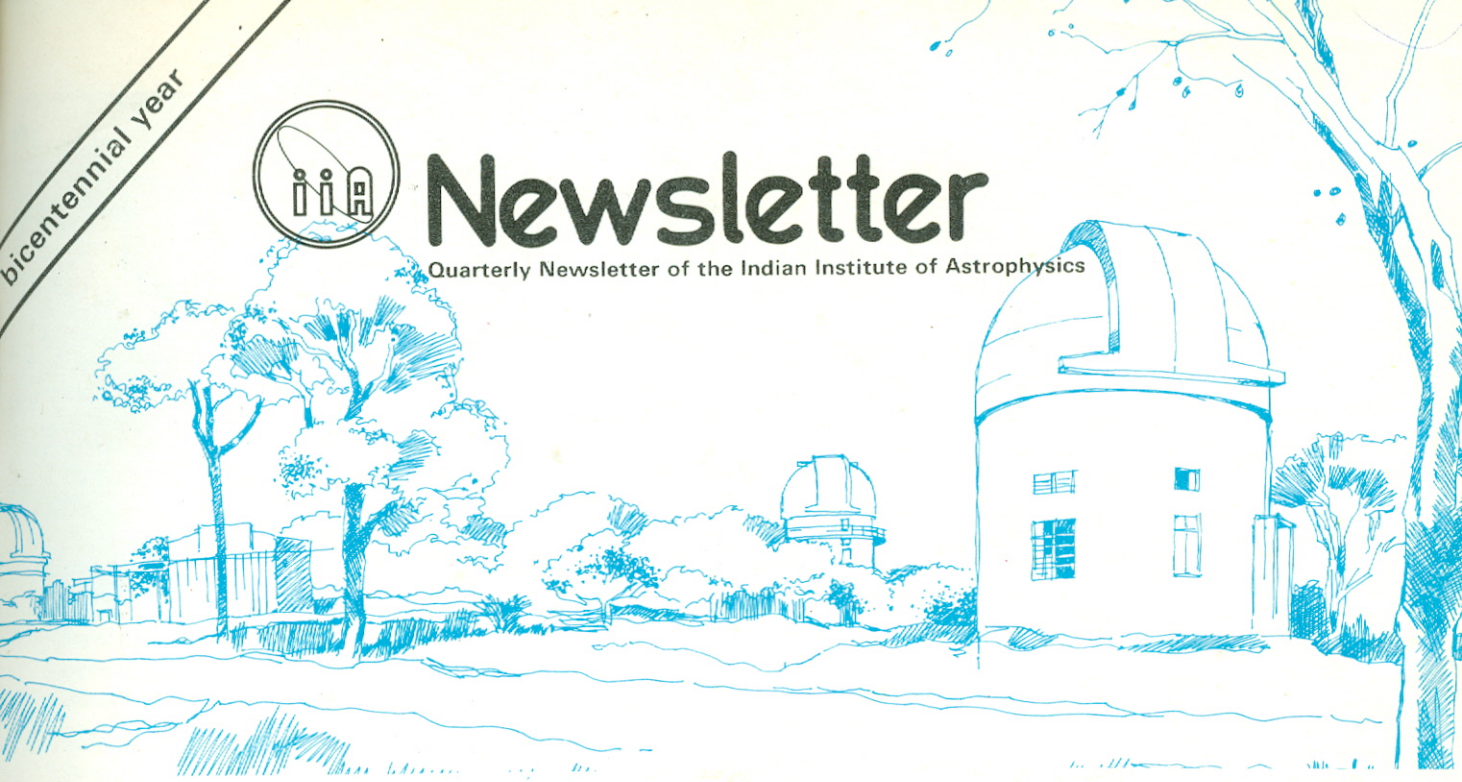
bicentennial year

Newsletter

Quarterly Newsletter of the Indian Institute of Astrophysics



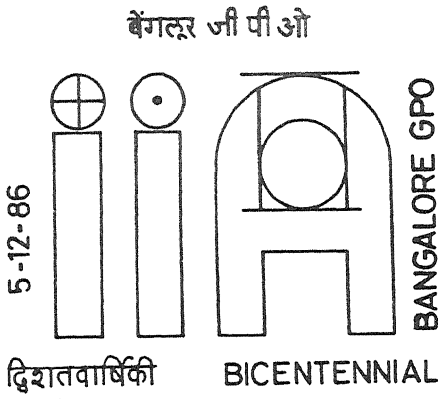
Volume 2 Number 1 January 1987

IIA Bicentennial Celebrations

Indian Institute of Astrophysics traces its origin back to an observatory set up at Madras in 1786 by William Petrie, an officer of the East India Company. The Observatory was taken over by the company in 1789. The astronomical activity shifted to Kodaikanal Observatory in 1899, which was made into Indian Institute of Astrophysics in 1971.

To mark its bicentennial, a symposium on *Two hundred years of Astronomy* was held at Bangalore on 5 December 1986. The date was chosen to coincide with the date of the oldest observation recorded in a manuscript at the Institute. Taken on 5 December 1786, presumably by Michael Topping, the observation pertains to the longitude and latitude of Masulipatam fort.

The symposium held at Guru Nanak Bhavan, Karnataka government auditorium, was attended by about 300 delegates: professional astronomers and astrophysicists from all over the country; a few visiting astrophysicists from abroad; students and teachers from universities; and informed laypersons. Conspicuous by his presence



The special postal cancellation.

Special covers being cancelled at Kodaikanal.

Uday Shankar (RRI) explaining decametric radio astronomy at Gauribidanur.

in mufti was Air Chief Marshal Dennis A. La Fontaine.

An exhibition of old instruments, old books, and old and new photographs on the history of the Institute was also set up at Guru Nanak Bhavan.

The three field stations at Kavalur, Kodaikanal and Gauribidanur observed 5 December 1986 as Open House Day. The observatories were kept open for visitors, and a public lecture on *Astronomy, the old ever-young science* was delivered. The speakers were S. Mohin (Tamil, Kavalur), G. S. D. Babu (English, Kodaikanal), and G. N. Rajasekhara (Kannada, Gauribidanur).

Simultaneous special postal cancellation at the four Institute centres was a special feature of the day.

A plaque to mark the bicentennial was installed on the south pier of the 2.3 m Vainu Bappu Telescope at Kavalur.

