

OBITUARY

M. K. Vainu Bappu

India has had a long and distinguished tradition in science from the earliest days of its recorded history. In this tradition of scientific excellence were the great contributions this subcontinent made to the world of science in the fields of mathematics and astronomy: the use of zero and nine numerals in the decimal system; the value of π to increasingly higher degrees of accuracy; the earliest extant astronomical and mathematical text, the 'Aryabhataiya' written in the fifth century A.D. by the famous astronomer Aryabhata; highly precise computations relating to planetary movements, equinoxes, solstices and parallaxes. However, the work in the area of observational astronomy ceased in the early 18th century with Maharaja Sawai Jai Singh, the builder of the massive masonry solar observatories called the Jantar Mantars. And this position continued until the advent of M. K. Vainu Bappu on the astronomical scene of India.

Manali Kallat Vainu Bappu was born on 10 August 1927 in Madras, the only child of Manali Kakuzhi Bappu and Sunanna Bappu. Vainu's father, M. K. Bappu, who was an astronomer at the Nizamiah Observatory, Hyderabad, had contributed a large number of observations to the American Association of Variable Star Observers and to the variable star section of the British Astronomical Association. Young Vainu would accompany his father to the observatory dome, and as he said later "I learnt my astronomy on the lap of my father". The advice that school-going Vainu got from his father was: "Whatever you do, do with deliberation"; he followed this advice throughout his life.

While still in his teens, in 1946, he published two papers "The effect of colour on the visual observations of long-period variable stars" and "On the visual light curve of RT Eridani"; which appeared in volume 15 (1946) of *Current Science*, Bangalore. For his M.Sc. studies he was made the fellow of the Nizam College (1946-48). While still an M.Sc. student Vainu constructed a spectrograph of dispersion 120 Å/mm and used it to obtain spectrograms of the air glow. He obtained two exposures of 100 hours each during March and April 1947, and prepared the photometric scans at the institute of Sir C. V. Raman with whom he maintained a life-long contact. These results later appeared in the *Astrophysical Journal* (1950). He obtained his M.Sc. degree in 1949 from the Madras University, for which he wrote a thesis on spectroscopic and photo-conducting properties of amethyst quartz.

As a student Vainu met Sir Harold Spencer Jones and Prof. Harlow Shapley when they visited Hyderabad. Through Shapley's efforts Vainu was admitted to the

Harvard astronomy school, which he joined in January 1949, as a 'Hyderabad state scholar for postgraduate studies in astronomy' (1949–51); both Spencer Jones and Shapley having played their part in persuading the Hyderabad government to give him a scholarship. Harvard was at its prime then, with Harlow Shapley at its helm, and stalwarts like Donald Menzel, Bart Bok, Cecilia Payne-Gaposchkin and Fred Whipple among its staff.

In July 1949, Vainu Bappu, with Bart J. Bok and Gordon A. Newkirk, Jr. discovered a comet, named Comet Bappu-Bok-Newkirk. The discovery has an interesting history. On the early morning of 2 July 1949, Vainu Bappu took a 60 min exposure plate in Cygnus, for a special program, with the 24–33 inch Jewett Schmidt telescope at the Oak Ridge station of the Harvard college observatory. The plate was developed the following afternoon, and just as Bok and Bappu started to examine it for image quality and focus, Newkirk, an undergraduate student, who chanced to pass by — it had been a hot day and he was looking for his shirt — was invited to note the excellent quality of the plate. On inspecting it, he noticed the trail of 'an asteroid or something'. Upon which Bok took a look and commented: 'This is no asteroid—this is a hairy comet'. Apart from the discovery of the comet on the plate that he took, Bappu's achievement was in computing its orbit immediately, ahead of the more experienced workers. The Bappu-Bok-Newkirk comet earned the three discoverers the Donohoe comet medals of the Astronomical Society of the Pacific.

Vainu Bappu obtained his doctorate in 1952 with a thesis on "The problems of Wolf-Rayet atmospheres" under the supervision of Donald Menzel. He then spent 1951–52 as a Carnegie post-doctoral fellow at CalTech, working at Mt Wilson and Palomar observatories, where he collaborated with Olin C. Wilson on a study of stellar chromospheres.

Science was in very good standing in the United States in the 1950s. Astronomy and astrophysics in particular were fast developing fields. Bappu, as an established astronomer, could have had attractive positions at any of the leading centres. But a sense of patriotism made him return to India. As he himself remarked: "I was returning to a country with facilities which were primitive compared with those in the United States; the largest telescope I could expect to use was a 15-inch refractor. For this reason, I...took with me...a photomultiplier tube, some optics for a spectrograph, and some coude and Cassegrain spectra taken at Mt Wilson and Palomar. My principal encouragement was some advice from Plaskett on how it was possible to do good work even with limited resources if the topic were chosen carefully. Such words were crucial and have on occasions had great significance; I have had occasion to recall them many times in the next quarter-century".

