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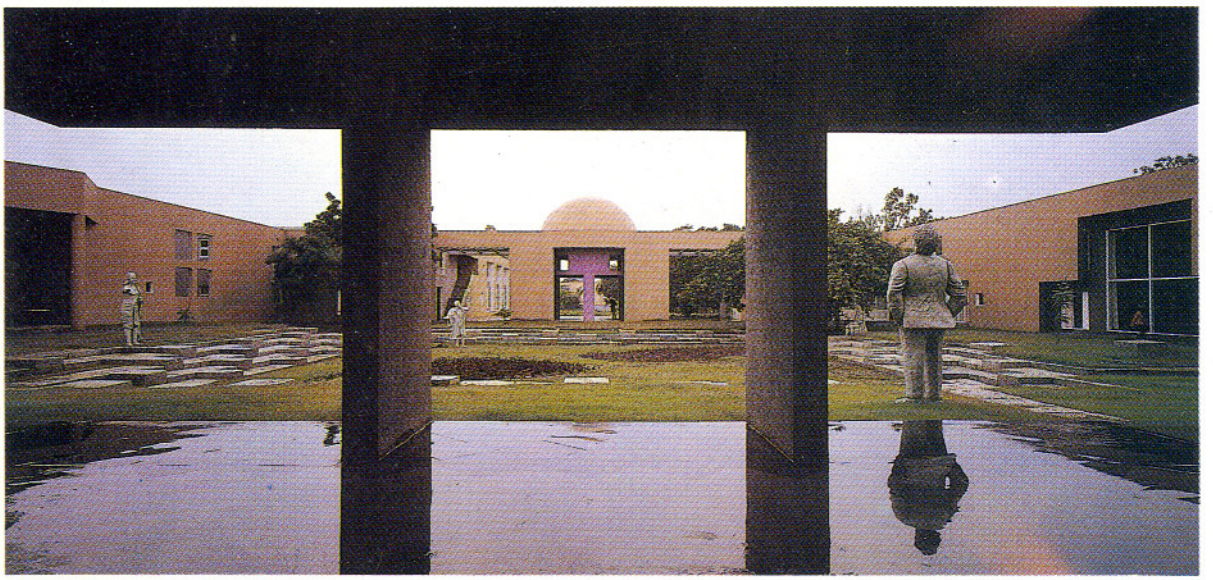
A Bulletin of the
Inter-University Centre for Astronomy and Astrophysics
(An Autonomous Institution of the University Grants Commission)

No. 19 **July 1994**



How much did IUCAA cost?

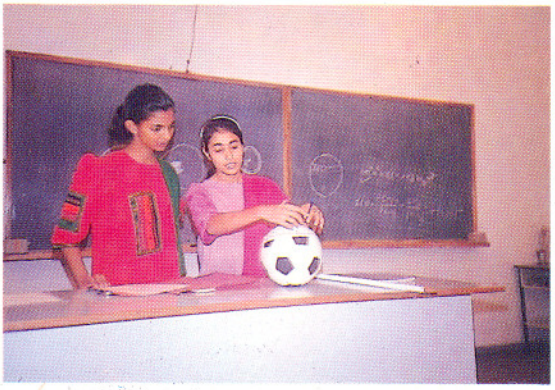
While almost everyone who visits IUCAA has a word of admiration for its campus, there may be quite a few who come away with the impression that all this must have cost an exhorbitant amount. People also wonder how the project could be completed so fast. Well, here is the inside story for what it is worth:

Inclusive of the Akashganga, staff housing colony, the Devayani complex of institutional buildings and the Auditorium in the Aditi complex, the total covered area built (plus the central Kund) is approximately 19360 square metres. The cost for these, inclusive of civil works, utilities like water, power and drainage, campus roads and the fees of architects and consultants, works out to Rs. 8.8 crores. A simple arithmetic gives the per square foot cost as Rs. 430 approximately. For a comparison, institutional buildings built by some other educational/scientific organizations around 1990-92 report costs of Rs. 500 per square foot or more. In addition, for interiors and furniture , inclusive of acoustics, auditorium and lecture hall chairs, curtains and carpets, lighting and landscaping, we spent an amount not exceeding Rs. 1 crore. These expenses, again, are within the standard government norms. How did we manage it ? We were lucky in being able to keep the costs so modest because of several factors. Several senior members of the centre took keen interest in ensuring time schedule and quality, the UGC released funds in time so that the project was never held up, our own administration responded by a streamlined approach to many day to day problems, the construction management consultants exercised good supervision on the contractors and last but not the least, we were fortunate in having an architect who successfully coupled his imaginativeness with the budgetary limits of the project.

