IAU

mandākini

XIX GENERAL ASSEMBLY
NEW DELHI 1985

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Editor : ARCHIE E. ROY
Associate Editor : A. RATNAKAR

WELCOME TO DELHI

The XIX General Assembly of the International Astronomical Union is being held in New Delhi from 19 to 28 November, 1985. This is the first time that the IAU is meeting in India. The initiative for holding this meeting was taken by the late Dr. M.K. Vainu Bappu, Past President of the IAU. The first thoughts that flood my mind as I write this, are memories of that great astronomer, gentleman and friend, Vainu Bappu.

Before I say a little more about him, let me, on behalf of the National and Local Organising Committees, extend a very warm welcome to all participants and their guests; and particularly to our friends from many countries who have come from great distances to be with us. I extend this welcome also on behalf of the scientific community of India, and in particular the astronomers, astrophysicists and cosmologists; and on behalf of the Government of India. The commitment of the Government of India to science, to fundamental research, and to research in astronomy and astrophysics is clearly manifest in the gracious agreement of the Prime Minister, Shri Rajiv Gandhi, to inaugurate the General Assembly on 19 November.

I would like to particularly welcome Prof. R. Hanbury Brown, President of the IAU, who will be presiding in his homeland; many may not be aware that Prof. Hanbury Brown was born in South India in the Nilgiris.

The IAU General Assembly is being held at a time when a particularly interesting astronomical event is with us — the appearance of Comet Halley. Comets have aroused anxiety, fear, awe and excitement in people around the world since times immemorial. Today the appearance of a comet, like Halley's, provides an opportunity for all in society to observe, understand and appreciate the power of the scientific method and rational thinking. A comet is an exciting sight to scientists and non-scientists alike. Comet Halley, in particular, is unique in its longest record of reappearances, displaying the full complement of cometary phenomena, and offering an extended period of availability for observation. There is a major Indian Halley Observation Programme, involving many institutions in the country. It is, therefore, appropriate that a postage stamp to commemorate the IAU General Assembly in New Delhi will be on Comet Halley; and will be released by the Prime Minister on 19 November, 1985.

One of the greatest scientists that India has produced in the recent past, Prof. C.V. Raman, has remarked: "Let me say, here and now, my belief that there is no science so grand, so elevating, so intensely interesting, as astronomy". Amongst the greatest living practitioners in this field is Prof. Subrahmanyan Chandrasekhar who, in his Jawaharlal Nehru Memorial Lecture in 1968, remarked, "One aspect of astronomy is certain: it is the only science for which we have a continuous record from ancient times to the present ..... Man's contemplation of the astronomical universe has provided us with the one continuous thread that connects us with antiquity ..... It has also inspired in him the best".

Prof. M.G.K. MENON
Chairman
National Organizing Committee
XIX General Assembly
International Astronomical Union

India has had a long and distinguished tradition in science from the earliest days of its recorded history; and in this tradition were great contributions to the fields of mathematics and astronomy: the decimal place value system; the Aryabhatiya written in the 5th century A.D. by the famous Arabhata; the trigonometric methods of Hindu astronomy best known through Surya Siddhanta, and so on. Prior to the British period, serious observational astronomy ceased in the early 18th century, after the great masonry works called the Jantar Mantar, (one of which is in Delhi), built by Maharaja Sawai Jai Singh. During the British period there was the setting up of an observatory in Madras, then in Kodaikanal, significant new results based on eclipse observations, the great discovery of M.N. Saha related to thermal ionization, and considerable work on positional astronomy at the Nizamia observatory. It is since Independence that there has been, with significant Government support, a new beginning in observational astronomy, with two 40" (Nainital and Kavalur), a 48" (Rangapur) and now a 90" (Kavalur) optical telescopes, a large cylindrical telescope (Ooty) a millimetre wave radio telescope (Bangalore), a 1.2 m infrared telescope (Gurushikar), and ground, balloon, rocket and satellite based work on infra-red, gamma ray and X-ray astronomy and cosmic rays. There are now many institutions working in these fields, and a large community of astronomers, astrophysicists and cosmologists. It is hoped that the holding of the IAU General Assembly will mark a milestone in the efforts of Indian scientists to work with their fellow scientists in other countries, at the frontiers of these fields, on a contemporary basis.

A towering element in this renaissance in astronomy was Dr. Vainu Bappu. He was Director of the U.P. State Observatory, Naini Tal, which he set up; then of the Kodaikanal Observatory, and at the time of his death, of the Indian Institute of Astrophysics, which he created, and where he embarked on a programme to build a 234 cm optical telescope. Dr Vainu Bappu represented the best traditions of the field; and the holding of the XIX General Assembly of the IAU in India will be a tribute to his memory.

The inauguration of the XIX General Assembly will be on 19 November, the birth anniversary of Indira Gandhi, the late Prime Minister of India. She had graciously agreed to inaugurate the General Assembly, when we could have greeted her on an auspicious day of her life; but alas that was not to be! The General Assembly will be a tribute to the memory of this great lady, an outstanding national and international leader, who stood for peace, friendship, Social justice and Secularism throughout her life, and who provided Indian science with unstinting support and encouragement for which it will ever be grateful.

I am delighted that Prof. Archie E. Roy has been good enough to come all the way from Glasgow to assist us in editing the daily Conference newspaper, Mandakini, in which this appears. The paper is an important element in binding together the vast number of participants who come to such a General Assembly, by establishing a regular channel of communication concerning events, programmes and personalities. Prof. Archie Roy is well known for his success in this in the past.

I conclude with very best wishes for a successful scientific meeting and the hope that the participants and their guests will be able to greatly enjoy their stay in India.

ANNOUNCEMENTS

In view of the changed hour of the Inaugural Ceremony, the Presidents Meeting will now take place at 1700 hrs in Room 'B' in the Vigyan Bhavan. Transport has been arranged for the Presidents from Siri Fort to the Vigyan Bhavan immediately following the first session of the General Assembly.

Transport has also been arranged for participants in Commission meetings at the Vigyan Bhavan. Buses will leave at exactly 1230 hrs for Siri Fort. Chairmen of Commission meetings are kindly requested to terminate their sessions in time.

Invited Discourse II

A few days ago the speaker for Friday's invited discourse, Prof. R.Z. Sagdeev, was requested by his Government to be present in Geneva to assist during the talks between the USSR and the USA. The Executive Committee greatly regrets that Prof. Sagdeev will therefore be unable to present his invited discourse, and has asked Prof. A.G. Massevitch to give his talk.

IAU Computerised files

An IBM KT computer has been installed at the IAU Secretariat in the Vigyan Bhavan with the IAU member files. We would greatly appreciate it if all members take the opportunity to inform us about any change in address, etc., which will then be immediately corrected.

Richard M. West

ALTERED MEETING SCHEDULE: VIGYAN BHAVAN

Date : 19.11.1985

Room	19-1	19-2
C	5/6	5/6

1. *Please note:* The inaugural function at SIRI FORT will be at 14.00 hrs. You must take your seat by 13.30 hrs. No handbags, brief cases or cameras will be allowed inside the auditorium. This is a Security requirement.

2. To avail of the special concessional rates for the IAU participants, you should pay for. your hotel ROOMS at the Ashok Tours and Travels Counter in Vigyan Bhavan, and obtain a voucher to be given to the hotel.

3. Please reconfirm your international flight reservations. This is a must.

4. There is a bar and a cafeteria in the Annexe of Vigyan Bhavan.

EDITORIAL

Welcome to the Delhi General Assembly of the IAU. Welcome to all old friends seen in Patras in 1982 and Montreal 1979. And a special welcome to all new friends who are at their first General Assembly.

This is your official newspaper. Its name *Mandakini* means in Sanskrit the Divine Celestial River and usually refers to the Milky Way, the great sparkling veil of the Galaxy thrown across the night sky and seen in all generations of mankind. To the left of the name in the mast-head is the well-known logo of the International Astronomical Union; to the right is the logo for the XIX General Assembly at Delhi, derived from one of the famous astronomical observatories of Jai Singh which many of you will no doubt visit.

It seems no time to me since I edited *Astrocosmos* at Patras and promised myself that I would never edit an IAU newspaper again. But just as I had almost recovered from my stint, Richard West invited me to serve the cause again. Since he was so insistent and since I am a fully paid-up member of the Society of Cowards, I accepted the invitation before he could send the heavy mob from the IAU Secretariat to persuade me. And so here I am. Fortunately I have as associate editor Mr Ratnakar, who has already proved himself to be a tower of strength, a person of great resourcefulness and capability, so that I am encouraged that his strengths and talents will sustain me in the days to come, smoothing over the crises which inevitably will appear in producing a daily newspaper.

In the newspaper from day to day you will find accounts of meetings, programmes, special articles, astronomical and cultural, local recipes, cartoons, crosswords, correspondence. If you wish to express your views, please come and see the editors or send us anything you wish to say. We cannot guarantee to publish it but we will assuredly do our best. In particular, organisers of meetings, commissions, etc who wish announcements of dates or changes of date to be made should certainly contact us. Send us reports of meetings. Remember this is your newspaper.

Enjoy yourself and learn from your sojourn in India, a land of ancient civilisations, of cultures and religions that have given much to the family of mankind. It is the land of the *Bhagavad Gita* and the *Upanishads* not to mention the *Kama Sutra*. At the beginning of this XIX General Assembly of the International Astronomical Union with so much for you to see, and do and hear, I can do no better than to end this editorial with a quotation from the Kalama Sutra, attributed to the Buddha and applicable to many walks of life: "Do not believe on the strengths of traditions even if they have been held in honour for many generations and in many places; do not believe anything because many people speak of it; do not believe on the strength of sagas of old times; do not believe that which you have yourself imagined, thinking a god has inspired you. Believe nothing which depends only on the authority of your masters or of priests. After investigation, believe that which you yourself have tested and found reasonable, and which is for your good and that of others."

—Archie E. Roy

DOWN MEMORY LANE — GLIMPSES FROM PAST GENERAL ASSEMBLIES

Every day we will give in these columns a very short resume about past General Assemblies for your interest, especially since few readers will have been to them all! Owing to lack of space it will not be possible to give the full report and hence if any particular speaker's name or topic of discussion is omitted, it is through such limitation of space. We hope you will enjoy these glimpses and if you want more details you can always get them from the Transactions of the Union and many of them from *Publications of the Astronomical Society of the Pacific*, *The Observatory* and *Sky and Telescope* (the source of most of the material) published during or after the particular general assembly year. The editors are grateful to Ms Vagiswari, Librarian, Indian Institute of Astrophysics, Bangalore, for her help in collecting the information.

I GENERAL ASSEMBLY IN ROME 1922

The Union met at its first General Assembly during May 2-10, in Rome; about 85 delegates from seventeen countries participated. The inaugural meeting took place in Campidoglio at which both Cardinal Maffi and the King of Italy were present.

Prof. Benjamin Baillaud, delivering the presidential address, traced the early events leading to the formation of the Union and commended the good work carried out by Prof. A Fowler, Secretary of the Union, during the past three years. He stated that at this time of his life he was more than ever optimistic about the future development of astronomy.

A discussion on Relativity was held jointly with the Academia del Lincei and a meeting took place at the Institute of Physics in which several members of the Union presented accounts of their recent work.

Various Committees met to discuss matters pertaining to them and their reports were presented at the General Assembly when it met subsequently. Among the many reports presented were those by Sir Frank Dyson on behalf of the Committee on Relativity and by Prof. Stroobant on the Standardisation of Astronomical Rotation. One of the propositions concerned the use of the same letter in different forms to indicate different aspects. For example, a letter, say K, should be given in italics to denote a chemical element, in parenthesis (K) to denote the Fraunhofer line and be used unaltered to denote a spectral line.

Prof. Norlund presented a report on dynamical astronomy and astronomical tables, Dr St John on wavelength standards, Prof. Sears on stellar photometry, Prof. Shapley on variable stars; Monsieur Bigourden gave an historial presentation on nebular astronomy; Prof. Russell reported on stellar classification, and Prof. Sampson on the measurement of time.

Britain extended an invitation to the Union to hold its next assembly in Cambridge.

TREASURE ARCHIVES AND HOW TO GET IN

W.D. HEINTZ
IAU Commission 5

When your paper has been published, and the reprints have been mailed to the colleagues, sit back and relax; the trolls of documentation will now go to work so that the paper and the original data it contains are properly recorded for posterity. Most researchers are well acquainted with bibliographical services, taped catalogues, and even with on-line data acquisition, because the quick and comprehensive access to such existing materials saves a great deal of effort and expense. Thanks to computer processing, a previously unimaginable volume of bibliography and numerical data influx can be handled in the documentation centres. Naturally, a few rules have to be adhered to, in order to play the computer game. How can you ensure that the material you need will be complete and correct?

Never-ending house-cleaning

That is why the people in Commission 5 - charged with the coordination of the secondary processing of data and publications, identifiers of astronomical objects, data formatting, undesired ambiguities in data coding, abstracts, keywords and vocabularies - an effort of continued house-cleaning to keep the archives in shape. Experts in five Working Groups are busy to efficiently link the researchers' needs with the documentation techniques now available, and they maintain contacts with other international organisations such as CODATA, ICSTI, and FAGS. A few necessary - and easily implemented - recommendations to authors and editors have been made, and our technical papers to make the "data traffic" better have been augmented by the "Guide to the Presentation of Data" (Wilkins 1982), the "First Dictionary of Nomenclature" (Fernandez, Lortet, and Spite 1983), and its Supplement (1985).

Forthcoming discussions

To be brought to the attention of colleagues and representatives from other commissions are particularly two discussions scheduled at this General Assembly: "Designations" will be discussed on the morning of November 19, so that the problems we encountered in data storage can be subsequently taken up at meetings of the respective subject commissions. Object names that are ambiguous, unreferenced, or otherwise interfering with the existing codes are proliferating to such an extent as to jeopardise proper archivation and retrieval. The status of "Abstracting Services" will be on the agenda for November 23.

COMMISSION MEETING ON STELLAR SURFACE ELEMENT ABUNDANCES

ARTHUR N. COX
President, Commission 35

It is widely believed among stellar astrophysicists that all elements heavier than helium have been produced in the interiors of stars during their evolution. The helium produced in the big bang is added to by hydrogen burning in the main sequence stars. The link to heavier elements is by the triple alpha process which produces carbon. Then the addition of another alpha particle creates oxygen. This fusion, together with the carbon cycle hydrogen burning, can produce every one of the commonly observed elements of the solar system.

Other element -building processes, such as the slow (s-process) and rapid (r-process) addition of neutrons, can create elements heavier than the most stable elements in the iron group. Evidence of these nucleosynthesis processes is also seen in the solar system abundances.

Commission 35 has a session right at the start of the General Assembly (November 20) on the recent research results on observations and interpretations of stellar surface abundances. This session, arranged by Professor A. Tutukov from Moscow, will emphasize the many anomalies observed but not explained with current ideas of stellar evolution and the dredgeup of elements by deepening surface convection zones. Everyone is invited to participate.

POSTSCRIPT

An aspiring young star-gazer called Hersch-al
Wished the post of Astronomer Royal
Stars seen and unseen
He named by king and queen
and was knighted for being so loyal

C. SIVARAM

A massive compact neutron star
Drew matter from his friend afar
To realise his chosen goal
Of turning into a black hole —
He's now a beaming pulsar

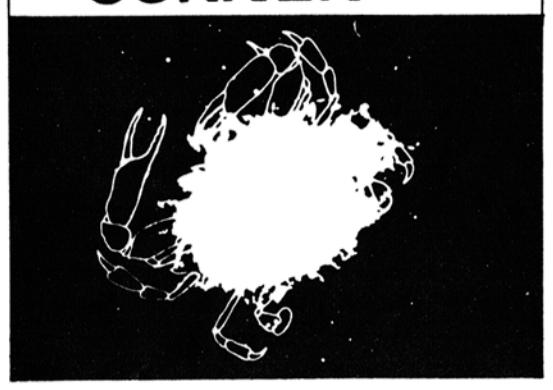
C. SIVARAM

Hung be heavens with black, yield day to night;
Comets importing change of Times and States,
Brandish your crystal tresses in the sky
And with them scourge the bad revolting stars
That have consented unto Henry's death . . . . . .
(W. Shakespeare)

In the year of our Lord 729, two comets appeared around the sun striking terror into all who saw them. One comet rose early and preceded the sun, while the other followed the setting sun at evening, seeming to portend awful calamity to east and west alike. One comet was the precursor of the day and the other of the night to indicate that mankind was menaced by evil at both times.

(Bede AD 673-735)

gASTRONOMY CORNER



There is a type of tourist who visits foreign countries and resolutely refuses to eat anything but his traditional fare. We hope IAU visitors will not include that type but will discover and enjoy the delights of traditional Indian meals. India is a large country with a wide variety of cuisines and so we will provide a recipe each day which we recommend you try while you are here or take home with you. It goes without saying that for every recipe given in *Mandakini* there are more you can look for.

In some of the recipes there is an ingredient called *'Garam Masala'*. It is a mixture of cinnamon, cloves, cardamom, black cumin seeds, nutmeg and mace, dried and powered. This powder adds taste, flavour, colour and aroma to Indian food.

Most of the recipes we will give you are taken from THE ASHOK GROUP OF HOTELS recipe book prepared for the INDIA FOOD FESTIVAL and we thank the Group sincerely for granting up permission to use them.

ALOO DUM BANARSI

(Potato Curry with Hot Spices - A Side Dish)

	Ingredients	Quantity
1.	Large potatoes	450 g
2.	Turmeric	a pinch
3.	Cumin seeds	a pinch
4.	Green chillies	5 g
5.	Coriander seeds	15 g
6.	Black pepper	a pinch
7.	Ginger	a small piece
8.	Fat	50 g
9.	Curd	30 g
10.	Curry leaves	a sprig
11.	Salt	to taste
12.	Green peas	50 g
13.	Coriander	1/2 bunch

Method

1. Prepare a gravy with all the *masala* and curd.
2. Parboil potatoes, cut into halves and scoop out.
3. Fill with seasoned, chopped green peas and coriander.
4. Join halves together with tooth picks and return to gravy.
5. Cook potatoes in the gravy and temper with cumin seeds.

NB : Serves Four.

KABAB - E - HAZARVI

(A chicken kabab and as the name indicates "one in thousands")

	Ingredients	Quantity
(A)		
1.	Broiler chicken	1 kg
2.	Seasoning	to taste
3.	*Garam masala* (mixed spices)	5 g
4.	Green coriander leaves chopped	1 table spoonful
5.	Chopped green chillies	1 table spoonful
6.	Vinegar	10 ml
7.	Ginger and garlic paste	20 g
(B)		
8.	Processed cheese	100 g
9.	Egg whole	1
10.	Cornflour	1 tea spoonful
11.	Cream	200 ml

Method

1. Debone chicken and cut into one-inch size pieces.
2. Mix together all ingredients as in (A), i.e. No. 2 to No. 7.
3. Rub the mixture well with chicken pieces and leave for 45 minutes.
4. Mash the cheese, add egg, and cornflour and make a fine paste in a large shallow dish.
5. Add cream to the mixture and gently fold it in.
6. Now add chicken pieces in to cheese mixture and leave to marinate for an hour.
7. Insert the marinated chicken pieces into a skewer and cook over an open charcoal-fired spit or in a *tandoor* (a kind of stove).

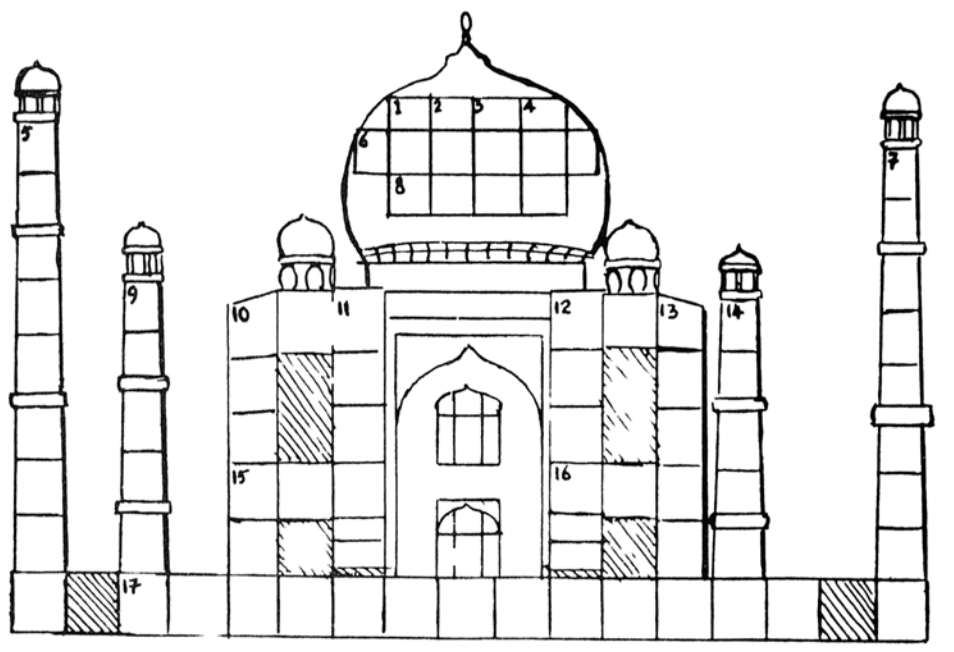
TAJ MAHAL CROSSWORD

ACROSS

1. Self-luminous object (4)
6. Brightest of these (6)
8. Add an 'H' to this to get a sweet-smelling plant (4)
10. You would not expect to find one of 12 across here (3)
12. In traditional science fiction this is the menace (3)
15. Much of a comet is supposed to be this (3)
16. A change of letter in our logo gives a sister organisation with much the same aim (3)
17. A black baby with a critical radius? (13)

DOWN

1. A mode of rest (3)
2. Attempt (3)
3. Necessary to have one in life (3)
4. French regret for taking the wrong turning? (3)
5. M 31 (9)
7. Son of the Taj Mahal's builder (9)
9. Awaiting a visitor (6)
10. Highest point on the Celestial Sphere (6)
11. A protest or a source of interest (6)
12. You often have to get down to them to understand (6)
13. An Italian observer (6)
14. Traditional home of a large and ferocious member of the cat family (6)



GAMMA RAY ASTRONOMY AT OOTY AT TeV ENERGIES

P.V. RAMANA MURTHY
Tata Institute of Fundamental Research Colaba, Bombay, India

Gamma-ray astronomy is the newest to arrive on the field after the optical, radio and X-ray astronomies. Gamma-ray observations on celestial objects or regions will enable one, either on their own or in conjunction with observations made at other wavelengths, to deduce the physical conditions prevailing at or near the object. Gamma-ray astronomy has also a strong bearing on the origin of cosmic radiation, a problem that is not solved as yet despite intensive research during the past seven decades. Most cosmic rays are charged particles and change their direction ever so often by deflection in the interstellar magnetic fields while traversing from the source to us. This makes it impossible even to identify the cosmic ray source direction. Gamma rays, being electrically neutral, are unaffected by the weak interstellar magnetic fields and travel almost in straight lines from the source to us. It thus becomes possible to know the direction of the source of the gamma rays and indirectly of the cosmic rays that produced them. Both the topics of gamma-ray astronomy and the origin of cosmic rays will be discussed in the various invited talks in the meetings of Commission 48 during November 19-21 at this General Assembly

Gamma-ray astronomy can be divided into 3 distinct energy regions that are distinguished by three different techniques employed to detect gamma rays which are in turn dictated by their fluxes that decrease with energy. First there is the high energy region, 100 MeV-10 GeV, accessible to balloon- and satellite-borne instruments. The two satellite experiments, SAS-2 and COS-B, were stories of success. Indeed the latter group published a list of 25 sources, the 2CG catalogue. Much has been learnt from these observations, not only about the source positions and fluxes but also about the distribution of matter and cosmic ray intensity in our galaxy. Then there is the Very High Energy (VHE) region, 100 to 10,000 GeV, scanned by the ground-based observatories like ours at Ooty. We will elaborate on these observations below. Finally there is the Ultra High Energy (UHE) region, 10^5 to 10^7 GeV, covered by the Extensive Air Shower technique; these observations are also ground-based.

Our group at the Tata Institute of Fundamental Research has been active in the VHEGR astronomy since 1969 with the following persons participating in the experiments at one time or another: A.R. Apte, P.N. Bhat, B.K. Chatterjee, N.V. Gopalakrishnan, S.K. Gupta, G.T. Murthy, P.V. Ramana Murthy, B.V. Sreekantan, S. Swaminathan, S.C. Tonwar, P.R. Vashwanath and R.H. Vatcha (deceased since).

The Atmospheric Cerenkov Technique

The observations make use of what is known as the Atmospheric Cerenkov Technique. Celestial gamma rays impinge on the terrestrial atmosphere and initiate electromagnetic cascade showers. Because the more energetic electrons and positrons in the showers have velocities greater than that of light in air they emit Cerenkov radiation in the atmosphere. While the particles themselves get absorbed in the atmosphere, the Cerenkov photons in the optical band continue to travel downwards, making angles of less than a degree from the direction of the incident gamma ray. These Cerenkov photons arrive in a flash lasting less than 10 ns and are spread over areas of a few tens of thousands of square metres by the time they arrive at mountain altitudes or sea-level. The Cerenkov light intensity is very low, being typically a few tens of photons/square metre for incident gamma-ray energy of 1000 GeV. So it is imperative firstly to make observations only during clear moonless nights. Secondly, one employs large-area parabolic mirrors (*see* photograph) to gather and focus the Cerenkov photons on to the cathodes of fast photomultipliers mounted at the foci of mirrors. The Cerenkov photons produce an electrical pulse in the photomultiplier lasting for no more than 10 ns. Of course, there are also pulses due to photomultiplier noise and due to night sky background. These backgrounds are easily eliminated by taking fast coincidences or fast majority logic, e.g. demanding pulses from any

three-out-of-four in the same short time interval. One serious background, however, remains. It is the one due to showers initiated by cosmic ray particles. This background is isotropic in space and random in time. Making use of these known facts, one looks for spikes either in spatial or in temporal distributions over a uniform background of showers. Such spikes are interpreted as due to gamma ray sources. One operates the detectors either in drift scan or tracking modes. In the former, the aligned mirror system is kept stationary and one looks for an increase and then a decrease in the trigger rate as the source walks in and out of the view of the telescope. In the latter, one tracks the source for 1 to 6 hours and the time of occurrence of each event is recorded to a high accuracy. Off-line, one converts the event times using a mainframe computer to the solar system barycentre to steer clear of the Doppler effects introduced by the Earth's rotation and orbital motion. The barycentre times are folded modulo the pulsar period (known from radio or optical observations) and the phase of each event is determined. Cosmic ray showers are expected to populate the phase plot uniformly. If one sees a statistically significant peak in the phase plot, one attributes it to the pulsed emission of VHE gamma rays by the pulsar with the same period as that at radio. Because of the severe restrictions imposed on the observations, duty factors are very low. One hardly gets more than 50 to 100 hours' observation time in an year on any given object. This fact when coupled with low gamma ray fluxes and severe cosmic ray backgrounds makes it very hard to obtain strong gamma ray signals.

Observations from Ooty

Our group made the observations mostly from Ooty, a hill-station (2.2 km a.s.l.) in South India. As shown in the photograph, our set-up consists of 10 equatorially mounted parabolic mirrors of 0.9 m diameter and 8 of 1.5 m diameter. We concentrated mostly on pulsars though we also looked at other objects. During the past 9 years, we have seen pulsed emission of VHEGR from the Crab pulsar on 3 occasions and an equal number of times from the Vela pulsar. During the other times we did not see any. The implied variability in the emission of VHEGR has been the experience of other groups also working in the field as a general feature. Rather than give only our own results, I will combine ours with those of all the others and present a global view of VHEGR astronomy, in the next paragraph.

A Global View

At the outset one recognizes that the gamma ray fluxes are variable not only year by year but during the same year on time scales of minutes, seconds or even tens of milliseconds. Our own group has seen variations in the VHEGR emission by the Crab pulsar over time scales ranging from 15 minutes down to tens of milliseconds. If one considers time-averaged flux values, for whatever they are worth, typical values (in units of gammas per sq cm per sec) at energies greater than 1 TeV appear to be 4.10^{-12} (Crab pulsar), 3.10^{-12} (Vela pulsar), 6.10^{-11} (Cyg X-3), 3.10^{-11} (Her X-1) and 2.10^{-10} (M31); these fluxes in turn imply luminosities (in units of ergs per second), assuming isotropic emission, of 6.10^{33}, 3.10^{32}, $2.5.10^{36}$, 3.10^{35} and 3.10^{40} respectively. In addition, more recent observations claim (1) a 5.6 sigma steady emission from Crab nebula/pulsar (Mt Hopkins group), (2) pulsed VHEGR emission from the two millisecond pulsars PSR 1937+21 and PSR 1953+29 and from 4U 0115, an X-ray binary (Durham University group), and (3) discovery of a 12.5908 millisecond pulsar in the Cyg X-3 system (Durham). If the last observation is true, it is the first successful attempt in identifying a pulsar in Cyg X-3 system which is believed to be the power-house supplying energy to all the exotic phenomena associated with Cyg X-3. Most of these last mentioned observations are to be confirmed independently, however.

It must be conceded that the VHEGR signals reported so far are not at such high statistical significance (e.g. 10 sigma level) as to convince even the sceptics. However they are not insignificant either to be ignored altogether; for, in most cases the probability that they are caused by chance fluctuations is less than 0.1 per cent.

Prospects for the Future

This brings us to the question: How does the future of Very High Energy gamma ray astronomy look? Bright, one should think. Our own group is shifting the observatory to Panchmarhi in Madhya Pradesh in order to increase observation times. Ooty skies become cloudy during both the monsoons and in particular some of the interesting objects like Cyg X-3, millisecond pulsars, Galactic centre, etc come up in the night time during the monsoon period. We hope to do better at Panchmarhi. Also, finances permitting, we want to increase the mirror area to lower the detection threshold energy of the gamma rays. There is another group in India operating from Gulmarg; they are poised to make some significant contributions to this field. At Mt Hopkins (USA) and at the Crimean Astrophysical Observatory (USSR), the groups will make full use of their recently completed multi-element detector systems at the focal planes of their reflectors. Either new groups or old groups at new places intend to go ahead with larger efforts in Hawaii (USA), Narrabri (Australia), Adelaide (Australia) and South Africa. In particular a French group is trying to convert a solar energy power station to a giant VHEGR observatory with a total mirror area of about 860 square meters. This is indeed a quantum jump by more than an order of magnitude. This branch of astronomy is worth watching.

Aerial view of the array of gamma-ray telescopes at Ooty

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Editor : ARCHIE E. ROY
Associate Editor : A. RATNAKAR

PRIME MINISTER INAUGURATES DELHI IAU

Political barriers should not prevent countries from having ties at scientific level.

This appeared to be the take-home message the Prime Minister Mr Rajiv Gandhi gave while inaugurating the XIX General Assembly of the International Astronomical Union. The ceremony, colourful as it was, beginning with India's national anthem and a Vedic hymn, was held at Siri Fort, the modern monument from the ninth Asian Games, in New Delhi.

Mr Gandhi told the world body of astronomers that science preached "brotherhood and oneness."

"The world's biggest problem today is political barriers," he said. But, he added, there are many areas, one of them science, that cut across nations irrespective of what the barriers are.

Mr Gandhi, who also released a commemorative postage stamp depicting Halley's Comet, hoped the conference "would lead to much greater friendship among scientists of all nations." The special Re 1 stamp was issued by the Indian Posts & Telegraphs Department.