The Institute had organized—jointly with the Visvesvaraya Industrial and Technological Museum, Bangalore—an astronomy quiz on Bangalore television for college students in and around Bangalore, and an all India Essay competition. The winners were given astronomy books as prizes. The quiz winners won 7.5 cm telescopes for their colleges.

About 200 delegates visited Vainu Bappu Observatory Kavalur on 6 December. The bicentennial programme was followed by the eleventh meeting of the Astronomical Society of India hosted by the Institute.

The Bicentennial Symposium

The symposium started with opening remarks from Professor Satish Dhawan, who pointed out that India had a long tradition in astronomy, the oldest and the most profound of all sciences. Though the tradition unfortunately remained interrupted for some time, the country has gradually acquired nearly all the requirements to do front-ranked modern astronomy encompassing the entire electromagnetic spectrum, employing the latest detectors, and from ground and space. Dhawan hoped that the revival of astronomy in India will be considered even more seriously in the future through encouraging young people, especially at schools and universities.

Professor K. D. Abhyankar, who chaired the morning session, recalled his days at Kodaikanal where his career as a student and professional astronomer began. He also appreciated the yeoman service IIA has been doing in spreading astronomy among the masses.

Professor R. K. Kochhar, who had planned and organized the symposium in particular, and the celebrations in general, spoke on the *Advent and growth of modern astronomy in India*, covering the period up to the end of the nineteenth century, on the firm grounds of his own research.

Kochhar divided the development of practical astronomy into two phases—the first motivated by calendar making and astrology, and the second by navigation. He pointed out that Jai Singh could not impart any impetus to astronomy in India since 'though he belonged chronologically to the second phase, intellectually he was rooted in the first, pre-telescopic phase'. The impetus for revival of astronomy in India came later from the British need to understand the geography of the country.

