be known internationally. With his demise, that era of TIFR has come to an end. Naranan was a close colleague of the late B. V. Sreekantan, and both played major roles in developing experimental Cosmic Ray and X-ray Astronomy in India. His other significant achievements include: (i) Discovering new applications of physics-based models for Information Theory/Bibliometrics and quantitative linguistics. (ii) Applying laws of statistics and mathematics to several topics. His publications on these diverse topics include, 'Arithmetic of Quotas' the 'Elephantine (Diophantine) equation', 'Kaprekar constant', 'Universal calendar', and the 'A statistical study of failures in solving crossword puzzles'. For the latter, he meticulously analysed 35 years of his own data from solving the Hindu Crossword Puzzles! (iii) 'Kolams' are an ancient South Indian art and tradition. He created and published kolams based on the Fibonacci number series.

Naranan was born on 17 April 1930 in Kattupputtur, near Tiruchirapalli, Tamil Nadu. He obtained his BSc, with first

rank from Utkal University in 1948. He chose Banaras Hindu University for advanced studies, and learned experimental spectroscopy from R. K. Asundi, and graduated in MSc (Physics) with record marks – 198/200.

The 1940s was marked by establishment of key institutions for developing India's science and technology. Naranan was among the pioneering group of scientists that Homi J. Bhabha recruited to establish the Tata Institute of Fundamental Research (TIFR). Notably, Naranan was the last PhD student of Homi J. Bhabha, and he worked closely with Sreekantan on cosmic rays. Naranan designed electron, mu_meson, and hadron detectors, and defined detector array layouts for the experiments. He also made comparisons between theory and experiment. He studied effects of cosmic rays in deep underground sites such as Kolar Gold Fields (KGF), under water (Sathanur Dam), in a tunnel (Khandala), and in Ootacamund. His PhD work on the interactions of muons in cloud chambers confirmed Bhabha's hypothesis on the Penetrating Component of Cosmic Radiation (1937). Later, Naranan contributed substantially to the TIFR team's findings on very high energy interactions ($>3 \times 10^{14}$ eV). Notably, this work contributed to the inference of creation of heavy nuclear active particles ($>10^{16}$ eV interactions), both from