Some 1400 astronomers from all over the world including 300 from India are attending the conference being held for the first time in India.

Paying rich tributes to the late Indian astronomer Dr M.K. Vainu Bappu, former President of the IAU, Mr Gandhi said India had a long tradition of astronomy. Some of the early masonry observatories, such as the Jantar Mantar, are still serving a useful purpose, in that they still attract foreign tourists.

Indian astronomers had been in touch with their counterparts abroad for a long time "and this helped in the development of our sciences," he pointed out.

Talking about Indian science at the present, the Prime Minister said that if India is to progress, scientific temper must be built into our culture and not in a few pockets at higher levels. "The pyramid of science must be built from bottom up," he said, "this is the direction we would like to take."

Mr Gandhi said that since the days of Jawaharlal Nehru India was committed to the use of science and technology for development. "But what we mean by development is not dams or big projects, but development of the human being as a whole."

According to the Prime Minister the root had to come from India's heritage and traditions that are unfortunately coming under increasing pressure from modern technologies. Scientists must strike a balance between 20th century science and technology on the one hand and on the other the values, sprituality and inner strength inherited from ancient civilization.

The Indian Prime Minister welcomed the astronomers from abroad and hoped they would not only have a fruitful conference but also a good time in India.

Prime Minister Mr Rajiv Gandhi addressing the delegates

In a nostalgic reference to the IAU President Prof. Hanbury Brown's childhood, Mr Gandhi said he was much more clcsely associated with India because his father and grandfather were also born in India.

In his turn, Prof. Brown said one of the major objectives of the conference was international cooperation in astronomy. "Co-operation is very essential in this area as we all live under the same sky," the Australian astronomer said. He added that the IAU had taken considerable efforts to bring in young astronomers to the conference which he hoped "will create great public interest in astronomy in India."

The IAU President, impressed by the optical observatory in Kavalur and radio astronomy research in India, noted: "The tradition of science we find in Indian history is very much alive here today." He described the late Dr Vainu Bappu as the best ambassador of Indian science.

Prof. M.G.K. Menon, Chairman of the National Organising Committee, who traced the Indian contribution to astronomy from Aryabhata, noted the great strides Indian scientists had made during the study of solar eclipses. Pointing out that the first observation of helium in the Sun was made from India, Prof. Menon said a giant metre-wavelength radio telescope is to be built in India before 1990. Continuing, Prof. Menon said India is at a stage where there are major new instruments to enable Indian scientists to work at the frontiers of astronomy.

IAU President, Prof. Hanbury Brown

The ten-day IAU Conference is being held under the auspices of the Indian National Science Academy. Its President Prof. C.N.R. Rao, in his welcome address, said the Academy's interest in astronomy had been age-old. Prof. Rao added that INSA was also closely associated with the activities of the IAU.

The function ended with a vote of thanks by Dr A.P. Mitra, Chairman, Local Organising Committee.

XIX GENERAL ASSEMBLY'S FIRST SESSION

The atmosphere was strictly business-like yet it wasn't boring. The wit and humour of the IAU President Prof. Hanbury Brown, who was in the Chair, kept the proceedings lively. Ably matching Prof. Brown's wit were General Secretary Richard West's interpolations. The occasion was the first session of the XIX General Assembly of the IAU at the Siri Fort Auditorium in New Delhi. It followed immediately after the formal inauguration by the Prime Minister Mr Rajiv Gandhi.

Prof. Brown underscored in his presidential address the principal aim of the IAU. Emphasising that it was a very worthy aim, the speaker said the IAU aimed to develop astronomy through international co-operation. One of the modes of fostering international co-operation, Prof. Brown said, was to sponsor international scientific meetings, international scientific programmes and international scientific services, which astronomers need necessarily. The Union also represents the interests of astronomers on a host of international bodies. One of the principal ways in which it does so is by creating a community of people with a common interest in *the one sky* which all humanity shares. One special feature of the IAU is that it enlists *individuals* as members. Two, it spends a great deal of time and money in bringing the individuals together every three years.

(Continued on p. 7)

EDITORIAL

FAMILY GATHERING

From time to time the scattered members of a family come together in a family gathering. Though they may have corresponded with each other, and though individual members of the family may have visited each other's houses, there is undoubtedly something special about an occasion where as many as possible come together for as long as possible. For the family gathering is a source of strength, of renewal, of joy in seeing so many relatives at the same time and also, it must be said, of sadness remembering loved ones who are no longer with us.

The General Assembly of the IAU is in truth a family gathering. Already we are reviving and strengthening bonds of friendship; at the reception at the Hotel Taj Palace yesterday evening the joy of participants at meeting friends last seen in Patras in 1982 was evident. In the days to come during addresses, joint discussions and informal meetings we will obtain a much deeper appreciation of our friends' efforts, successes and problems in pursuing our much loved science in their own countries. We will gain a much clearer insight into how those of us who are fortunate in the possession of facilities and resources can help others to achieve their aims.

The New Delhi General Assembly of the IAU is also a triumph for one who will not be present but who will be remembered with affection by those who knew him as a person who was a true and great scientist and a gentleman. Vainu Bappu, such is fate, by reason of his serious illness, could not be present at the Patras IAU General Assembly; those of us who were, remembered the shock felt by the Assembly when we heard of his death. Now, recalling his wish that the IAU should meet in Delhi, our regret that he cannot be with us is tempered by the knowledge that his wish has finally come true.

So in that spirit let us make it the best ever family gathering of the IAU.

Archie E. Roy

DOWN MEMORY LANE — GLIMPSES FROM PAST GENERAL ASSEMBLIES

II GENERAL ASSEMBLY IN CAMBRIDGE (UK) 1925

The second General Assembly was held at Cambridge during July 14-22, with nearly two hundred and fifty people participating in the deliberation. At the opening ceremony, which was inaugurated by Lord Balfour, the Chancellor of the University, Prof. W.W. Campbell, President of the Union, indicated the importance of having the Assembly at Cambridge where standards and traditions set by Newton, Adams and Clerk Maxwell still prevailed. Dr Jeans, Secretary of the Royal Society and President of the Royal Astronomical Society, said that the meeting at Cambridge was a pilgrimage to the memory of Newton, who at Cambridge analyzed white light into its constituent parts. He also referred to the origins of dynamical astronomy and to the invention of the reflecting telescope at Cambridge.

The admission of the Central Powers to the Union came under discussion in the light of the proposal from the United States that the Union should invite Prof. van Rhijn and other members of the Committee on Selected Areas to consider the advisability of reorganizing it under the auspices of the Union. The motion was deferred for the time being by the President, Prof. Campbell. It was stated by Prof. Brown on behalf of the American delegates that the time had come when for the success of the Union it was essential to remove the nationality restrictions and that the participation of astronomers from the United States in future assemblies would not be recommended until the statutes permitted the participation of astronomers from all countries. Prof. Cerulli said that it was the opinion of the Italian delegation that until the Union became truly international, no further meeting should be held.

Two new commissions, No. 33 (Stellar Statistics) and No. 34 (Solar Parallax), were begun and Commission No. 1 on Relativity was discontinued. Though no agreement could be reached with regard to the name to be used for GMT counted from midnight, it was agreed that the Julian Day should continue to commence at noon. During the period of the Assembly there was a meeting of the Cambridge Philosophical Society at which J.J. Thomson gave a lecture on 'The Nature of Light' and Prof. Eddington on 'The Interior of a Star'. (It was announced in this lecture by the speaker that a shift in the spectral lines of the companion of Sirius agreeing with the Einstein-shift predicted had been found by Dr Adams). Many of the visiting astronomers reported their work at the meetings of the British Astronomical Association and the Royal Astronomical Society.

As a part of the social engagements, there were a number of receptions including a dinner hosted by the Master and Fellows of Trinity College and visits to the observatories.

The next General Assembly was to be held in Leiden in 1928

WHAT'S IN A NAME?

Mandakini: In Sanskrit Mandakini means a divine celestial river. It usually refers to the 'Milky Way' and is pronounced as "MUN DAH KINI' the 'U' as in 'Nun', the 'DAH' as in 'PURDAH' and the 'KINI' as in 'BIKINI'. We hope you will agree that it is an appropriate name for your newspaper.

IAU Symp. No. 119 on QUASARS

Vijay Kapahi
Chairman, Local Organizing Committee

The International Astronomical Union's symposium No. 119 on Quasars is scheduled to be held in Bangalore, India, from December 2 to 6, 1985 soon after the XIX General Assembly in New Delhi. It is for the first time that an IAU symposium is being devoted entirely to quasars. It has been jointly sponsored by Commissions 28 (Galaxies), 40 (Radio Astronomy), 47 (Cosmology) and 48 (High-Energy Astrophysics).

The wide range of topics that would be discussed in the symposium can be broadly divided into the following six categories:

1. Quasar surveys in the optical, radio and X-ray regions
2. Continuum studies : basic properties such as spectral energy distributions, polarization, morphology and variability in the different regions of the electromagnetic spectrum
3. Spectral line studies : narrow and broad line regions, ionization mechanisms, cloud dynamics, broad absorption lines, etc.
4. Theoretical models and mechanisms for the activity in quasars
5. Cosmological studies : luminosity functions, red shifts, clustering, isotropy, etc.
6. Quasars as probes of the intervening medium : gravitational lenses, absorption line systems, etc.

The scientific programme of the symposium will consist of about 25 invited review talks and as many short contributed talks. In addition, there will be nearly one hundred papers in the form of poster presentations.

About 200 participants from all over the world are expected to attend the symposium. The vast majority of the participants will be staying in Hotel Ashok, the venue of the symposium. A number of social and cultural events are being arranged for the participants and their guests.

Specially for the benefit of those participants who are also attending the XIX General Assembly, a package tour has being organized by Ashok Travels & Tours between 28 November and 1 December 1985. The tour covers sightseeing (palaces, a 13th century rock temple, etc) in and around Mysore, a trip into the wildlife sanctuary at Mudumalai and a visit to the large radio telescope at Ooty in the picturesque surroundings of the Nilgiri Hills.

The Scientific Organizing Committee for the symposium consists of G. Gwarup (chairman, India), P. Biermann (FRG), D.L. Jauncey (Australia), K.I. Kellermann (U S A), E. Khachikian (U S S R), T.K. Menon (Canada) M. J. Rees (U K), M. Schmidt (U S A) and G. Setti (F R G).

The local organizing committee consists of V.K. Kapahi (chairman), Gopal-Krishna, A.K. Kembhavi, V.K. Kulkarni, T.M.K. Marar, T.P. Prabhu and G. Srinivasan.

IAU SYMPOSIUM No.120 ON ASTROCHEMISTRY

Goa, India, December 3-7, 1985

K.S. Krishna Swamy
Chairman, Local Organising Committee

An International Symposium on Astrochemistry will be held at Fort Aguada Beach Resort, Goa, during December 3-7, 1985. About 100 eminent scientists from abroad and 50 from India are expected to participate in this symposium. The distinguished participants will include scientists from the USA, the USSR, the UK, Germany, France, Japan, Italy and other countries. This symposium is sponsored by the International Astronomical Union (IAU) and the Tata Institute of Fundamental Research (TIFR), Bombay. This is the first symposium of its kind ever to be held in India and participation in it is by invitation only.

In recent years the discovery of the presence of various types of molecules from simple to relatively complex form in various astronomical objects has excited all scientists alike. It is realised with this discovery of molecules that chemical processes not only go on in stars and galaxies but also may have played an important role in the formation of galaxies in the early phase of evolution of the universe. It is obvious from the diverse nature of objects where molecules are observed that the same chemical processes are not responsible for occurrences of even the same molecule in different objects. The underlying physics, however, cannot be different, but differences in physical and dynamical situations in different objects have their effect on the observed molecules. The aim of the symposium is to collect together astronomers of various fields, physicists and chemists to understand how chemical processes occur in various astronomical objects and to share experiences of researchers working in one field with those in another.

The Government of Goa has been deeply interested in this symposium and has extended all help for making it a success.

POSTSCRIPT

A bright little comet performed a turn
When passing by the planet Saturn,
The resulting trajectory
Is now ancient history -
They're still waiting to see him return

A foolish wandering satellite
Strayed too close to its host one night
and in its Roche's limit
Met a fate so blackly grim, it
Quite shattered it and slung it out of sight

C. SIVARAM

gASTRONOMY CORNER

SHORBA-E-ASHOK

(Indian Soup - An Appetiser)

	Ingredients	Quantity
1.	Tomatoes	500 g
2.	Chicken stock	700 ml
3.	Curry powder	25 g
4.	Diced chicken	50 g
5.	Bouquet *garni*	1 no
6.	Coconut milk	50 ml
7.	Onions	50 g
8.	Carrots	50 g
9.	Salt	to taste
10.	Butter	15 g

Method

1. Wash and slice tomatoes.
2. Chop onions and carrots. Place in a pan along with tomatoes.
3. Cover with stock. Dip in bouquet *garni* and cook till vegetables are done.
4. Pass through a vegetable masher and strain, return to fire.
5. Rub in butter into curry powder and add to the soup, stirring constantly.
6. Add the coconut milk.
7. Check seasoning. Serve hot garnished with diced chicken pieces.

NB : Serves Four

HELPFUL HINTS FOR PH.D. CANDIDATES

For the benefit of those astronomers who have Ph.D. students we provide the following useful hand-out.

The life of a Ph.D. candidate is divided into several well-marked phases.

Phase 1. The initial reading period during which one is increasingly convinced that (a) 'I will never read all the relevant literature' and (b) everything has already been done. This phase, one of decreasing enthusiasm and growing despair, merges into Phase 2 after some nail-biting months.

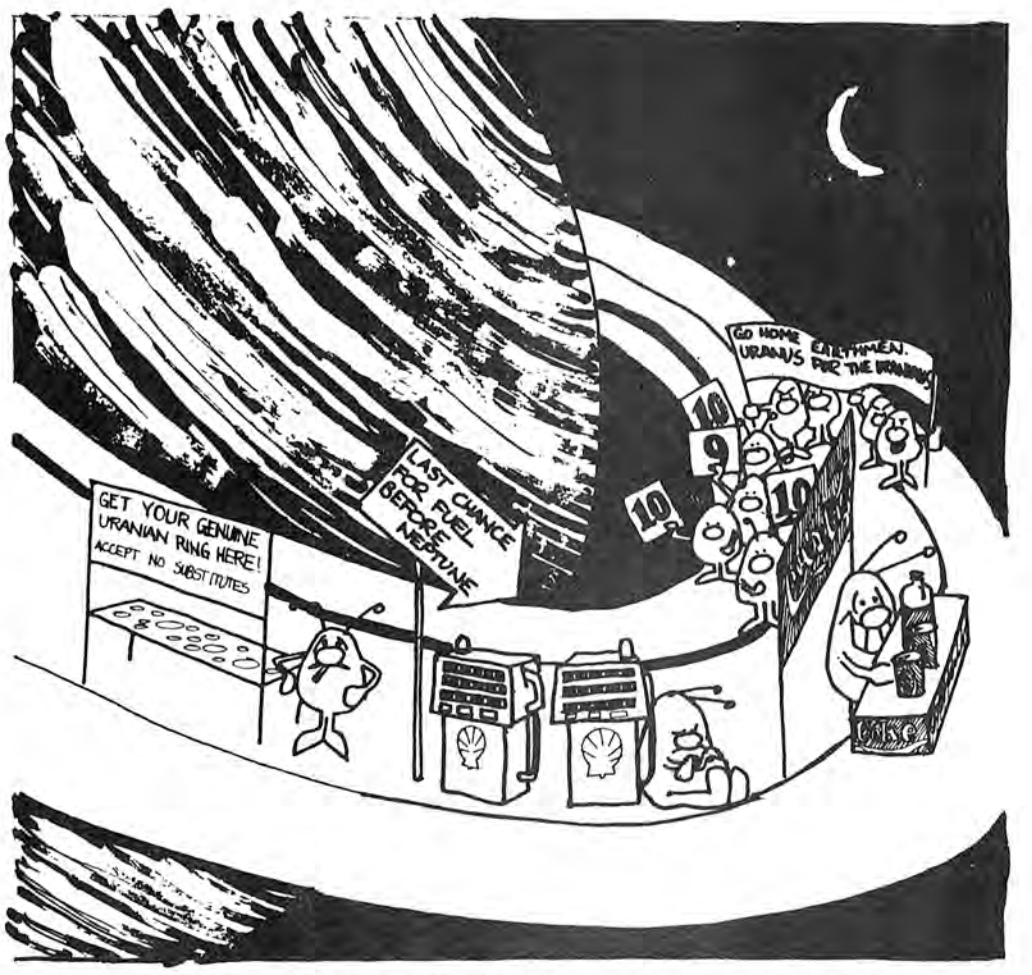
Phase 2. The growing realisation that there are at least some loose ends to be tidied up, a conviction arrived at with or without the help of one's supervisor. (*Definition:* a supervisor is the person who allegedly guides one's research, offers a sympathetic ear and encouragement but is quite often the one member of staff away on extended, observing trips or lecture tours.).

Phase 3. The transition of reading time into research time: it is advisable to pursue at least 3 lines of research at the same time since one will turn out to be a dead end and a second will turn up successfully completed in a depressingly competently written paper found in a journal just before your thesis is begun. Hopefully, this will not happen to the third research line. If it does — but then let us not be pessimistic.

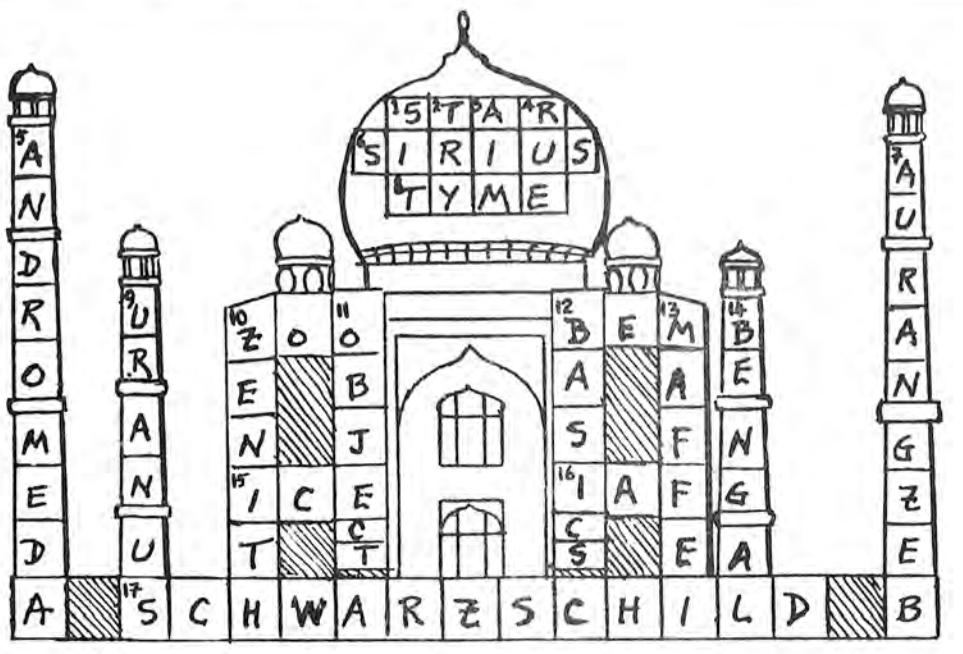
Phase 4. The thesis. Pay no attention to snide remarks that writing a thesis is like 'shovelling bones from one graveyard to another'. The thesis is the distilled essence of your genius, the vintage gathered from your labours in the astronomical vineyard. Yours will undoubtedly be one of the few that, unlike the vast majority that end up unopened and dusty in the university library, will become one of the great landmarks in the history of your subject, a quarry to be mined for the material of innumerable papers continually listed in the *Science Citation Index*.

Phase 5. The Oral — the last hurdle. Regardless of the merit of your thesis, a few matters should be kept in mind. When you meet with the External Examiner remember that at that moment you are probably one of the world's experts in your particular research field. Even so, it will have done no harm to find out something about your External Examiner's own career, likes, dislikes and idiosyncracies. If he is a fanatic anti-smoker, it is not advisable to enter the room wreathed in smoke or smelling like a seldom emptied ashtray. If he is a keen mountain-climber it is still not advisable to go in dressed in lederhosen, Tyrolean hat and carrying an alpenstock as if you have just rushed back from your own well-loved sport for the oral. He might ask too many searching questions. Be subtle. Let it be known at the coffee-break that you are familiar with one or two of his lesser-known published works and are surprised that they have not received the recognition they undoubtedly deserved. Be appreciative of his well-honed sense of humour. Be enthusiastic even when he picks holes in your thesis. And hopefully you will enter the next phase.

Phase 6. You are now Dr - . Undoubtedly there is a tendency to sign yourself everywhere as Dr. - . But take care. Remember Stephen Leacock's experience. Newly-graduated D.Litt, he signed himself Dr Stephen Leacock .on a small cruise-ship. He was wakened in the night by the purser who asked him in his capacity as a doctor to come along and examine the stewardess' leg which she had hurt in a fall. Hurrying along to her cabin he found he had been beaten to it by another doctor — a newly graduated Doctor of Divinity!



Our tachyon telescope catches last minute preparations by the Uranians for the forthcoming Voyager fly-past.



Blinded with Science?

When Halley's Comet comes to Earth at the end of the year many astronomers will have their eyes pinned on it.

— A schoolboy

KODAIKANAL AND KAVALUR: OBSERVATION TOWERS FOR THE SKY

J.C. BHATTACHARYYA
Indian Institute of Astrophysics
Bangalore

It may be a pure coincidence, but the three major installations of the Indian Institute of Astrophysics are located in places whose names start with the letter 'K': Kodaikanal, on the Palni Hills near Madurai; Kavalur, among the sandalwood forests of Javadi Hills; and Koramangala, a fast-growing suburb of Bangalore. The history of the establishment of the observatories is spread over seven decades during which the roots of modern astronomical research took a firm grip in the Indian soil.

A move to establish an observatory amidst the hills of Southern India was initiated towards the end of the last century. Norman Pogson, as the Government astronomer in Madras, had been pressing for shifting of the observatory to a suitable site. The necessity dawned upon the administrative authorities only after Pogson's death in 1891. The new director, Michie Smith, was asked to select a new site; in 1897 a peak almost 8000 ft high was chosen, near the scenic blue waters of Kodai lake; there was a small colony of tea and coffee planters and the site was within walking distance from the colony. The approach to the hill station was by mule-track from the nearby town of Periyakulam and the first telescopes were brought up by the same route. In 1901, Kodaikanal Observatory started functioning with an emphasis on a newly flourishing branch of astronomy — solar astrophysics.

It is entirely to the credit of Michie Smith and his new young assistant, John Evershed, that Kodaikanal grew up to be one of the leading solar observatories in the world. In January 1909, Evershed announced the epoch-making discovery of radial motion around sunspots, which started world-wide investigation on the new phenomenon, the Evershed Effect. Evershed also noticed in his fine Doppler-heliograms signs of small-scale velocities, which only recently have started engaging the attention of solar astronomers.

Kodaikanal survived the age of depression in the late twenties and thirties and the war years. Royds and Narayana pressed on with the available equipment to bring out some thought-provoking results in solar physics and spectroscopy. Prominent activities during this period were deeper probes in the solar near-infrared region and a search for relativistic shifts in spectral lines by Royds, and an exhaustive set of laboratory spectroscopic investigations by Narayana.

The look of Kodaikanal Observatory changed after Independence in 1947. Funds for setting up new instruments and observational facilities started flowing in. The first radio astronomical measurements in India were obtained in 1952, when 100 MHz solar radiations were recorded through a two-element interferometer. The old units of geomagnetic variometers were put back to start a new regular series of observations. A vertical ionospheric sounder commenced a long series of observations of the variation in the outer ionized layers of our atmosphere. The 20-inch Bhavnagar telescope was totally overhauled and fitted with new instruments to take part in the International Mars Observation Programme of 1954-55.

A New Responsibility

During the IGY, Kodaikanal Observatory undertook a big responsibility. Lack of solar observatories in a wide area in the eastern hemisphere had been threatening the desired continuity of solar observation. A.K.Das took over the responsibility and provided the necessary observations by promptly updating some of the facilities. He had hoped to use the new solar equipment ordered from England, but they arrived only after the IGY was over.

The sixties saw Kodaikanal with a new series of modern solar equipment and a very energetic young director, who transformed not only the complexion of Kodaikanal Observatory, but the entire astronomical work of the country. Vainu Bappu had taken over the directorship of Kodaikanal in 1960, with all the equipment for a modern horizontal solar telescope together with a high dispersion spectrograph, a monochromatic Lyot filter and a coronograph.

The solar tower spectrograph was installed in 1960, and after extensive modifications, it was put into operation in 1962. In 1965, a photoelectric solar magnetograph was built around it; investigations ranging from the physics of the temperature -minimum regions to the global oscillations have been followed by this equipment.

The observatory of Kodaikanal is a complete solar observatory. Observations on the Sun in optical and near infrared have been carried out over a long time; radio observations from just beyond the ionospheric cut-off frequencies to the centimetre wavelengths are monitored. Even the high-energy radiations from the Sun during flares have also been estimated from the changing ionization pattern high up in our atmosphere. Studies of magnetic variations and micropulsations at this observatory have revealed intricate structures of solar wind and interplanetary shock fronts. Truly it is a laboratory where concerted efforts towards understanding many of the enigmatic solar processes can be thought of and executed.

Vainu Bappu's Dream

Kavalur Observatory, in the Javadi Hills of Tamil Nadu, is of a relatively recent origin. The idea of such an observatory was voiced by a scientific committee in 1945. Initially searches were confined to a place in central India. It was Vainu Bappu who convinced the authorities about the advantages of a location in Southern India. The site was picked up by Bappu after careful observations; a small telescope was installed in 1967 and regular photoelectric observations started thereafter. This phase continued until the installation of a Zeiss one-metre telescope in 1972.

The site of Kavalur is not very high in altitude, but several factors concerning the physical conditions of surrounding areas have helped make this a convenient astronomical site. A scrutiny through the climatological maps of the Deccan shows a general tendency of cloudiness, particularly in the afternoon; but a triangular patch marked by the cities of Madras, Vellore and Cuddalore in Tamil Nadu is statistically found to have a greater number of clear days. Kavalur is located in this area. Compared to the sites on northern plains, the air here is much clearer. This site has a few additional advantages; by virtue of its location in a slightly depressed zone surrounded by higher hills, this area is shielded from strong winds and the extensive ground cover provided by the dense sandalwood forest reduces the ground heating by insolation. The net result of all these is that the boundary layer is comparatively stable, which gives good astronomical seeing.

After the installation of a Zeiss telescope, more detailed observations of atmospheric seeing and transparency became available, and these have supported the initial speculation regarding the suitability of the site for bigger telescopes. In fact, before finalising the site for the recently compeleted 234-cm telescope, comparative observations at three well-separated sites in the southern peninsula showed several points of superiority of Kavalur over other sites.

Now the observatory has six optical telescopes: a just-completed 234 cm reflector, a Zeiss 102 cm reflector, 75 cm, 40 cm, and 38 cm reflectors, all fabricated locally and a 60 cm/45 cm Schmidt, also fabricated locally, and initially intended for use in the Indian Halley Observation Programme. The two larger telescopes have a battery of optical instruments, some of them backed up by on-line computers. There is an active plan of linking other telescopes to a central computer system.

But it is not the big instrument and hardware for observations that catch the eye of a visitor to Kavalur. They are all hidden behind glazed partitions and locked cupboards, periodically making their appearances at the focal planes of the telescopes. Even the telescopes are really only exposed to the sky during the darkness hours. But the white glistening domes atop the greenery of surrounding forests set up a contrast in colour, creating an unearthly atmosphere. Inside the campus, part of the old forest had to be cleared; in its place flowering trees have been planted — Gul Mohurs, Jacarandas, Cassias. The winding lanes are lined up with colourful Bougainvillas and Crimson Poinsettias. On entering the campus, one notices a groove of graceful arecanuts shielding a denser growth of tropical trees in the background. Following the narrow driveway small cottages of unusual designs come to the view, until one comes amidst white towers housing the telescopes. Many visitors have exclaimed, 'What a beautiful garden!'

This beautiful garden was the lifelong dream of a scientist who had searched, perceived and admired beauty in all corners of the Earth and the cosmos. And in an attempt to capture some of it for posterity, Vainu Bappu created this garden observatory.

THE PUZZLING PULSATIONS OF B STARS

Arthur N. Cox
President, Commission 35

Most pulsations of stars have causes that are reasonably well understood. They are usually the k and γ effects produced when hydrogen or helium becomes ionized in the layers just below the stellar surface. Another cause is the modulation of the nuclear reactions at the stellar centre by the cyclical motions. Both mechanisms add heat to layers at their maximum compression, reinforcing the pulsation motions. These first effects produce pulsations by turning on and off the flow of luminosity, while the second effect turns on and off the source of luminosity. Other more intricate mechanisms have also been discussed for various classes of variable stars. In spite of our extensive knowledge of stellar pulsations, the mechanisms operating in the B star β Cephei variables remain uncertain.

A small group of investigators from many different Commissions is meeting on November 26 to brainstorm about what is going on with the B star pulsations, and, in particular, the β Cephei variables. These variable stars discovered as long ago as 1902, and intensively studied since 1960, present a puzzle that still defies explanation. Everyone is invited to participate in this session organized by Dr Morris Aizenman from the National Science Foundation in Washington, D.C.

ANNOUNCEMENTS

Modified Schedule

Session 47/4 'Anisotropy of the Cosmic Background Radiation' will be held in Room E (Session III); and Session 47/7 'Clusters of Galaxies' will also be held in Room E (Session IV) on Friday November 22.

Sessions 47/2 and 47/3 'Primordial Nucleosynthesis' will be held in Room H (Sessions I and II) on Monday, November 25.

I.A.U. COMMISSION 50
SESSION 50/5 — NOVEMBER 20, 1985
ROOM - F
RADIO FREQUENCY INTERFERENCE

Overview: Radio Astronomy & Spectrum Management (including major international problems) —*V. Pankonin*

Protection of Radio Astronomy in India (including noise surveys for the GMT) —*G. Swarup*

Radio Noise Surveys for the Australia Telescope —*J. Roberts*

Protection of Radio Astronomy in the USA (including noise surveys for the VLBA) —*V. Pankonin*

Radio Frequency Interference (to optical astronomy) —*J. Osorio*

Next Generation Weather Radar (interference to optical & radio astronomy) —*A. Hoag*

The Man of Science appears to be the only man who has something to say just now — and the only man who does not know how to say it.

—Sir James Barrie

Because you see, what has made science successful as a social leaven over the last three hundred years is its change from the practice of individuals, however great their ingenuity, to a communal enterprise

—Jacob Bronowski

PRESIDENT OF THE IAU

ROBERT HANBURY BROWN

R. Hanbury Brown was born on August 31, 1916 at Aruvankadu, India. In 1936 he joined Robert Watson-Watt's team, which developed radar in Great Britain, He was also a member of the group led by E.G. Bowen, which pioneered airborne radar, work which involved him in long stints of experimental flights to develop radar for night fighting and for ship and submarine detection.

After the war he moved to Jodrell Bank and found there a large fixed paraboloid antenna 218 ft (66.5 m) in diameter which had been built for a radar experiment. Hanbury Brown used this antenna to make detailed radio maps of the region of sky within its grasp. The radio emission from the Galaxy was one of the features of these maps and suggested that other galaxies might also be detected in the radio region. Working with C. Hazard, Hanbury Brown in 1949 succeeded in detecting emission from Andromeda Galaxy, M 31. Their work in the next few years with the paraboloid led to the design and construction of the 250 ft (76.3m) Mark I fully steerable dish at Jodrell Bank.