In the last analysis, however, time is money : save the former and you save the latter.

Summer School

An Introductory Summer School on Astronomy and Astrophysics (A & A), funded by DST and hosted by IUCAA and NCRA, was held at IUCAA during May 23 to June 11, 1994. This was the fifth in the series of schools, the venue for which alternate between Pune and Bangalore. About 35 students of physics and engineering from all over the country, took part in the school.



Students demonstrating parallel transport on a football

There were 50 lectures on various topics in A & A, which were delivered by leading scientists from different A & A centres in the country. In addition, the students also took part in individual projects under suitable supervision. Observations through an optical telescope, a visit to the GMRT site and computer demonstrations were also some of the activities arranged during the school. The school provided adequate exposure to A & A and emphasized the thrust areas in the field.

Parsecstones in Astronomy - 7

J. V. Narlikar

From Laplace to Leverrier : Further Checks on Newton's Gravity

Halley's comet was a striking demonstration of the applicability of Newton's law of gravitation to comets (*see* Parsecstone - 6). It was probably the first demonstration of what is expected of a good scientific theory, namely that it should extrapolate and widen its realm of applicability. While Newton was the pioneer in describing the mathematics of planetary motion and Halley extended it to cometary motion, the *tour de force* of the Newtonian method was provided by the French mathematician Pierre Simon Laplace (1749 - 1827).

Between 1799 and 1825, Laplace published five volumes of *Mecanique Celeste*. In its impact on contemporary astronomy, it has been compared with Ptolemy's classic *Almagest* published seventeen centuries earlier. In this work, Laplace calculated the trajectories of the then known planets and their satellites, in all some eighteen bodies, moving not only under the gravity of the Sun but also under each other's cross influences. Using the latest available mathematical techniques, he was able to demonstrate that all these bodies move in an entirely predictable manner. Indeed, one can say that it was Laplace's effort that truly established Newtonian mechanics and gravity on a firm pedestal.

It is said that when Laplace presented his five volumes to the French Emperor Napolean, the latter, on glancing through it asked, why a book attempting such a mammoth task of explaining the working of the solar system did not make any mention of God. Laplace replied: "Sire, I had no need of that hypothesis."

Nevertheless, a good theory derives strength through the challenges it has to face from time to time. In Parsecstone - 6 , we saw how the apparent discrepancy in the predicted motion of planet Uranus led to the discovery of a new planet -- the planet Neptune. That was a vindication of the Newtonian framework. But, while the discovery of Neptune was another feather in the cap of Newtonian theory, its run of successes seemed to flounder in another astronomical setting in the solar system.

Observations extending over several decades after 1764 began to reveal that everything was not right with Mercury , the planet nearest to the Sun. The perihelion, that is the point in its orbit nearest to the Sun, was slowly shifting in space indicating that the orbit of Mercury itself was precessing. Part of this effect could be explained by the gravitational pull of other planets on Mercury, but still a small residual shift remained unexplained. Leverrier, who had been so successful in the case of Uranus, tried the same prescription again, by arguing that an unidentified intra-Mercurial planet (which he named, Vulcan) caused the above precession.

However, this time the trick did not work. Vulcan was looked for, but was not found and the mystery remained unsolved during the last century. How the issue was finally resolved will be part of a future Parsecstone article.

Workshop on Two Years After COBE

A workshop on Two Years After COBE was held during April 25 - 28, 1994. It brought together about twenty people to discuss various aspects of cosmology and structure formation related to the COBE discovery of Anisotropy in the microwave background. Most of the lectures were of pedagogical kind.

