

KHAGOL

THE
IUCAA
BULLETIN



Inter-University Centre for Astronomy and Astrophysics
An Autonomous Institution of the University Grants Commission

No 13

January 1993

The D-Day

The time was close to 7 p.m., the date December 28, 1992 when a young man of 82 dressed in a dignified charcoal grey coloured suit stepped forward to press a button that set in motion the Foucault Pendulum in IUCAA's Aryabhata Building.

This symbolic act by Subrahmanyam Chandrasekhar launched IUCAA which a few minutes earlier had been formally dedicated by G. Ram Reddy, Chairman, University Grants Commission --- dedicated to the academics participating in the Centre's numerous activities.

As the 500-odd gathering in the Central Quadrangle watched the pendulum bob swing to and fro on a large TV screen, the walls of the Devayani Campus lit up dramatically and two young ladies gave a melodious chanting of sanskrit shlokas from the balcony of the Bhaskara Building. Then the audience was treated to an intellectual feast of a rare kind by Chandrasekhar's dedication address on *The Series Paintings of Claude Monet and the Landscape of General Relativity*.

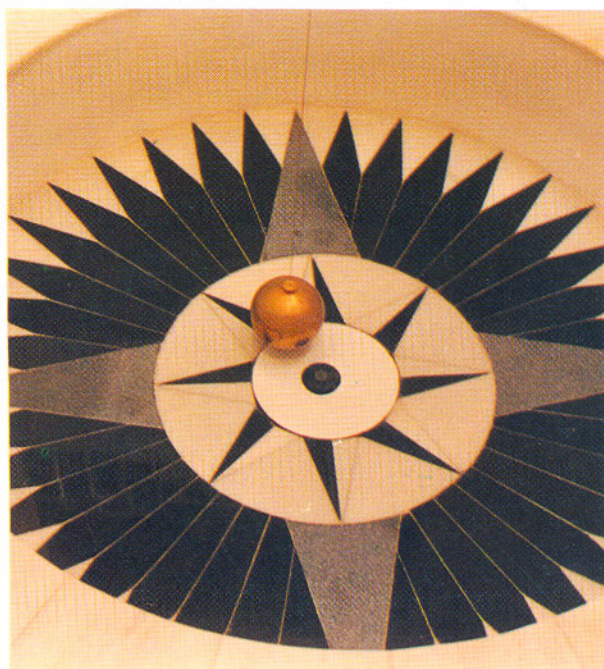
This formal ceremony was followed by a two-day Dedication Seminar covering a broad range of topics in A & A. Speakers included Chandrasekhar, Krishna Abhyankar, Richard Bond, Russell Cannon, Ramnath Cowsik, Donald Lynden-Bell, Jayant Narlikar, Bill Saslaw and Govind Swarup.

On December 29, IUCAA's Foundation Day, the Founder, Yash Pal delivered the fourth Foundation Day Lecture on *Paralleling and Networking India*.

We hope to bring out the above lectures as publications in due course. The details will be announced in the future issues of Khagol.

Name Dropping...

The IUCAA Campus and Buildings have been named as follows : (i) *Akashganga* for the Housing Complex, (ii) *Devayani* for the Institutional Complex and (iii) *Aditi* for the Auditorium Complex. Astronomers need not be told that *Akashganga* (Our Galaxy) and *Devayani* (Andromeda) are neighbouring galaxies. Devayani has an interconnected complex of buildings named *Aryabhata* (office block), *Bhaskara* (lecture halls), *Brahmagupta* (instrumentation laboratory and computer centre), *Varahamihira* (library), *Ballava* (canteen), *Nalanda* (hostel) and *Takshashila* (guest flats).



The Pit and the Pendulum

Observational Astronomy from Gauhati University

A.K. Sen of IUCAA was invited by H.L. Duorah of Gauhati University during September 21-24 and October 30-November 3, 1992 to assist them to set up and demonstrate experiments for observational astronomy with their 6" Zeiss reflector. The experiments are designed for inclusion in the M.Sc. (Physics) practical classes. Experiments like the determination of period of rotation of sun, heights of lunar mountains, polar axis alignment of a telescope, etc., were explained through practical demonstrations and related theoretical lectures.