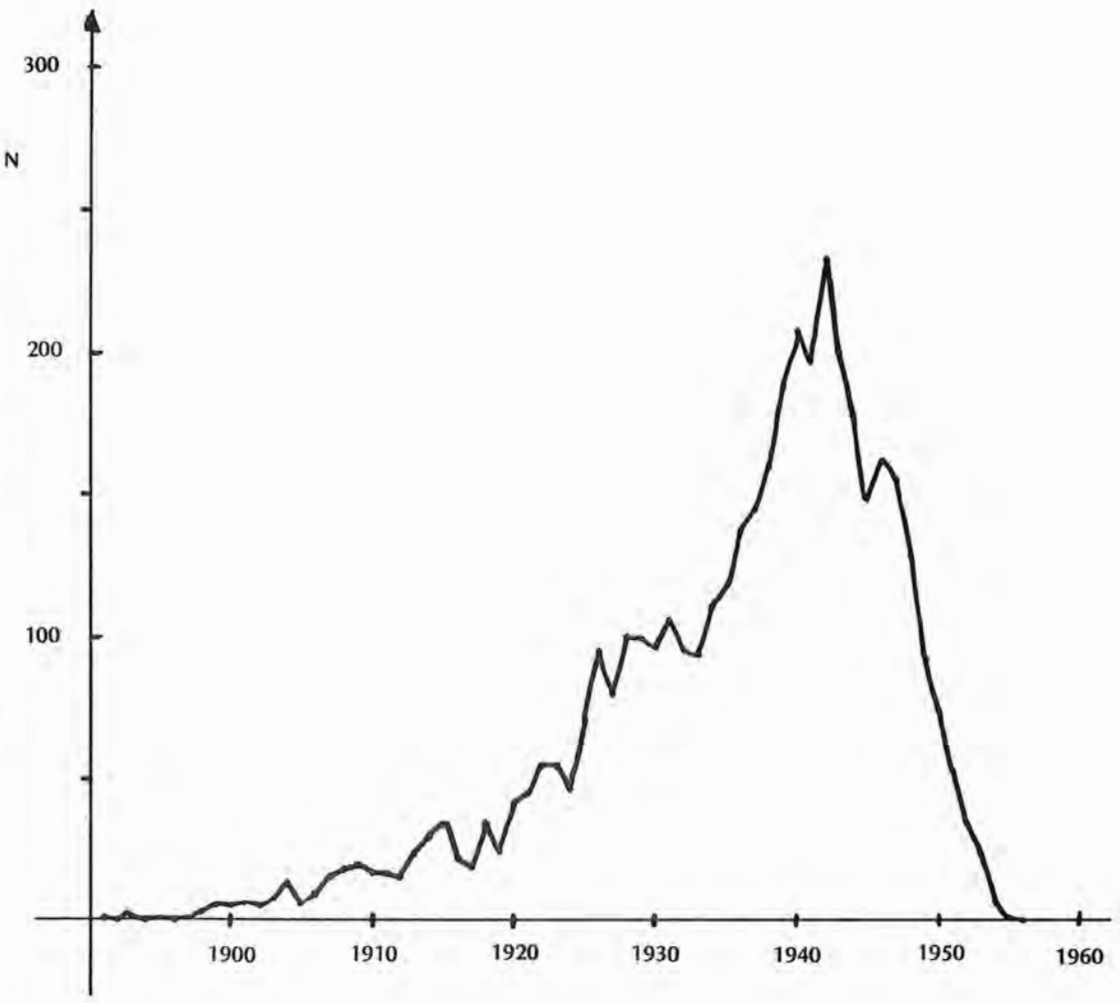
The so-called 'radio stars' found at this time prompted Hanbury Brown to devise ways of measuring their angular diameter; his researches led from 1949 onwards to a new and fruitful phase of his career, the development and use of intensity interferometers. In collaboration with R.Q. Twiss, he was able to measure, with his radio and optical interferometers, not only the angular diameters of radio sources such as Cygnus and Cassiopeia but also the diameters of stars such as Sirius (in 1956) and Vega (in 1964). Subsequently, measurements of over 32 other stars were made. Much of this work was done at the Narrabri Observatory of Sydney University, Australia.

Hanbury Brown was appointed Professor of Radio Astronomy at the University of Manchester in the same year (1960) in which he became a Fellow of the Royal Society. Many honours have deservedly come his way; he is, for example, an honorary fellow of the Indian National Science Academy and of the Indian Academy of Sciences. Moreover, he was the first Raman Professor. Among prizes awarded to him are the Holweck Prize of the French Physical Society (1959), the Eddington Medal of the Royal Astronomical Society (1968), the Lyle Medal of the Australian Academy of Sciences (1971) and the Hughes Medal of the Royal Society of London (1971).

It is very fitting that Robert Hanbury Brown, like so many of his distinguished predecessors, is the President of the International Astronomical Union.

FROM THE IAU COMPUTERISED FILES

YEAR OF BIRTH FOR 4209 MEMBERS OF IAU (STATUS : 23 OCTOBER 1985)



CREATING THE IAU XIX GENERAL ASSEMBLY SOUVENIR POSTCARD

DONALD MALCOLM

During a visit to my home in Paisley (Scotland) in March of this year, Professor Archie Roy mentioned that he was going to India in November to attend the General Assembly of the International Astronomical Union. As he had done previously in Greece in 1982, he was to edit the daily IAU newspaper.

I suggested that it might be worthwhile thinking about a special postcard for the XIX General Assembly, whose logo is based on one of Jai Singh's observatories, with its magnificent sundial, the *Mistra Yantra.* Archie Roy agreed and Peter Westwood and I, who have been producing postcards on various subjects since 1983, undertook to design and print a card. Our previous cards were produced in black and white. This time, we decided to try one in colour, which poses problems of its own — and so it proved.

The first step was to sketch basic designs, which I did (One is shown in Fig.1). At this stage, I had no illustrative material and it was a case of deciding on the elements to be included: a portrait of Jai Singh, one of his observatories, part of a map of India centring on Delhi, the XIX Assembly and IAU logos and Halley's Comet.

Fig. 1 was produced as a colour design, using the colours of the national flag of India. In fact the card was finally printed in black and yellow. The central idea was to have the eyes of the astronomical world focused on India, particularly on Delhi, and for that reason, Jai Singh was shown as looking towards the East. It seemed to be evident early in the project that a horizontal format was more suitable.

These designs were sketched in March. A copy was sent to Margaret Morris, an eminent philatelist with an international reputation for her superb collection on the theme of astronomy and she responded with a sheaf of illustrations that were to provide the basis of the finished design.

I produced a mock-up (Fig.2) in June and already the card was taking the desired balance of the elements. It was at this stage that Peter took over and the professional touch is immediately evident, as seen in Fig. 3. And the reversal of the design achieves the dramatic effect that we were aiming for. While Peter was deciding on the colour scheme and arranging the colour-separation trials, work proceeded on the details that were to appear on the reverse of the card. Archie Roy provided biographical text about Jai Singh.

Initially an edition of 3000 cards had been proposed. Then it became clear that transportation of such a weight of cards would pose problems and the number was cut to 1000; 250 were retained as samples and for sale in Britain.

It is but appropriate that the card was conceived, designed and produced in Paisley, Scotland, famous in the 19th century for its shawls using the teardrop motif which first appeared on shawls made in Kashmir.

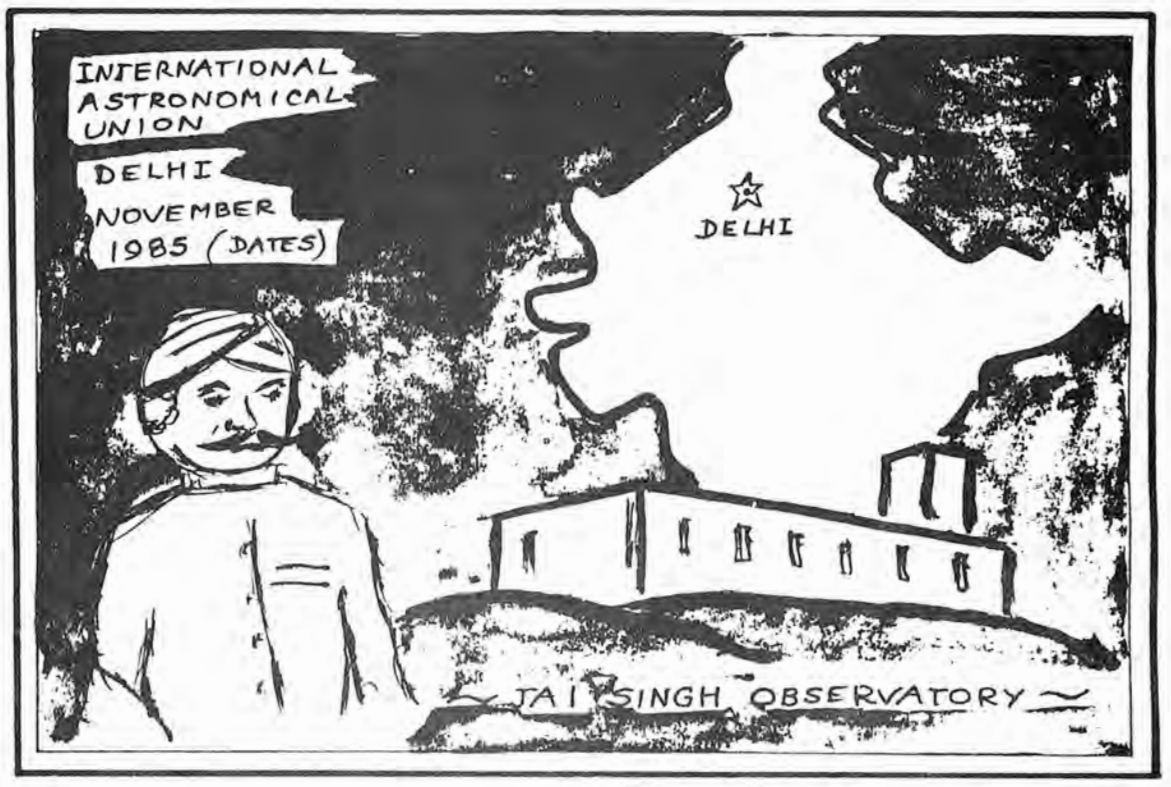


Fig. 1.

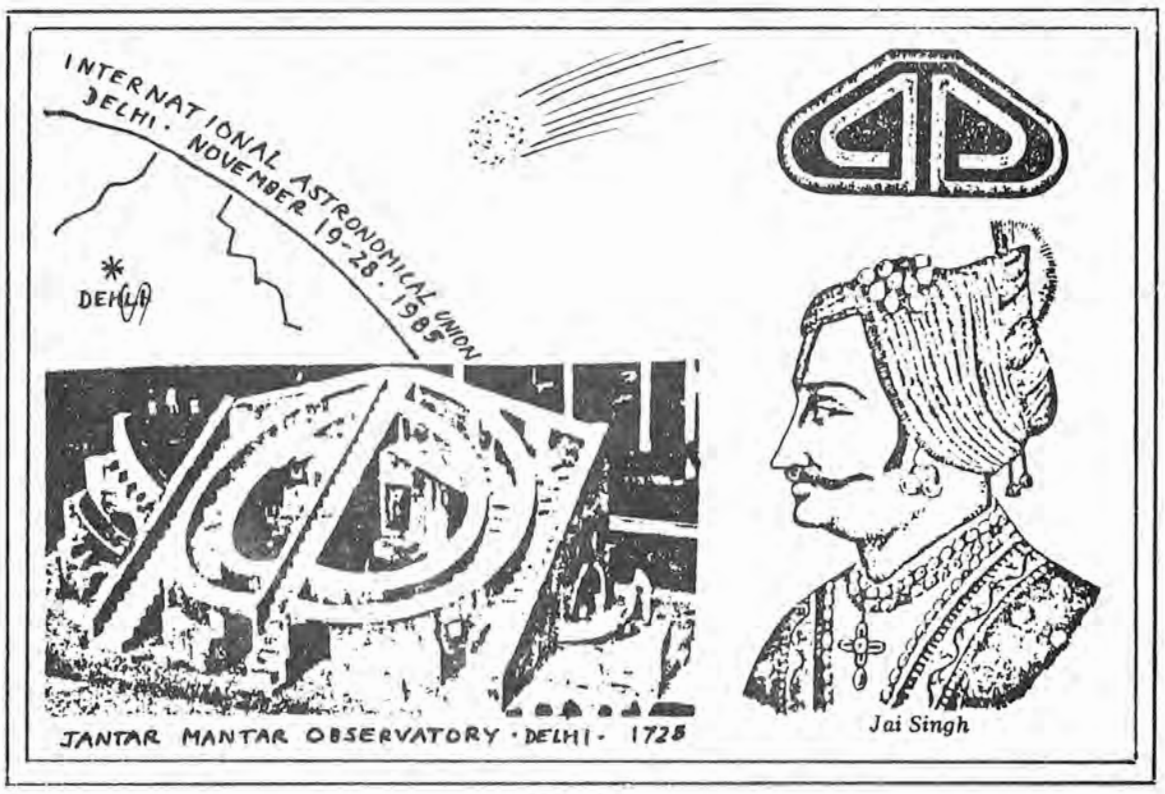


Fig. 2.

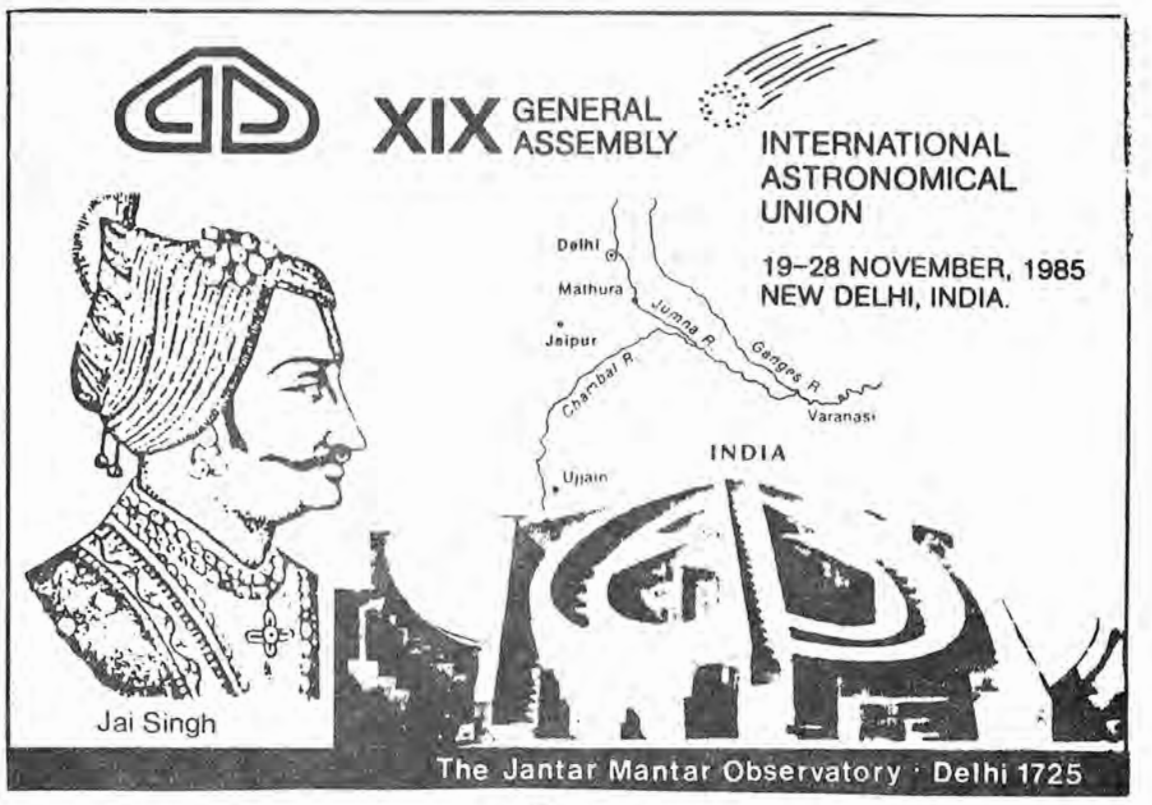


Fig. 3.

Peter and I are honoured to be associated with the XIX General Assembly of the International Astronomical Union in Delhi and we trust that the souvenir postcard meets with the approval of the delegates. With it come our best wishes for an enjoyable and fruitful meeting.

The XIX General Assembly IAU Souvenir Postcard is on sale now at R 4/-. It can be obtained at the MANDAKINI office, Room 213. Together with the special commemorative stamp bearing Halley's Comet and the special cancellation it must surely become a collector's item of great interest.

JOINT DISCUSSION 1 REFERENCE FRAMES

J.A. HUGHES
President, Commission 8

Reference Frames have always played an important role in astronomy, either directly as in kinematical studies or indirectly, where, for example, measurements made within a frame permit one to make astrophysical conjectures or reach conclusions. Indeed, the early preoccupation of mankind with populating the sky with all manner of gods, heroes, animals and so on, served to produce a reference frame of sorts whose use lingers yet today. The constellations are certainly of historical and cultural interest, but on the other hand consider some of our modern nomenclature, such as Sco-XI. Such names do have a ring to them, obviously they are more dashing than a pedestrian BD number. The charm of such names notwithstanding, however, astronomy needs the most accurate, global, isotropic and operationally accessible reference frame it is possible to produce. The Joint Discussion on Reference Frames, JD 1, is concerned with just this need. Representatives of various specializations will present the required characteristics of reference frames as used in their work. Note that "local reference frames" such as are used in parallax work are not included here.

Until recently, the only global reference frame available was that founded upon the dynamics of the solar system. All astronomers know what the vernal equinox is, and a few even know how to determine where it is (more or less accurately). Since such a reference frame has ultimately depended upon Newton's Laws, the name "inertial coordinate system" is often used. The application of these dynamical laws allows the equinox to serve as a fiducial point, albeit a moving one, for a non-rotating, two-dimensional coordinate system. (Similar comments apply to the celestial equator.) This system is currently being refined by automatic, photoelectric transit circles and classical instruments, and extended to fainter, International Reference Stars, IRS.

Recently a new type of reference system has emerged. It is based upon the observation of objects thought to be so distant that they may be presumed to have proper motions of the order of perhaps microarcseconds per year. It is very fortunate that these distant objects appear point-like optically and have reasonably detectable levels of radio emissions. Owing to these properties, quasars have been successfully used to set up a radio coordinate system of unprecedented precision and accuracy by means of radio interferometry. Since no dynamical considerations are involved (only the kinematical properties implied by Hubble's constant enter) such frames are called "quasi-inertial coordinate systems." The determination of UT1 and Polar Motion (Earth Rotation Parameters) in particular has benefited and will benefit tremendously from the existence of such a frame and the use of VLBI. It should be noted that a somewhat similar approach to defining a reference frame is represented by the programmes determining proper motions with respect to galaxies.

Traditional optical reference frames, such as the forthcoming FK5, are based upon bright stars and are extended to fainter magnitudes through wide field, astrographic astrometry. In the case of the radio frame, however, the optical counterparts of the radio sources must be observed by small field, large aperture instruments so that the extension of the faint quasar reference frames on a global basis to brighter objects is not as straightforward as the reverse, classical process. Methods are being devised, however, and this is also a topic considered in JD 1. Observations of galactic radio stars and reference stars for radio sources are also in progress.

A programme of particular interest, the ESA HIPPARCOS satellite, should result in a highly precise, "rigid" network of stars to about m=11. This system will then be oriented and rendered non-rotating by two methods. One uses galactic radio stars as the intermediary, that is, these stars will be observed by HIPPARCOS stars and optical counterparts of radio sources by Space Telescope. A link to the FK5 optical system will also be made, thus this programme promises to be most interesting. The JD will present essentials; complete coverage of HIPPARCOS will be given in a Joint Commission (7, 8, 24, 25, 33 and 37) meeting on November 23, 1985.

The techniques of optical and IR interferometry promise to become extremely important astrometric tools. Both are under development as are new ventures in space astrometry. These will be discussed.

As the accuracy of reference frames increases, it becomes necessary to refine the underlying principles and concepts related to them. For this reason JD 1 will consider the new J2000 standard equinox and the FK5 as well as those relativistic principles and effects which bear upon the very concept and realization of reference frames and which define the true character of "inertial" coordinate systems.

Finally, time has been set aside in JD 1 for round table and general discussions. Although this has placed unfortunate restrictions upon the times allotted to speakers, one may say that a Joint Discussion should be just that.

(Continued from p.1)

Prof. Brown was particularly happy that a large contingent of astronomers from the Peoples Republic of China had participated in this General Assembly. He also highlighted the fact that the IAU was increasingly concerned with encouraging young astronomers to make their mark in this branch of science, which is as old as civilization itself.

Prof. Brown also outlined the procedures and measures various Commissions and Committees of the IAU were taking to streamline the functioning of the International Union. Many of the Agenda items, which were presented by the President in concert with the General Secretary Dr Richard West, were businesslike in their approach but not bereft of interest.

Just to bring in the flavour of President Brown's fine sense of humour — a rare trait among scientists — here below is what the India-born astronomer said in the context of IAU's Sub-committee on Resolutions: 'If you have a dog, you don't need to bark yourself'.

It was announced at the meeting that a record number of more than 900 applications for membership had been received by the IAU. The membership file is being computerised and a complete list with all relevant particulars of members will be brought out as a book sometime in 1986.

THE MANDAKINI SERIAL

BETWEEN THE TIDES

DONALD MALCOLM

In this portrayal of an alien culture in crisis, Donald Malcolm gives due prominence to the vital similarities of civilization without undermining the essential differences. The major problems menacing our own civilization must make us sympathetic to the dangers threatening the ancient society of Hasub—dangers external and internal. In Mandakini *day by day follow the efforts of the Hasub Society to escape destruction by means of their great project — the Wheel of Crystal.*

ONE

The Crystal wheel rotated serenely in orbit a thousand miles above the planet Hasub like a flawless jewel. It shone with pale fire, pink, almost lilac at times.

Succeeding generations had watched it grow and spread. Now, with a diameter of a mile, it was complete. Trailing behind it in orbit, like a single strand of a web, was a crystal rope, five hundred miles long, a glittering, tenuous connection with reality. At the end of the rope was the ship.

As he watched the launch of a service shuttle, not Simde Yorea thought: it's been like a fairly tale, a one hundred and 64-year-old fairy tale.

He turned away from the telescope, rubbing his eyes, and leaned against the ledge that ran the full length of the window. Unseasonably warm night air, rich with the scents of flowers and trees, nuzzled his fine pelt through the openwork of his tunic. It was the time of falling leaves, which scuttled like crisp spiders across the land. Soon the world would sleep and dream. His hopes and aspirations were now fully awakened. Not for him, or Atira, or their cubs, or the eight other families, would there be the long hibernation until the sap rose again in the trees and the wind sang with renewed life.

He looked over his shoulder, at the crystal wheel and beyond it, to deep space. As yet, there was nothing to see, except stars. But the capricious planet was there, moving in its immutable course along a track of cosmic dust. The astrophysicists had assured him that the planet would be on time, as it had been every one hundred and sixty-four years since planets had formed within the binary system.

Something primal in him shuddered at the thought of the venture, and he closed the window, shutting out the night, and his own fears.

The room was in darkness. It soothed him. Imperceptibly, awareness of the objects there began to impress themselves on his retina. This was where it had all begun. In the cabinets along the wall on his left were the tapes and records. They told a story of nadir and zenith, frustrations and discarded plans, high hopes and achievements. Above the cabinets were ancestral photographs, the men and women who had kept alive a project that, many times, must have seemed like fantasy.

He walked across the soft fibrous floor and sat on the edge of his drawing table. Switching on a low light, he contemplated the wall plan view of the star system.

Reduced to coloured circles, orbital and trajectoral lines, it all seemed so simple. There were two stars in the system, 8,370 million miles apart. Hasub's star was type M, the other was type F. Hasub was a solitary world, without even a moon. The other sun had four planets. Once every 164 years, a planet from the other star, in a figure-of-eight trajectory, came within twenty million miles of Hasub. But Simde's people didn't have the technology to enable them to reach it. There it was, so necessary to the plan, and so elusive.

Hasub had been growing colder for hundreds of years. Already the polar caps had spread considerably towards the equatorial regions, where the small population of around five hundred thousand lived. Prolonged observations had shown that two of the planets in the other part of the binary system would sustain life. Simde was going to attempt to take a small group there, to establish a colony. If the plan to get them there worked, then the race would have a new beginning and continue to exist. If not, it would become one with the encroaching cold.

Atira, his wife, came into the room quietly, as if wafted there gently by the soft light behind her.

'Simde.'

They touched their right hands briefly, their six digits spread out in the ritual fan, the sex digits stirring faintly. This was just one of the old customs being ignored by most of the younger members of society, and many of the older ones. Few had faith that the voyage would succeed. So ritual and discipline were discarded. Some degenerate people were even foregoing hibernation by the use of drugs. Invariably, they stopped their food plants, and, often, themselves.

Atira and Simde went into another room and sat on the cushions surrounding the psycho-food plant. Each inserted their index finger and thumb of the left hand into the plant and took nourishment through the tubes that extruded from the tips. Their minds began to merge with that of the plant on a subconscious level and they were again part of the sublime cycle of nature. The cold was not the only danger to the continued existence of the inhabitants of Hasub. Many of the food plants were blighted. It was not known how the blight had started. Fortunately, their plant was, so far, untainted.

'Are the cubs in bed?'

'Yes, Cered's reading and Rogdon is annoying him.'

Simde eased his index digit to adjust the flow, and said, 'Then we can expect trouble.'

She smiled, her lips curving over the subdued blue staining on her gums.

'No. He won't keep it up. I've left a few toys beside his bed. He'll soon fall asleep.'

They were silent for a time, letting their minds and bodies respond to the produce of the food plant. He studied the lines of her lowered face, marvelling at the myriad flashes of light gently entrapped in her fine, pale brown pelt.

'Simde.'

He waited for her to go on. The food plant became bright grey-green as it replenished itself from roots deep in the planet. This was their last full bonding with the plant, which had been a member of Simde's family since before the project had begun and it was one of the oldest functional plants on Hasub. There were others older, but the bonding was of the minds only and no nourishment was provided. Since its initial bonding with Simde's ancestors, the plant had nourished the family regularly every thirty-one days, and eased and cleansed their minds. Neri Falrac, the psycho-botanist of the project, had examined the plant and she had told them that it would soon stop. The plant had been prepared for the imminent farewell for a long time, now, and Neri was convinced that it had decided to stop of its own accord.

She said his name again, this time looking at him, her eyes a clear violet.

'Are you having doubts?'

'No. This is something our race would always have had to do. Not merely because we need to reach the other planets to perpetuate the racial existence. Even if all was well on Hasub, we would need to break out of this region, to widen our horizons, physically, mentally, philosophically, spiritually. These are all sound justifications, but they aren't necessary. Since its conception, this project has always been considered as a practical, scientific undertaking. Look at the advances that have accrued to almost every discipline—'

'But our detractors say — rightly — that we haven't learned how to stem the blight that is steadily stopping the food plants, or to defeat the cold.'

He wagged a long digit at her.

'I'm glad you're on my side, Atira. You argue too well. As you know, new strains of food plant are being developed in zero gravity conditions on the space platforms. No one can tell if they will be satisfactorily solved. The cold is more of a long-term worry. People could always go underground. The only doubts I have are about not going. Look how society has changed since we were cubs. The increased pace of life, noise, crime, material pressures, a falling birth-rate and fewer live births. It's almost as if nature has decreed that Hasub and all its life-forms shall stop. This is a world we no longer understand.'

'They say that you are running away.'

'Who says that?'

'Irah and Noss, for two.'

He stared at her.

'I can't believe it. They are among our closest friends. They were witnesses at our joining.'

She reached up and touched his face.

'You've been so involved with the project that you've become blind and deaf to what others are saying. Most of them don't see it as the noble aspiration—'

He was indignant.

'I don't think of it as "noble". It's work, something that has to be done...'

He floundered into silence under her unwavering, compassionate gaze.

'But you do, Simde, you do.'

He stood up and wandered into the other room, to the window, fighting the impulse to be hurt.

'You're right, Atira, I see myself as a minor god, about to crown the culmination of hundreds of years of faith and effort. I've taken that responsibility to myself and accepted it. Was it so wrong to make a "noble aspiration" of it? The reality is very uncertain.'

Atira moved behind him and encircled him with her arms as he continued talking.

'You asked me if I had doubts. I said "no" and I mean that. But I have fears for you, for the cubs, for the others who are going with us. Any kind of simple accident could stop some, or all of us. Even if we reach our goal, perhaps we'll find that, for any number of reasons, we can't live there.'

Atira turned him round to face her.

'We have two planets to choose from and you haven't come this far to fail now. I know you will be successful and together we'll found a new world. Let's go and see the cubs and then go to bed.'

They left the room, their hands entwined, the sex digits anticipating the joining. Far down below the house, the food plant felt almost imperceptible twinges in some of its roots.

Simde and Atira lay together in the silence. He said,

'Noss and Irah. I really can't believe it of them. At least not of Noss.'

'Don't worry about them. They've involved themselves with a younger, wild crowd. Irah, no doubt, wanted to be among people nearer her own age, while Noss — it can only have been because of Irah, I suppose. They've both been silly. And I think that they're beginning to realize it, now. Anyway, now that the climax is near, Noss won't let anything interfere with his work.'

'I'm sure you're right, Atira,' Simde said. He'd see Noss tomorrow.

Privately, Atira thought that Noss's actions could be traced to his desire to be on the expedition; it had been part of his life for so long. And Irah's influence had also to be considered. Atira was glad that she hadn't told Simde that Irah was joining with one (or possibly more) of her new 'friends'. Even Noss didn't suspect that. Irah had no cubs. Perhaps that was the main reason for her behaviour. Five years was a long time to carry a cub, to have it born stopped, to know that you could have no more. Nature gave three chances, but only if the first cub was born alive. Irah had used her chances and was now barren. Her first cub had stopped shortly after its separation. Atira had been fortunate in separating two live cubs and naving them survive the separation. Hasub was a kind world to very few.

Their sex digits joined and it was joyous. It might be the last joining they would have on Hasub. Or perhaps the final one of their lives.

(To be continued)

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IAU

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XIX GENERAL ASSEMBLY
NEW DELHI 1985

NO. 3 : THURSDAY 21 NOVEMBER

Editor : ARCHIE E. ROY
Associate Editor : A. RATNAKAR

FIRST INVITED DISCOURSE

The spacious auditorium of Vigyan Bhavan was filled to capacity despite the fact that it was around 6.30 p.m. — the fag-end of the working day 20 November — for the first invited discourse of the Assembly. The discourse was on one of the hottest topics in astronomy today: Pulsars. The speaker was one of India's top-ranking radio astronomers Prof. Radhakrishnan, Director of Raman Research Institute, Bangalore. The learned discourse was dedicated to the memory of the late Dr M.K. Vainu Bappu, past President of IAU, who passed away in Munich when the Patras Assembly was in session in 1982.