Speakers included Tarun Ghosh, J.V. Narlikar, T. Padmanabhan, Varun Sahni, T.P. Singh, Ramesh Sinha, K. Subramanian and M. Vivekanand.

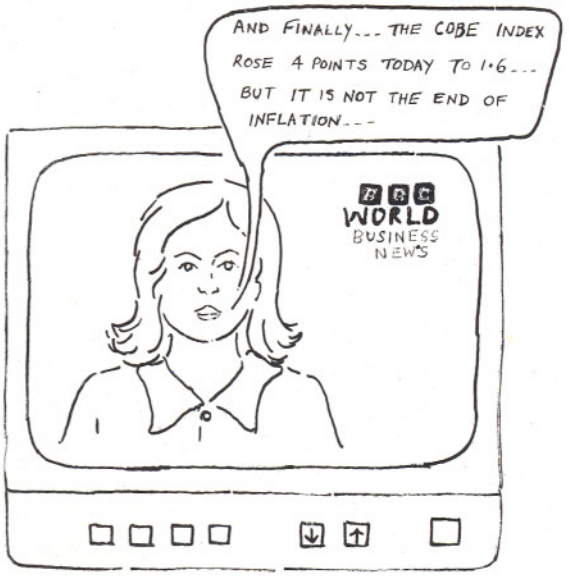
Vacation Students Programme 1994

The VSP - 94 is being held during June 1 - July 15, 1994. About 10 students, selected from applications received from various universities and IITs, are participating in this programme. The programme consists of about 25 lectures, covering all aspects of Astronomy and Astrophysics as well as a project work by each of the students. The students will be graded based on their performance and those who perform well will be pre-selected for the position of Research Scholar starting from August 1995.

Workshop on Making a Sky Globe and a Simple Telescope for School Science Teachers of Pune

This workshop was organised at IUCAA during April 29 - May 3, 1994. An enthusiastic response from 55 schools made the workshop most lively and fruitful. Under skillful supervisions, each teacher made a sky globe and a small astronomical telescope during the workshop. The cost per set of sky globe and telescope turned out to be as low as Rs. 125 and they were presented to the teachers.

School Students making Kaleidoscopes



Seminars held during April - June

21.4.94 T.K. Menon on *Galaxy Interactions and Origin of Radio Sources*, 4.5.94 Supurna Sinha on *Brownian Motion and Magnetism*, 10.5.94 Samuel Joseph on *Fractional Spin from Gravity*, 17.5.94 N. Ratnashree *On the Approach to Stability of Radio Pulsar Profiles*, 19.5.94 Sukanya Sinha on *A Fluctuation-Dissipation Relation for Semiclassical Cosmology*, 26.5.94 S.D. Mohanty on *the Non-locality of the Lagrangian Evolution of the Weyl Tensor*, 27.5.94 S.D. Mohanty on *A Modified Periodogram Analysis of the Gravitational Wave Signal from a Coalescing Binary*, 21.6.94 A. Goyal on *Bounds on Neutrino Mass and Magnetic Moments from SN1987A and* 30.6.94 V.I. Korchagin on *Sites of Massive Star Formation in Disk Galaxies*.

Summer Programme for School Students

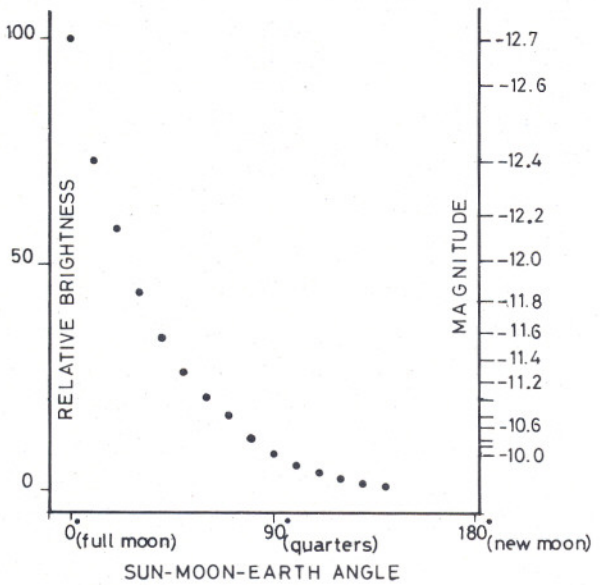
Drawing inspiration from our last year's experience, the summer programme for the local school students was conducted, in which 130 students from 67 schools participated in six batches during the six weeks from May 2 to June 10, 1994. Every student was attached to an academic member of IUCAA for a week and it was left to the teachers and students to decide what kind of projects they would like to carry out. The experiment was quite a gratifying one, both from the teachers' and students' point of view.