Vainu Bappu left USA in September 1952 by sea and visited observatories in England, France and Italy before reaching India in December 1952. He came back home with a mission to put India on the astronomical world map, but without a job.

The scholarship which had enabled him to go to Harvard entailed that he serve the Hyderabad state on his return. Hyderabad was, however, unable to offer him a position in astronomy, and by July 1953 he was free to try elsewhere. In January 1954 he got a senior research fellowship of the National Institute of Sciences (now the Indian National Science Academy).

During this period he received offers of jobs from USA and Australia, but he refused to be tempted. He utilized this time to publish his M.Sc. thesis on amethyst quartz as a series of papers in the Indian Journal of Physics (1952, 1953). He spent most of the time analysing the spectrograms he had brought from Mt Wilson and Palomar. A preliminary report on the correlation between the widths of the H and K emission lines of ionized calcium and the luminosity of stars later than G0, well known as the Wilson-Bappu effect (The Astrophysical Journal, 1957), was read at a symposium on astrophysics in New Delhi and appeared in the Mathematics Student (1954). The Wilson-Bappu effect is an important means of determining the absolute magnitudes, and therefore distances, of late-type stars. Apart from serving as a new luminosity indicator, the Wilson-Bappu effect gave an impetus to the study of stellar chromospheres. Bappu continued to be interested in this field till the very end of his life; and one of his last contributions, in collaboration with Y. Uchida, is on this subject (Journal of Astrophysics and Astronomy, 1982).

Vainu Bappu joined in November 1954 the Uttar Pradesh State Observatory (UPSO), Varanasi, as the chief astronomer. The observatory then consisted of a 25 cm Cooke gravity-driven refractor which was lying in boxes. The observatory had been set up in April 1954 on the initiative of A. N. Singh, the principal of the newly established D. S. B. Government Degree College, Nainital, who was made the honorary director of the observatory. Singh died in July 1954 and Bappu was appointed to head the observatory. He was able to persuade the then chief minister of Uttar Pradesh to go in for astronomy in a big way and shift the observatory to a better location. In November 1955 the observatory moved to Nainital at the foot of the Himalayas, where clear skies prevail in winter. For the next few years he instrumented the small telescopes available at the observatory and utilized them in developing H-gamma photometry for an absolute magnitude calibration of early-type stars, in addition to making observations of Mars and the polarization of comets, and continuing his favourite study of Wolf-Rayet stars. He also led an expedition to observe the total solar eclipse of 1955 in Sri Lanka. While other observations of this eclipse in the Philippines were generally successful, it was a failure in Sri Lanka due to weather. The only photograph obtained at Sri Lanka was by Bappu who was alert enough to photograph the crescent of the eclipsing sun when the clouds thinned for just a few moments.

Within a few years a team of young and highly motivated astronomers had been trained. UPSO now has a 1m reflecting telescope and is a well-established observatory.

Vainu Bappu married Yemuna, daughter of Sarojini and R. K. Sukumaran, on 14 November 1956. Yemuna, charming, gracious and ever a perfect hostess, was Vainu's most trusted companion and a soothing influence. She took great personal interest in the welfare of the members of her husband's institute.

Bappu was invited to be the director of the Kodaikanal observatory in April 1960 on the retirement of Anil Kumar Das. The observatory was part of the India Meteorological Department, and had been set up in 1792 in Madras by the East India Company to 'promote the knowledge of astronomy, geography and navigation in India'. N. R. Pogson and J. Evershed figure in the list of its illustrious directors. The observatory at Kodaikanal was established at the turn of the century for making solar observations. When Bappu took over, the observatory was rather well equipped for solar studies; it had a 36 m solar tower telescope with a 18 m high dispersion spectrograph, a 20 cm coronagraph, and an H-alpha heliograph. It also had an

ionospheric laboratory and a magnetic observatory. But as for stellar astronomy the observatory could boast of only a 50 cm Grubb reflector, which it had acquired in 1912, and which had been purchased in the last decade of the nineteenth century for the Poona observatory from a grant by the Maharaja of Bhavnagar, after which it was named.

Almost immediately on his arrival in Kodaikanal, Bappu started thinking in terms of bigger telescopes and a proper location for them. After an extensive site survey, Kavalur, a small village in the Jawadi hills in Tamil Nadu, was chosen and a 1 m telescope acquired from Carl Zeiss, Jena, in March 1969. The Kavalur field station started working in 1968 when a 38 cm reflector built at the observatory was commissioned. The 1 m telescope was put to use in 1972, a year after the observatory had become the present autonomous research institute, the Indian Institute of Astrophysics. Bappu then decided to purchase a glass blank and build a 2.3 m telescope entirely within the country. He got the necessary administrative and financial approval for the project, and proceeded full steam with the design and fabrication of the instrument on an entirely indigenous basis. The telescope is scheduled to be commissioned at Kavalur by the end of 1983 and was uppermost in his mind when Bappu died. It was on this project that Vainu's organizational ability, planning and vision were best demonstrated.