In a moving tribute to this great astronomer, the current IAU President Prof. Hanbury Brown said that Bappu's best-known astrophysical contribution arose from the collaborative work with O.C. Wilson, leading to the dually eponymous Wilson-Bappu effect — the relation between the absolute magnitude of bright G, K and M stars and the width of their H and K absorption lines. Having distinguished himself abroad, Vainu Bappu returned to India to promote and build up a strong base for astronomical research.

To Bappu's credit, Prof. Brown said, stand not only the modern Naini Tal Observatory and Kodaikanal's Solar Observatory, but the Indian Institute of Astrophysics at Bangalore and a modern optical observatory at Kavalur. Making a touching reference to Bappu's endearing qualities as a man, Prof. Brown described Bappu's departure as a grievous loss to his friends, in India and elsewhere, and to the world body of astronomers.

Later, the IAU President introduced the speaker Prof. Radhakrishnan to the audience, describing him as 'one who is highly respected among radio astronomers' because of his very significant contributions to our knowledge of pulsars in particular. To underscore the point

Prof. Radhakrishnan lectures on pulsars

that specialization could limit one's vision, he emphasized that Radhakrishnan possesses extraordinary perceptions to ask insightful questions about science itself — a metaphysical quality characterizing all great scientists.

Prof. Radhakrishnan started with a brief introduction to pulsars, which are astronomical objects emitting bursts of radio energy with clock-work regularity. The first of these objects came to light in the course of radio-astronomical studies in late November 1967. Pulsars were different from the other enigmas of astronomy, namely, quasars and microwave background radiation. The latter two concerned extreme distance and times. But pulsars were objects within our Galaxy which made them so attractive to radio-astronomers.

After the brief introduction, the speaker went straight into the theories about the origin and evolution of stars which ultimately led to the birth of pulsars. Massive stars having masses exceeding the Chandrasekhar Limit are known to collapse into neutron stars. Highly massive stars, towards the end of their life, sometimes explode violently and release enormous energy in a few seconds leading to the rapid expulsion of the outer matter. The remnant is often a neutron star known as a white dwarf. It was initially believed by astronomers that pulsars originated in these supernova explosions, as is the case with the pulsar in the Crab Nebula.

But what was baffling astronomers was the rapid rate, often of the order of a fraction of a second, of the radio pulses emitted by these objects. One of the simplest explanations was that they were rotating bodies which sent out radio beams like lighthouses. From the Earth these beams appear as radio-pulses.

The speaker then narrated the various mechanisms to explain how high-energy radio-waves and X-rays could be generated in pulsars. He said that more than one model was necessary to explain all the pulsars observed so far, which number over 300. The Crab Nebula, he said, was made by the particles and magnetic field produced by the pulsar within it.

Citing the work of his colleagues and other researchers, Radhakrishnan went on to describe a new mechanism for the origin of pulsars. Supernova explosion of single stars, he said, could not account for the high transverse velocities of pulsars, which ranged from 10 km/s to as high as 400 km/s. His explanation was that the progenitor of all pulsars was the binary systems, because, as he put it, the origin of pulsar velocity is not due to the asymmetric "kicks" of supernova explosions in single stars. He had sound arguments to support his theory.

It was a scholarly discourse on a highly debated and still a controversial subject. The speaker illustrated his talk with a plethora of slides, some of them in colour. One of them showed a dancing couple to explain, in a lighter vein, how mass exchange takes place in binary stars. The audience also had a chance to listen to the tape-recording of the radio pulses from a pulsar which sounded like a musical note.

Prof. Hanbury Brown while paying his vote of thanks not only paid compliments to the learned speaker but also felt nostalgically that the topic would have interested greatly Dr Vainu Bappu to whom this lecture was dedicated.

A rapt audience at the first invited discourse

ANNOUNCEMENTS

ALTERED MEETING SCHEDULE: VIGYAN BHAVAN

Date : 21.11.1985

Room	21-1	21-2
K	29/12-45/3	29/13-45/4

Session 27/4 (11.00 a.m. on Thursday, 21 Nov. Room I) will be a joint session with Commission 12 to discuss a proposal by C. Sterken and J. Christensen-Dalsgaard (see Information Bulletins Nos.53 and 54) for a new joint working group on "Coordinated Multisite Observations" All interested persons are invited to attend.

State Bank of India counter at Vigyan Bhavan will be happy to assist the delegates of the IAU with any exchange problems. They are open from 0900 hrs to 1700 hrs, except between 1300 - 1400 hrs, on all the days of the General Assembly.

Please note

1. To avail of the special concessional rates for the IAU participants, you should pay for your hotel ROOMS at the Ashok Tours and Travels Counter in Vigyan Bhavan, and obtain a voucher to be given to the hotel.

2. Please reconfirm your international flight reservations. This is a must.

COMMISSION 6

Because of a conflict in time with the Comet Halley press conference on 26 November, Commission 6 will have its meeting in Room I at 9.00 a.m. on 25 November.

COMMISSIONS 29, 30, 45

The times and places of the meetings of Nucleosynthesis and of the Standard Stars are exchanged. Similarly the meetings of the Peculiar Red Giants and of the Be Stars are exchanged. There is no change in the meetings of the Ap Stars and of the Synthetic Spectroscopy and Photometry. The revised programme in order of date is given below:

No.	Title	Date/ Session	Room
29/12, 29/13	WG on Be Stars	21-1, 21-2	K
29/8, 29/9	WG on Ap Stars	23-1, 23-2	K
29/4, 29/5	WG on Standard Stars	26-3, 26-4	H
29/6, 29/7	WG on Peculiar Red Giants	27-1, 27-2	G
29/2, 29/3	Nucleosynthesis in the Galaxy from Studies of Low Mass Stars	27-3, 27-4	G

EDITORIAL

MENS SANA IN CORPORE SANO

Some of the remnants of a classical education still rub uneasy shoulders with my scientific knowledge — such as it is. One such, the title of this editorial, surfaced the other morning as I sat at breakfast with Mr Ratnakar in the dining room of the India International Centre. The Centre is set on the edge of the Lodhi Gardens, 60 acres of splendid park land with plenty of paths to meander along. From my seat each morning I watch those Indians who have taken to the American sport of jogging pursuing their health goal along the paths. Isn't it extraordinary how all the best ideas begin in America and quickly spread overseas? — but I digress.

These joggers, as in other nations, are of all ages and every degree of fitness from youngsters glowing with health, jogging effortlessly along to others whose puffing creaking efforts to achieve anything beyond a slow stroll strike sympathy and admiration in my heart. There was the other morning one soul who also puffed heavily at a cigarette, for heaven's sake, which did seem a trife self-defeating.

In general, of course, there can be nothing but admiration for any movement designed to promote one's health, remove adipose tissue, flush the lungs with life-giving oxygen, tone up the muscles, strengthen the heart muscle. The mental benefits are also by no means negligible. For after all, the effort must be maintained over many weeks before any real progress is evident — there is no sudden popping-up of Rambo-like muscles all over the body. And again I am told by my colleague Dave Clarke that a mental alertness accompanies the improved physical state; he tells me that if he does not train for a fortnight he feels the difference both physically and mentally. He ought to know; he takes his sport so seriously that when he goes observing in the USA he loves nothing better than to run down *and up* the Grand Canyon!.

It is also so obvious, isn't it? One side of the coin, a healthy mind in a healthy body; the other, sluggish damaged mental states arising from neglected, poisoned bodies. There is even something in it similar to the Eastern concept of *karma*, the Western expression of this being surely "As ye sow so shall ye reap". If you put off for too long the initial step to remedy matters, it takes at the best so much more effort and time to undo the damage and at the worst it may be too late.

If all this is obvious, then why do we continue to damage the quality of life on our planet by polluting atmosphere and oceans, to destroy the rain-forests that are the lungs of the biosphere and to poison international relations within the human family?

In the dining-room of the India International Centre I sit at breakfast and watch the joggers in the Lodhi Gardens and promise myself that one day I will join them. And since my tea-cup is empty and the waiter is not at hand I reach out to lift the heavy teapot myself. The exercise will do me good.

Archie E. Roy

DOWN MEMORY LANE — GLIMPSES FROM PAST GENERAL ASSEMBLIES

III GENERAL ASSEMBLY — LEIDEN (HOLLAND) 1928

Leiden was the venue of the third General Assembly during July 5-13, at which two hundred and sixty-one astronomers participated. Though Germany and Austria had not yet adhered to the Union, a number of astronomers from these countries attended the meeting on the personal invitation of President W. de Sitter. Delivering the Presidential Address, de Sitter stressed the importance of international cooperation for dealing satisfactorily with the various aspects of astronomy. He expressed the view that the results of the present meeting would be the most important ever reached, if the importance of conclusions was proportional to the number of persons by whom they were adopted.

The Commission on Notation recommended the fixing of the borders of the Constellations on the basis of arcs of hour circles and parallels of declination of epoch. A resolution agreed upon by the members of the Commission on Ephemerides and passed at the General Assembly related to the usage of GMT. Astronomers were advised not to use the letters GMT in any sense for the present.

Prof. Stormer gave a lecture on Aurorae. A film on the eclipse of 1927 and the Polish Party expedition was screened.

Though no action was taken, a suggestion made by Lallemand that the Union should hold its meetings about the same time and place as that of the Geophysical Union was considered. The new office bearers of the Union were to be Prof.F.W. Dyson (President), Professors A. Abetti, H. Andoyer, N.E. Norlund, F. Nusl and F. Schlesinger (Vice Presidents) and Prof. F.J.M. Stratton (General Secretary).

The venue of the next Assembly, it was decided, would be Cambridge (USA) in 1932.

IV GENERAL ASSEMBLY CAMBRIDGE (USA) 1932

Cambridge, Massachusetts, was the venue of the fourth General Assembly which met during September 2-9. A little over two hundred members attended the General Assembly.

The Secretary of the Navy, Charles Francis Adams, welcomed the delegates and stressed the role played by nautical astronomy in modern naval warfare. There was a discussion on the advisability of a four-year interval between two assemblies but the prevailing three-year interval was upheld. Sir Arthur Eddington gave a lecture on 'The Expanding Universe'. The Commission on Solar Physics (No. 35) was split into four separate Commissions on sunspots, chromospheric phenomena, solar eclipses and solar radiation, and spectroscopy. A new Commission for spectrophotometry was started.

The following were elected as office bearers: Dr Frank Schlesinger, Director of the Yale University Observatory, as the President; Prof. T. Banachiewiwitz, Director, Cracow Observatory and Prof. E. Bianchi, Director, di Brera Observatory, Milan, as Vice Presidents; Prof. F.J.M. Stratton, Director of the Solar Physics Observatory, Cambridge (England), as the Secretary for the second time.

MINOR PLANET NAMED AFTER PROFESSOR M.K.V. BAPPU (1927 - 1982)

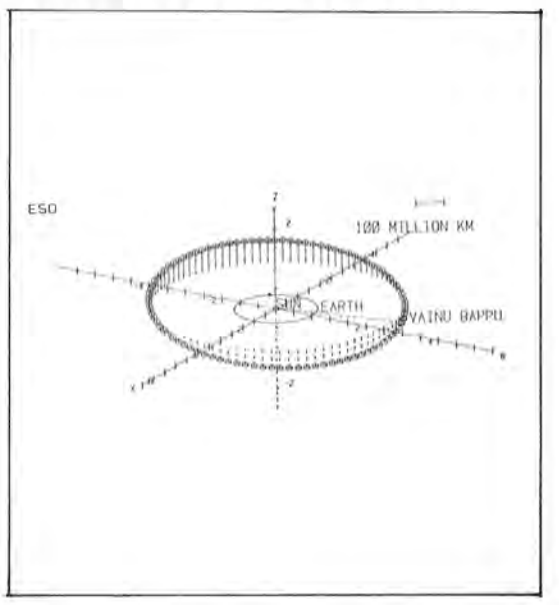
The Minor Planet Center of the International Astronomical Union has announced that Minor Planet (asteroid) no. 2596 henceforth will carry the name VAINU BAPPU.

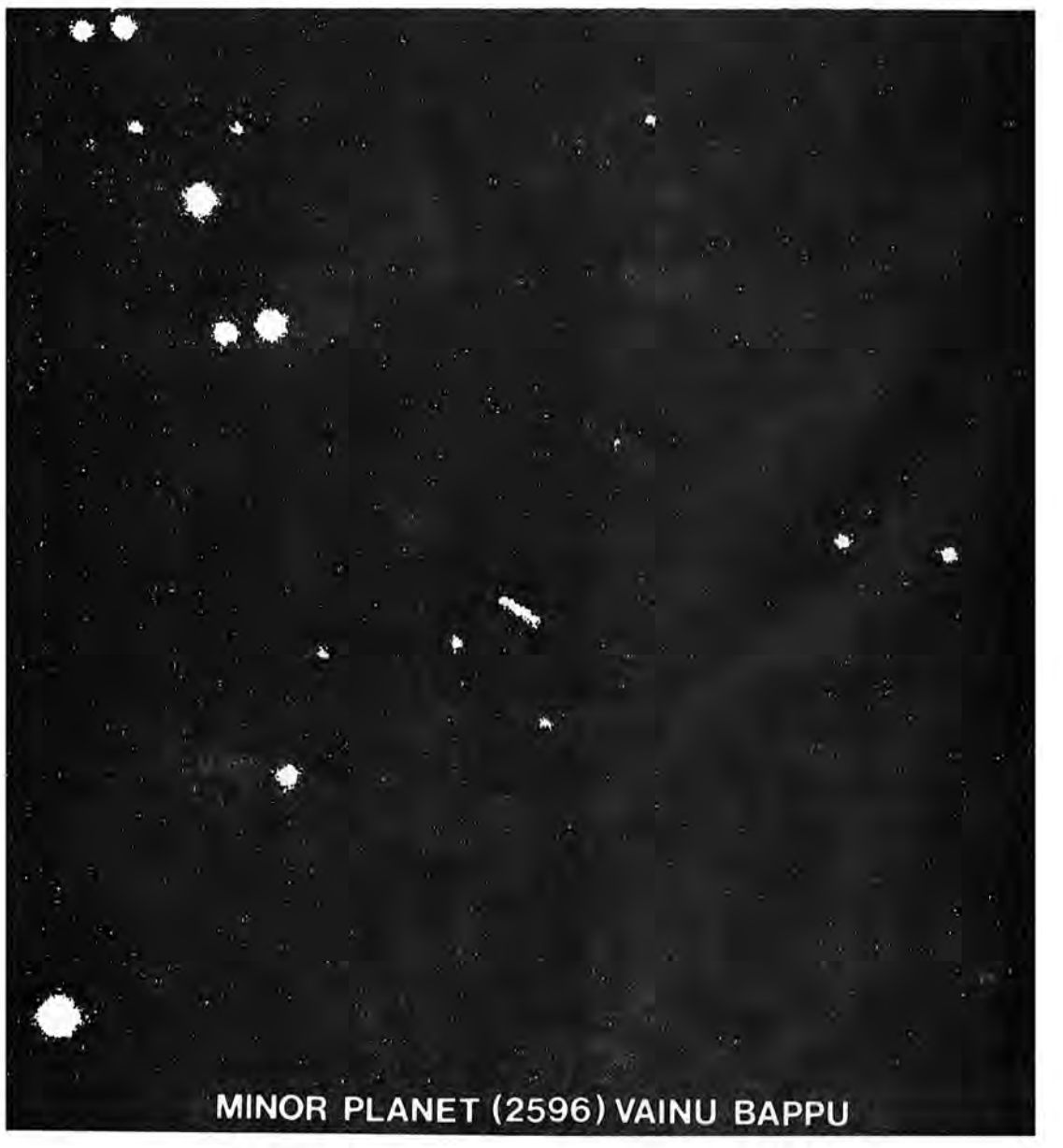
Discovered on 19 May 1979 by R.M. West at the European Southern Observatory, the asteroid is now named in memory of Manali Kallat Vainu Bappu (1927-1982), famous Indian astrophysicist and a dear friend of the discoverer. Educated at Harvard and Caltech, he established, under difficult circumstances, the first modern Indian observatory at Naini Tal during the 1950s. Appointed director of the Kodaikanal Observatory in 1960, he subsequently founded and directed the Indian Institute of Astrophysics in Bangalore. He was the initiator and driving force of many projects, among them the 2.3-m Kavalur telescope, entirely designed and built in India. In the multiple roles of brilliant scientist, teacher and administrator, he contributed decisively to the high level of astronomy and astrophysics in India today. He served as Vice-President (1967-1973) and President (1979-1982) of the IAU and as chairman of the editorial board of the Indian Journal of Astronomy and Astrophysics.

The attached 3-dimensional drawing shows the orbit of (2596) VAINU BAPPU in the solar system, outside the Earth's orbit. The orbital period is 5 years 4 months and the mean distance from the Sun is about 450 million kilometres. The diameter of the planet is estimated at 8 kilometres.

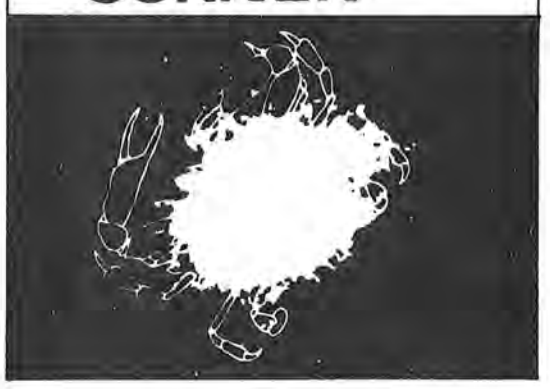
The picture shows the trail of (2596) VAINU BAPPU, on 4 October 1979, when it was 281 million kilometres from the Earth. It was obtained during a 30-minute exposure with the European Southern Observatory's 1-m Schmidt Telescope in Chile, South America. The images of the fixed stars are round, but the planet's image is elongated, due to its motion during the exposure.

This photo of Professor M.K. Vainu Bappu was taken, in 1980 in solar eclipse campus in Yawalagere (India), by Yugoslav astronomers.





gASTRONOMY CORNER



SHAMMI KABAB

(Round Mutton Cutlets for your cocktail parties — To be eaten with Mint chutney or sauce)

	Ingredients	Quantity
1.	Minced meat	500 g
2.	Split peas (Dal channa)	60 g
3.	Garlic	6 cloves
4.	Onions	60 g
5.	Salt	to taste
6.	Ginger	30 g
7.	Green chillies	2 nos.
8.	Chopped coriander leaves	1 table spoonful
9.	Fresh lime juice	1 tea spoonful
10.	*Garam masala* (mixed spices)	¼ tea spoonful
11.	Egg	1 no.
12.	Melted fat	for frying

Method

1. Clean, wash and mince the meat.
2. Boil minced meat, sliced onions, split peas, garlic and salt together.
3. Grind the above mince meat mixture with ginger and green chillies. Add *garam masala*, lime juice, coriander leaves and the whole egg.
4. Mix, knead a little and divide the mixture into small roundels.
5. Shallow fry till golden in colour.
6. Serve with mint chutney.

ELEPHANT CROSSWORD

ACROSS

1. The whole show (6)
2. Meditational aid (6)
7. PC Tess Cooper is mixed for detecting stars' nature (12)
15. Your Editors' initials (2)
16. American form of address (2)
17. Add to 16 phonetically and eas-ily get a cluster (6)
18. Part of India's family (4)
19. An Italian satellite? (2)
20. Add 'E' to this to obtain agreement (2)
21. Repair or swear mildly (4)
22. One more in the list (4)
24. A squad of Zulu warriors (4)
25. Binaries certainly are (6)
27. Recumbent dissembler operation (3)
28. Hard to train because it is restless, says Krishna (Bhagavad Gita 6,35) (4)
29. Recently celebrated its 40th birthday (2)

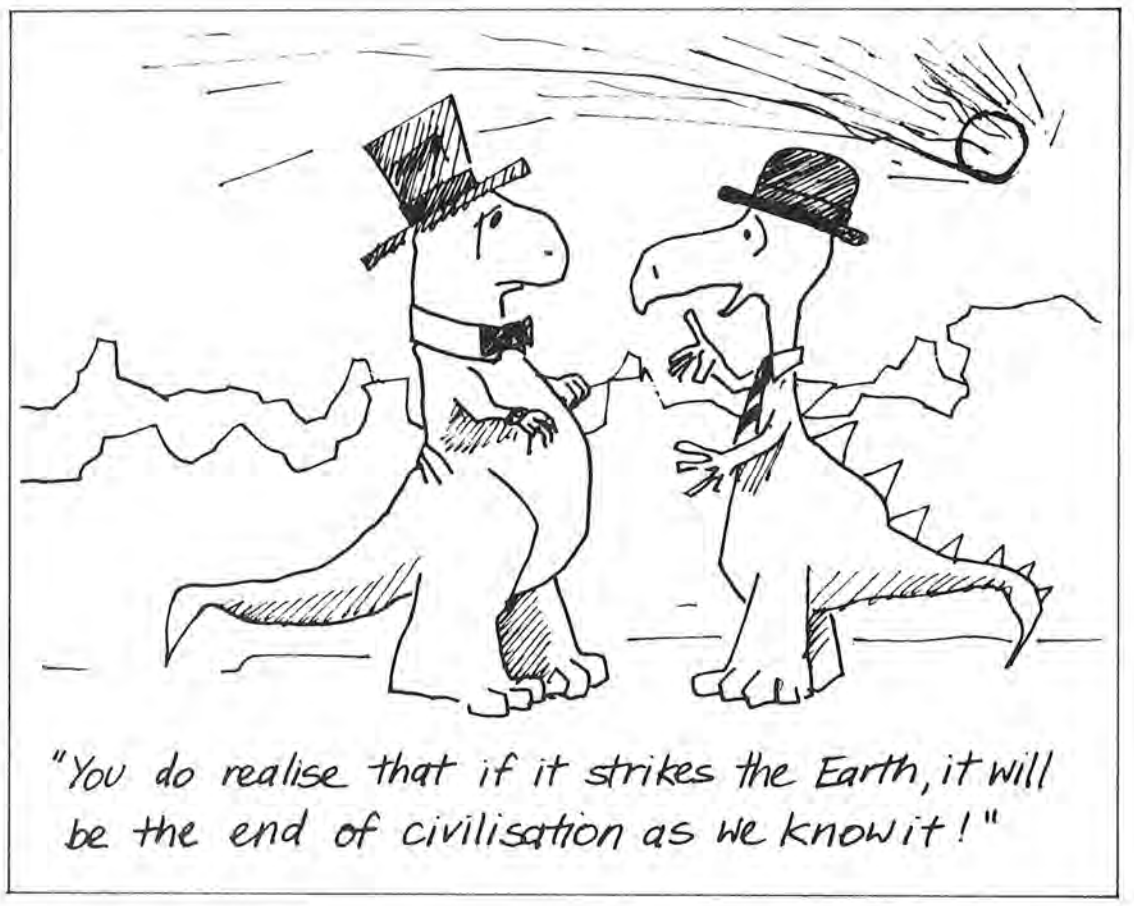
DOWN

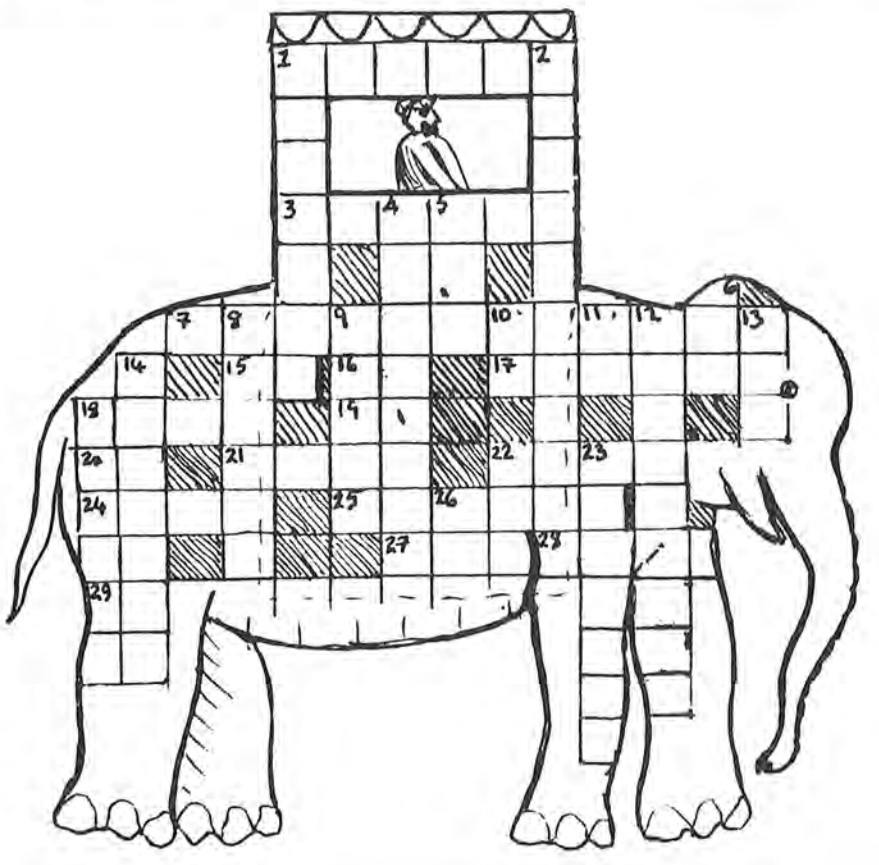
1. Larger than a room (7)
2. Being probed in recent years (5,6)
4. Pertaining to a country (8)
5. Small hill (3)
6. First cousin? (3)
8. Indian respected scholar (6)
9. Birds do it (5)
10. Exclamation (2)
11. Examines the books (2)
12. Misfit (3,3 3)
13. Friendly rival to Nasa? (3)
14. Just reward (7)
18. Jai's City (6)
22. Anger (3)
23. I stored this to the last for your kindly..... (7)

We found this on our desk the other day. We suspect our secretary put it there. She cannot be serious.....Can she?

Some Handy Hints For Dictation

1. Never start work first thing in the morning. The typist much prefers a terrific rush in the afternoon.
2. Please smoke whilst dictating; it assists pronunciation.
3. Do not face the typist whilst dictating; this is far too easy for her.
4. The hours of dictation are: during the lunch hour and any time between 4.30 p.m. and 5.00 p.m.
5. Please call the typist in for dictation and then proceed to sort out papers, look up old files, telephone and receive calls.
6. When dictating, please parade up and down the room. The typist can understand what is said more distinctly.
7. Please lower the voice to a whisper when dictating names of people, places, etc. and under no circumstances spell them to the typist. She is sure to hit upon the right way of spelling them. The typist knows the name and address of every person, firm and place in the world.
8. When the typist does not hear a word and you are asked to repeat it, shout it is loudly as possible, or alternatively, refuse to repeat it at all. The typist has second sight and it may come to her.
9. Whenever possible you should endeavour to keep the typist late. A typist has no home to go to and is only too thankful for somewhere to spend the night.
10. Should a letter require alteration after it has been typed, score the word heavily through about four times and write the correct word beside it, preferably in ink or heavy pencil, and always make the alteration on the top copy.
11. Should the typist be too busy to take dictation, please write the letters with a blunt pencil held in the left hand whilst blindfolded. Incorrect spelling, balloons, arrows and other diagrams are very helpful to her.
12. With regard to statements, do not on any account use lined paper. If figures are altered, please write heavily over those previously inserted, the correct figures in each case being the ones underneath.
13. Should work be required urgently, a most unusual occurrence, it aids the typist considerably if you rush in at intervals of 30 seconds to see if it is done.
14. If extra copies of a letter are required this desire should be indicated either after "Yours faithfully" or overleaf so as to ensure that it is the last thing the typist will see when the letter is completed.





Old men and comets have been reared for the same reason; their long beards and their pretences to foretell events.
(Jonathan Swift, 1667-1745)

GIANT METRE-WAVELENGTH RADIO TELESCOPE

G. SWARUP
Radio Astronomy Centre, Tata Institute of Fundamental Research, Udhagamandalam

It is planned to construct a Giant Metre-Wavelength Radio Telescope (GMRT) in India. This would fill an important gap in the available facilities in the world at long wavelengths. The radio telescope consists of a large number of antennas distributed over an area of about 25 km. Apart from making high-resolution maps of galactic and extragalactic radio sources, the telescope is being designed to search for (i) the red-shifted 21-cm line radiation from neutral hydrogen clouds that might have existed before the formation of galaxies, and (ii) short-period pulsars. The telescope is to be operated in the bands protected for radio astronomy at metre wavelengths, namely those around 38, 151, 325 and 610 MHz. It is to be completed in two phases during 1985-1992.

Why at Metre Wavelengths?

There are many exciting and important astrophysical problems that are best studied at metre wavelengths. Yet, the largest radio telescopes constructed over the last two decades have been designed primarily to operate at centimetre and decimetre wavelengths. There are several reasons. First, for a given aperture size, the angular resolution is higher at centimetre than at metre wavelengths. Secondly, because of the high galactic background noise at the longer wavelengths, a larger collecting area is required to obtain good sensitivity. Since the metre-wavelength radio telescopes do not require high tolerances, a simpler construction may be employed, but it would be labour-intensive. Thirdly, the ionosphere is a nuisance at the longer wavelengths because it distorts the wavefront from a distant radio source. Finally, in Western countries there is a good deal more manmade radio interference at metre wavelengths than in the protected radio astronomy bands at shorter wavelengths.

The radio interference is not a serious problem in India. Further, we have gained considerable experience at Ooty at a wavelength of 0.92 m. Also, recent developments in mapping radio sources with aperture synthesis radio telescopes, such as MERLIN, VLA and Westerbork, have shown that the harmful effects of the ionosphere can be largely overcome by a suitable telescope design and by using special image-processing techniques. Recognizing these developments, we have proposed GMRT as a major new facility in radio astronomy. The facility would provide both high sensitivity and high resolution (a few arc-sec) for studying a large number of astronomical phenomena. GMRT is estimated to cost about Rs 220 million (US $ 18 million).

Scientific Objectives

A substantial increase in the sensitivity and resolution of a new astronomical telescope often leads to unexpected discoveries. Nevertheless, a new instrument is generally designed with certain clear objectives. One of our aims is to search for the red-shifted 21-cm line radiation from the neutral hydrogen clouds which are expected to occur before the formation of galaxies and clusters in the Universe, perhaps at redshifts between 3 and 10. Hence, deep searches at frequencies around 151 and 325 MHz, perhaps also a frequency in between, are likely to have an important bearing on our understanding of the formation of galaxies.

GMRT would discover hundreds of pulsars. Perhaps this would also enhance our limited knowledge of the short period pulsars (rotation periods in milliseconds!). It would provide thousands of high-resolution maps of galactic and extragalactic radio sources. It may reveal in these sources many extended diffuse features which are characteristic of the oldest population of relativistic electrons in the Universe. Studies of stimulated radio recombination lines, flare stars, and solar radio bursts are amongst many other examples of interesting metre-wavelength phenomena.

GMRT Antennas: A Battle Between Dishes and Dashes!

According to the original proposal, GMRT is to consist of 34 steerable parabolic cylinders, each of size 92 m long and 35 m wide. Sixteen of the antennas are to be placed in a central 4x4 square array of the size of about 1 km. The other 18 antennas are to be placed along the 3 arms of a Y-shaped configuration, with each arm being about 14 km long. The reflecting surface consists of 2 cm x 2 cm mesh. By mounting different dipole arrays on the 4 faces of a rotatable square steel truss placed along the focal line of the parabolic cylinders, it is proposed to operate GMRT at either 38, 151, 325 or 610 MHz. It is planned to put an RF amplifier, a phase - shifter and an attenuator after each dipole. The total numbers of these units are about 1500, 6000, 12,000 and 24,000 at the above four frequencies respectively. It is proposed to use a rapid monitoring scheme and quick replaceability to achieve a good reliability of the system, in spite of the large number of amplifiers used.