MEASURING THE BRIGHTNESS OF MOON

The moon's brightness depends on the day of the lunar month and one might think that the brightness is in proportion to the apparent solid angle on the particular day, i.e., half for half moon, etc. However, it so happens that the brightness of moon decreases much faster than its apparent area (solid angle) in the sky (as shown in the graph below); this is due to the uneven structure of its surface and the properties of the surface material.

In order to measure the brightness, a simple solid state photometer can be used. The photometer (see the diagram) is pointed towards moon, when it is closest to zenith, and its reading R_M is taken. Next, the photometer is pointed about 10^o away from moon and its reading R_B is taken. The difference of the two readings R_M - R_B, is a good measure of moon's brightness. [More readings can be taken at different angular distances from moon, e.g., 20^o, 30^o, etc., and these can be used to estimate the distribution of the scattered background light]. For the circuit shown here , the signal R_M for full moon would be about 10mV per square mm area of the diode, and you may like to increase the gain of the circuit by adding another stage of amplication.

These readings can be taken at different phases of moon; one should make sure that the readings are taken at least 1 hour before sunrise or at least 1 hour after sunset.



Relative brightness and magnitude of the moon for different phases

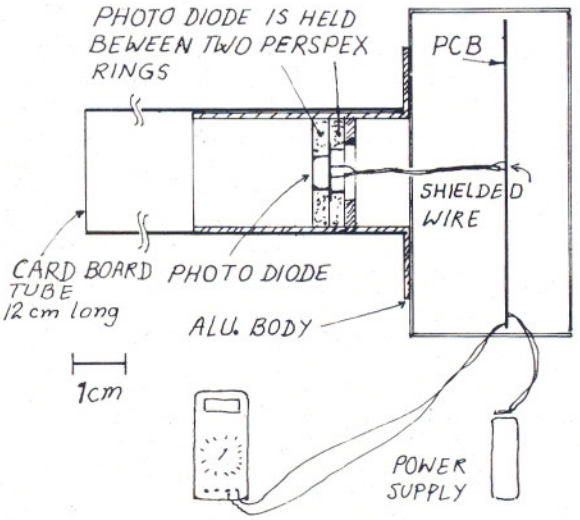
(an increase by 1 magnitude means a reduction by a factor of 2.5 and therefore increase by 5 in magnitude means a reduction by a factor 100 in brightness).

The readings can be converted to magnitudes by the following equation:

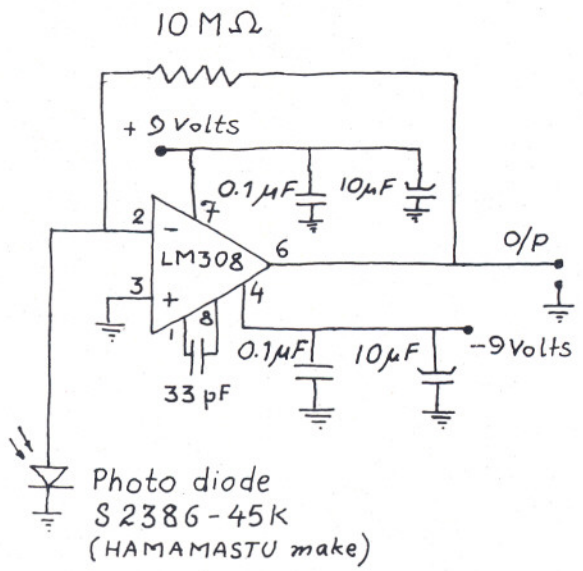
$$m = -\ 2.5 \log_{10} \left\{ \frac{R_M - R_B}{(R_M - R_B)_0} \right\} + m_0$$

where, the suffix zero refers to readings near full moon.