Colloquia held during last three months

12.10.92 H.V. Sahasrabudhe on *A computational study of Hindustani music*, 19.10.92 B.V. Sreekantan on *The Universe as seen in high energy radiation*, 2.11.92 R. Ramaswamy on *Quantum Chaos : The wave mechanics of classically chaotic systems*, 16.11.92 N. Mukunda on *Aspects of the relationship between physics and biology*, 30.11.92 P.R. Pisharoty on *Water*

Active Galaxies and Quasars

The Science and Engineering Research Council of the Department of Science and Technology has agreed to sponsor five advanced schools on various topics in astronomy and astrophysics over a five year period. The first of these schools, on Active Galaxies and Quasars, was held at IUCAA during November 22 - December 11, 1992. A range of topics, observational as well as theoretical, were covered, providing a broad review of the current state of knowledge on AGN, Quasars and related objects like starburst galaxies. The lecturers, Sandip Chakrabarti, Naresh Dadhich, Sanjeev Dhurandhar, Chanda Jog, Ajit Kembhavi, Pushpa Khare, Tushar Prabhu, D.J. Saikia and Kandaswamy Subramanian, each gave 3 to 8 lectures, presenting the topics in depth. Seminars on topics of current interest were presented by various astronomers and tutorial sessions were conducted by G.C. Anupama and Debiprosad Duari of IUCAA. About 25 persons from university departments and research institutes attended the school. The participants included research scholars as well as more senior persons, all of whom are either actively working or interested in working in the areas covered by the school. The lectures at the school have provided a comprehensive summary of the field, valuable introduction to methods

and techniques, as well as ideas for research. The course directors were Naresh Dadhich and Ajit Kembhavi.

National Workshop on Amateur Telescope Making

As a part of its ongoing programmes on popularisation of astronomy and promotion of amateur astronomy in the country, IUCAA organised a National Workshop on Amateur Telescope Making during November 12-20, 1992 in its premises. Fifteen amateur astronomers participated in the programme by invitation. Pramod Rathod, an engineering student from Bombay, was invited as an expert instructor, assisted by Arvind Paranjpye of IUCAA and Kiran Shah of Jyotirvidya Parisanstha, Pune. All participants were amateur astronomers ranging from undergraduate students to college principals and retired professors. The Indian Institute of Astrophysics (IIA), Bangalore, had kindly gifted 15 mirror blanks, each of 6-inch

PEP talks

The graduate students of IUCAA have initiated a series of informal after-dinner lectures and discussions to acquaint themselves with developments in the rapidly evolving field of Physics. This series has been named PEP* talk (* Perceptions of Evolving Physics). There is continuing active participation of the students from IUCAA and NCRA with encouragement from their respective faculties. These lectures have emphasized the basic concepts and fundamental issues in several areas of physics.

PEP talks by Locals

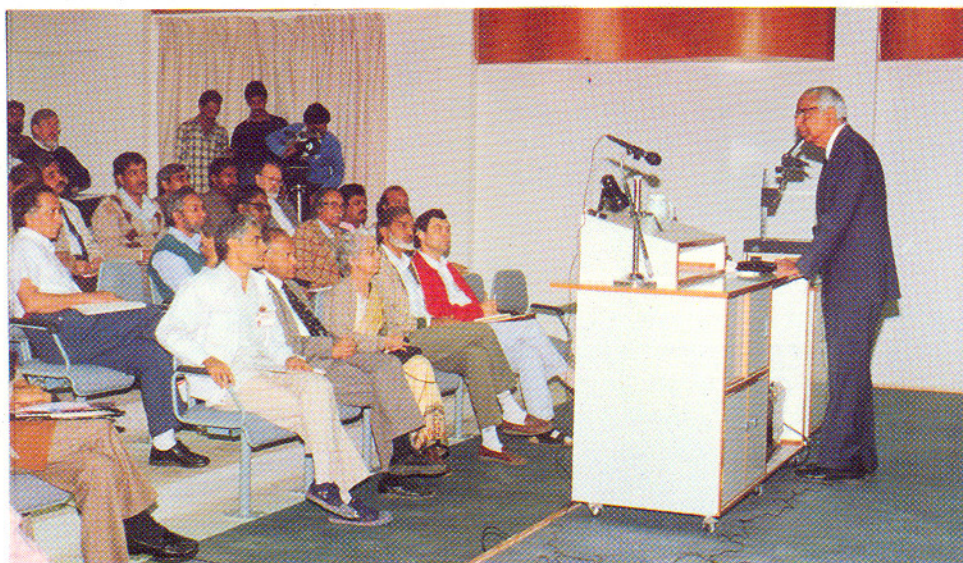
11.09.92 T. Padmanabhan on *Mach's Principle*, 25.09.92 Kanti Jotania on *Gravitational Waves*, 16.10.92 Jayant Narlikar on *Arrow of Time in Electrodynamics*, 30.10.92 Jasjeet Singh Bagla on *Equivalence Principle on the anvil of Experiment*, 13.11.92 K. Subramanian on *Where do Cosmological Magnetic Fields come from?*, 27.11.92 Naresh Dadhich on *Ashutkar Variables*.