For a given collecting area, parabolic dishes are much more costly than parabolic cylinders. However, compared to parabolic cylinders, parabolic dishes allow a wider steerability over the sky, less complex electronics and easier change of the opeating frequency. Hence, we are investigating the possibility of using in GMRT, 88 numbers of parabolic dishes, each of 25 m diam with a total cost not exceeding about Rs 130 million (US $ 11 million). This may seem to be a very difficult objective because the cost of one 25 m dish for operation at cm wavelengths currently exceeds US $ 2.5 million. However, for the GMRT dishes we can tolerate errors up to about 1.5 cm rms.

To reduce the total tonnage of steel required for fabricating the dishes, we must reduce their wind resistance area. A 2 cm x 2 cm mesh made of 0.5 mm stainless steel wire has only a 4% 'solidity' ratio (filling factor). But, using a conventional design of the backup structure of a dish, we get a solidity ratio of about 0.4 or even higher at certain orientations of the dish. Hence we are also considering special designs, such as the use of spring steel for the backup structure as in an umbrella (don't think of an umbrella, only when it's wet!). Our preliminary studies seem promising. However, the total physical or effective area of 88 dishes of 25 m diam. is only about 40% of that of 34 parabolic cylinders of size 92 m x 35 m. Hence, we must weigh the pros and cons carefully. A final decision would be taken in a few months.

I have highlighted here only a few of the many problems of GMRT. It is a very challenging project and I hope it would attract young scientists and engineers from across the world, to rough it out with us. After several detailed tests, a site has been chosen about 80 km north of Pune and about 200 km east of Bombay. The project has been approved at a high level. The final clearance is expected to be obtained within about a month.

THE WORLD DATA CENTRE SYSTEM

M. HAPGOOD
Rutherford Appleton Laboratory
Science and Engineering Research Council, UK

The World Data Centre C1 at Rutherford Appleton Laboratory (RAL) is part of the wordwide system of geophysical data centres, known as the World Data Centre System. The System was established at the time of the International Geophysical Year (IGY) in 1957 - 1958, with the initial objective of collecting, archiving and redistributing the data acquired during that enterprise. The system continued to operate in the years following IGY and has now become a permanent feature of the world geophysical scene. To formalise the operation of the system at an international level the International Council of Scientific Unions established, in 1968, a Panel on World Data Centres. This panel has the responsibility for coordinating and overseeing the operation and evolution of the WDC System.

The system retains the basic structure set up at the time of the IGY. Firstly, there are different centres to deal with different geophysical disciplines (e.g. Solid-Earth Geophysics, Snow & Ice, Oceanography, Meteorology, Rockets & Satellites). Then within each discipline there are usually four centres holding similar data. One centre (WDC-A) would be in the USA, another (WDC-B) in the USSR, the third (WDC-C1) in Western Europe and the fourth (WDC-C2) in Japan or India. This replication of data at different centres guards against the total loss of data through the catastrophic destruction of one centre, and meets the geographic convenience of scientists around the world.

The WDC at RAL is one of eight World Data Centres and World Digital Data Centres (WDDCs) holding data applicable to the discipline of Solar-Terrestrial Physics:

* WDC-A for Solar-Terrestrial Physics, BOULDER, Colorado, USA
* WDC-A for Rockets & Satellites, NASA GODDARD Spaceflight Center, Maryland, USA
* WDC-B2, MOSCOW, USSR
* WDC-C1 for Solar-Terrestrial Physics, CHILTON, United Kingdom
* WDC-C1 for Geomagnetism, COPENHAGEN, Denmark
* WDDC-C1 for Geomagnetism, EDINBURGH, United Kingdon
* WDC-C2 for Geomagnetism, KYOTO, Japan
* WDC-C2 for Ionosphere, TOKYO, Japan
* WDDC-C2 for Geomagnetism, BOMBAY, India

World Data Centre C1 for Solar-Terrestrial Physics

The Centre at RAL collects and holds a wide range of data from the discipline of Solar-Terrestrial Physics, including a very extensive collection of ionospheric data ranging from the early 1930s to the present day. The Centre provides a variety of services, which are outlined in this article. In particular, increasing emphasis is being given to the provision of computer-based services which can be accessed via public data networks.

The services of the RAL Centre are available to all scientists and engineers without restriction and are usually provided free of charge. The Centre reserves the right to charge for the costs of copying and postage, and will do so for very large requests. Customers who wish to access the on-line services will have to pay their own telecommunications costs.

Database Services

On-line services:

* On-line catalogue of the ionospheric vertical soundings data held in the WDC.
* On-line retrieval of solar-geophysical activity indices (Kp, Sunspot Number, Solar Radio Flux, IF2).
* On-linc implementation of the MSIS83 model of the temperature and composition of the neutral upper atmosphere.
* Information about UK scientific meetings in STP.
* Leave a message for the WDC staff.

File transfer:

* Solar-geophysical indices can be transferred to any other computer which supports the JANET file transfer protocol.

Batch services:

* Batch retrieval of solar wind data and of ionospheric data from UK stations. The printed output can be sent to any computer on the JANET network.

These services can be accessed via the IBM computer at RAL, which is connected to the UK Academic computer network (JANET). Access to JANET can be obtained via public data networks such as PSS, TRANSPAC, ITAPAC, etc. A Database Users Guide is available on request.

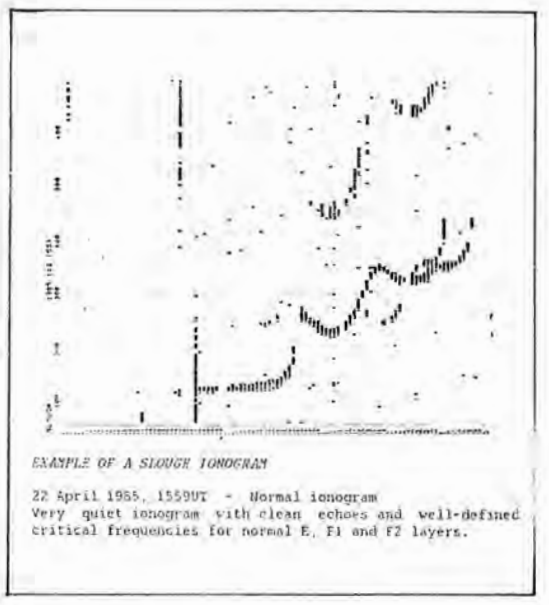
Summary of Data Available

Ionospheric

* Vertical soundings - hourly values and monthly median values of scaled parameters, ionograms on films, some f (frequency) plots - for about 300 stations worldwide.
* Absorption - measured by riometer, pulse echo and field strength methods.

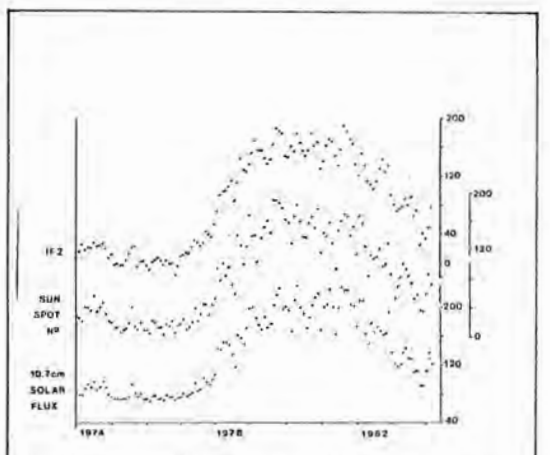
Solar-Geophysical indices

*Sunspot Numbers	Provisional and forecast values received by monthly telex; final values received after about four months.
*Solar 10.7cm Radio flux	Current values received by daily telex; forecast values received monthly
*Ap	Provisional values received by daily telex
*Kp	Received with a delay of about one month
*Dst	Received with a delay of about three months.

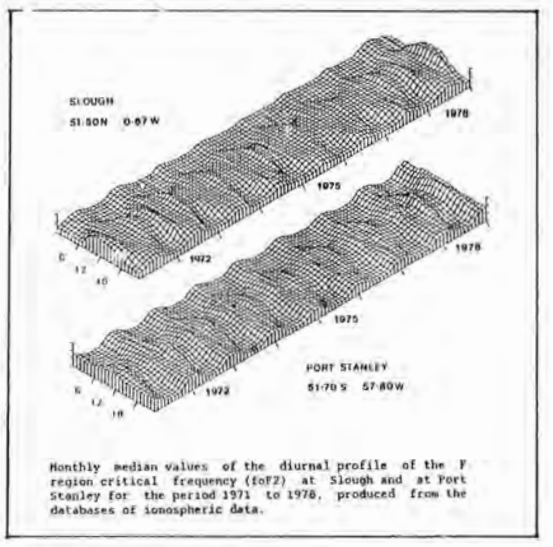


EXAMPLE OF A SLOUGH IONOGRAM

22 April 1965, 1550UT - Normal ionogram
Very quiet ionogram with clean echoes and well-defined critical frequencies for normal E, F1 and F2 layers.



Monthly values of IF2, an index of ionospheric behaviour, plus values of Sunspot Number and Solar 10.7cm Radio Flux. The long period behaviour of the ionosphere is well correlated with solar activity.



Monthly median values of the diurnal profile of the F region critical frequency (foF2) at Slough and at Port Stanley for the period 1971 to 1978, produced from the databases of ionospheric data.

*AE	Now available up to December 1981.
*IF2 & IG12	Provisional and forecast values received monthly.

Reports & forecasts of solar-geophysical conditions

* Reports & forecasts of current solar & geomagnetic activity received by daily telex.
* Reports & forecasts of current radio Propagation conditions received by daily telex.
* "Preliminary report & forecast of Solar-Geophysical Activity", published weekly by WDC-A, Boulder.
* "Solar-Geophysical Data", detailed reports published by WDC-A, Boulder with a data delay of 2 to 5 months.
* Monthly reports of solar-geophysical conditions from West Germany, Australia, USSR, India.
* Predictions of radio propagation conditions from Australia, South Africa, USSR, India.

Solar wind data

* Magnetic field & plasma data from 1963 onwards.

Data Centre Publications

* IONOSPHERIC DATA. Monthly bulletins of ionospheric parameters from the ionosondes operated by RAL at Slough, Port Stanley & South Uist and from the ionosondes operated by the British Antarctic Survey at Argentine Islands (Faraday) & Halley Bay. Available on microfiche.
* ANNUAL CATALOGUE OF IONOSPHERIC VERTICAL SOUNDING DATA. This catalogue lists in detail the data received by the WDC from ionospheric observatories worldwide. This catalogue is published in paper form.

Reports held by the WDC.

* National Reports to COSPAR from various countries
* COSPAR Information Bulletins
* Upper Atmosphere Geophysics (UAG) Reports, 1968 to present
* Solar-Geophysicsl Data, 1964 to present
* Telecommunications Journal
* Pennsylvania State University, Ionospheric Research Scientific Reports, 1957-81.
* University of Illinois Reports, various, 1963-83.
* NASA Reports
* NOAA Technical Reports
* Japan Meteorological Satellite Center Reports, 1978 to present
* Macau Meteorological Observations, 1974 to present
* IGY Reports
* Various Japanese & Russian Literature on Ionosphere, Geomagnetic Research Rockets, Cosmic Rays etc.
* Various Reports from Canada, Germany, Sweden, Poland, Pakistan, Brazil, UK and USA.

Requests and Further Information

Users can request copies of data, which will be sent by post, or they are welcome to visit the WDC in order to browse through the archives. Data from other WDCs can be ordered via the WDC at RAL. A computer link has been established with other data centres and is used to exchange messages and data.

Users are invited to contact the WDC if they require further information on the services provided by the WDC at RAL, or about services available at other WDCs.

All enquiries and requests should be sent to:

Cathy Doidge or Mike Hapgod

at:

World Data Centre C1 for STP
Rutherford Appleton Laboratory
Chilton
Didcot
Oxfordshire
OX11 0QX
United Kingdom

Telephone : 0235-21900, extension 6579

Telex : 83159 RUTHLAB G

Electronic Mail : to CMD or CYM on computer RLIB

PROF. M.G.K. MENON

THE CHAIRMAN OF THE NATIONAL ORGANISING COMMITTEE

Prof. M.G.K. Menon was born on August 28, 1928 in Mangalore. He obtained his Ph.D. degree in 1952 from Bristol University, where he worked with Prof. Cecil Powell. He joined the Tata Institute of Fundamental Research, Bombay, in 1955 as a Reader and rose to the position of Director in 1966, succeeding Dr H.J. Bhabha.

Prof. Menon has occupied many important positions in the Government of India — as Secretary to the Government of India and Chairman, Electronics Commission (1971-78); Scientific Adviser to the Minister for Defence and Director-General, Defence Research and Development Organisation (1974-78); Director-General, Council of Scientific & Industrial Research (1978-81); Secretary, Department of Science and Technology (1978-82); Secretary, Department of Environment (1980-82); Chairman, Commission for Additional Sources of Energy (1981-82); and Chairman, Indian Space Research Organisation (1972-73). Currently, he is Member, Planning Commission, Government of India, and Chairman of the Science Advisory Committee to the Cabinet.

He is a Fellow of the Royal Society; Hon. Foreign Member, USSR Academy of Sciences; Member, Pontifical Academy of Sciences; Vice-President, Third World Academy of Sciences; Hon. Foreign Member, American Academy of Arts and Sciences; and Vice President, International Union of Pure and Applied Physics.

Prof. Menon is the recipient of a number of awards and honours, among them the Shanti Swarup Bhatnagar Prize for Physical Sciences in 1960, the Cecil Powell Medal of the European Physical Society, the NOPEX Award for Professional Excellence, *Padma Shri* in 1961, *Padma Bhushan* in 1968, and *Padma Vibushan* in 1985.

Prof. Menon's principal scientific contributions have been (i) the development of nuclear emulsion techniques, (ii) elucidation of the properties of the strange particles, (iii) cosmic-ray studies near the geomagnetic equator at high altitudes, (iv) deep underground studies in India relating to muons, neutrinos and weak interactions, and (v) the most recent experiment relating to the search for the stability of the nucleon around life-times of 10^{31} years; some candidate events including high-quality confined events have been recorded, which are suggestive of nucleon decay.

INDIAN ASTRONOMY: A SOURCE-BOOK

Professor Olaf Pedersen, Chairman, IAU Commission 41 and President, International Academy of History of Science, released today Nehru Centre's publication, *Indian Astronomy: A Source-Book* compiled by Dr. B.V. Subbarayappa, Director, Centre for History and Philosophy of Science, Bangalore and Dr. K.V. Sarma, Adyar Library, Madras. Releasing the book, Prof. Pedersen commended the publication as having a good deal of compact original textual material of importance in respect of Indian astronomy.

Based primarily on Sanskrit sources, this publication, in nearly 3000 verses extracted from a large number of original texts on Indian astronomy and presented with translation and notes, attempts to provide a scientific insight into the main characteristics of Indian astronomy, the methodologies developed, instruments used, mathematically developed computation procedures, innovative trends as well as the rationale associated with them. The material presented in the *Source-Book* would possibly lead to fresh attempts towards a comparative and critical appreciation of Indian astronomy in relation to those of the other culture-areas.

Copies of this attractively produced publication are on sale in the book section of the Exhibition at Vigyan Bhavan. Priced at US$ 50 or Rs.600/-, 20% speical rebate is available (US$ 40 or Rs.480/-) to the delegates to the IAU General Assembly during its session.

GOOD NEWS FROM THE AAVSO

JOHN R. PERCY
Vice-President AAVSO

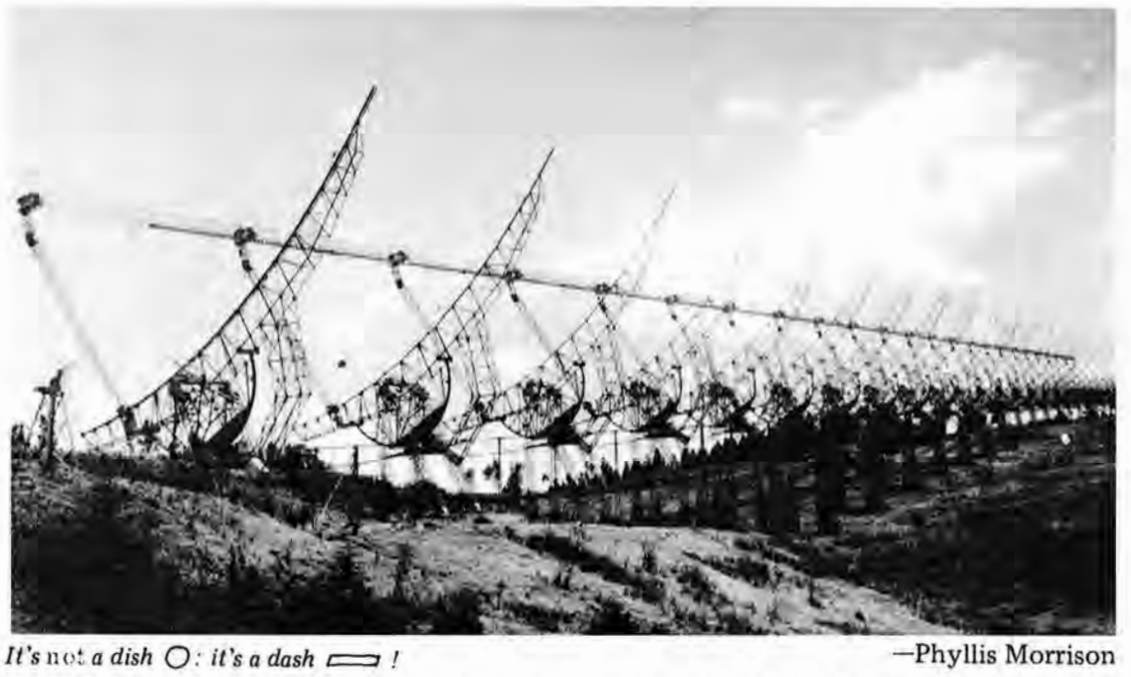
The American Association of Variable Star Observers (AAVSO), based in Cambridge USA, receives and archives nearly 250,000 visual observations of variable stars each year, from dozens of countries around the world. The 1982 General Assembly of the IAU passed a resolution encouraging and supporting the publication of this unique and valuable collection of observations. The AAVSO is pleased to report that, thanks to this resolution and to a financial contribution from the IAU, it has been able to attract further financial support, and to begin publication of these observations. The publication is in the form of monographs on individual stars. The first monograph — on S S Cygni - has just been published, and further monographs will be published at the rate of two or three each year. The AAVSO is grateful to the IAU, and to Commission 27, for their support.

The AAVSO celebrates its 75th anniversary in 1986. A special anniversary meeting will be held from 6 to 9 August, 1986, in Cambridge USA. The meeting will feature historical and scientific sessions on Variable Stars, as well as the dedication of the Association's new permanent home (address below). All astronomers are cordially invited to attend. For more information about the AAVSO, its publications, and its 75th anniversary meeting, write to the AAVSO, 25 Birch Street, Cambridge, MA 02138, USA — its new address effective December 1985.

OOTY SYNTHESIS RADIO TELESCOPE

MOHAN JOSHI and PRAMESH RAO
Radio Astronomy Centre (TIFR)
Udhagamandalam

Set in the scenic Nilgiri Hills of South India at a height of 2300 m, the Ooty Synthesis Radio Telescope (OSRT) operates at a frequency of 327 MHz and has a resolution of 50 arc-sec. All the elements of the OSRT are parabolic cylinders that are equatorially mounted with their axes in the north-south (NS) direction, which is possible since the latitude of Ooty is only 11 deg N. The cylinders can mechanically rotate from -4.2 h to +5.5 h in hour angle and point between ±35 deg in declination by means of electrical phasing. The most important element of the OSRT is the Ooty Radio Telescope (ORT), which is 530 m (NS) by 30 m (EW) and has an effective collecting area of 8000 m^2. Since the field of view of the ORT in NS is only 5 arc-min, the ORT is divided into 5 sections each of which has a field of view of 40 arc-min in declination and about 3 deg in right ascension. The remaining 7 elements of the OSRT are 'baby' cylinders having dimensions 25 m in NS and 9 m in EW. Though the effective area of the baby cylinders is small, baselines formed by correlating a baby cylinder with an ORT section have large effective area. Two of the baby cylinders are within 300 m of the ORT, one is 1 km west of ORT and the remaining 4 cylinders are 4 km west of ORT. Because of its low latitude, the OSRT can best observe sources at low declinations. To get good UV coverage for such sources, the 4 cylinders at 4 km are spread in NS over 2 km. All the antennas are controlled by telemetry and the signals from the antennas are correlated by a 12 C_2 digital delay line correlator system. The three nearby cylinders are connected by cables while the remaining four are connected by space links. The local oscillator signal is also distributed in the same way and the phase variations due to propagation are monitored for later correction. The control of the antennas and the data acquisition are done by a PDP 11/24 computer, while the offline data reduction is done by using a PDP 11/70 computer.



It's not *a dish* ○ *: it's a dash* ▭ *!* —Phyllis Morrison

The OSRT is currently being used to map a number of galactic and extragalactic objects. High resolution maps of supernova remnants like Crab nebula, W44, W50, G18.95 - 1.1, etc. reveal interesting details. The optical jet seen in the northern part of the Crab nebula has been detected at 327 MHz, indicating that it has a nonthermal spectrum. Distribution of relativistic electrons in nearby spiral galaxies like NGC4631, NGC4666, etc. is being investigated. The special index variation in the halo of NGC4631 suggests the presence of galactic winds. Steep spectrum cluster sources are also being mapped. A giant radio galaxy, 0504-28, of about 3 Mpc size has been discovered recently. High dynamic range maps of strong sources like Cygnus-A, Virgo-A, Hydra-A, etc. are being made by using self-calibration algorithms. The halo of Virgo-A has been resolved and its S-shaped structure indicates that it could be caused by a precessing jet. The OSRT is also being used for monitoring the metre wavelength variability of a number of extragalactic objects.

THE MANDAKINI SERIAL

BETWEEN THE TIDES

DONALD MALCOLM

TWO

CLOUDS, grey bronze, pink cyclamen, drifted across the eastern sky as the star rose, starting to dispel the glittering frost. It was an intense, throbbing red. The number of strong flares recorded during the past year had been unprecedented. Birds were busy among the branches of the trees screening the airship shed from the rear of the house. The breeze was light, so Simde didn't have to rotate the shed. He walked the little craft out on its trolley and, minutes later, he was flying down from the hills and across the plain to the launch complex. Everywhere was ordered activity. A service shuttle landed and another was preparing to take off. Ground cars — maintenance, goods, private — zipped about like insects. Simde landed his airship in its place beside the workshops and went to his office on the ground floor. He preferred to be as near as possible to the site, where parts for the space ship were fabricated, then ferried up to orbit.

Noss wasn't in his office and Simde assumed that he was out somewhere on the shop floor, where he usually was. As Chief Technical Officer of the project, Noss was always fully occupied and worked harder than anyone, Simde included. And he was never late, which was more than could be said for some of the younger workers. It was fortunate that the Yorea Company was tolerant.

Despite the rapturous joining of the previous night, Smide hadn't slept well. Concern about the project was probably mostly to blame. But he had been unable to stop thinking about Noss, his life-long friend, his most skilled and diligent employee, virtually a partner and soon to be the owner of the Yorea Company. Simde had never mentioned this to Atira, that he thought that Noss had made a bad joining with Irah. She was younger than Noss, a beautiful and resolute woman who took what she wanted and damned the consequences. At first, she had seemed good for Noss, who tended to see everything in terms of stresses and strains, tolerances and workloads.

Eidas, his vivacious assistant, came in and he asked her if she'd seen Noss. She took some papers from a sheaf in her arms and put them on his desk.

'Not this morning, Simde Yorea. I don't think that he's been in his office.'

'He's probably outside somewhere. Could you put out a call for him, please, when you've finished your rounds? He might be back by then. Thank you.'

He was half-way through the reports when he heard the call go out for Noss. He glanced at the tell-tale on his communicator. Noss didn't respond. Usually, he would come through, acknowledge the call, and say when he would appear.

Simde went into Eidas' office.

'Come to think of it, his airship isn't outside. Could he be where the call can't reach him?'

'He always leaves a note in that case. Shall I try again?'

Simde had been thinking about what Atira had said last night.

'No. Would you get me his home code, please?'

He returned to his own office as the communicator buzzed to indicate that a line was open and the code being called.

A woman's voice said, 'Noss Sidl's house. Who's calling, please?'

The video screen stayed blank. As Simde's code had automatically registered on her set, she knew who was calling.

'Irah. Simde here.'

He heard her breath indrawn and the screen cleared. Irah looked something — apprehensive, irritated — Simde couldn't be sure. She was wearing a demure lemon-coloured lounging tunic and her long tawny hair glistened. Her gum staining was, for her, subdued.

'Simde — Good morning.'

'Good morning, Irah. Is Noss there? He doesn't seem to be at work.'

'No... yes. He's here. He's...ill.'

Simde felt a stab of alarm. If anything had happened to Noss at this critical stage—'

'What's wrong with him? Is it serious? When did he take ill?'

She passed a hand across her forehead and her eyes were like enormous green pools.

'I don't know. Simde. The healer is with him now. It happened about thirty, forty minutes ago.'

'Sorry, Irah I shouldn't have fired off questions at you like that. Is there anything I can do? Would you like Atira to come to you?'

The great green eyes were wary.

'Not just now, thanks.'

'Please call me again as soon as you know what is wrong.'

'I'll do that, Simde.'

The screen blanked out, leaving Simde with the feeling of knowing less than he did before he called.

He punched out his own home code. Atira took the call.

'Simde. This is a surprise.'

He could hear the cubs arguing in the background.

'Noss is ill. I called Irah. The healer's there now.'

Atira's eyes changed colour, to a deep mauve.

'Oh.' That was all she said.

'Oh? What does that mean?'

Simde was getting more puzzled by the minute.

Atira reached down out of sight of the screen and activated the scrambler.

'It means,' she said distinctly, 'that Irah has been joining with some of her young men and that Noss has found out the painful way.'

Simde was suddenly conscious of the blood in his veins.

'Then he has...he has —' He couldn't say it.

'Yes, Noss has the disease.'

'You knew.'

'That Irah was joining elsewhere, yes. And I suspected as much when their food plant was causing so much trouble. Noss must have thought that it was blight. Did you never *really* wonder why I wouldn't let the cubs go there in recent months, why we've never taken up their invitations, or given any? There was danger even in the ritual bonding all guests partake in.'

'We've all been busy with the final stages of the project'. He broke off and asked: 'Is there no way to prevent Noss knowing?'

'Be realistic. It's *there*, in his body, in his blood. Irah has tainted him and their food plant. I think it will be too late to save him.'

Simde said through his sorrow, 'How long has Irah — I mean—'

He thumped the desk in exasperation.

'About half-a-year, I'd say. She never actually *told* me, of course, but all the signs were there for a woman to see. Noss might not be as bad as we fear. He and Irah didn't join much, if at all recently. Noss is much older than Irah and she did tell me that Noss was never very keen on joining even at the beginning.'

Atira started to laugh and smothered it at Simde's scowl.

'Irah once said that Noss always tackled joining as if it were a mechanical problem and seemed to be scared that he would strain himself.'

'How like Noss.'

'So you see what I mean—'

'But surely the frequency of joining has nothing to do with it? Once would be enough.'

'We'll have to wait and see. What are you going to do?'

She knew that Noss was vital to the success of the initial part of the project.

(Contd. on p.8)

ELECTRONIC PUBLISHING

WILL THIS REVOLUTION SET IN?

P.S. SHANKAR
Publications & Information Directorate (CSIR), New Delhi

Mandakini, the IAU's XIX General Assembly's official newspaper, comes to you on the much-wonted print-on-paper (POP) form, which you can browse through, at leisure and possibly with pleasure, in your hotel suite or toilet, or in buses or cabs on way to the evening's cultural feast. Will the Union's XX GA's newspaper, whatever the name or wherever the Assembly takes place, come to you in the same paper form? More likely, not, though I may sound a bit of a fortune-teller.

Let me examine the what, the how and the why of the likely new mode of the publishing scenario — a complete breakaway from Gutenberg, bidding adieu to him, to him whose movable type transformed European learning and culture some 500 years before.

What's on the publication horizon is clearly the electronic mode — a bane or boon, depending on whether you are a Luddite or a technological optimist. To the POP orthodoxy (the Americans call them the POP bastards), Electronic Publishing, or EP for short, sounds more like an oxymoron — paperless print. The sole pupose of EP, whatever that means, is to cut down drastically the gap between the generation of new knowledge and its dissemination to its seekers — all, in fact, being scientists themselves. It now takes anywhere from 3 months to 3 years before a communication sent to a learned journal is available to its readership. It is no exaggeration to say that sometimes it takes more time to disseminate than to create new knowledge. Imagine the frustations of a pioneer scientist who finds the POP a barrier to inform his peers planet-wide in this Space Age.

Whether or not our Sun is a binary, whether or not the GUTS will rule the roost in future, what appears inescapable before the next Comet Halley appears on the horizon, if not before the turn of the century, is that EP or EJ (EP's sibilant, electronic journal) may become a practical reality — economically and commercially viable. As real as that Man landed on the Moon. For technology is no respector of 'Flat-Earthers'. This is no science fiction. It is only an extrapolation of the publishing trend, a bit of technological forecasting, albeit with its hazards, *pace* Lord Rutherford who was emphatic that nuclear energy was implausible.

The idea of an EJ is usually attributed to John Senders of the University of Toronto. It was he, along with Harold Bamford (Jr) of the (US) National Science Foundation, who suggested in 1976 that printed journals might become extinct because of increasing costs, falling subscriptions and the problems of distribution and retrieval of information from them. His thesis for proposing the concept of EP/J was not so much that the surrogates were desirable but that economic pressures would force their birth.

The essence of EP/J is the replacement of the traditional means of printing, storage and dissemination of paper articles by the equivalent operations on electronic messages. The definition, if the concept could be defined, may be expanded to include dissemination of text and graphics over electronic channels — TV, radio, Cable TV, and telephone wires. (Don't curse me if your hotel 'phone is dead.)

What prompts me to see a bright future for EP/J is the British experiment BLEND — short for Birmingham-Loughborough Electronic Network Development — which is in progress since 1981 and has successfully concluded its first phase of the study and entered the second stage. A salient feature of the BLEND experiment is the development of *RAAJ* (no relation to the British 'Raj'), which expands to *References, Abstracts and Annotations Journal*. *RAAJ* contains a database of bibliographical references in the subject area of Computer Human Factors up to 1981 and more recent references and authors' abstracts from selected journals. This electronic medium provides two types of information: *factual* (references, abstracts and summaries) and *evaluative* (annotations).

To the Luddites of the publication technology let me offer four forms of EJ which have emerged on the EIES (Electronic Information Exchange Systems):

- an informal newsletter
- an unrefereed paper
- a journal that replicates the traditional print-based system
- a highly structured inquiry-response system.

We already have, for example:

(i) *Electronic Publishing and Bookselling*, whose medium is computerese rather than English — or 'Broken English' as John Ziman would like to describe a scientist's lingo — the first issue appearing in June 1983.

(ii) *Electronic Publishing Review*, a quarterly from publishers 'Learned Information' (Oxford)

(iii) *Monitor*, a monthly from the same publishers, starting from January 1981.