The derived 'm' values can be compared with the graph shown.



Sketch of the photometer



The circuit

Workshop on Astronomy Curriculum in Schools

IUCAA had organised in its campus a workshop on Astronomy Curriculum in Schools during April 4 - 8, 1994. About 20 teachers from different parts of India attended and presented the astronomy portions of the existing curricula in various states. This has been collated in the form of a recommendation for possible action to be taken up by NCERT. The teachers also took part in an astrophotometry practical session with a piggy-mount telescope and a simple photometer.

Pep Talk by a local...

22.4.94 Sukanya Sinha on *Some Aspects of the Transition from Quantum to Classical Physics*

and by a visitor...

9.5.94 Joseph Samuel on *Theory of Falling Cats*

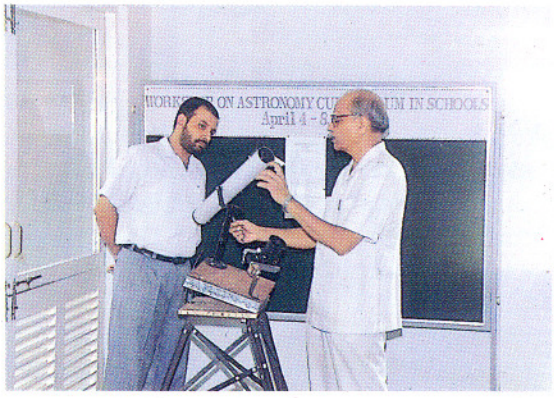
Colloquia held at IUCAA....

7.4.94 S. Modak on *Encyclopedia Genetica;* 18.4.94 S.R. Gadre on *Molecular Electrostatics* and 2.5.94 D.D. Bhawalkar on *Laser Fusion*

IUCAA Preprints during April - June

Listed below are the IUCAA preprints released during April to June 1994. These can be obtained from the Librarian, IUCAA.

R. Balasubramanian and S.V. Dhurandhar *Performance of Newtonian Filters in Detecting Gravitational Waves from Coalescing Binaries,* IUCAA-10/94;Varun Sahni *Gravity Waves as Probes of the Early Universe,* IUCAA-11/94; A. Kumar, T. Padmanabhan and K. Subramanian, *Neutral Hydrogen at High Redshifts as a Probe of Structure Formation - II: Line Profile of a Protocluster,* IUCAA-12/94; Shiv Sethi *Neutrino Decay, Gunn-Peterson Effect, and Other Constraints,* IUCAA-13/94; N. Dadhich and L.K. Patel *On the Uniqueness of Nonsingular Inhomogeneous Cosmological Models,* IUCAA-14/94; Masafumi Seriu *Back Reaction on the Topological Degrees of Freedom in (1 + 2) Dimensional Spacetime,* IUCAA-15/94; T. Padmanabhan *Observational Constraints on Cosmological Models,* IUCAA-16/94



Ved Ratna, demonstrating his simple equitorial tracking device for astrophotography

Workshop on Sky Globe Making

IUCAA had sponsored a workshop on Sky Globe Making at Nanded in joint collaboration with Department of Physics, N.E.S. Science College, during April 18 - 21, 1994. The teachers and students from colleges in and around Nanded as well as from local high schools participated in the workshop. The participants completed the job of sky globe making within the period of four days. The technical assistance was provided by N.C. Rana of IUCAA. Special lectures by N.C. Rana, L.K. Kulkarni and N. G. Phatak were organised. A practical sky watching programme was also organised for the participants