Interestingly, though the development of modern astronomy came about for practical reasons, the earliest use of telescope in India was for abstract astronomy. Kochhar pointed out that the earliest use of telescope on Indian soil was good 38 years before Fr. Richaud's in Pondicherry, when on 3 November 1651, a young Englishman Shakerley used a telescope at Surat to observe the transit of Mercury.

Whereas the earliest use of telescopes, for determining longitudes and latitudes, was made in Bengal, it was only at Madras that astronomical activity could develop into a tradition—thanks to the efforts of William Petrie, a Company civil servant, and of Michael Topping, marine surveyor and astronomer, who were instrumental in the company's taking over Petrie's private observatory.

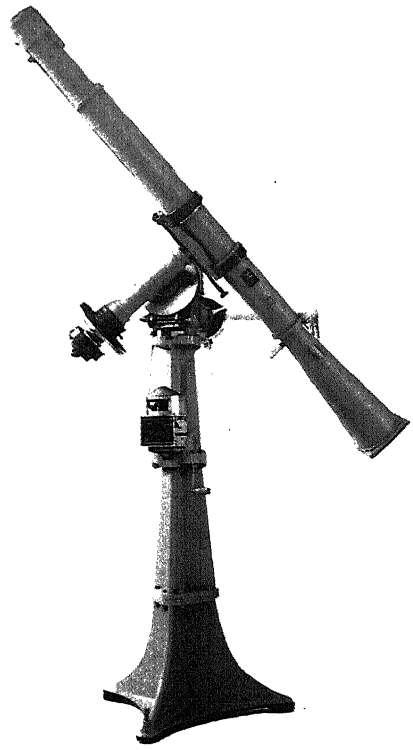
> *Poor observatories cannot afford the luxury of history*
>
> *R. K. Kochhar*

Though the company's interest in the observatory was primarily geographical and navigational, Petrie could persuade the company to keep the observatory alive for astronomical purposes.

Kochhar developed the history of the observatory through its successive directors: William Petrie, Michael Topping, John Goldingham, John Warren, Thomas Taylor, W. S. Jacob, J. F. Tennant, Norman Pogson, and C. Michie Smith. Taylor's catalogue of more than 10,000 stars based on the observations made at Madras was widely used in the nineteenth century.

Historical research!

Michael Topping



The photoheliograph, originally made for the 1874 transit of Venus experiment, was sent to Madras in 1895 for use at the planned Kodaikanal observatory.

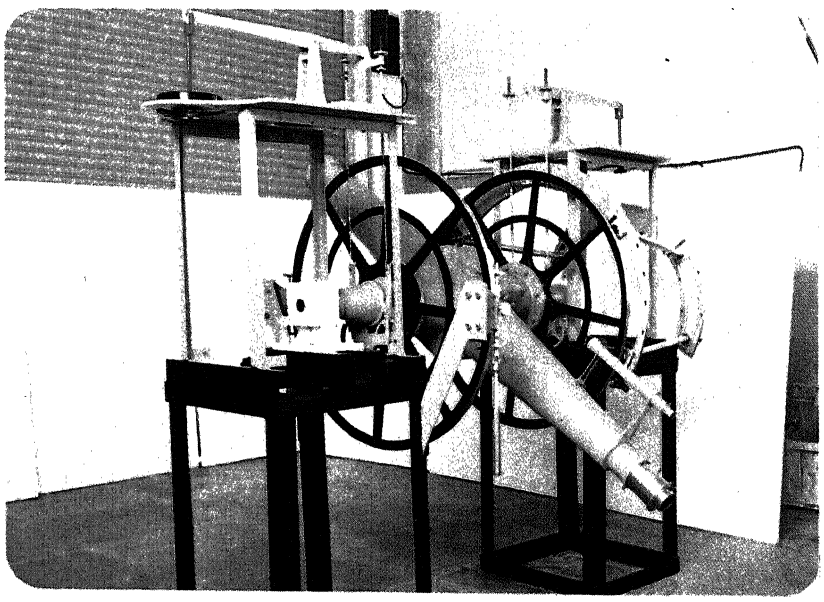
The most glorious period of the observatory during the last century was when Pogson was observing. 'Pogson arrived at Madras with tremendous reputation for his discoveries of asteroids and variable stars, and for his definition of stellar magnitude scale'. Though the Astronomer Royal had wanted him to do only routine observations with the transit circle, he continued using the 6-inch and 8-inch telescopes to work on his atlas of variable stars (published posthumously). Kochhar remarked that the transits of Venus in 1874 and 1882 gave an impetus to the studies of physical aspects of astronomy and also helped in acquiring better instruments, just as transits of 1761 and 1769 had given impetus to positional astronomy a century earlier. Kochhar ended with a shifting of the astronomical activity to Kodaikanal in 1899 by Michie Smith.