... and by Visitors

29.09.92 Ashoke Sen (TIFR) on *What are Strings ?*, 29.09.92 T. R. Sheshadri (Delhi University) on *Extended Inflation*, 3.11.92 R. Ramaswamy (JNU) on *Chaos and Fractals*, 10.11.92 R. Nityananda, (RRI) on *Entropy*, 25.11.92 Milind Diwan, (Stanford University) on *Neutrinos*.

diameter and ground to f/8 spherical, together with pitch laps, powder and flats. For this we are grateful to R. Cowsik, Director, A.K. Saxena and his colleagues of IIA. The participants figured their mirrors, polished and performed the Foucault test. While the mirrors were being aluminised in Bombay and eye-pieces were being procured, the participants assembled the wooden Dobsonian mounts with the help of skilled carpenters. The telescope making was a grand success, and the participants

were allowed to take their telescopes, to be used by their local Astrosocieties. At least 6 participants felt confident that they had acquired enough practice to run such workshops on their own in future. The cost of material per telescope turned out to be about Rs. 1,800, out of which IUCAA's contribution has been about Rs. 1,400. The quality of optics was good enough for future observations by the respective groups of amateur astronomers.



Dedication seminar : The speaker describing the relevance of Principia to the audience of today

Parsecstones in Astronomy - 1

J V Narlikar

In astronomy, as in the rest of the sciences, the path of progress towards the truth has not always been straight and narrow. It meanders with occasional wrong turnings. In this series of snippets we describe some of the significant developments, largely maintaining a chronological sequence.

Measurements of the Radius of the Earth

Erastosthenes of Cyrene (ca 276-195 B.C.) was nicknamed Pentathlos as well as Beta because of his expertise in several fields like, philosophy, literature, geometry, geography, astronomy, etc., in each of which he was second only to the best. At the relatively young age of forty he was appointed in-charge of the famous Alexandria Library. Amongst his astronomical exploits was one that began right at home. He used astronomy to measure the circumference of the earth.

By hindsight his method seems very simple. He found that at Syene the sun shone directly overhead (so as to be seen on the deep surface of a narrow well) while at the same time it was about

7.5° from the zenith at Alexandria located some 500 miles north on the same meridian. Thus he calculated that the distance of 500 miles produces an angle of 7.5° at the centre of the earth. So an angle of 360° would correspond to 24000 miles. His actual estimate was 24662 miles which falls short of the modern estimate of the earth's circumference by less than 200 miles.

In a highly perceptive passage Eratosthenes also conjectures : "If the extent of the Atlantic Ocean were not an obstacle, we might easily pass by sea from Iberia (Spain) to India, keeping in the same parallel."

EQUATORIAL SUN-DIAL

Shadows of objects cast by sun give an indication of time during the day - the relation between the shadows and the time being due to the regular, apparent, motion of sun. This motion of sun has been the basis of time measurement from ancient days, and an equatorial sun-dial (also called Sam-rata Yantra and seen in the Jantar Mantars of Delhi, Jaipur, etc.) is a scientific instrument made for this purpose. In this article, the working principle of an equatorial sun-dial is explained and a simple way of constructing one is described. (You can understand the description given below easily if you take pieces of cardboard and scissors to make the Yantra, as shown in Fig. 2.)

In order to understand the principle of this instrument, consider the apparent motion of sun. As earth spins on its axis, sun appears to revolve around earth's axis. The earth's rotation around sun is in a plane which has an inclination of about 23.5° with respect to the plane of equator. As a consequence of this inclination, the apparent revolution of sun occurs either in north or south of the plane of equator at different periods of the year. Thus, the apparent motion of sun could be considered to be on the surface of a cylinder whose axis coincides with the earth's axis; on any given day, the solar track is an almost closed circle and the azimuth angle of sun on this track corresponds to the solar time (see Fig. 1).