Heritage of Ancient Indian Astronomy

IUCAA is planning to hold a workshop on Heritage of Ancient Indian Astronomy during October 31-November 4, 1994, in which practical work of modelling Gnomon, Sundial, Samrat Yantra, Water Clock, Sidhantic Models of Solar System, etc. along with lectures on Vedic Astronomy, Sidhantic Astronomy, Panchang System, etc. will be arranged. Interested persons including teachers from schools, colleges and universities may apply by sending a short resume with recommendation from their Head of the Department. The applications should reach the Coordinator, Core Programmes, IUCAA, by **September 15, 1994.**

Regional Meeting for Universities of Eastern India

This meeting will be held at the Department of Mathematics, Bhim Rao Ambedkar Bihar University during October 3-4, 1994. The theme of the meeting will be IUCAA's interaction with universities/colleges/institutes for promotion and growth of astronomy and astrophysics in their campuses. Those interested in attending the meeting (from universities/colleges/institutes in Bihar, Orissa and eastern part of Uttar Pradesh) should contact Bhola Ishwar, Department of Mathematics, Bhim Rao Ambedkar Bihar University, Muzaffarpur 842 001, Bihar. The applications, with recommendation from their Head of the Department, should reach Ishwar, by **July 25, 1994.**

IInd Indo -US Workshop on Array detectors and Image Processing

This workshop will be held at IUCAA during **November 28 - December 10, 1994.** Contact the Coordinator, Core Programmes, IUCAA, for further information on participation.

The Second Workshop on Experimental Techniques in Space Sciences and Astronomy

This workshop, sponsored by IUCAA, will be held at Gujarat Universtiy during September 13-17, 1994. The objective of this workshop is to introduce some modern experimental techniques developed in various laboratories in India to research scholars and university/college faculty members. It is proposed to cover techniques on CCD, photometry and its applications in Space Sciences and Astronomy. A limited number of financial support will be given to a few selected participants as per UGC rules. Those interested in participating in the workshop may send their application to S.D. Verma, Department of Physics and Space Sciences, University School of Sciences, Gujarat University, Ahmedabad 380 009. The application should be recommended by their Head of the Department and should reach by **August 10, 1994.** The participants should also send a write-up (of about 100 words) on their field of interest in experimental techniques in Space Sciences and Astronomy.

A **Preparatory Workshop on Total Solar Eclipse 1995** will be arranged at IUCAA during October 3-7, 1994, to make concrete recommendations to the Astronomical Society of India panel as to the specific and voluntary role of amateur astronomer participants. Interested amateur astronomers may apply for participation by sending a short resume to the Coordinator, Core Programmes, IUCAA, before **August 20, 1994.**

Welcome to the IUCAA Family

IUCAA is happy to announce the selection of the fifth batch of Associates and Senior Associates, who are selected for a tenure of three years beginning July 1, 1994.

Associates

* S.S. De, University College of Science, Calcutta.
* B.N. Dwivedi, Institute of Technology, BHU, Varanasi.
* Suresh C. Mehrotra, Marathwada University, Aurangabad.
* P.S. Naik, Gulbarga University.
* V.M. Nandakumaran, Cochin University of Science and Technology.
* R.R. Rausaria, Regional Engineering College, Jammu.
* R. Ramakrishna Reddy, Sri Krishnadevaraya University, Anantapur. @
* D.C. Srivastava, Gorakhpur University. @
* S.K. Srivastava, NEHU, Shillong. @
* P.C. Vinodkumar, Sardar Patel University, Vallabh Vidyanagar

Senior Associates

* Bishwanath Chakraborty, Jadavpur University, Calcutta.
* M.C. Durgapal, Kumaun University, Nainital.
* Udit Narain, Meerut College. @
* Asim K. Ray, Visva Bharati, Santiniketan.
* T. Singh, Institute of Technology, BHU, Varanasi. @
* S.G. Tagare, Hyderabad University. @

@ Appointments of these second batch of Associates and Senior Associates are extended for three years.

URANUS AND NEPTUNE

Arvind Paranjpye

Uranus and Neptune are at opposition on July 17 and July 14, 1994 respectively. A planet is said to be at the opposition when it is exactly opposite to the Sun or the angle made by the planet, the Earth and the Sun is 180^{o} (or nearly 180^{0}). At this configuration, the planet is closer to the Earth and brighter and bigger. For our Indian latitudes, closer to the equator, a planet at opposition rises as the Sun sets, and can therefore be seen all through the night.