Professor J. C. Bhattacharyya, spoke on *Astrophysics in India over the years,* covering the period from 1868 to the present. He pointed out that some of the most important observations of astrophysical relevance were made from the Indian soil, during the solar eclipses of the last century: Norman Lockyer discovered helium from Guntur in 1868, and Janssen discovered the F-corona at Ooty in 1871. The first Indian expedition for solar eclipse was at Jeur in 1898, led by Kavosji Naegamvala.

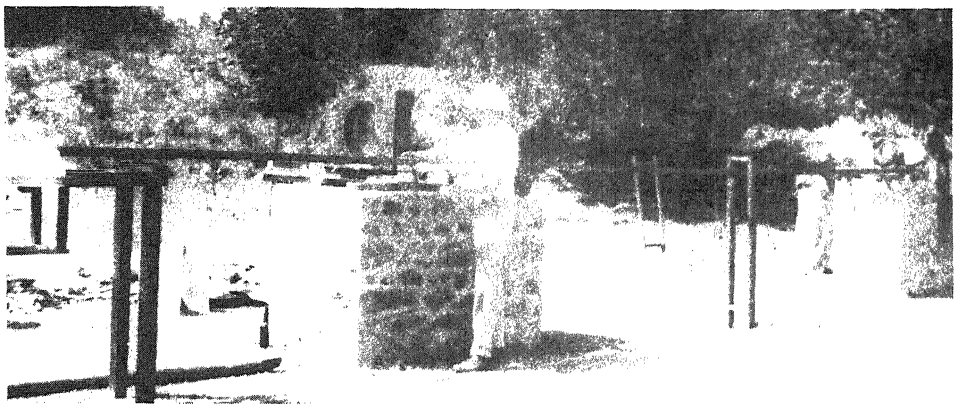
Naegamvala also set up an observatory at Poona, and bought a 20-inch telescope utilizing the funds donated by Maharajah Takhtsinghji of Bhavnagar. After Naegamvala's death the observatory was closed down, and the telescope was transferred to Kodaikanal in 1912. Here it was installed and used by Bappu in the 1960s, was later shifted to Kavalur, and is currently in use at Leh.

'The two most important events during the early part of this century were the setting up of Kodaikanal Observatory, and of Nizamaiah Observatory where a 15-inch telescope was set up by a rich nobleman'. At Kodaikanal, John Evershed joined initially as a deputy director and later took over the directorship. He equipped the observatory with spectroheliographs and spectrographs. On 5 January 1909, Evershed discovered the mass flow of matter in sunspot regions—now known as the Evershed effect. Kodaikanal has been obtaining daily pictures of the Sun in calcium K-line, hydrogen-alpha line and in white light, since 1904.

Bhattacharyya suggested that the 1910 apparition of comet Halley influenced the development of astronomy in India to a great extent. It generated tremendous



The transit circle with $5\frac{1}{2}$-inch object glass, similar to—but smaller than—G. B. Airy's Greenwich instrument, set up at Madras observatory in 1862.



John Evershed photographed during his site survey at Srinagar (1914–1916) for a proposed solar observatory. (The observatory was never set up.)

Evershed

interest in the subject, and led to the formation of the Astronomical Society of India at Calcutta which lasted 10 years.