Bappu's scientific activity spanned a quarter century and a wide variety of topics: solar and stellar chromospheres, comets, planetary rings, Wolf-Rayet stars, galactic structure, red stars in the Magellanic clouds, ultralow dispersion spectroscopy of stars and galaxies, instrumentation and techniques. The Kavalur observatory is equipped with instruments mainly designed by him and constructed in the laboratories of the institute. He collaborated with the Raman Research Institute in setting up of a low-frequency radio array at Gauribidanur.

Bappu was a visiting professor at the University of Arizona and Kitt Peak National Observatory in the spring semester of 1963; a fellow of the Japan Society for the Promotion of Science during May–June 1981; Vikram Sarabhai Professor at the Physical Research Laboratory, Ahmedabad, in November–December 1981.

He was the editor of the *Journal of Astrophysics and Astronomy*, started by the Indian Academy of Sciences, Bangalore, in 1980.

One of Bappu's many scientific interests was the study of the solar eclipses. This was clearly evident to all those who were privileged to listen to one of the finest lectures on this subject by Vainu Bappu at the annual session of the Indian Academy of Sciences in Lucknow on 14 November 1980. With his sense of history and tradition Vainu recalled that it was at the solar eclipse of 18 August 1868 that in the prominence spectrum was detected a bright yellow line, more refrangible than the well known D lines of sodium—the first ever observation relating to helium; the discovery of the Fraunhofer corona by Janssen during the 12 December 1871 solar eclipse; and Evershed's observations at the eclipse of 22 January 1898 of ultraviolet spectra of the chromosphere and prominences, and continuous emission shortward of the Balmer limit, a feature important for determination of electron temperature and density. All these observations were made during solar eclipse studies in India. Vainu had a fascination for eclipse observations.

Vainu Bappu was awarded the Shanti Swarup Bhatnagar prize of the Council of Scientific & Industrial Research for physical sciences in 1970; the Hari Om Ashram

Trust's Megh Nad Saha Award of the University Grants Commission for research in theoretical sciences in 1977; and the Satyendra Nath Bose medal of the Indian National Science Academy in 1983. The President of India awarded him the Padma Bhushan in 1981.

Bappu was an honorary foreign member of the Royal Society of Sciences, Liege, and of the American Astronomical Society, and an honorary foreign associate of the Royal Astronomical Society, London.

He was the first president of the Astronomical Society of India 1973–1974; and vice-president of the International Astronomical Union 1967–1973. Bappu was elected president of IAU in 1979. He left India in May 1982 to spend a few months as a visiting scientist at the European Southern Observatory, Garching, before going to Patras, Greece, to preside over the eighteenth general assembly of the IAU. He never reached Patras. He had to undergo coronary by-pass surgery in Munich on 9 August 1982. His heart condition had become very bad and the by-pass surgery was of no avail. He passed away on 19 August 1982 in Munich.

Vainu Bappu was a perfect gentleman, very much more in the tradition of the leisurely nineteenth century gentlemen scientists than the aggressive twentieth century ones. Suave, softspoken and gracious, he was a man of great personal charm. He had a deep sense of commitment to society, to his colleagues and particularly to those who depended on him. His social conservatism was matched by his intellectual openness. He had a healthy curiosity about almost everything. He was a great lover of nature and took particular care that the setting up of the observatory at Kavalur did not disturb the local ecosystem. He was a great teacher and one of the finest lecturers to audiences at all levels.

He was fond of cricket and used to play it till the doctors put a stop to it. He also liked to paint. His love for roses was well known and the rose gardens of the Institute and in his home bear testimony to this.

But astronomy remained his first passion. Even though his heart condition was not good, he climbed up the 1700 m high Gurushikhar where scientists from the Physical Research Laboratory, Ahmedabad, are setting up a 1.2 m infrared telescope. When asked why he did so, he simply said, "How could I have said no?"

When he left for Munich he knew he might not come back alive. He was as meticulous in planning for his death as he had been for the numerous solar eclipses. He cleared his desk and catalogued his personal books and journals which he bequeathed to the institute. He specified where he was to be cremated and at what spot his ashes were to be immersed.

He had a keen sense of history. He liked to read biographies of great scientists, and would recommend them to the younger generation, quoting Longfellow:

Lives of great men all remind us
We can make our lives sublime
And, departing, leave behind us
Footprints on the sands of time

He is survived by his mother and his wife.

(R. K. Kochhar & M. G. K. Menon)