The two maps given here can be used for finding the Uranus and the Neptune. Uranus will be + 5.6 magnitude object in the beginning of July. It fades to +5.7 by the end of September. Neptune remains at +7.9 magnitude object during this period.

The map 1 shows the Scorpius, Sagittarius and the Stars upto 6th magnitude and the boxed area is enlarged in the map 2. On the map 2, the faintest star is of 8.5 magnitude. On the tracks of the planets, positions of the planets at the begining of the month, indicated by the month number, is given. The map 2 also shows the way you may star - hop to reach the planets. Uranus will not be a difficult object to spot, but you may have to observe Neptune over two or three days to confirm it. The motion of the planets is most enjoyable, when it passes near a star.

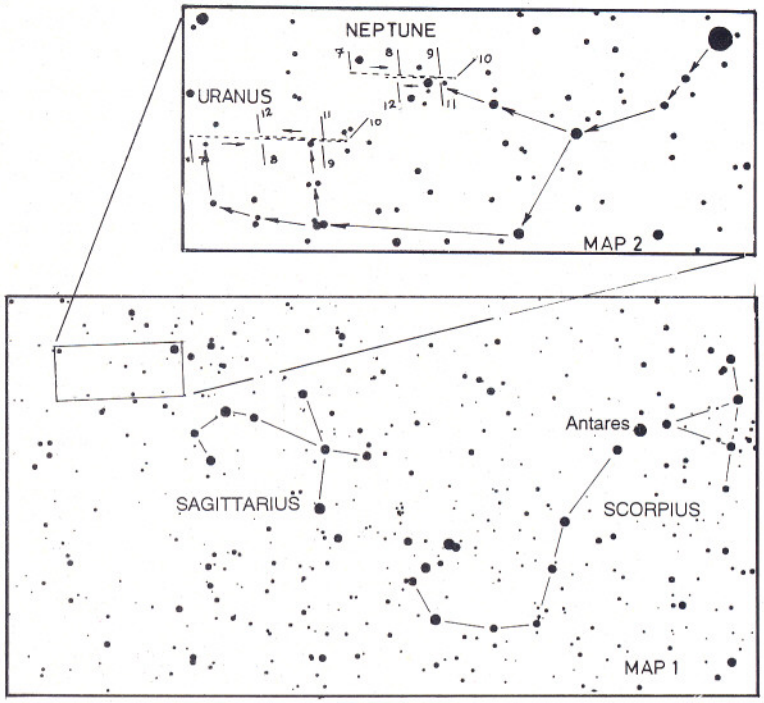
Strictly speaking , Uranus at +5.6 magnitude is just visible to the naked eye under dark sky conditions, but you should be a keen-eyed observer to spot it. A pair of 7 x 50 binoculars will show both the planets. They are within 3^{0} of each other.

Uranus was discovered by William Herschel on March 13, 1781. He was German, musician turned astronomer, emigrated to England.He found Uranus by chance, while doing systematic survey of the sky, and mistook it for a comet. Further observations showed that the orbit of the object was like planets and not comet.

By the beginning of the nineteenth century, astronomers found that they could not predict the position of the planet accurately using Newtonian mechanics.

In 1845 John Couch Adam, a student at Cambridge University, England, suggested the existence of a planet beyond Uranus, influencing it to move in a path, different from that was predicted using gravitational influences of other five planets. He even calculated the position of this "planet". Adam was not taken seriously.

Working on the similar lines, French Astronomer Leverrier independently reached the same conclusion. His prediction of the position of the "planet" differed by less than 1^{o} from that of Adam's. Leverrier sent his predictions to Johann Gottfried Galle at the Berlin Observatory, requesting him to verify that prediction. On the day, Galle received Leverrier's letter, Galle discovered the predicted planet, i.e., on September 23, 1846. Later the planet was named 'Neptune'.