Early in the 1920s, Megh Nad Saha gave his equation of ionization equilibrium, and theory of stellar spectra which shaped the course of spectroscopic astrophysics. Saha also trained several astrophysicists in the country, and also drew a blueprint for the development of astronomy and astrophysics in the country. 'The main features of the blueprint were (1) computation of almanac and astronomical ephemeris, (2) teaching of astronomy, (3) modernization of existing facilities at Kodaikanal, and (4) establishing a new observatory with a large telescope.

Bhattacharyya concentrated on the third and fourth topics. Whereas A. K. Das modernized Kodaikanal,

M K V Bappu

Vainu Bappu fulfilled the last item in Saha's blueprint. Bappu helped in drawing up the requirement for a 48-inch telescope at Hyderabad, moved the U.P. state observatory (UPSO) to Nainital, and established the observatory at Kavalur now named after him. He also planned and supervised the fabrication entirely within the country of the 2.3-m telescope which became operational after his untimely death.

> *Now we have astronomical instrumentation that matches our theoretical ability*
>
> *J. C. Bhattacharyya*

A mention of Udaipur Solar Observatory, and the Physical Research Laboratory's (PRL) new 48-inch infrared telescope at Gurushikhar completed the list of existing facilities in the country. Bhattacharyya stressed the need for a 4-m class infrared-optical telescope, and described the site surveys already being done in Kumaon hills, and around Leh in Ladakh by different organizations.

There was then a break for coffee after which Professor A. K. Raychaudhuri spoke on the *Evolution of ideas in theoretical cosmology.*

Raychaudhuri began with the vedic and biblical mythologies both of which agreed that there was a beginning. While Bible ascribed the creation to God, Vedas suggested it began with the 'desire—the primal germ of mind'. 'Vedas wondered whether even gods really knew the true story of creation'.

'Denying . . . a beginning, the physicist was left with two lines of thought': a static universe and a cyclic universe—the latter similar in some respects to the old Hindu concept. Olbers, in 1915, pointed out a difficulty with the static universe—that it would attain thermodynamic equilibrium contrary to what is observed. Also, dynamically, an equilibrium is possible only if a repulsive force counteracts the gravitational attraction as postulated by Seeliger (1895) and Neuman (1896).

Raychauduri then went over to the 'cosmology as we understand today', after the work of Einstein in 1917.

> *Einstein's paper [of 1917] was physically barren—it did not have any observational data to explain . . . [nor did it] predict anything which could be readily subjected to observational varifications*
>
> *A. K. Raychaudhuri*

Einstein proposed a homogeneous, isotropic and static universe with a cosmological (repulsive) term.

Shortly afterwards, de Sitter proposed a solution of Einstein's equations, giving expanding universe, but with no matter in it. Friedmann had an intermediate solution with no cosmological term, with matter present, and predicting expanding universe which Hubble had suggested by then. Eddington favoured a cosmological model that was Einstein-static to start with, but which began to expand due to an instability which could have been triggered by local density enhancements as suggested by N. R. Sen in 1933.

In 1948 Bondi & Gold, and Hoyle proposed a steady-state universe. This theory did not have the problem of an initial singularity that the big bang theory had. Though Eddington and Tolman believed that the singuiarity may be avoided in an inhomogeneous anisotropic universe, Raychaudhuri showed in 1955 that it cannot be. The discovery of microwave background in 1965 favoured the big bang cosmology. However, the very next year, Hoyle & Narlikar put forward their theory of 'bubble universe'. Though 'the theory gained little support . . . many of its features are extremely similar to . . . the inflationary models'.

On the front of big bang cosmology Wagoner in 1973 continued the early work of Gamow on nucleogenesis and brought about a good agreement with observed abundances. Galaxy formation is another challenging problem related to cosmology, and has a bearing on the associated problem of the nature of dark matter.

Raychaudhuri remarked that 'with the development of grand unified theories, theoretical cosmology has taken a new turn'. Furthermore, inflationary universe has been proposed during the present decade. Much work has been done during the recent years in quantum cosmology. Thus it would appear that the field of theoretical cosmology is just being opened up.