At any point on the equator, let us do the following on one of the two equinoxes (March 21 or September 23) :

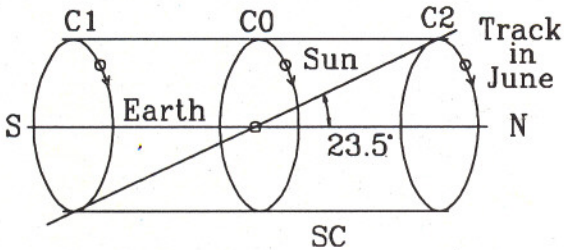


Figure 1 : The apparent motion of sun is shown. On the days of equinoxes (March 21 and September 23), the motion is in the plane of equator as shown by the circle C0. The track shifts to north (south) in summer (winter) as shown by the circle C2(C1). Thus, the apparent solar motion on any day is constrained to be an almost closed circle on the cylinder SC whose axis is parallel to earth's axis.

Place a transparent cylindrical shell with its axis horizontal and pointing north-south, i.e. , a miniature version of the cylinder on which sun moves. The shadow of the axis would fall vertically down at midday, and azimuth of the shadow would move from west to east at a rate 15° per hour, i.e. ,lower half of the cylinder is traversed by the shadow in 12 hours.

It can be seen that the daily motion of shadow remains the same through the year, because this motion is caused by earth's spin and this spin is stationary. It can also be seen that as earth is very small as compared to solar distance, what we see at the equator would also be seen anywhere on the earth as long as the axis of our cylinder keeps aligned with earth's axis. Thus an equatorial sun-

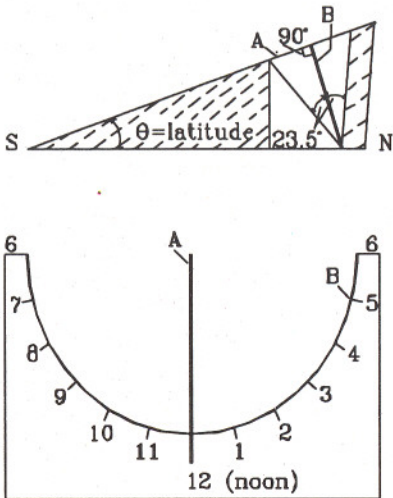
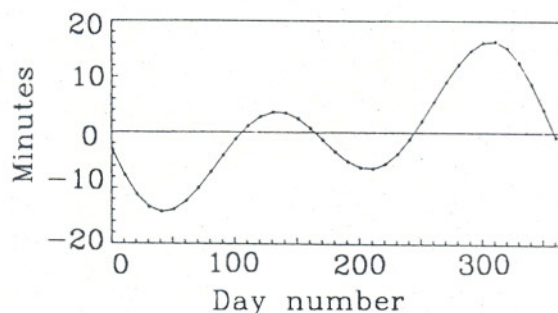


Figure 2 : Two pieces of cardboard, A and B, are used to make a simple Samrat Yantra. The piece A is a right angled triangle with a height of about 15 cm, placed such that its hypotenuse is aligned with the earth's axis. The piece B is made by cutting out a semicircle of radius about 10 cm, from a rectangular piece; the two faces of B have divisions to give 12 equal parts of the semicircle indicating hours, which could be further divided into parts indicating quarter hours. The pieces A and B are joined such that their planes are normal to each other and centre of the circle in B lies on the hypotenuse in A. Note that the two views shown have different scales.

A more stable instrument could be constructed with plywood (or particle board etc.) of 10-15 mm thickness. In this case the hypotenuse in A would need to be sharpened as shown in the diagram, and the markings for hours could be done on the face of the semicircle (which would be a short length semi-cylinder now).

dial (or Samrat-Yantra) can be made as shown in Fig. 2. The hypotenuse of the triangle A acts as the axis of the cylinder and casts its shadow on the cylinder simulated by the semicircle in B. (Notice that only a limited portion of the hypotenuse, as indicated by the two lines drawn at 23.5° in Fig. 2, is effective in giving the shadow and therefore the shaded part of the triangle need not be there). The shadow at the midpoint of the semicircle in B corresponds to 12 hours.



Variation in the equation of time throughout the year.

Figure 3 : The equation of time is shown as a function of day in the year; 0 corresponds to the morning of January 1st.

Visits Abroad

Naresh Dadhich visited the Department of Applied Mathematics, University of South Africa, Pretoria for two weeks, October 1 -15, 1992. He gave a series of seminars on Ashtekar Variables, Gravity without metric and Black hole energetics. He also visited Natal University, Durban and the University of Cape Town and discussed with the South African colleagues possible cooperation in organising joint schools and workshops. On way back, he visited the University of Mauritius and gave two popular talks on our current view of Spacetime and Black holes.