To go back to the homeland of the EP/J concept, the Information Access Company in the USA decided at its ONLINE'84 meeting on the creation of a commercial professional journal called *Information Publishing: An Electronic Journal*. Again on the US scene where the NSF was the funder of pioneer Senders' project, the Association of the American Publishers (AAP) has launched the 'Electronics Manuscripts Project' (EMP) in cooperation with the Aspen Systems Corporation, also a pioneer in electronic publishing — a vision, in fact, of Vannevar Bush, who called it MEMEX as early as in 1945. Ironically the AAP's Electronic Publishing Subcommittee has brought out its first report in the self-same POP form. EP is touted as of becoming a reality partly because of the phenomenal progress in digitisation of both text and images over the last decade.

Believe it or not, the monumental 16-volume OED (Oxford English Dictionary), weighing 115 pounds or about 50 kilograms, has already started to go electronic in a $ 10 million project — a project which aims "to *dispeple* each new wrinkle of the English language". And the organic chemist's bible Beilstein, the German monument, is also going electronic.

The next IAU newspaper may just as well have an electronic EPC (editorial processing centre), with the breath-taking result that even after the last 'page' of the 'paper' is laid out, a participating astronomer may send in his or her latest discovery of a star, stationary or variable, and the day's *'E Paper'* could still find time and space for flashing the news on its front 'page', though in an artless form.

Some questions yet remain to be answered on this new ripple of fashion which threatens to become a technological reality, if not a marvel. If reading traditional journals is like entering a well-kept cemetery, then will EP/J bring in a new vitality to sciences?, ask some scientists. What has so far happened is that publishers are learning new skills and it is the editors and authors who should necessarily learn them that are reluctant to do so. In other words, it is the scientists the ultimate beneficiaries who are proving to be bottlenecks in the instant publication process. A greater bottleneck, however, is neither technological nor commercial: it is, in fact, human acceptability that may be problematic. Maybe the future will see the publishing pundits' prophesy become a reality.

While thinking of the EP/J scenario, I was composing my thoughts and script using the age-old paper and pencil in the small hours of November 15.

"Was it a vision, or a waking dream?'— Only the computer cognoscenti can answer the doubt Keats poses in 'Ode to a Nightingale'.

Never fear big words. Long words name little things. All big things have little names, such as life and death, peace and war, or dawn, day, night, love, home. Learn to use little words in a big way — It is hard to do. But they say what you mean. When you don't know what you mean, use big words: They often fool little people. —*SSC Booknews July 1981*

But the main errors in his writing
Are those common in his reading

—*H.J. Tichy*

Nature fits all her children with something to do, He who would write and can't write, can surely review.

—*James Russel Lowell*

BETWEEN THE TIDES

(Continued from p. 7)

Simde was at a loss. 'As you say, wait. We can carry on here for a bit, and hope that no snags arise. I want to go and see Noss, but I don't think that the time is right. And Irah doesn't want you there, either.'

Atira said without malice, 'I'm not surprised. Anyway, I'd better let you get back to work. I'll see you this evening.'

She had reminded him gently that he was spinning out time.

He said good-bye and went into Eidas' office.

'If Irah Sidl calls, let me know and hold till I get back here. I'm going to talk to Remlin Dor — Noss is ill and I don't know when he'll be back at work.'

'Is Noss seriously ill?'

He'd hoped to evade that question and was snappish, unusual for him.

'I don't know, Eidas. I wish I did.'

Eidas — and everyone else — would know soon enough what was wrong with Noss.

(To be continued)

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JOINT DISCUSSION ON REFERENCE FRAMES

J.A. HUGHES
Chairman, JD1

The Joint Discussion on Reference Frames, JD1, was held as scheduled on November 20. Judging from the attendance and the calibre and diversity of the papers given, the JD must be considered a success in every way. The producers of reference frames found the presentations by users of the same, most enlightening. Since the writer is of the former persuasion he can only suppose that a two-way flow of information took place. (All indications are that it did).

Starting with R. Wielen's talk on galactic astronomy, and ending with V. Abalakin's discussion of Ephemerides and Celestial Mechanics, the user portion of the programme covered the required characteristics of reference frames from cometary studies to the distance scale.

The JD was "universal" in outlook, including classical results and traditional representations of accumulated data, progressing to contemporary developments in both earth- and space-based astrometry. The diversity of topics was large. Contemporary activities described ranged from automatic meridian observations to the ESA HIPPARCOS satellite. G. Wilkins discussed the MERIT project as part of the coverage of Earth Rotation Parameters, while J. Dickey gave a comprehensive report on reference frame studies at JPL.

Theoretical considerations were provided by B. Guinot and C.A. Murray with T. Fukushima, the latter two speaking on general relativity and the concept of a "natural frame." The very important activity involving the comparison of optical and radio frames was covered by K. Johnston and Chr.de Vegt.

Probably the most important part of the JD consisted of the closing round table and general discussions. It may be said that general agreement exists on what must be done to provide a greatly improved extra-galactic based reference frame. *How* to accomplish the necessary tasks is less clear, but this is not to imply any basic problem; the questions are primarily operational and perhaps to some extent conceptual.

The immediate product of JD1 was a proposed resolution, adopted by attendees without opposition, which invites the presidents of commissions 4, 7, 8, 19, 20, 24, 31, 33 and 40 to form a working group with appropriate sub-groups devoted to various specialized topics. This resolution, if accepted by the commissions, should go a long way to focus the very considerable efforts which are now clearly indicated. The diversity of interest in reference frames (as shown by the nine commissions involved) certainly requires a mechanism to ensure efficient, coherent and useful efforts in this area. The discussions at JD1 and the proposed working group are desirable and significant steps to provide just such efforts.

JOINT DISCUSSION III – SOLAR AND STELLAR NONRADIAL OSCILLATIONS

ARTHUR N. COX
Chairman
Scientific Organizing Committee
Joint Discussion III

Recent observations and theoretical interpretations have shown that many stars display complicated oscillations. These are much different from those seen in the classically known variable stars such as the Cepheids. The Cepheid radial (spherical) pulsations have revealed some information, such as their radii, about the yellow giant stars, but other data like their masses and surface compositions are still being discussed. The situation with the nonradially pulsating bluer stars, or the lower luminosity main sequence stars, such as our Sun, promises to bring in even more information and puzzles for us to decipher.

Joint Discussions III on Solar and Stellar Oscillations will bring together for discussions experts in the many types of variable stars. Usually an observer of the complex light and radial velocity variations of our Sun is not aware of the details of the nonradially pulsating B supergiants. Or the intricate variations of spectral line shapes often seem unrelated to complex light curves of the δ Scuti variables. Yet the basic type of the motions in all these stars is very much the same. The JD III will cover the stellar variable star classes: ZZ Ceti, DB white dwarf variables, the PG 1159 variables, the δ Scuti and Ap stars, the solar oscillations, the β stars, the Be stars, and the supergiant and Wolf-Rayet variables.

The usual evolution of the research in variable stars consists first in obtaining considerable data about the light and velocity variations. It may be over 150 years before the causes of the variability are known, as in the case of the Cepheids. Observations and theoretical interpretations come faster these days. Now in a period of less than 20 years, the nonradial oscillations of the degenerate white dwarf stars and the precursor PG 1159 and planetary nebulae nucei seem reasonably well understood. Data recently accumulated will enable even direct measurements of the cooling and shrinking of these stars.

In a similar situation, the δ Scuti and magnetic Ap stars are now being understood. As for the degenerate stars, the seat of the pulsation instability is in the outer layers. Periodic blocking of the outflow of the luminosity by opacity, convection or even magnetic effects valve the flow in such a way that, with each pulsation cycle, the star gets a push. These pushes add to give an observable light or radial velocity variation which is limited in its amplitude by other damping effects.

The Shaking Sun!

For the Sun, the cause of the nonradial oscillations is still being debated. It does seem as though the five-minute (p-type) modes are always decaying, only to be reexcited frequently. The hour or longer period g modes are predicted to decay very slowly (perhaps over more than 10,000 years), and therefore observers have always been able to correctly predict the phase of oscillation for a given mode. The interest for the Sun is currently in what interior data can be learned from only the periods of the 10 million known modes. The helium composition in the convection zone, the internal hydrogen composition structure, and the internal rotation are a few of the parameters that are currently being refined.

Pulsation causes for the upper main sequence stars remain to be definitively known. Many proposals over the last 25 years have been proven incorrect or are inapplicable for these massive stars. Current research is aimed at getting high-quality observations that can possibly limit the theoretical hypotheses, in order to help us understand eventually these oscillations and other internal details.

The participants of the JD III hope that their presentations and discussions will shed more light on why these B stars are variable and what can be known about their structure. The meeting will bring in new thoughts to all nonradial observations.

STATE BANK OF INDIA

State Bank of India counter at Vigyan Bhavan will be happy to assist the delegates of the IAU with any exchange problems. They are open from 0900 hrs to 1700 hrs, except between 1300 - 1400 hrs, on all the days of the General Assembly.

JOINT DISCUSSION V

Stellar Activity:
Rotation and Magnetic Fields

Magnetic activity in stars has caught the interest of many of us. The Joint Discussion on Monday, 25 November, will centre on rotation and magnetic fields. Almost certainly the magnetic activity in F, G, and K stars involves dynamo action, since it depends on rotation and convection-zone depth. (The source of fields in early-type stars is still uncertain.) But beyond this basic idea, there are still few links between the theories and the observations. The purpose of the Joint Discussion is to bring together some of the ideas and observations bearing on this topic.

The flow of topics during the day is from the stellar interior outward to the corona. And, thanks to the diligence of the organizing committee, we have a well-rounded selection of topics spanning both theoretical and observational aspects of magnetic activity. Our speakers come from ten countries around the globe, in keeping with IAU purpose and tradition, and the Joint Discussion itself is sponsored by seven commissions of the IAU.

Although there will be no contributed papers at this Joint Discussion, there is a small amount of time for questions and discussion following the invited talks. So plan to come and help make Monday a lively day.

ATTENTION DELEGATES

Please don't forget to reconfirm your international flight reservations.

This is a must.

PROGRAMME FOR THE REGISTERED GUESTS

Sr. No.	Date	Time	Event
1.	22-11-1985	10.00 a.m.	Visit to National Gallery of Modern Art
2.	25-11-1985	10.00 a.m.	Demonstration of Herbal Cosmetics
3.	26-11-1985	10.30 a.m.	Cookery demonstration
4.	27-11-1985	10.00 a.m.	Demonstration of traditional Hair Styles

Note: The visits will start from Vigyan Bhavan. For any details please contact Mrs. Mithlesh Saxena at Ashoka Travels & Tours counter at Vigyan Bhavan.

EDITORIAL

A TUG AT THE HEARTSTRINGS

I had an interesting experience the other night which I recommend to you.

My good friend and colleague Mr Ratnakar felt that I had been working too hard (I am glad someone appreciates the hard work and effort I put in in producing this newspaper — but I digress) and so he suggested that we take the evening off and go to a movie. We did so. At the cinema off Connaught. Place we saw an Indian film called 'Ganga'. The word 'Ganga', pronounced 'Gunga', is the name of the sacred river — known to old-timers and ignorant foreigners like myself as the Ganges.

The film was in the truest sense of the word 'Spectacular'. The scenery of the Himalayas was breathtaking, the colours of the scenes and of the actors' and actresses' costumes were beautiful, there were numerous songs and dances gracefully and energetically performed. Suspension of disbelief on the part of the audience — and by me — was total even though, no matter where the protagonists were, be it city or high mountanous meadow, an invisible orchestra always accompanied them, ready to provide supporting background music at the drop of a turban.

The plot was ageless. Boy and girl of widely different social class meet and fall in love. Due to circumstances they are parted and the boy returns to the city much further down the sacred river at a level where it is polluted by effluent. Due to the machinations of evil and corrupt men he is prevented from returning to the pure source of the Ganges, where his girl, also called 'Ganga', lives and waits for him. Finally, she travels down the river to find him, falls victim to the same evil men and it is only after heroic endeavours and after great vicissitudes that they are reunited in a triumphant finale. (Incidentally, the heroine's name in real iife is 'Mandakini': I kid you not).

The audience cheered and clapped at appropriate places, for example, where the 'friend of the family' spoke directly to the audience informing them of his determination to help the boy out of his predicament. I understood this because although the language used was Hindi and my knowledge of this Indian tongue is limited to those words in it pronounced "doctor", "I'm sorry", "OK", "jolly good" and so on, Mr Ratnakar kindly kept up a running commentary in a low whisper which the kindly Indians around us only rarely shushed.

I enjoyed every moment of the film and found myself wondering why it was all so familiar. And then I realised why Indian cinema has ingeniously married Shakespeare to opera with perhaps more than a dash to Victorian melodrama of the 'East Lynne' vintage. Certainly Mrs Henry Wood would have approved of 'Ganga'.

But it is more than that. All over the world there is still a deep belief in the abiding verities of life — love, truth, justice, self-sacrifice, and the credo that in the end good must triumph over evil. A story such as 'Ganga' still touches the heartstrings of human beings everywhere and that it does seem to me to shine like a torch of hope in the encircling gloom of our planetary problems.

Long may it do so.

Archie E. Roy

25 YEARS OF RADIO SEARCHES

MICHAEL D. PAPAGIANNIS
President, IAU Commission 51

At the 1959 General Assembly in Montreal, we timidly organized a Joint Session of Commissions 16, 40, and 44 on the Search for Life in the Universe, which proved extremely successful. On the next evening, when Frank Drake and I summarized the results for the general membership of the IAU, the large auditorium of the University of Montreal was packed to standing room only, showing the wide interest among IAU members for this subject. The Proceedings of this meeting were published by Reidel under the title, "Strategies for the Search for Life in the Universe" (ed. by M.D. Papagiannis), and the machinery was set in motion.

IAU Commission 51 - Search for Extraterrestrial Life - was established at the next IAU General Assembly at Patras, Greece, in 1982. It is the youngest of all IAU Commissions, but has grown rapidly in the past three years to a membership of over 270, making it one of the large IAU Commissions.

In June 1984, Commission 51 organized in Boston its first IAU Symposium. It was co-sponsored by four other IAU Commissions (15,16,24, and 40) and four other major international organizations (COSPAR, IAF/IAA, ISSOL, and IUBS). It received wide coverage in the press, including a whole page article by Walter Sullivan in the *New York Times*, and its Proceedings, edited by M.D. Papagiannis, have just been published by Reidel under the title "IAU Symposium 112 — The Search for Extraterrestrial Life: Recent Developments." Our Symposium coincided with the twenty-fifth anniversary of the publication in *Nature* of the pioneering papers of Cocconi and Morrison, "Searching for Interstellar Communication," which in 1959 became the first call for a scientific search for radio signals from other advanced civilizations in the Galaxy. They recommended to search at the 21cm line of atomic hydrogen, which at the time was the only radio line known (having been detected only in 1951). During the Boston Symposium we honoured Philip Morrison with a commemorative plaque for the silver anniversary of that historic paper and for his many subsequent contributions to this field. It is interesting to note that Prof. Philip Morrison of MIT and Prof. Edward M. Purcell of Harvard, a Nobel Laureate in physics and co-discoverer of the hydrogen line at 21 cm, were the co-chairmen of the Local Organizing Committee of our Boston IAU Symposium.

False Alarm

This year we are celebrating the 25th anniversary of the first radio search, which was conducted in 1960 by Frank Drake using the largest radio telescope then available in the United States, the 85 ft Tatel radio telescope of the National Radio Astronomy Observatory (NRAO) at Green Bank, West Virginia. He observed for 200 hours two nearby Sun-like stars, Epsilon Eridani (10.7 l.y.) and Tau Ceti (11.9 l.y.), at the hydrogen line. No signals were detected except for a shocking false alarm, a strong radio signal pulsing 8 times per second which they started receiving when they first turned their antenna to Epsilon Eridani, and which later tests showed to have been a high-flying airplane. Frank Drake, together with Nikolai Kardashev of the Soviet Union, are the two Vice-Presidents of our young Commission and at the end of this General Assembly he will become the next President of IAU Commission 51, exactly 25 years after his celebrated Project Ozma.

It is interesting to note that the 1,000 ft Arecibo radio telescope with its modern receivers would have been able to do the 200 hours of Drake's Project Ozma in just a fraction of a second. In these past twenty-five years there have been nearly fifty search projects, which have accumulated about 120,000 hours of observations with constantly improving sensitivity and spectral resolution. We have used some of the largest radio telescopes in seven advanced countries (USA, USSR, Australia, Canada, Germany, France, and Holland), with Japan getting ready to join the group with its new Nobeyama millimetre radio telescope. There are now two SETI-dedicated facilities (SETI=Search for Extra-Terrestrial Intelligence) which conduct SETI observations on a continuous

(contd. on p.4)

Philip Morrison holding the 25-th Anniversary Commemorative Plaque presented to him during the IAU Symposium 112. Standing by are the President Michael D. Papagiannis and the Vice-President Frank Drake of IAU Commission 51.

DOWN MEMORY LANE — GLIMPSES FROM PAST GENERAL ASSEMBLIES

V GENERAL ASSEMBLY—PARIS 1935

Over three hundred and seventeen astronomers attended the fifth General Assembly held at Paris during July 10-17. The French Minister of Education inaugurated the General Assembly. The President of the Union, Prof. Frank Schlesinger, spoke about the long tradition of astronomy in Paris. Rich tributes were paid to the late Dr B. Billaud, the first President of the Union. An interesting film depicting the work of the Bureau International de l'Heure, which is supported by the Union, was screened.

Among the discussions held by various Commissions were those by the Commission on Spectroscopy which discussed 'Standards of Light Intensity'; conditions and programmes for observing the solar eclipse of 1936 were discussed by the Commission on Solar Eclipses. In the discussion of the Commission on Stellar Constitution, Prof. Arthur Eddington stressed the importance of theories of stellar constitution of recent laboratory discoveries concerning subatomic phenomena. Dr S. Chandrasekhar mentioned the significance of the creation of positive and negative electron pairs in the regions of massive stars. At a joint discussion of the Commission on Nebulae and Spectrophotometry, Dr Shapley spoke on the resultant spectra of entire galaxies and their interpretation; the lack of agreement between theory and observation of energy distribution in planetary nebulae was dealt with by Prof. Plaskett. "Which stars are to be used in future as fundamental stars and what positions are to be used for these stars" was discussed in a joint meeting of Commissions 4 and 8. It was decided to recommend that FK 3 be the fundamental catalogue to be used for the apparent places of stars in all astronomical ephemerides.

Among the important resolutions adopted were: to make a twenty-five per cent reduction in the unit of subscription for countries adhering to the Union; the terms Universal Time (UT) should be used for Greenwich Mean Time (GMT) reckoned from the midnight.

A new sub-committee on novae was begun in the Committee dealing with stellar spectra; the Committee on the Moon was reconstituted with sub-commissions.

An interesting astronomical exhibition was organized during the Assembly. An important social engagement was the banquet on the platform of the famous Eiffel Tower.

The following were elected as the office bearers for the next term:

E. Esclangon (President); W.S. Adams, O. Bergstrand and H. Spencer Jones (Vice-Presidents) and F.J.M. Stratton (General Secretary).

gASTRONOMY CORNER

NAAN

(Indian Bread)

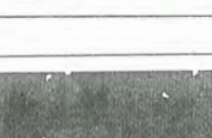
	Ingredients	Quantity
1.	Refined flour	500 g
2.	Eggs	1 no.
3.	Salt	to taste
4.	Baking powder	5 g
5.	Sugar	10 g
6.	Milk	100 g
7.	Water	to mix

Method

1. Make a smooth dough with flour, sugar, salt, baking powder, egg, milk and water.
2. Leave it to prove for 30 - 40 minutes.
3. Let the dough rise to double till the texture is very soft (similar to bread dough)
4. Make eight equal balls, flatten the balls, into conical shape.
5. Now using your palms, flatten the balls into conical shape.
6. Cook on the hot sides of a *tandoor* or in an oven at low temperature.
7. Serve hot with main dishes.

HISTORICAL NOTE

Which IAU Commission never met? Commission 1 on 'Relativity' was formed in 1921. Prior to the 1924 Assembly, the Commission found that there was nothing to coordinate, and discontinued itself!



WHAT THE STARS FORETELL

MADAME ZAZA

Many of those attending the XVIII General Assembly of the IAU at Patras were so helped by Madame Zaza's column in Astrocosmos *that we prevailed on her to provide a similar column for* Mandakini. *She tells us that to obtain her predictions she uses not only the most up-to-date computing power in her calculations but backs them up with a wide variety of more traditional technology such as tea-leaves, tarot cards, entrails of animals (what she laughingly calls 'getting to the guts of the matter'), the flight of birds, the sound of rose petals falling and the promises of politicians.*

— Editor

Taurus (Apr 21 - May 21) Once again you will find yourself in strange and exotic surroundings, mingling with strangers, many of whom have likewise travelled long distances. If your birthday happens to be in the next ten days the remarkable alignment of planets present at your birth ensures that you will certainly inherit a huge fortune the day after tomorrow. This is guaranteed.

Gemini (May 22 - June 21) You are entering a period of life where the influence of Mercury (otherwise quicksilver) puts you in contact with an unusually large number of glib talkers who will try to persuade you of the essential correctness of their views of the universe. Be selective. Remember the old Persian Khayham's experience, "Myself when young did eagerly frequent Doctor and Saint and heard great argument, about it and about: but evermore came out by the same door as in I went."

Cancer (June 22 - July 23) Your sign means water, or a life influenced by water, or that you are more serious than most (cf. 'still waters run deep') or that you will meet your future life-partner on a cruise or did, that you will drown. It also means "The Crab" as you may be shifty (cf. walking sideways) or nippy with a sharp tongue or fond of sea-food. Really you are a confusing character — all 400,000,000 of you born under this sign — babies, children and adults, the lot!

Leo (July 24 - Aug 23) You are undoubtedly too gullible a persoh, always believing what people tell you. I feel concerned about you since romance, money and superlative career opportunities are about to enter your life — but only if you make the correct decisions. For a detailed horoscope guiding you to the right path, send $1000 in cash to me, care of the editor. Believe me, you will not regret it.

Virgo (Aug 24 - Sep 23) Your scintillating wit, warm, engaging personality and attractive appearance will outdo this week anything they have previously achieved. The stars and planets are particularly favourably disposed to help you, especially M31, NGC224 and Andromeda. Oh, hang on! Sorry. Two calculations got mixed up. Yours is the next one.

Libra (Sep 24 - Oct 23) Not a good week. Mars is in the ascendant, so Venus is hiding behind the Sun, Pluto is in eclipse several times. Really if I were you I'd stay in my room all week behind locked doors, occupied in non-stop fasting and prayers. Of course — see above — this applies to Virgo above. Yours is the one listed for Capricorn. At least, I think so. The papers are so difficult to read what with all the coffee stains smudging them that it's difficult to say.

Scorpio (Oct 24 — Nov 22) The stars have conspired to present you with tremendous opportunities in the next ten days for sampling a wide variety of new foods and experiences. But remember Krishna's words: "A harmony in eating and resting, in sleeping and keeping awake: a perfection in whatever one does. This is the Yoga that gives peace from all pains."

Sagittarius (Nov 23 - Dec 21). The universe smiles benignly upon you — Moon, Sun, all the planets from Mercury to Pluto, the stars — Proxima Centauri outwards, Andromeda, galaxies, black holes, pulsars, quasars, the lot, all beam their rays (Ed. Even black holes?) down upon your head, regardless of distance and direction. The charts show that this unusual configuration will last but one week so make the most of it.

Capricorn (Dec 22 - Jan 20) An opportunity for doing someone a kindness will present itself this week. Try to overcome your well-known reluctance to take this step even if it means being cruel to a masochist or allowing a speaker during a session to get away with an argument so blatantly hand-waving in its lack of supporting evidence and logic that even you can see its faults.

Aquarius (Jan 21 - Feb 19) You will sparkle in company like a star today, shine with the brilliance of a supernova, bestride the scene like Comet Halley, warm everyone with the solar rays of your personality, attract attention like the Crab Nebula — (That's enough astronomy. Ed.) OK. You've got the message. Have a good day!

Pisces (Feb 20 - Mar 20) You may well think that everyone is conspiring against you in major and minor ways and that nothing goes quite right for you. This may be because Neptune has entered your sign and Neptune before discovery, worked away unseen to put Uranus off its predicted course. Uranus itself is also working, against you, come to think of it, as is Saturn and — Look. They can't all be .....? Well. Just try to get through the day as best you can.

Aries (Mar 21 - Apr 20) In the next ten days you will experience an increasing tendency to be overwhelmed by a wider variety of people and events than you are accustomed to. Regard it as part of life's over-changing pageantry, an opportunity to renew old friendships and form new ones. Your sign Aries means RAM, or Random Access Memory to which you can consign new experiences to be recalled later to enjoy when you return home.

Tandoori (Jan 1 - Dec 31) Sometimes called by the ignorant '*Chapatti*' (Who he? Ed.). This is an ancient Indian astrological sign having an increasing influence in our western cultures as people appreciate its importance. People born under this sign are advised to look upon their fellow humans as diverse ingredients which when blended cooperatively will produce a sublime and harmonious confection but when used without regard for their individual worth will result in a charred mess in the kitchen of the universe.

POST SCRIPT TO EP/J

One of the nation-wide dailies, The Times of India *(Delhi edition) among others, carried the news item, reproduced below, with this paper's caption from UPI dated 20 November. We thought it appropriate to add this as a footnote to* Mandakini's *feature 'Electronic Publishing' which appeared on 21 November on p. 8.*

UPI's story uses the wrong honorific 'Mr' instead of 'Dr' or 'Prof.'. Just the name itself without any honorifics would have sufficed. *— Editor*

KNOWLEDGE ON A PINHEAD

A Nobel Laureate who challenged scientists 25 years ago to discover a way to write the Encyclopedia Britannica on the head of a pin awarded his $1,000 prize to a California graduate student.

Stanford Unversity graduate, Tom Newman, met the challenge with the aid of an electron beam not much wider than an atom.

"I am surprised it took this long but I am delighted with this young man's work," said physicist, Mr. Richard P. Feynman, who issued the challenge during a speech in 1960, offering $1,000 of his own money as a prize.

Mr Feynman did not expect a scientist to actually write the encyclopedia on the head of a pin, but he did expect them to prove they had discovered the technology to do so.

That proof, he said, would be for the scientist to reduce the text of any page of print 625 million times—roughly the size, he calculated, needed to fit the text of the encyclopedia, without photos, on a pinhead.

Print this small would mean entire libraries could be stored in a shoe box and all the books of the world in a bin one yard square, said Mr. Feynman, a professor of physics at the California Institute of Technology in Pasadena.

— (UPI)

THE MANDAKINI SERIAL

BETWEEN THE TIDES

DONALD MALCOLM

THREE

INSTEAD of going immediately to see the Assistant Chief Technical Officer, Simde went back to his office and sat at the desk.

Noss, I haven't really thought about him, only about the project and the inconvenience to me. Perhaps Atira was right. I am blind and deaf. Selfish. What would Noss do — supposing he recovered? Joining outside the family was, or had been, virtually unknown on Hasub. Social and environmental conditions were slowly changing that and many other parts of the old, accepted code of conduct, and the pace was accelerating. But among people of their level — He couldn't recall when he'd last heard of such an occurrence. Would Noss contemplate the ultimate step of breaking the joining? It entailed much anguish for the man, the woman and their psycho-food plant. Fortunately there were no cubs. Simde hoped that Atira was wrong. That was unlikely. Sometimes he wondered if she could see the future, even in a vague way. Cases of such a gift, if that's what it was, had been reported occasionally from remote places.

He went to the fabrication shops and had been with Remlin Dor for about thirty minutes, when Eidas buzzed him.

'Irah Sidl calling.'

He excused himself and returned to the office.

'She sounds very agitated.' Eidas whispered, anxious, somehow, to involve hereself in what was happening.

So would you be, if you knew, Simde thought.

'Irah—'

Simde! Noss has left the house, in his airship. I don't know where he's gone. He won't answer his communicator. I'm worried.'

Simde felt like telling her it was a bit late for that. Instead, projecting a calm he didn't feel, he asked. 'What did the healer say?'

'I — I don't want to talk about it here.'

'But it *is* serious?'

Irah started to react to his brusqueness, then the fight went out of her.

'Yes.' Her voice was barely audible. 'The healer went into another room to arrange for Noss to go for observation and treatment. Noss suddenly ran out and then I heard the airship taking off.'

'Which way did he go?'

'I...don't know. I was so confused.'

Simde, his mind racing on, said. 'Try and relax. Noss won't do anything rash. He's probably coming here. I'll ask Atira to go and see you.

Without waiting for a reply, he cut the connection and dialled Atira. He told her the story and she agreed to go at once and see Irah.

Simde sat drumming at his desk. Noss wasn't coming to the site, he knew. He had said that to calm Irah. The two families had a cabin in the mountains. Noss would go there. It was about an hour's flight from the complex. He called in Eidas.

'I'm going to be away for some time. I don't know how long. If it's vital, you can reach me on the airship circuit. Let Remlin Dor know.'

Soon he was airborne. He didn't try to get in touch with Noss. The extra time on his own might help. Simde didn't know what he was going to say or do when he arrived at the cabin, so he pushed the problem to the back of his mind and thought about the project.

The space ship would be ready, if they maintained schedule, in eight days. The parts being finished off in the fabrication shop would be sent to orbit tomorrow. The main hulls of the vessel were assembled and some engine tests had been successful. Nothing must be allowed to go wrong, now.

The incoming planet would be at opposition in sixteen days, when it would be twenty million miles from Hasub and travelling along its orbit at 25.5 miles a second. If the launch did not take place then, all the years and frustrations of planning and hoping would be for nothing and the opportunity would be lost, perhaps for ever. Certainly, he and Atira would never see the planet again. If the impetus were not to carry them to the new worlds, then it would falter and stop, as surely they would. It had to be now.

He was deep into the mountains. The sun was almost at the zenith and its sombre, fiery glare suffused sky and land in crimson and mauve and indigo and black. Hasub was not a bright world. (How would it be to live in the light of that other star?) It seemed perpetually on the brink of a cosmic cataclysm. Perhaps that was closer than anyone realized.

There, on his right, was the cabin, standing near the edge of a small lake like a mirror of sparkling fire. Noss's airship was behind the cabin. Noss himself was sitting on their boat, idly throwing stones into the water, and watching the approach of Simde's craft.

Simde landed beside the other airship and, alighting, went to meet his friend.

Noss skimmed a stone over the smooth surface of the lake and said. 'I knew you'd come, Simde.'

Back at Noss's house, it was warm enough to sit on the terrace. Irah and Atira, in their deep, fibre chairs, looked elegant and beautiful. The hills formed a wide curve behind the house. The sun was high and, below them, the tall, feather-like trees, pregnant with many birds and insects, swayed in the soft breeze. Beyond lay the plains.

'You must have known for a long time.'

Atira continued to gaze at the view, although Irah's tension brushed her like static electricity.

'Yes. You could hardly help but notice that our social intercourse had fallen away to nothing. I couldn't risk my family or myself being tainted. You understand.'

She looked at Irah; her head was down and her long hair hid her face.

'Why did you do it, Irah? You are young, beautiful, loved, with everything you want, perhaps two hundred years of life ahead of you.'

'Noss made me feel *old*!'

The bitterness of the revelation shocked Atira.

'I should never have joined with him.'

'No, you shouldn't. Simde and I, and many others, always thought that. Noss was much older than you. Maybe he saw in you his last chance for a glimpse of immortality and you couldn't give him even that.'