After lunch, the symposium continued with Professor R. R. Daniel in the chair. The first talk was by Professor Govind Swarup on *Radio Astronomy at metre wavelengths—new challenges.* After briefly describing the development of radio astronomy since Carl Jansky,

> *Radio astronomy is a young subject. When you have a young daughter, you only talk about her*
>
> *Govind Swarup*

Swarup moved on to the efforts at the Tata Institute of Fundamental Research (TIFR) in this field. In 1963, the idea of setting up the metre wavelength parabolic cylindrical telescope at Ooty germinated, motivated by the possibility of obtaining linear sizes of radio sources through lunar occultation technique. Considerable interest had already been generated by the work of Martin Ryle in 1955 wherein source counts were used to test cosmological models. The Ooty telescope provided sizes of about 1000 sources with 7 arcsec resolution or better, which could be used to develop an angular size-intensity relation as a cosmological test.

Swarup then described the present facility at Ooty where about a dozen 'baby cylinders' of 200-m^2 collecting area situated over an area of 4 km radius are operated in conjunction with the main telescope to enable mapping of radio sources. The entire system constitutes the Ooty synthesis radio telescope (OSRT). Swarup then took up the proposal of the giant metre-wavelength radio telescope (GMRT) which is already taking shape. Whereas observations at metre wavelengths are important, they are not well-covered because (1) 'It is easier to get better angular resolutions at lower wavelengths', and (2) 'Ionosphere disturbs the metre-wavelength observations'. Swarup felt that the most important results from the GMRT would be the possible detection of proto-clusters or primordial neutral hydrogen clouds, if galaxy formation did take place at redshifts of 3 to 10. The GMRT can also provide observations of millisecond pulsars, and of coherent processes—fields in which interest has already been generated in the country. The GMRT would consist of about 36 dishes of 45 m size which would provide both good resolution and large collecting area. Swarup described two different engineering concepts of low-cost dishes being considered. The proposed site for GMRT is about 80 km north of Pune, and the headquarters would be situated in the campus of the University of Poona.

After the coffee break, Professor P. C. Agrawal dwelt on *Space astronomy in India: Past and present.* He covered a broad range of topics: Gamma rays, X-rays, space ultraviolet and far-infrared radiation, as well as cosmic rays. Agrawal described the Indian efforts using balloon-borne and rocket-borne telescopes as well as the space platforms on Indian and foreign satellities.

Agrawal began with a summary of cosmic-ray observations in India, beginning with Homi Bhabha's flight of a cluster of rubber balloons from the Central College, Bangalore, for the meson experiment. Balloon flights from other places like Madras and Srinagar followed, and a study of cosmic rays as a function of altitude and latitude was taken up.

TIFR began to fabricate polythene balloons after 1955 and several important studies were taken up in the 1960s. Important among these related to the odd–even effect in abundances and the energy spectrum in the range 15–300 GeV. Later, experiments were made with the Skylab, and with the instruments flown in Anuradha Satellite, to study the anomalous component of cosmic rays.

Agrawal then moved over to X-ray astronomy, his own field of interest, pointing out that it is very young, the first

> *X-ray astronomy is even younger than radio astronomy*
>
> *P. C. Agrawal*

source having been discovered accidentally in a rocket flight in 1962. TIFR's efforts in this direction started in 1968 using balloon-borne instruments. Important observations were made of the temporal variation of Sco X-1 and flares and spectrum of Cyg X-1. PRL also began balloon flights in 1970, and observed source such as Cyg X-1 and Her X-1. TIFR is currently concentrating on the study of X-ray emission lines from pulsars, and proposes satellite payload for the augmented space launch vehicle (ASLV).

Agrawal spent some time on the gamma-ray observations using balloon-borne instruments. Indian Space Research Organization has proposed an instrument for the observations of gamma-ray bursts, to be flown by ASLV.

Agrawal briefly touched upon the far-infrared observations using the 1-m aperture balloon-borne telescope, and also the ultraviolet astronomy carried out by TIFR, IIA and PRL under the Guest Investigator programme on IUE.