A Second Term

J.V. Narlikar has been reappointed Director of IUCAA for a second term of five years beginning June 1, 1994.

Visits Abroad...

J.V. Narlikar visited the United States under the Indo-US Exchange Programme between IUCAA and the Harvard-Smithsonian Center for Astrophysics. He visited and gave seminars at several universities in the USA and also at the Canadian Institute of Theoretical Astrophysics at Toronto.

J. Bagla, D. Munshi and S. Sethi visited Nepal to attend the 5th BCSPIN summer school on selected topics in High Energy Physics and related areas. The main focus of lectures at the school was on the interface of Particle Physics and Cosmology.

Blunders of the Great

Harlow Shapley's autobiography ends with the following anecdote :

Not so long ago, when I was going down a street in Harvard Square, I met a dean, who stopped me and said, in effect, "It is your turn to entertain the Exam Club. Your paper is slated for next Monday."

"Oh, no," I said, "things are not going well. I have nothing to contribute. I don't know anything. Why do you say it is my turn?"

"Because it is your turn. All you have to do now is to give me the title of what you are going to talk about and I shall send out the notices. That will give you time to do some useful thinking".

"All right. I will do it since I must do it. And the title of my talk can well be: 'The Scientific Blunders I Have Made."

"Oh, no." said the dean, "Not that; it is only to be a one-hour program."

Visitors to IUCAA April - June 1994

April: S.R. Kulkarni, S.K. Parui, S.D. Verma, S.H. Behere, P. Dasgupta, Rathnashree Dasgupta, Ved Ratna, J. Samuel, Supurna Sinha

May: A. Banerjee, H.V. Mone, S.G. Tagare, G.K. Johri, D.B. Vaidya, B. Ishwar, V.O. Thomas, R. Tikekar, K.S.V.S. Narasimhan, K. Sankara Sastry, S.M. Alladin, N. Hassan, L.M. Saha, M.K. Das, S. Mukherjee, L.K . Patel, P.P. Saxena, S.S. Prasad, S.D. Verma, D. Lohia, Z. Khan, R. Nityananda, H.M. Antia, A.C. Balachandra Swamy.

June: U. Narain, Sushil Kumar, B. Basu, P. Khare, A. Goyal, A. Pradhan, U.S. Pandey, S. Chakrabarty, M.N. Anandram, B.A. Kagali, P. Subramanian, D.C. Srivastava, R. Ramakrishna Reddy, Nazeer Ahmed, H.L. Duorah, S.R. Valluri.

Visitors Expected

July: K.D. Abhyankar, Hyderabad; J.R. Bond, CITA; S. Shandarin, University of Kansas; P. Coles, Queen Mary and Westfield College; D. Pogosyan, CITA; B.J.T. Jones, Nordita; V. Loukach, Space Research Institute; S. Boudnick, Space Research Institute; A. Shukurov, Moscow State University; P. Catelan, Oxford University; S. Mataresse, University of Padova; Lacheze-Rey, CERN; F. Bernardeau, CITA; W. Saslaw, University of Virginia, I. Suisalau, Nordita; A. Doroshkevich, Keldysh Institute of Applied Mathematics; F. Bouchet, Institute of Astrophysics; N. Kaiser, CITA; A. Dekel, Hebrew University; S.M. Chitre, TIFR; R. Cowsik, IIA; T.P. Singh, TIFR; S. Banerjee, TIFR; S. Iyer, PRL; T.R. Seshadri, MRI; S. Bhardwaj, RRI; J. Samuel, RRI; R, Cannon, Anglo-Australian Observatory; D. Lynden- Bell, Institute of Astronomy; B.V. Sreekantan, Institute of Advanced Studies, Budh Ram , New Mexico State University.

August: S.R. Prabhakaran Nayar, University of Kerala; V.R. Venugopal, Madurai.

September : A. Sharma, Kurukshetra University; P. Ulmschneider, University of Heidelberg; U. Narain, Meerut College .

Khagol **(the Celestial Sphere) is the Quarterly Bulletin of IUCAA.We welcome your responses at the following address:**

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