Irah's great green eyes stared at Atira, disbelieving her words and tone, and her lips were drawn back over her gaudily-stained gums. Her breast, normally always flat in adult females, distended with her tremulous breathing.

Atira had never spoken to Irah in this way before, preferring not to interfere, guiding and adivising the younger woman whenever possible. But now she pressed on, determined to make Irah realize the enormity of her fall, before society inevitably did so. It might help to ease the impact of what was to come.

'Noss did everything he could to make you happy—'

'That's part of what went wrong. Our whole life together was minutely planned and calculated. I couldn't bear it all the time. I had to get release somehow.'

She was appealing to Atira as a woman and that drew a response. However, Atira was also a wife and a mother and a devoted friend of Noss.

'You knew all that before you joined.'

Irah pulled her hair with a distraught hand and said in a low voice. 'I admit that, Atira. Only, once I knew that I would have to live with it, all the time — I wasn't strong enough.'

'But you were devious enough, and thoughtless enough, to endanger Noss.'

Irah was crying quietly and the tears clung to her fine facial pelt like early morning dew.

'How serious is it with Noss?'

'The healer wouldn't say, but I knew from his manner that it must be very bad. Noss knew, too. What am I to do, Atira?'

The sound of an airship, coming this way, reached their ears.

Atira went to her and held her. 'Wait, Simde has gone to find Noss, at the lake, I suspect. He must go for treatment. And you must identify those with whom you've been joining. The healers will find out what drugs they have been taking to by-pass their sex-sublimation centre and that knowledge might help to save Noss.'

The airship was recognizable, now. The Custodians. Irah clung to the older woman.

'We'll do all we can for you.'

The airship landed at the end of the terrace and one of the two Custodians, in his smart, effacing tunic, jumped out and came to them.

He acknowledged the women and said: 'Irah Sidl.'

'I'm ready, Custodian.' Irah raised her head high.

They held hands briefly, then Irah went to the airship. Atira watched until it was out of sight. Then she, too, cried. It had begun.

(To be continued)

25 YEARS OF RADIO SEARCHES

(contd. from p.2)

basis. They are the Ohio SETI project of John Kraus and Robert Dixon at the Ohio State University, and the Sentinel Project of Paul Horowitz at the Harvard-Smithsonian Oak Ridge Observatory.

Most of these searches have been conducted at the hydrogen frequency, following the initial idea of Cocconi and Morrison that the extraterrestrials will try to make contact as easy as possible by transmitting at a universally known radio frequency. Several other radio lines have also been used in these searches, including those of hydroxyl (OH), water, carbon monoxide, etc. The lack of any positive results at all these frequencies has prompted NASA to develop a new search programme that will explore with high frequency resolution the entire microwave window (1-10GHz) of the Earth, and especially the region near the H and OH lines, which is often called the "Water Hole."

Future Prospects

The cornerstone of this new programme will be a revolutionary Multi-Channel Spectrum Analyzer (MCSA) with 8.25 million channels now being developed for NASA by Stanford University. The NASA SETI Programme will have two components, the Targeted Search that will focus on about 1,000 Sun-like stars and selected other targets and will emphasize high sensitivity and spectral resolution (1 Hz/channel), and the Sky-Survey that will scan the entire celestial sphere and will emphasize sky coverage and frequency range covering the entire microwave window but with a resolution of 32 Hz/channel. This programme is expected to get under way around 1990,and hopefully will be completed by the year 2000 or so, greatly enhancing the volume of the Search Space (the "Cosmic Haystack," as it is often called) that will have been explored.

Thus in this new field with so many interesting anniversaries, by the year 2007, when Radio Astronomy (and I!) will be seventy-five, the Space Era fifty, and our Commission twenty-five years old, we will know much more about the prevalence of life and intelligence in the Universe. The ancient Greek philosopher Metrodorus of Chios wrote 2,400 years ago, "It seems impossible in a large field to have only one shaft of wheat, and in an infinite universe to have only one living world." At long last we have the science and technology to try to answer this old and profound question.

It has been a privilege to serve as the first President of IAU Commission 51, and to be part of the astronomical search for extraterrestrial life, this new and exciting branch of Astronomy which is rapidly becoming known as "Bio-astronomy."

ANNOUNCEMENTS

REVIEW MEETING OF IAU COMMISSION 51

Saturday Morning 23 November 1985
Room A 9-12 a.m.

CHANGE IN PROGRAMME

49/5 scheduled for 22-2 in Room No. K changed to 22-3 and will be in Room J.

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XIX GENERAL ASSEMBLY
NEW DELHI 1985

NO. 5 : SATURDAY 23 NOVEMBER

Editor : ARCHIE E. ROY
Associate Editor : A. RATNAKAR

SECOND INVITED DISCOURSE

The topic of the second invited discourse at the General Assembly on Friday evening was Venus — which is often called the twin sister of our planet. Many at the XIX IAU had been eagerly looking forward to hearing one of the leading Soviet space scientists, Prof. Roald Zimmerovich Sagdeev. But as was announced earlier, Prof. Sagdeev could not come and the talk was read by his compatriot Prof. A.G. Massevitch. Prof. L. Kresak of the Astronomical Institute of the Slovak Academy introduced the speaker.

Commencing her presentation in a lighter vein, Prof. Massevitch said that a talk on Venus — which has always been the symbol of beauty, love and femininity — should surely be given by a man. While almost everyone in the audience applauded, one could clearly hear a lone female voice saying 'No'!

The well-organised review of the current status of our knowledge of Venus began with a brief history of man's efforts to understand the planet. She said that it was only in the twentieth century that most significant results in the astronomical studies of Venus could be obtained with sophisticated technology when spectral investigations were started and radio astronomy techniques were first employed. She said that even 15 years ago our knowledge of the nature of the Venusian clouds was completely obscure.

It was with the help of radioastronomy that we determined its retrograde rotation and the radius of the solid body of Venus. The next major step in our quest to gain a greater understanding of Venus came, predictably, after the space era.

The space era crucially changed many of our concepts about Venus. New data on the physical and chemical properties of the atmosphere, abundances, mechanical properties, the images of the planet's surface and other features were obtained by the USSR automatic stations Venera-4 to 16, the spacecrafts Vega 1 and 2, and by the US space vehicles Mariner-5, 10 and Pioneer-Venus.

Prof. Massevitch then went on to describe the most essential results of recent investigations, particularly those concerning the physical and chemical properties of its atmosphere and the surface.

Measurements of temperature and pressure variations with height were carried out with the help of descending probes. Results obtained from space vehicles Venera-7 to 10 established that the surface temperature was about 750 K and the pressure about 100 atm.

The early space-borne experiments clearly showed that carbon dioxide is the major component of the Venusian atmosphere; its abundance was estimated as 96.5%. An important minor component, sulphur dioxide (150 ppm) was confirmed by direct measurements from Pioneer-Venus and Venera-12 probes in 1979.

Data collected by Vega-1 and Vega-2 missions have convincingly proved the presence of sulphuric acid aerosols in the Venusian clouds. If the Vega data on the presence of chlorine and phosphorus is confirmed, it would lead to a radical revision of our current ideas of the chemistry of the planets.

NOT the speaker at the Invited Discourse II BUT one of the beautiful dancers at the cultural evening on Thursday at Hotel Ashok

Another question that is receiving attention concerns the mechanism by which Venus lost its water, and we are yet not sure how it happened. Other interesting results of Venus concern the abundance of inert gas isotopes, and the distribution of thermal currents in the atmosphere and its relatively low magnetic moment.

The second part of the talk dealt with the atmospheric dynamics of Venus, particularly the super-rotation of the atmosphere and the interesting results obtained through the Vega balloons, each one of which operated for about 48 hours and obtained information over 11,000 km of their drift. Experiments are under way which should provide information on the direction of large-scale pulsations of horizontal and vertical components of the wind velocity.

The talk turned to the surface of Venus. Imaging reveals that it is rather flat with a few lava flows dotting the plains. Venusian rocks are similar to terrestrial rocks and lunar basalts. Many craters, possibly of impact origin, and some less-prominent formations indicate that in the past 600 million to 3 billion years, the surface of Venus was intensely reworked.

Maybe, these problems do not cover the whole range of problems related to studies of Venus but, undoubtedly there remain problems to be solved such as the determination of the chemical composition of the near-surface atmosphere and aerosol in the cloud layer, study of the UV absorption, the intensity of the volcanic and seismic activity of Venus, the interior structure and the water deficit problem.

Prof. Sagdeev's review gave due credit to the enormous contributions made to our knowledge of Venus by the several US space missions, and reaffirmed the necessity for continued international collaboration.

Concluding her presentation, Massevitch wondered whether the new discoveries would change our idea of Venus as a symbol of love; beauty and femininity. She was sure that the high temperature and sulphuric acid could not change our image of Venus. After all, who would like love to be lukewarm or which family is free of minor explosions.

ASTRONOMY FOR EVERYONE

Commission 46 arranges an informal discussion on "Popularization of Astronomy" (meeting 46/7) in Room L on 25 November, Session 4 (16.00 - 17.30). James Cornell, President of the International Science Writers' Association, and Lief Robinson, editor of *Sky and Telescope*, have agreed to lead the discussion.

ANNOUNCEMENTS

CITY TOUR

The City Tour on Saturday 23 November begins from Vigyan Bhavan. The tour is free to all IAU participants and registered guests. All those who wish to join the tour should assemble in front of the main entrance to Vigyan Bhavan at 2 p.m.

The tour will take you for brief visits to the Red Fort, Raj Ghat, Jantar Mantar and Qutab Minar. *En route* you will see Safdarjung Tomb, Ferozshah Kotla, Haus Khas, Purana Qila, India Gate, Parliament House and Rashtrapati Bhavan.

The buses will bring you to the Red Fort at 6 p.m. for a *Son et Lumiere* Show.

This tour is restricted to delegates and registered guests only.

AGRA EXCURSION

For "Agra Excursion", coaches will leave from the following hotels at 7.00 a.m. on Sunday 24 November 1985: Ashoka, Kanishka, Janpath, Lodhi, Qutab, Centaur, Ashok Yatri Niwas and Ranjit.

Those who are *not* staying in these hotels may please reach nearest one of the above hotels by 6.45 a.m. positively.

CULTURAL PROGRAMMES

For all Cultural Programmes, sightseeing tour and excursion to Agra, delegates and registered guests are requested to wear their badges.

PROGRAMME FOR REGISTERED GUESTS

Venue of registered guests' programme for 25, 26 and 27 November, 1985 is

BANQUET HALL
HOTEL ASHOK

Those who would like to reach directly may please do so. However, buses for the same will leave Vigyan Bhavan at 10 a.m. as usual.

RADIO DISCUSSION

All India Radio, Delhi-B (450.5 m) will broadcast programme 'Current Affairs' on *Astronomy in the Modern World* Sunday, 24 November 1985 at 9.30 p.m.

Participants are:

Prof Hanbury Brown, Dr. Richard West, Dr. W. Livingston and Dr. J.C. Bhattacharya.

EDITORIAL

TRUTH – DO WE *REALLY* WANT IT?

The popular view of the scientist (widely held throughout his varied disciplines) is of the searcher after truth, prepared to follow the evidence no matter where it leads him, no matter if the direction is the one he is most reluctant to take. Truth is all. He bemoans a lack of data, he is constantly striving to devise new methods and instruments that will increase his stock of facts. Unlike the late Sam Goldwyn, who is alleged to have said (among so many other couthy aphorisms he may or may not have uttered) "My mind is made up: don't confuse me with facts", our scientist is solely motivated by his regard for the truth of the matter. Often he would claim that his most deeply nurtured and cherished hypothesis would be stoically abandoned if contradictory facts were uncovered.

And yet experience tells otherwise. It is the nature of things that many a beautiful hypothesis is slain by an ugly little fact and to hear the screams of anguish wrung from the lips of the owners of these hypotheses and observe their reluctance to change their minds, you might be forgiven for thinking that their lives were at risk. Consider, for example, how long it took for the helicocentric theory to supplant the geocentric.

It is of course one of the strengths of science that it is conservative and views innovations with suspicion. It is all very well for enthusiasts for change to point out that the lot of the great pioneer is invariably one of rejection and struggle, a slow progress through the well-known trinity of reactions by the establishment: (1) the man's mad; (2) well I suppose we'd better take a little time to find the flaw and get rid of him; and (3) of course I always knew he was right. But equally well, the establishment can point to Marx's great dictum — Groucho, not Karl: They claimed Galileo was mad when he said the Earth orbited the Sun but he was right; they said the Wright Brothers were crazy when they tried to fly, but they did; they said my Uncle Wilbur was mad as a hatter — and he was!

But I digress.

This matter of truth arose the other morning when your editors, taking a little time off from their never-ending labours in composing and producing *Mandakini*, walked in the beautiful Lodhi Gardens, a sixty-acre spread of woodlands and park, ponds, shrubs, flowers, and ancient monuments that inspired me to ask Mr Ratnakar questions about the spectacular tombs, which in their grandeur, rivalled many mediaeval European castles. Mr Ratnakar told me they belonged to the Lodi dynasty which flourished in the fifteenth century. I wished to know more but truth was buried in the sands of time. We thought how useful it would be to have a time-machine which would take us back to see the dynasty's works in their heyday; we discussed the astronomer's time machine, the telescope, courtesy of the finite velocity of light, and as we trode the attractive paths of the Lodi Gardens, we found ourselves following another well-trodden path (cf Isaac Asimov's story 'The Dead Past'). If a machine was indeed invented by which it was possible to view the past, then all truth would be accessible in history, religion, geology, astronomy ..... the lot.

Marvellous! But wait a minute. The past begins when? Certainly a minute ago is part of the past. And so all truth would likewise be known about living people — politicians, famous public figures, *and* ourselves, known to everyone in possession of a timescope.

Could society survive such an avalanche of truth? Or would it truly be, in the well-worn words, 'the end of civilisation as we know it?

Mr Ratnakar and I came to the conclusions that we simply did not know what would be the consequences of such an invention, where quite literally nothing is hidden from the user of a timescope. Try it for yourself. Consider the ramifications of such an invention and then ask yourself: do we *really* want the truth? Even in our chosen discipline of astronomy, would we for example really want to know that in an almost infinitely large universe the human race is the only intelligent(?) life or, if not, is probably the most primitive species of the lot?

If you have a moment to spare, write us a letter about your views. And if you are on the point of inventing a timescope, I think I'd really rather you didn't. To quote another well-worn phrase, I don't think 'man was meant to meddle in such realms'.

— *Archie E. Roy*

DOWN MEMORY LANE — GLIMPSES FROM PAST GENERAL ASSEMBLIES

VI GENERAL ASSEMBLY, STOCKHOLM 1938

The Astronomical Union held its sixth General Assembly in Stockholm during August 3-10. Around two hundred and ninety people participated in the deliberations.

Four colloquia on different topics were held. These were on 'Emission Lines', 'Galactic Structure and Allied Problems', 'Spectrophotometry' and 'Energy Generation in Stars'.

Speaking at the colloquia on 'Emission Lines', Prof. Russell pointed out that examples of resonance radiation were provided by the spectra of chromospheres and comets. The formation of emission lines in nebular envelopes was discussed by Dr H. Zanstra; problems raised by the spectrum of the solar chromosphere were presented by Prof. Menzel; Dr P.W. Merril described the observational data relating to stars. In the colloquium on 'Galactic Structure', Prof. B.J. Bok referred to the programmes of extensive star counts; Prof. Lindblad presented his theory of galactic rotation and star-streaming; the recent work at the Harvard Observatory was presented by Prof. Shapley. At the colloquium on 'Spectrophotometry', Prof. Unsold described the theory of the formation of continuous and absorption spectra in stellar atmospheres, and Dr R.O. Redman outlined the difficulties encountered in the measurement of line profiles. At the colloquium on 'Energy Generation', presentations were made by Stromgren, Atkinson and H.N. Russell. Among the

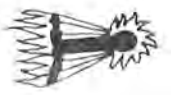
(Continued on p. 8)

NEAR-INFRARED ASTRONOMY IN INDIA

P.V. KULKARNI
Physical Research Laboratory
Ahmedabad

A decade ago, Physical Research Laboratory (PRL), Ahmedabad, decided to take up experimental programmes in the field of near-infrared astronomy. Even on the world scale then it was a young branch of astronomy and the tropical latitudes of India were considered to be an advantage to have access to more sources.

Beginning in 1976 was modest with a photometer fabricated in-house and having a PbS, uncooled detector. However, the complete photometer including a data acquisition system was home-made, which gave some experience in IR photometry to PRL group. Another version of the above photometer was fabricated with a PbS detector cooled to solid CO_2 temperature. Photometry in J, H and K bands (1.2, 1.6 and 2.2 μm) on several sources brighter than the first magnitude in J was done and the results were compared with those of others to test the reliability of the instrument and to find out the long-term variability of some IR sources. Some dark clouds were also scanned. The first 2/3 years were needed to learn the IR observing techniques and for getting ourselves familiar with the IR instrumentation. In late 1978 with an imported photometer with a LN_2 cooled InSb detector and the peripheral electronics built in PRL, the group began professional IR photometry.



Infrared Bursts

Early in 1979 scientists from the Tata Institute of Fundamental Research (TIFR), Bombay, while trying to model the rapid X-ray burster, thought that the mechanism they had in mind would also emit near-IR bursts along with those in X-rays. Upon this suggestion PRL scientists with their IR photometer monitored the rapid burster MXB 1730/333 at Kavalur on the 1 m telescope of the Indian Institue of Astrophysics (IIA) and observed six IR bursts on April 5, 1979 emitting total energies between $1\text{-}3 \times 10^{38}$ erg in H band. This was a very exciting result which would enable monitoring X-ray bursts from stars with ground-based IR observations. Unfortunately, at that time there were no simultaneous observations in X-rays. After about five months, astronomers from Imperial College, London, observed similar bursts on September 5 1979 and confirmed our findings. At this time also there were no simultaneous observations in X-rays and the basic question of whether X-ray bursts emit near-IR emissions simultaneously could not be verified experimentally. There has been only one negative result and the good boy MXB 1730-333, who was very regular in his behaviour for the 2-3 previous years, started behaving unpredictably; so the verification still remains.

The PRL astronomers studied Be stars as a class for their IR emission and found IR excess in most of them. A model which was proposed showed that the excess is due to the circumstellar envelope and is accounted for properly by taking into consideration the total luminosity of the central star and not merely the Lyman continuum in the UV. The infrared luminosity also showed a good correlation with $H\alpha$ luminosity estimated by French astronomers.

Studies at IIA and PRL

The Indian Institute of Astrophysics (IIA), Bangalore, and PRL have studied several stars in the near-IR. the RCrB type XX Cam did not show any IR excess in contrast to the stars of its class. It was suggested that this may happen in a stage of evolution later than the RCrB and the RY Sgr stars showing deficiency of hydrogen and lithium and enhancement of carbon. The Hr 2947, a B6 Vn star, was used as a photometric standard, but was found to have varying magnitudes. If the variation was real, it was suggested with near-IR observations that this would be due to the formation of a thin gas shell around the star.

While trying to detect sources in near-IR already detected by the IRAS satellite, PRL astronomers detected an uncatalogued source with $m_k = 4.3$ at $04^h52^m08^s$ $44^o26'5$. There was no optical counterpart brighter than $m_v = 15$. The star is not a variable.

From the wavelength-dependent observations in the near-IR,2-2.5 m region on the eclipse depths of the Epsilon Aurigae, the presence of light-obsorbing particles larger than 10 μm size was proposed by PRL scientists.

Activity at TIFR

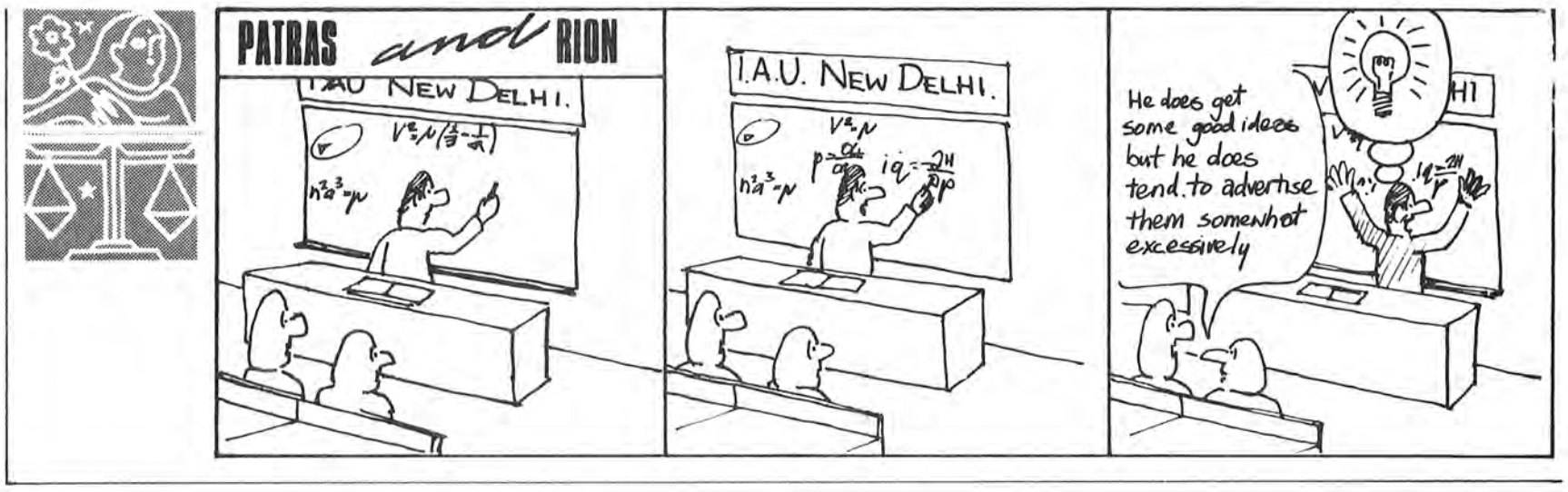
A major activity of TIFR infrared group is in the far-infrared ballon programme. However, since 1980 they also have experimental programmes in the ground-based near-IR observations. They have taken up investigation of "unidentified sources" of the Equatorial Infrared Catalogue-I (EIC-I). They have detected over 80 stars and catalogued their magnitudes in J.H.K spectral bands, and concluded that most of them are reddended M type giants. A few of them could be potential reddened T Tauri stars. They also concluded that in general the unidentified class of stars in EIC-I were fainter than their identified counterparts.

Infrared Telescope

The ground-based IR astronomical work in India so far is done on the conventional optical telescopes. Therefore a need for a dedicated IR telescope was felt,right from the beginning. PRL has taken up this responsibility. A 1.2m IR telescope is in the final stage of installation and testing at Gurushikhar Infrared Observatory near Mt Abu, Rajasthan, India. This place is at 24^o 39' N latitude, $72^o43'$ E longitude, at an altitude of 1700 m, and is 250 km north of Ahmedabad. Systematic measurements of total precipitable water vapour were made for a few years and it was concluded that the site is good for an IR telescope. Average number of clear nights per year should exceed 250. A Fourier Transform Spectrometer covering 1-3 μm range is under fabrication and is expected to be used on this telescope for solving a number of problems requiring high resolution spectroscopy.

With this new facility coming into operation in a few months it is hoped that a group of infrared astronomers would come up in India.

gASTRONOMY CORNER



GAJAR HALWA

(An Indian Sweet. Made of Carrots and Milk)

	Ingredients	Quantity
1.	Carrots	225 g
2.	Sugar	115 g
3.	Milk	120 ml
4.	Fat	55 g
5.	Dried fruits and nuts	20 g
6.	Cardamom	a little
7.	Khoya (cream)	50 g

Method

1. Wash carrots, peel and grate.
2. Add carrots to the milk and cook till the milk dries up.
3. Add fat and fry.
4. Add sugar, prepared fruits, crushed cardamom and sprinkle khoya on to the halwa.
5. Serve hot.

NB : Serves Four.

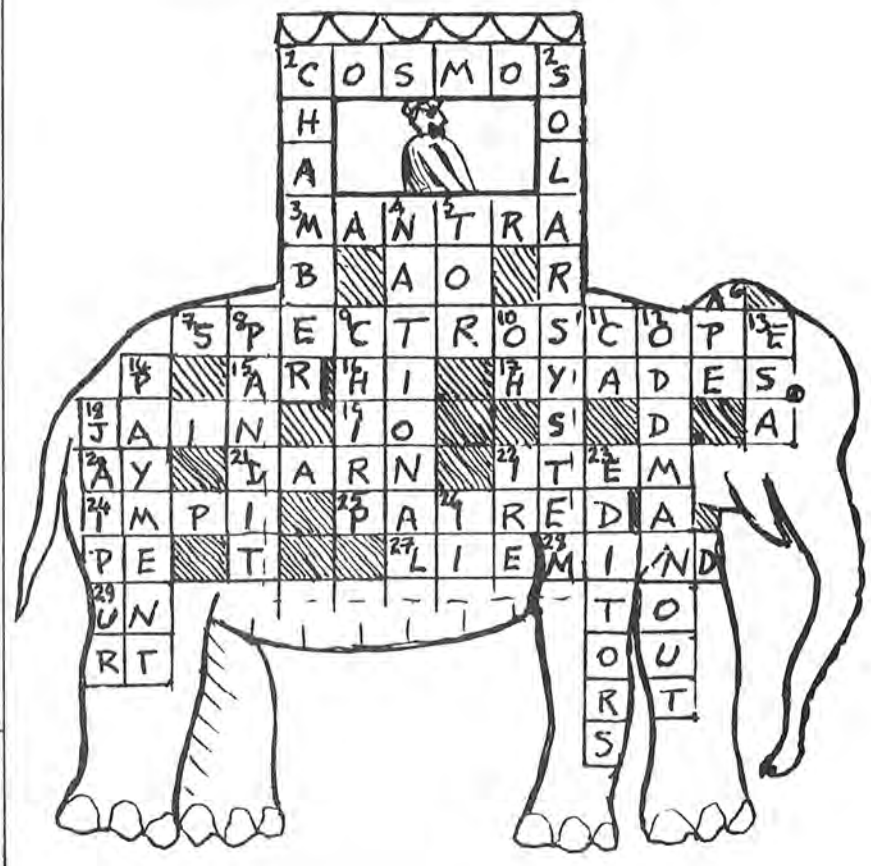
YOUR DELICIOUS LUNCH DISHES

These come to you at Vigyan Bhavan from Ashok Mayur (AM), a unit of ITDC. Not merely the palatable dishes, AM provides, if you need, facilities of photocopiers and electric typewriters also.

Comet Mania

The fact that the Earth would pass through the tail of Halley's Comet on 19 May 1910 caused some panic. This postcard is typical of the feeling of the time; the comet approaches, people are seen leaving Earth with all possible speed to avoid "The End of the World" while the Moon awaits them with welcoming arms. Some enterprising persons even sold to the gullible such items as "Comet Pills", gas masks and shelters.

SOLUTION TO ELEPHANT CROSSWORD



BINARY STARS: AN EMBARRASSMENT OF RICHES

MARIO E. FRACASTORO

The first IAU General Assembly was held in Rome, Italy, in 1922. Among the several commissions, instituted with the aim of promoting worldwide collaboration in the various specialized fields, a commission dedicated to binary stars was inevitable. Under this label, at that time, all binary systems were included, namely those separable at the telescope (visual binaries), as well as those shown as doubles through the variability of their radial velocity (spectroscopic binaries) or through photometric changes (eclipsing binaries). For these "close" binaries a special commission was instituted in 1948.

In 1982, again for Commission 26, a new denomination was adopted, namely "Binary and Multiple Stars", to take account of the fact that many systems contain three or more components.

In 1922 R.G. Aitken, unanimously recognised as the highest authority in the field, became the President of Commission 26 and he remained in chair until 1928, when he was succeeded by E. Hertzsprung, well known for his contribution to the H-R diagram. He had great merits also in the photographic study of binaries. In turn he was succeeded in 1938 by H. van den Bos, one of the most assiduous observers of double stars in any era. He worked mostly in South Africa, using a long-focus refractor and having at his disposal the almost unexplored skies of the southern hemisphere.

A Certain Reluctance

The story of binary stars is similar to that of the variables. As a residual Aristotelian mentality (immutability of the heavens), the idea that stars could change their brightness was accepted reluctantly. It has often been suggested that *Algol* bears this Arabian name (which means "the devil") just because somebody in ancient times had noted its variability. Certainty was only reached later (Montanari, 1650); however, variable stars were considered as extremely rare cases. Consequently, when the problem rose of compiling a list of them for each constellation, it was thought that a letter of the alphabet would be sufficient. Moreover, the denomination started with the letter "R", supposing that the list would be exhausted well before arriving at "Z". It is well known how things subsequently evolved.

Similarly, binary stars were not accepted easily by astronomers. W. Herschel, perhaps too much bound to his hypothesis that all stars have the same intrinsic luminosity, was reluctant to admit that a faint star, angularly very close to another much brighter, could actually be at the same distance. In vain the Rev. Mitchell objected, on statistical grounds, that too many pairs in the sky were observed to arise by chance. Herschel surrendered only when, after decades, an orbital motion was observed of the companion around the main star. At this point, the search for double stars was taken up in earnest and their number grew rapidly. Every discoverer had his own list and worked industriously to add new entries to it, in a sort of competition among the most assiduous sky watchers.

Meanwhile, somebody had to take up the task of gathering and cataloguing this material, even if some inhomogeneity was unavoidable owing to the variety of people and instruments contributing to the compilation of these partial lists.

Good Advice Ignored

Let's come back now to our chronology. When van den Bos became President, he did not hesitate to go against the current fashion, saying that it was nonsense to discover new pairs when the available manpower was not sufficient to keep under control those already catalogued, with most of them waiting even to be observed a second time after their discovery.

G.P. Kuiper clearly stated that it was necessary to restrict attention mainly to these nearby couples having a well-determined parallax and consequently known absolute magnitudes and masses, the fundamental target being the empirical construction of the mass-luminosity relationship.

In practice, the suggestions of van den Bos and Kuiper were largely ignored. Who would renounce the pride of adding a *new* entry to *his/her* list in order to give an almost anonymous contribution to an already known binary? After all, periods are usually so long that several decades must elapse before the companion describes a complete orbit, or at least a significant part of it.

In passing, it must be admitted that often people succumbed to the temptation to calculate new orbits well before the right time, perhaps trusting the analytic methods or the computers currently in use, forgetting that neither the method nor computer can create information when this is intrinsically meagre! In fact, experts claim that, among all orbits already calculated, only 5 per cent, namely about fifty of them, are reliable enough for deducing good orbital elements. That means that, out of some fifty thousand binaries stored in the most recent catalogues, only one out of a thousand has given a contribution not merely statistical.

In this competition among double-star observers, there intervened at a certain moment W.J. Luyten who, comparing Schmidt plates taken at different epochs, singled out hundreds and later thousands of couples formed by stars having a common proper motion, namely travelling together inside the Galaxy. When their number reached seven thousand Luyten declared he had discovered, inside his laboratory, more binaries than anybody else. Unfortunately, the experts' advice was that these couples could not be considered as binary systems, lacking in practice the possibility of pointing out a gravitational link and therefore they could not be included into the commission competence. And Luyten resigned.