The proceedings of symposium are being published by IIA.

The Eleventh Meeting of the Astronomical Society of India

The eleventh meeting of the ASI was held at Guru Nanak Bhavan, Bangalore, 7–9 December 1986 on an invitation by I.I.A.

The scientific meeting departed from the general practice by having a large number of invited review talks (10), and in placing all the contributed papers (over 100) as posters. The poster papers were divided into 9 groups, and were discussed in rapporteur sessions of one hour for each group.

The review talks are listed below:

1. *Halley's comet from the ground and from Space* K. R. Sivaraman
2. *High resolution spectroscopy at PRL — status and prospects* J. N. Desai
3. *The 10.4 m millimetre wavelength radio telescope at RRI* R. Bhandari
4. *Observational techniques at millimetre wavelengths R. S. Arora*
5. *The moral of millisecond pulsars* G. Srinivasan
6. *Advances in helioseismology* M. H. Gokhale
7. *Effect of a compact object near a Be Star* S. P. Tarafdar
8. *Image processing for infrared observations* R. P. Verma
9. *Radiative transfer in a moving medium* K. E. Rangarajan
10. *Recent advances in observational cosmology* V. K. Kapahi

ASI's programme to popularize astronomy

To promote amateur astronomical activity in India, the ASI offers visiting fellowships to amateur astronomers who wish to benefit by interaction with professional astronomers at leading astronomical centres in India. The fellowship carries a grant of Rs. 400/- to enable them to visit and work at one of these centres for a period of about 1–2 months.

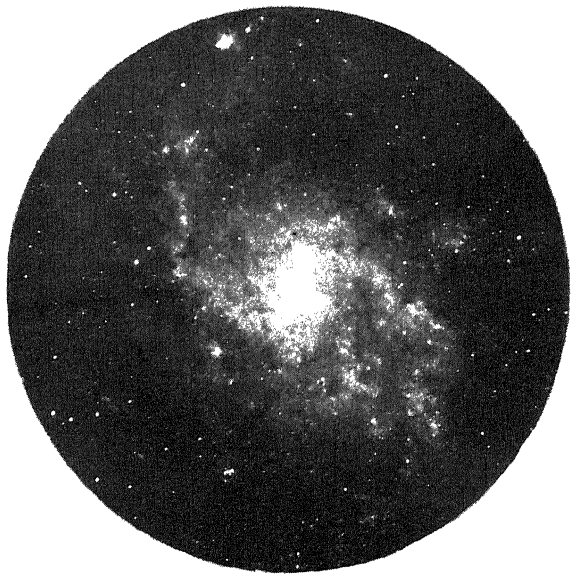
Details may be obtained from T. P. Prabhu, coordinator of ASI's popularization of astronomy programme, Indian Institute of Astrophysics, Bangalore – 560034.

Dr. Ram Sagar of IIA has been awarded the Astronomical Society of India's Young Astronomer's award for the years 1983–84 for the paper *Integrated photometric parameters of open and globular clusters* by Ram Sagar, U. C. Joshi & S. D. Sinvhal (Bull. Astr. Soc. India (1983) **11**, 44–55) which was published while Ram Sagar was at UPSO. He shares this prize with A. K. Pandey of UPSO for the paper *The occultation of Hyd—20° 51695 by Uranus on 1982 May 1* by A. K. Pandey, M. S. Mahra & V. Mohan (Bull. Astr. Soc. India (1984) **12**, 258).