During September 21 - 28, 1992 **Varun Sahni** participated in the First Iberian Conference on Gravitation held in Evora, Parhyel where he spoke on the effect of density perturbation and gravity waves on the anisotropy of the Cosmic Microwave Background Radiation. From September 28 - November 20, Varun visited ICTP and the University of Padova in Italy, and the Universities of Cambridge, London, Sussex, Edinburgh and Newcastle in the U.K., where he gave seminars on issues relating to the formation and evolution of the large scale structure of the Universe.

The time indicated by a solar-dial is solar time and not IST (Indian Standard Time). In order to convert the measured local time to IST two corrections need to be applied -- one corresponding to the longitude of the location and the other for the date. The first correction is done by adding $[82.5 - \text{LONGITUDE}(\text{east})] \times 15$ minutes to the dial time, and the second correction is done by subtracting equation of time, shown in Fig. 3, from the time obtained after the first correction. (Equation of time represents the effects of the non-uniform revolution of earth around sun and of the inclination of ecliptic to equator).

ASTRONOMICAL DATA CENTRE UPDATE

The DST sponsored Astronomical Data Centre (ADC) at IUCAA now has a collection of hundreds of large and small catalogues, as well as information on a much larger number. Software which allows very easy access to these catalogues has been developed, and access to foreign databases using e-mail is possible. Anyone needing catalogued material may contact **Ashwini Sohoni, IUCAA**. Limited travel funds are available for those who wish to extensively use the database at IUCAA.



Tree planting by Chandrasekhar under the watchful eye of Yash Pal

Workshop on Galaxy Distribution Functions

IUCAA hosted an Indo-USA binational workshop on Galaxy Distribution Functions, organised by W.C. Saslaw (University of Virginia and Cambridge University) and S.M. Chitre (TIFR, Bombay) during December 13 - 23, 1992.

The workshop discussed the physics of distribution functions, their comparison with computer experiments, and their relation to other statistical descriptions of galaxy clustering.

About forty astrophysicists, cosmologists and students attended from India as well as from England, France, Germany, Japan, Russia and the United States. In Addition to 90 minutes review talks each day, there was ample time for extensive discussions which led to

new results, clarifications and collaborations on many topics.

Minischool on Pulsars

A minischool on PULSARS is being organized at IUCAA during February 15 - 20, 1993. The lec-



**Chandrasekhar and Ram Reddy
at the dedication ceremony.**

VACATION STUDENTS PROGRAMME 1993

IUCAA invites applications for the third Vacation Students Programme (VSP). Students selected under the VSP will spend six weeks at IUCAA to work on specific research projects under the supervision of the IUCAA faculty. The programme will conclude with seminar presentations of the projects by the participants, a written test and an interview. Those who perform well will be preselected to join IUCAA as research scholars after the completion of their degree.

Students who enter the final year of the M.Sc. (Astronomy, Mathematics, Physics) / B.Tech. / B.E. courses in the academic year 1993-94 are eligible to apply. Application giving the academic record of the applicant as well as two letters of recommendations from teachers, mailed directly, should reach the **Coordinator, Core Programme, IUCAA** by March 1, 1993. The selected candidates will be informed by April 1, 1993 for the programme to be held from June 1 - July 15, 1993.

turers will include Bhaskar Datta, Ajit Kembhavi and Alak Ray. This school is open mainly to research scholars and young research workers actively engaged in the area of pulsars and related fields. The course contents will be : Radio, X-ray, Binary and Millisecond pulsars, Neutron stars, Supernovae and Relativistic physics. Interested persons may contact the **Coordinator, Core Programme, IUCAA**.

Regional School on Introductory Astronomy

A Regional School on Introductory Astronomy will be held in the Department of Physics, Kerala University, Kariavattam, Trivandrum 695 581 during March 10 - 15, 1993. This school is designed for M.Sc. students and college and university teachers with hardly any previous exposure to Astronomy. Those who are interested to participate in this school should write to the **Coordinator, Core Programme, IUCAA** by January 31, 1993 with biodata and a recommendation from the head of the department.

RESEARCH SCHOLARS 1993 - 94

IUCAA invites applications for its graduate school leading to a Ph.D. degree in Astronomy and Astrophysics. Selection for the academic year 1993 - 94 will be made on the basis of a written test and interviews to be held in Pune sometime early July 1993. The academic programme will commence in August 1993.