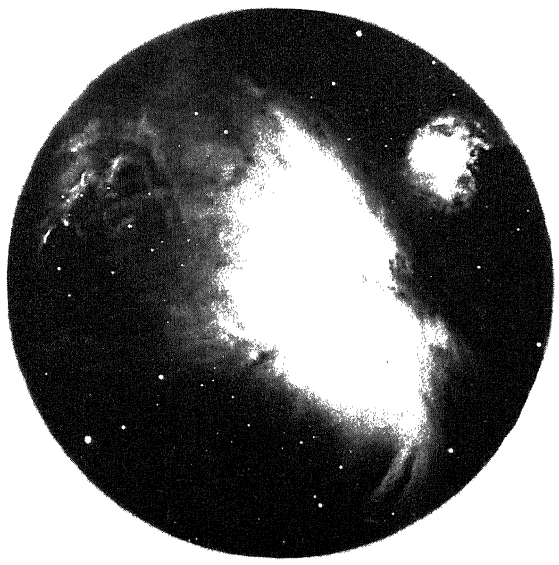
Sagar's work bridges the observation of star clusters in our galaxy with those in other galaxies, where only integrated parameters can be observed. The latter observations can be extended to a large sample using the Hubble space telescope.

from the director

With further improvements in the electronic controls and in the alignment of the Wynne correctors, the 2.3-m Vainu Bappu Telescope is now ready for deep-sky photography over a sizeable aberration-free field. Good photographs have been obtained of galactic nebulosities like the Orion nebula, Horsehead nebula, Crab nebula and galaxies like M33, M81, and NGC 891. Two of these photographs are reproduced here.



The spiral galaxy M33 in Triangulum photographed by K. K. Scaria & M. J. Rosario on Kodak 103aE emulsion on 1986 November 22. The exposure time was 100 minutes.



The Orion nebula photographed by K. K. Scaria & M. J. Rosario on Kodak 098-02 emulsion with Wratten 25 filter, on 1986 November 12. The exposure time was 15 minutes.

I welcome, once again, the proposals for observations with the VBT. The proposal forms are available on request. An 8-member, national review committee has already been formed to evaluate the proposals and to recommend allocation of observing time.

J. C. Bhattacharyya

of human elements

Tit for tat

'One thoroughgoing experiment,' Rutherford thundered in one of his lectures, 'is worth all the theories in the world – even if those theories are those of a Bohr.' Years later, Eddington uttered the dictum that he would not believe an observation unless it was supported by a good theory. I was an astronomer by that time and knew him well. I told him that I was shocked by his pronouncement. He smiled gently. 'I thought it would be good for Rutherford,' he said.

Cecilia Payne–Gaposchkin: An autobiography and other recollections

Edited by Katherine Haramundains, Cambridge University Press, 1984, p. 117

out of context

. . . . and it is greatly to be hoped that these [NGC numbers] will be *quoted* as little as possible.

Mem. R. astr. Soc. (1888) **49**, 4.

* *

We are of course fully aware of your result that we and our immediate neighbourhood may partake in a systematic journey toward the Virgo cluster.

IAU Symp. 79 (1978) D. Reidel, Dordrecht, p. 88.

* *

After falling for a while, as we progress outward toward the top of the photosphere, the temperature rises with increasing height in the chromosphere of the Sun.

Astronomy & Cosmology (1975) Freeman, San Francisco, p. 197.

* *

Winners of the quiz competition:

First prize:	Mr V. Arun & Mr Dinesh Nayak, M. E. S. College, Bangalore.
Second prize:	Mr Movin Miranda & Mr Rajiv Prabhakar, R. V. College of Engineering, Bangalore.
Third prize:	Mr T. K. Harish & Mr E. R. Muralidharan, Dr Ambedkar First Grade College, Bangalore.

The ten best entries in the all-India essay competition:

1. *Frontiers in Astronomy*	Ms V. G. Bhanu, Tirunelveli
2. *Message of Starlight*	Mr K. Sunder, Madras
3. *The Solar System*	Ms Archana Singh, Bangalore
4. *Astronomy in India*	Ms U. S. Suchitra, Gauribidanur
5. *The Solar System*	Mr V. N. Ekbote, Baroda
6. *Astronomy in India*	Mr N. Oruganti, Hyderabad
7. *Astronomy—The old, ever-young Science*	Ms S. Sathya Rani, Tirunelveli
8. *The Solar System*	Mr D. Rama Bhadra Rao, Hyderabad
9. *The Solar System*	Mr G. Amba Prasad, Machilipattnam
10. *Astronomy and Society*	Mr S. Manthira Moorthy, Tiruchendur

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