Graduate School : Selected students will undergo graduate courses in physics, astronomy and related areas for two semesters. Satisfactory completion of the courses will allow students to register for a Ph.D. programme. The graduate courses will be organised in collaboration with the National Centre for Radio Astrophysics (NCRA) of the Tata Institute of Fundamental Research (TIFR), Pune Campus. The total duration of the Ph. D. programme, including the graduate school, will be 4 years.

Qualification : Students with M.Sc. in physics / applied mathematics / astronomy / computer science or Bachelor's or Master's degree in engineering with adequate background in physics and mathematics are eligible to apply. Candidates with an engineering background and interest in experimental physics are also encouraged to

apply. Candidates expecting to obtain their degrees by July 1993 may also apply. All selected candidates will be required to clear the UGC/CSIR NET or GATE examination within one year of admission to the research programme, if they have not already done so.

Scholarship : Each student will be paid a scholarship of Rs. 1,800 p.m. for the first two years and Rs. 2,100 p.m. for the remaining two years. In addition there will be a contingency grant of Rs. 7,500 p.a. and other benefits including free accommodation. The continuation in the scholarship is however subject to satisfactory performance of the student every year.

Application : Forms can be obtained by writing to the **Coordinator, Core Programme, IUCAA**, alongwith 24 x 11 cm self addressed stamped (Rs. 2.00) envelope. Completed applications should arrive at IUCAA no later than April 1, 1993. Candidates called for written test and interviews will be paid 1.33 times the rail fare each way by II class (not air-conditioned) and a halting allowance for the days of the interview. A common test and interviews may be conducted for admission to IUCAA and NCRA (TIFR).

Refresher Course in A & A for College and University Teachers.

IUCAA will conduct a Refresher Course in A & A for postgraduate teachers in universities and colleges during May 10 - 28, 1993. The main idea is to enthuse interested teachers to initiate and strengthen teaching of A & A in their regular teaching programmes. The topics will include : (i) Basic Physics for Astrophysics, (ii) Stellar Structure and Evolution, (iii) Extra-galactic Astronomy and (iv) Astronomical Experiments.

The number of participants for the course will be 30. The interested persons should apply on plain paper giving their curriculum vitae, their interest in A & A, teaching and research. Applications should be supported by their Head of the Departments and it should reach the **Coordinator, Core**

Programme, IUCAA, by February 20, 1993. The candidates will be informed of their selection for the course by March 10, 1993.

Welcome

IUCAA welcomes Ravi Gulati, Jai-Chan Hwang and Navita Srivastava who joined as Post-Docs in IUCAA.

... and Farewell

We bid farewell to the outgoing nominated members of the Council : P.M. Mathews, R.K.Thakur, Asit Banerjee, and S.K. Trehan as well as the Vice Chancellors of Madurai Kamaraj, North Bengal, Sardar Patel and Punjabi universities.



The audience during dedication seminar.

Youth vs Directors

The discovery of Neptune on September 25, 1846 underscores the problems faced by young (un-recognized) astronomers.

John Couch Adams at Cambridge in England and Urbain Jean Joseph Leverrier in Paris, France, both young theoreticians working independently, predicted the existence of a planet beyond Uranus. Their calculations used the concept of gravitational perturbations of the orbit of Uranus caused by the predicted planet.

Both Challis and Airy, directors of observatories at Cambridge and Greenwich ignored Adam's suggestion that they look for the new planet. Leverrier fared no better with the senior astronomers in France. So he requested the Berlin Observatory. Fortunately for him, it was the director's birthday and he was at home with his family. In his absence Galle, a young assistant at the Observatory used the refractor to look for the planet. And he found it !

What would have happened if the director had not been on leave ?

Third All India Amateur Astronomers Meet

The third All India Amateur Astronomer's Meet will be held in Ahmedabad during February 20-21, 1993. Interested persons may contact **Vatsal Thakkar, Secretary, Astronomy Club, Vikram A. Sarabhai Community Science Centre, Navrangpura, Ahmedabad 380 009.**

RESCHEDULED

IUCAA mini workshop on 'Techniques for Astronomical High Resolution Optical and IR Spectroscopy' has been rescheduled and will now be held during March 22-26, 1993 at IR Observatory, Mt. Abu.

How to communicate with IUCAA

Post
IUCAA, Post Bag 4, Ganeshkhind,
Pune 411 007, India

Phone
(0212) 336415
(0212) 336416
(0212) 336417

Fax
(0212) 335760

e-mail
root@iucaa.ernet.in
uunet!shakti!iucaa!root

Telex
0145 7658 GMRT IN