The Milliarc second Goal

As a matter of fact, it is not easy to define a double star, namely to set a higher limit to the orbital period or a lower limit to the mass ratio. Suppose we put an apple around a star: does it become a double? An answer may be found from a pragmatic rather than a conceptual basis. A star can be considered as a binary system when the observations are good enough for detecting an orbital motion around a centre of mass, namely the existence of a companion, visible or not. After all, bodies having masses too small for triggering thermonuclear reactions and consequently for radiating, do exist. We live on one!

The term Astrometric binaries' is given to those stars for which a separation into two distinct images is not possible but where a nonlinear displacement of the photographic image with respect to the background stars is ascertained.

Suppose that an alien astrometrist, placed at 2 parsecs from us, observes our Sun. He will not see Jupiter directly, although it is separated by 2.6 arcseconds from the Sun. However, the Sun will show a wavy displacement among the field stars, as a consequence of its revolution around the centre of mass of the Sun-Jupiter system. The period of this oscillation will be about 12 years and its amplitude only 0.0026 arcseconds. Therefore, our Sun will be classified as a binary star only when our alien astronomer is able to measure angles as small as — say — one milliarcsecond (m.a.s.). His task will be to ascertain the physical nature of the invisible body gravitationally influencing the main star.

The millisecond of arc represents, in some way, the frontier between traditional astrometry and the new techniques. That's why discoveries of substellar bodies have been announced in recent decades and vigorously denied. Now, a young technique, "speckle interferometry", permits us to achieve the m.a.s. and to separate the images of very close pairs. Some of them till now were observed only as spectroscopic binaries. Conversely, technical improvements in radial velocity measurements will permit us very soon to examine as spectroscopic binaries, pairs hitherto observed as visual or astrometric doubles.

Paradoxically, an incentive to search for and to improve the statistics of binary stars (visual and astrometric) is given by space research. Objects like that are not good reference stars for the telescope and this implies an accurate inventory of all known binaries and the collection of reliable statistics about the frequency of double and multiple stars.

There is clearly a great amount of work to do in the coming years, for a lot of people, including those of the "old" Commission 26!

A comet is a star that runs not being fixed like a planet, but a bastard among planets. It is a haughty and proud star engrossing the whole element, and carrying itself as if it were there alone.

Martin Luther (1483-1546)

CHAIRMAN OF THE LOCAL ORGANISING COMMITTEE

A.P. MITRA

At present Director, National Physical Laboratory, A.P. Mitra was born on 21 February 1927. He obtained his D. Phil. from Calcutta University in 1955. Mitra joined the National Physical Laboratory in 1954 as Secretary, Radio Research Committee of CSIR, entrusted with the task of initiating work on Ionospheric Data Coordination and Prediction as a national effort. Within a few months, Mitra initiated an Ionospheric Prediction Service based on a new method of predictions of solar activity that has since proved to be surprisingly effective. In 1958 he was made Asstt Director and Head of the Radio Propagation Unit at NPL. When the Indian National Committee for Space Research (INCOSPAR) was formed, Mitra was one of its members and was associated with the planning and growth of space science in India.

In the 1970s, he was asked to serve as a member of the Task Force to plan and organise research efforts leading to large-scale troposcatter systems in the country. He was instrumental in the preparation of an Atlas of Radio Climatology over the Indian Subcontinent, now used as a basic reference document.

In 1980, Mitra was awarded the Jawaharlal Nehru Fellowship to carry out a study on Human Influences on the Earth's Environment. As Chairman, Scientific Advisory Committee of the Indian Middle Atmosphere Programme (IMAP), he has played a major role in the formulation and operation of IMAP.

Dr Mitra has held important positions both at home and in international scientific bodies. At present he is President International Union of Radio Science (URSI), and Member, General Committee of International Council of Scientific Unions (ICSU). He is also Chairman, Indian National Committee for URSI. He is a Fellow of the Indian National Science Academy and the Indian Academy of Sciences.

Dr Mitra is the recipient of several awards and honours, among them the prestigious Premchand Roychand Award and Mouat Gold Medal of the Calcutta University (1955), Shanti Swarup Bhatnagar Prize for Physical Sciences (1968), Jawaharlal Nehru Fellowship (1978-80), Sir C.V. Raman Award of the University Grants Commission (1982) and FICCI Award for Physical Sciences (1982).

INFRARED ASTRONOMICAL LABORATORY TO COME UP AT Mt. NIMMU

Indian scientists are planning to build an infrared astronomical observatory on the 4100-m Mt. Nimmu in the Himalayas. The site is about 25 km from Leh in the Ladakh District of the northernmost state of Jammu and Kashmir.

This was reported on November 21 by Dr S. Bhatnagar, Director of the Udaipur Solar Observatory, at the meeting of IAU Commission 50 on 'Protection of Existing and Potential Observatory Sites'. The Indian scientist said that the proposed observatory would be a national effort funded by the Department of Science and Technology. Participants in the project include Indian Institute of Astrophysics, Tata Institute of Fundamental Research (TIFR), Osmania University, Physical Research Laboratory (PRL), Udaipur Solar Observatory, Defence Research & Development Organization, and the Uttar Pradesh State Observatory in Naini Tal. Dr Bhatnagar said that a base station and automatic weather station (which sends data to New Delhi via satellite) have been set up in Mt. Nimmu and the guest house in Leh has been turned into a laboratory.

According to Dr Bhatnagar, the proposed site is free of cloud cover for eight months in a year, has 25 km visibility for 25 days a month, and very low water vapour in atmosphere. The site is ideal, he said, not only because of its location on the world's highest mountain range, but because the region is dry as it is outside the shadow of the Indian monsoon. The average rainfall is less than 12 cm a year.

Later, speaking to *Mandakini*, Dr Bhatnagar said: "We are presently evaluating meteorological and astronomical conditions in Ladakh region to see how they compare with data in other regions of the world where infrared observatories have been set up."

India may set up a 100-inch (254-cm) telescope in Mt. Nimmu in five to seven years. The observatory would open a new field of study to look at radiation in the wavelength up to 20μm.

He said there are only a few observatories in the world at heights above 4000 m, the US Observatory in Hawaii being one of them. It was reported at the commission meeting that Chile is also planning to set up an infrared observatory at 6000 m in the Andes.

According to Dr Bhatnagar, the proposed observatory in Mt. Nimmu will supplement Indian infrared observations currently being made from Gurushiker in Rajasthan (height, 1800 m) using a PRL-built telescope, and balloon-borne telescopes launched occasionally by TIFR.

TIFR astronomer Dr K.V.K. Iyengar told *Mandakini* that radiation in far-infrared could be studied using the one-metre TIFR telescope carried by balloons to a height of 30 km. He said that one balloon flight in 1980 recorded the temperature of Saturn and another flight in March this year provided valuable information in the 100-200 μm range.

WHAT IS THE STATUS OF ASTRONOMY EDUCATION IN IAU MEMBER COUNTRIES?

If you want to know how astronomy education and research are progressing in 20 of the 51 countries which are members of the IAU, you may read a copy of the IAU: Commission 46 — Teaching Newsletter, No. 18, Pt 1, May 1985.

This is the sixth report on the Development and Present State of Astronomy Education in Different Countries. This was specially prepared for the IAU's Delhi meet.

The report covers the following 20 countries: Australia, Belgium, Canada, Colombia, Egypt, Finland, France, GDR, FRG, India, Japan, Paraguay, Peru, Poland, Portugal, South Africa, Spain, USSR, UK and USA.

The reports of the various countries, which the newsletter carries, show the initiative of astronomers in countries both astronomically developed and struggling to make a start in astronomy, in countries of many different educational systems and political persuasions. Not only will these reports be useful to any astronomers anxious to develop astronomy education in their countries; they may also be able to convince their governments that astronomy education and proposed methods of astronomy teaching are both important and practical.

The report highlights the progress during 1982-85. Some salient features and excerpts from the report:

- In Australia the progress of astronomy in primary school and high school levels has reached a plateau because of the discontinuation of growth in national spending on education under a variety of governments.

  In Canada, as in USA, there has been recently concern about the quantity and quality of science education in the schools; and in many provinces, the school science curriculum is being reorganised and improved.
- In Finland astronomy education is confined mainly to the universities.
- In India no formal course in astronomy is given at school level.
- Similarly, in Poland astronomy is no longer taught as a separate subject in secondary schools.
- In USSR the popularity of astronomy and astrophysics is gradually increasing among all groups of population.
- In the UK the period 1982-85 being the period of decling budgets in all branches of education, astronomy has suffered the same fate as other subjects.
- In USA the period saw an increase in cooperation in astronomy education among the astronomy and physics societies, more attention being paid to educating the public about astronomy.

Owing to limitations of space it has not been possible for *Mandakini* to give a greater coverage. It is a useful document for educational departments of all countries.

Not the spinning couple Radhakrishnan showed in his slide to illustrate the mass transfer between stars but a real dancing couple at Hotel Ashok

A glimpse of Secretary West mining the IAU computerised file

Some organisers check that all participants are accounted for

ANNOUNCEMENTS

INDIAN VLBI STUDY GROUP MEETING

A meeting of the Indian VLBI Study Group will be held on November 26, 1985 in Room No. 'I' from 1400 to 1530 hours. All members of the Indian VLBI Study Group as well as eminent scientists (from India and abroad) who would like to advise/guide the Group are cordially invited to attend.

C.S. JOSHI
Convener VLBI Study Group

EXHIBITION OF BOOKS

There is a display of books and periodicals put up by several publishers. It is on the mezzanine floor on your left as you enter through the main entrance of Vigyan Bhavan.

SOLAR ECLIPSE 1988

Persons interested in discussing arrangements to observe the total solar eclipse in March 1988 are asked to meet on Tuesday, 26 November, Room I, 1100 hrs (Session II)

—Morris Aizenman
US Solar Eclipse Coordinator

COMMISSION 27 — VARIABLE STARS

N.H. BAKER
President, Commission 27

From the name of our Commission you might think it is very clear which stars fall within its scope and which do not. But things are not so simple. Whether or not a star is variable may well depend on how carefully you look at it, and now that even our Sun is known to be a variable star, who can say whether there are any non-variable stars at all? Of course we shall never be able to observe other stars as closely as we do the Sun, but it is still true that we don't yet know where the limits of the field of variable stars may lie.

The subject is so large already that several important classes of variables must be left to other commissions. Solar oscillations, which have given rise to the active new field of "helioseismology", are within the province of Commission 12 (Radiation and Structure of the Solar Atmosphere). [But now that similar low-amplitude oscillations are being discovered in other stars, it looks like we have another new field, which is already being called "asteroseismology".] Supernovae have their own Joint Working Group. Multiple systems belong to two other Commissions, 26 (Double and Multiple Stars) and 42 (Close Binary Stars). Our Commission works closely with these, and with others, like Commission 35 (Stellar Constitution), the natural home of variable-star theorists.

Like other Commissions, we help organize Symposia, Colloquia, Joint Discussions at General Assemblies, and the like. Sometimes Working Groups are organized to set up coordinated, simultaneous observations at several observatories or in several different regions of the electromagnetic spectrum. But because there are so many variable stars of so many different types, the bookkeeping becomes quite a problem, and one of the most important functions of Commission 27 is to help solve this problem. We do this in several ways.

A Catalogue on Tape

One of the most essential tools of the variable-star astronomer is the *General Catalog of Variable Stars.* This important reference book was first published in 1948 by the Soviet astronomers B.V. Kukarin and P.P. Parenago. It has been regularly updated and expanded so that by now the fourth edition, which will comprise five weighty volumes of closely packed data, is being published. An edition on magnetic tape is being produced at the same time. The total number of stars in the fourth edition will exceed 28,000, and data on variables in external galaxies will be included. The *GCVS* is a joint project of the USSR Academy of Sciences and the Sternberg State Astronomical Institute of the Moscow State University, and receives some financial support from the IAU through Commission 27. The astronomers primarily responsible are P.N. Kolopov and N.N. Samus.

Another important publication is the *Information Bulletin on Variable Stars,* which was started in 1961 to provide a vehicle for rapid dissemination of announcements and information about variable stars. Each issue is a pamphlet of a few pages, containing brief and current information about one or at most a few objects. More than 2600 issues have been published, and the popularity of the *IBVS* may fairly be judged by the fact that it is now necessary to print over 200 issues each year. From the start the *IBVS* has been produced by the Konkoly Observatory in Budapest. The first editor was L. Detre, who was succeeded by Bela Szeidl (the incoming President of our Commission at Delhi), now ably assisted by L. Szabados.

Variable-star observations are often copious, far too numerous to be printed in their entirety even in those journals known to have very tolerant editors. Yet sometimes these data can be useful to other observers, and in order to preserve them the "Archives of Unpublished Photoelectric Observations of Variable Stars" was established. Observational data (in a form that can be retrieved and used by other astronomers) are sent to the Coordinator (currently Michel Breger, in Vienna, who is the incoming Vice-President of our Commission), who forwards them to depositories in London, Strasbourg, and Odessa, from which they can be ordered. Current information about data submitted to the "Archives" is published in *IBVS.*

We have an active programme planned at Delhi, and we are all looking forward to it, but you can see from my account that Commission 27 keeps busy between General Assemblies, too.

SPACE JUNK: THE RINGS OF EARTH

ARTHUR A. HOAG
(IAU Commission 50)
Lowell Observatory, Flagstaff
Arizona

According to an article by Eliot Marshall in the October 25 issue of *Science*, there are now almost 6,000 manmade objects in orbit around the Earth that are large enough to be tracked (10 cm and larger). Add to this, 40,000 bits of debris in the one-centimetre size range and myriad smaller particles, and one sees that collisional hazards for astronauts and orbiting equipment are on the increase.

This junk is already a real hazard to some ground-based observing efforts. Russell Cannon, Head of the UK Schmidt Telescope Unit, reports, "I can easily produce examples of important photographs which have been spoiled by satellite trails running across objects of interest, and already we often find half-a-dozen or more trails crossing a single photograph."

Now we learn (*see*, for example, "News Notes" in the June 1985 *Sky and Telescope)* that the United States Government has authorized a private commercial concern to place reduced human remains, "cremains," in orbit. A number of resolutions adopted by the IAU address this issue, but they seem to have had no effect. The orbiting "cremains" proposal has been reviewed and approved by NASA, and by the U.S. Departments of State, Defence, and Transportation.

Members of Commission 50 urge that National Representatives of all IAU adhering nations bring this matter of the pollution of space to the attention of appropriate agencies of governments. Resolution No.1 of the XI General Assembly, Berkeley, 1961, is a prophetically valid concern:

Viewing with great concern the grave danger that some future space projects might seriously interfere with astronomical observations in the optical as well as in the radio domain,

and *believing* that a degree of contamination of space which at the present time would be hardly detectable, might, if long-lived, well be disastrous to future observations with improved techniques,

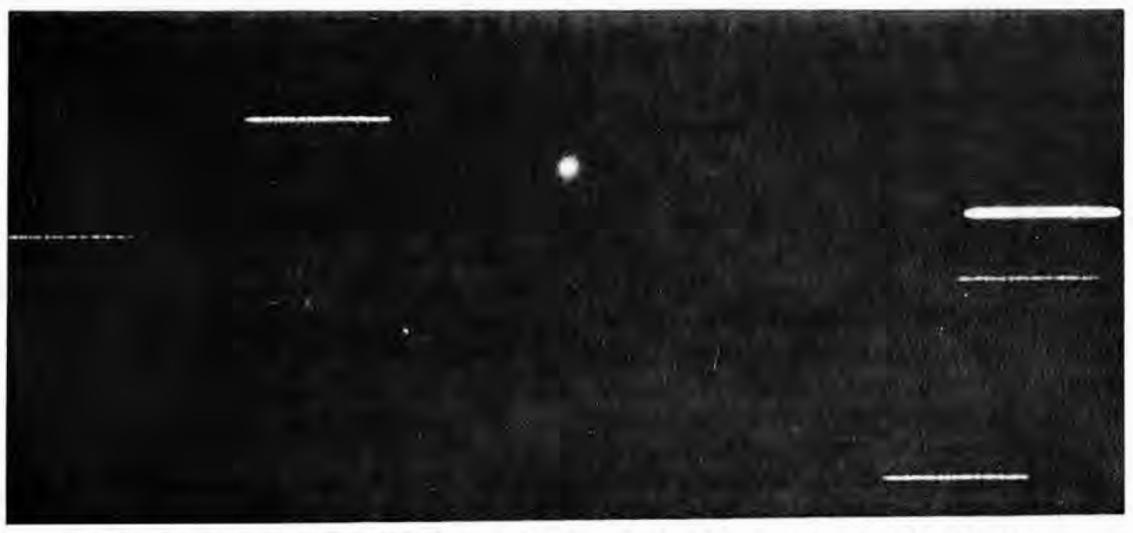
and *maintaining* that no group has the right to change the Earth's environment in any significant way without full international study and agreement;

the International Astronomical Union *gives* clear warning of the grave moral and material consequences which could stem from a disregard of the future of astronomical progress,

and *appeals* to all Governments concerned with launching space experiments which could possibly affect astronomical research to consult with the International Astronomical Union before undertaking such experiments and to refrain from launching until it is established beyond doubt that no damage will be done to astronomical research.

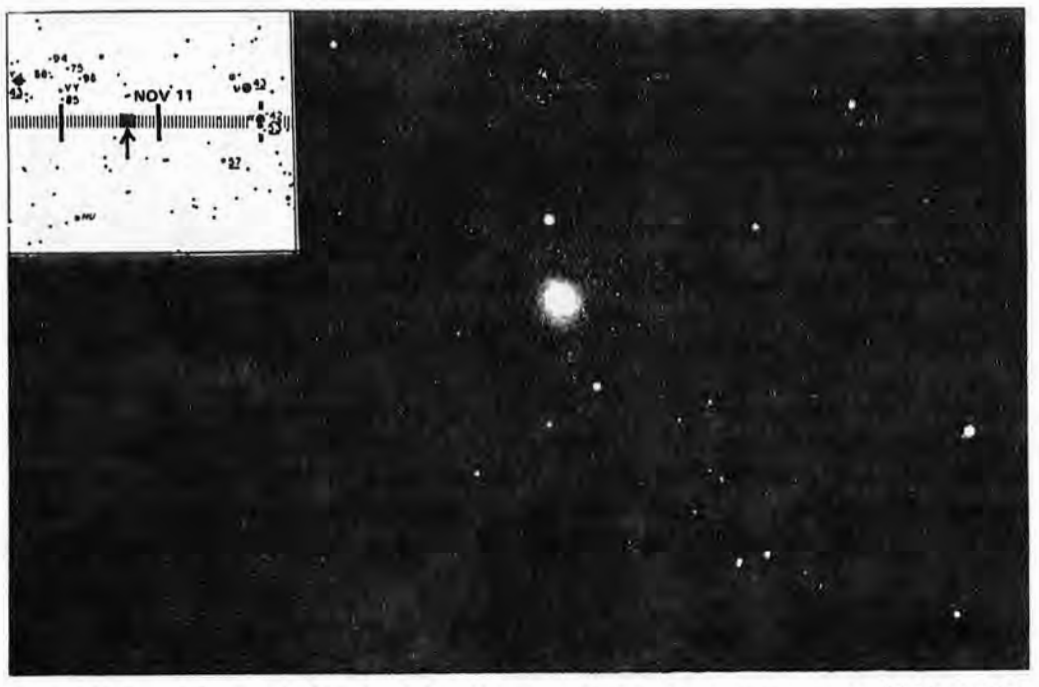
An example of "pollution" (dotted track) of a serious astronomical photograph by "space junk"

THE COMET IS HERE!



The above photograph of Comet Halley was taken with the 8-inch astrograph of the Japal-Rangapur Observatory, Osmania University, on 14 November 1985 at 21^h47^m IST (mid-time of 60 minutes exposure) by R. Swaminathan and C. Raghavender Rao. The exposure was made by guiding on the moving comet and hence the stationary stars have left their trailing marks. The brightest star-trail on the east side (right) is that of a 4.4 magnitude star (37 Tauri) in the Taurus constellation, to the east of Pleiades Cluster (Krithika).

The distance of the comet from the Earth at the time of this exposure is around 112 million kilometres.



Comet Halley, taken with Bosscha Schmidt Telescope, Lembang, Indonesia on 10 November 1985, 16.U.T.; on 103 aF + GG 14. Exp 5 min (B. Hidayat and E. Panjaitan)

THE DECAMETER WAVE RADIO TELESCOPE AT GAURIBIDANUR

CH. V. SASTRY

The Earth's atmosphere allows ground-based radio astronomical observations over a range of frequencies extending from a few megahertz to a hundred or more gigahertz. The high frequency limit exists because of absorption by water and oxygen in the atmosphere and the low frequency one because of refraction in the ionosphere. Observations made at frequencies of 30 MHz and below are generally referred to as low frequency, or decametric, measurements. This region of the radio spectrum is relatively unexplored owing to various reasons. Observations at low frequencies are difficult because of absorption, refraction and scintillation in the ionosphere. Among the other difficulties are the large antenna size necessary to achieve a reasonable resolution, and the very limited bandwidth which can be found free of man-made interference.

Decametric radio waves are put out by a variety of astronomical sources which are much weaker or are not detectable at high frequencies. In this wavelength range, synchrotron radiation is the dominant type from both galactic and extra-galactic sources, and synchrotron self-absorption becomes important. Information about magnetic fields and electron energy spectra in various types of sources can be derived from their decametric radio spectra. Free-Free absorption in the H-II region becomes significant at low frequencies, and its study can yield electron densities and temperatures in these ionized regions. Diffraction in both the interstellar and interplanetary media is very strong and can be used to study the medium itself or as a powerful tool in determining the size of small sources.

A new large radio telescope

The Raman Research Institute and the Indian Institute of Astrophysics jointly constructed one of the world's largest decameter wave radio telescopes now in regular operation. This telescope is being used for various types of radio astronomical observations such as those mentioned above. The essential features of the telescope are described below and some recent observations are also presented.

The decameter array is located near Gauribidanur, Kolar District, Karnataka (longitude 77°26'07"E); latitude 13°36' 12"N). It is a T-shaped array of one thousand broadband dipoles, 640 in the east-west arm and 360 in the south arm. All dipoles accept east-west polarization. A full reflecting screen (area 60,000 m^2) is mounted 1.5 m below the dipoles. The entire structure is supported on a grid of 3500 wooden poles of varying lengths of up to 35 feet to compensate for the terrain. The dimensions of the array are shown in Fig.1. A photograph of the east-west array taken from the eastern end is shown in Fig.2. Fig.3 is a photograph of the south array taken from the southern end. The outputs of the east, west and south arms are carried by coaxial cables to the centre of each arm and from there to the main observatory building. The signals are amplified and the sum of the east and west signals is correlated with that of the south arm. In this way a beam of about 26 x 38 arc-minutes at the zenith is produced at a frequency of 34.5 MHz.

The beam of the south arm can be pointed to anywhere within ± 60° of the zenith on the meridian. This is accomplished by adjusting the phase gradient across the aperture by using remotely controlled diode phase shifters. A special-purpose digital control system sets the beam to the required positon and also cycles it through several declinations sequentially. The time required to shift the beam from one position to another is of the order of a few milliseconds, and the number of declinations can be varied from one to sixteen. The beam of the E-W array can be tilted in hour angle to ± 5° of the meridian by remotely operated diode phase shifters controlled by another special-purpose digital system. It is thus possible to track a source for about 45 minutes around the meridian transit.

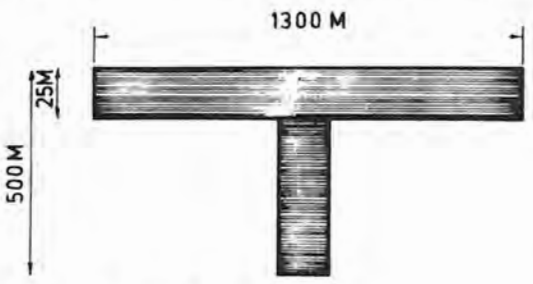


Fig. 1.

Fig. 2. The east-west array of the Gauribidanur radio telescope

Fig. 3. The south arm as seen from its southern end

In addition to the analog system, a digital correlation system is also available. The hardware for this system consists of a 32-channel double sideband front end and a 128-channel one-bit digital correlator. The sampling rate is 2 MHz and the integration time can be varied from 2 to 256 ms. For this receiver the N-S array is divided into 23 groups and each group is correlated with the E-W arm. At any instant the fourier transform of these correlations yields the brightness distribution of a strip of the sky of dimensions 26' (RA) x 15° (Dec.). The 128-channel digital correlator can also be configured to measure the autocorrelation function of a signal. In this mode the telescope can be used for observations of the spectral line.

A variety of projects

The radio telescope has been used for the following investigations.

Radio maps of the Quiet Sun and the slowly varying component are being made whenever possible. These are the first maps ever made of the slowly varying component at a decameter wavelength. We are using this radiation as a tool to probe the density and temperature structure of the quiet outer corona.

The telescope is also used to study the structure of extended galactic supernova remnants at long wavelengths. Radio maps of the supernova remnants Cygnus Loop and HB9 were made.

The low-frequency radio telescope is the most sensitive detector of ionized hydrogen regions in the galaxy. The temperatures of these regions are $\leqslant$ 10,000 K and so they appear as continuum absorption features against the very bright (30,000 K) non-thermal background radio emission from our galaxy. It is possible to measure the electron temperatures of ionized hydrogen regions directly, unlike the situation in high-frequency measurements where one has to assume LTE conditions in the nebulae to derive the temperatures. We have mapped the Rosette Nebula, an ionized hydrogen region, and the giant HII complex W51 in absorption using the decameter wave radio telescope.

One of the most interesting observations made with the decameter radio telescope in the study of extragalactic radio sources is the mapping of the diffuse radio emission in the Coma cluster of galaxies.

The radio emission is believed to originate in the intergalactic medium, owing to relativistic electrons and intracluster magnetic fields, by synchrotron process. The observed integrated radio luminosity of the diffuse source is 10^{41} erg s^{-1}. The magnetic field in the intergalactic medium of the Coma cluster can be estimated by assuming the minimum energy condition in which the magnetic energy density is equal to the particle energy density. On this basis the magnetic field strength is about 2 x 10^{-6} gauss. It is generally assumed that the relativistic electrons are produced in one or more radio galaxies in the cluster and diffused into the intracluster medium. It is possible to show that the relativistic electrons were ejected from the radio galaxies in the cluster at a mean rate of 10^{51} erg yr^{-1} for the past 3.5 x 10^9 years.

The telescope is also being used for observations of pulsars at low frequencies to determine the average pulse profiles, the average energy per pulse and the amount of interstellar scattering. With the digital autocorrelator described above the low frequency radio recombination lines of carbon (574 α and 575 α) in the direction of Cas A have been detected.

The Editor
Mandakini

Sir,

These days an increasing number of books, and proceedings of symposia and colloquia are produced from camera-ready typescripts. Use of a variety of typewriters – good and bad – gives an ugly look to the end product.

It would be ideal if the IAU could choose a typewriter and recommend its use to various institutions, and negotiate a discount with the manufacturers.

A uniform typewriter would make astronomy books – where information needs immediate dissemination – look elegant.

R.K. Kochhar
Indian Institute of Astrophysics
Bangalore

THE MANDAKINI SERIAL

BETWEEN THE TIDES

DONALD MALCOLM

FOUR

Noss rowed steadily, with economical strokes, until they were in the middle of the lake and he let the boat drift.

'I do this often, when I'm here alone. It keeps me in touch with the real world. Mountains, trees, birds, animals, clean air, silence. And the knowledge that I just have to tip the boat too far over and I would take my true place in the scheme of nature.'

Simde, the sunlight beating down on his face, let Noss talk on without interruption.

'I kept deluding myself that Irah was contented although I think I knew from the beginning that our joining was a mistake. But people will clutch at any chance when they see life passing them by, and I was no different. Probably sillier than most. I was born to be alone and lonely. I think if you hadn't come, Simde—'

He gestured to the water.

'You knew I'd come. You said it yourself. And things might not be as serious as they seem. We have to go back and take you for treatment. The advances in technique—'

Noss was shaking his head.

'It's too far gone, Simde. I can feel it. Who knows how long it has been here, inside me, killing me relentlessly and efficiently, only now bursting into the open? I'm like a fruit, rotting from the inside. I'm coming back, Simde. But not to go for treatment; to complete the project. I've seen it this far and I'm not going to let it fail now.'

'The healer says you'll have to go for treatment.'

Noss began rowing towards the cabin.

'It's my life, what's left, and I can do with it as I want. And what I want is the success of the project. That planet won't wait.'

Noss let the oars rest. 'We'd better change places, Simde. I don't want to stop too soon.'

He smiled, but there was no humour in it. Simde rowed savagely, his heart in turmoil. Noss sat silently, letting the essence of the world permeate his being.

When they were back on the beach, beside the airships, Simde said. 'You can come back to the project provided you at least go and see the healer. That's reasonable, surely?'

'It is, Simde, I'll see you tomorrow sometime. I take it Remlin Dor is doing all that's required in my absence?'

As he entered his airship, Simde said. 'Need you ask? You trained him yourself. Till tomorrow.'

Simde was always thrilled and excited by the view from orbit. Hasub spun slowly, a thousand miles below. The three continents were caught between the glittering jaws of the encroaching polar ice.

The eight families who were to make the journey were gathered together in the space ship, trailing on the end of its crystal cord, five hundred miles behind the wheel, like an afterthought. They were having another session with the psycho-food plant, after having had the rigorous mandatory check by the healers on Hasub.

The ship consisted of three parts, two five hundred foot spheres and a cylinder of the same length, with interconnecting tubes all held together by framework. Overall, it was 1,700 feet long. The first sphere contained the food plant and the hibernation cubicles, while the second provided all other facilities for the travellers. The propulsion units were in the cylinder.

The food plant was a triumph of psycho-botanical engineering by Neri Falrac and her team. The problem had been three-fold. First of all, a food plant had to be induced to grow and flourish in conditions of virtual zero gravity. Initially, Neri had experimented with speeds of, or near, one gravity, and had found that the plants died. It was found that the compression of the soil against the wall of the sphere was too severe, preventing the growth of the genetically-redesigned plants. On Hasub, plants sent roots very deep into the ground. In a 500-ft sphere, that was impossible. It was Noss who had suggested a thirty-one day rotation of the sphere. That had worked. The plant was in globular form suspended in a network of tendrils. The position and direction of each tendril was calculated for maximum efficiency and access. The complications posed by the provision of the equivalent of the radiation and light strength of an M-type star had been solved.

The third problem was the inducement into the plant of sufficient capacity and resilience to enable it to sustain the abnormally large number of symbiotes. Each person's psycho-pattern had to be tuned into the plant's system and the bond regularly reinforced. Assimilation and disposal of even the small amounts of Hasubian body waste provided another difficulty, but dedication and, often, inspiration bordering on genius, had brought solutions.

Neri, her plain, pleasant face smiling, looked into the common room and said, 'Your turn, Simde.'

He went with the botanist, leaving Atira and the cubs watching the manoeuvres of the fabricators as they unloaded parts for the space ship from a service shuttle.

Neri and Simde made the transition from one gravity to virtual weightlessness and entered the plant chamber. Simde had never quite become used to this experience. They went carefully along the catwalk and strapped themselves into the harnesses grouped around the plant globule at the centre. Simde, as advised by Neri, took a short time to relax and accustom himself to the conditions. Once every six days was enough of this, in weightlessness.

When he was ready, he gently inserted the appropriate digits into the resilent flesh of the food plant. Immediately he was aware of warm surges of soft, friendly green-ness filtering into his mind, like water finding its way along runnels in sand. This plant had accepted him at and from the first contact and the bonding was mutually beneficial. Food plants were akin to Hasubians in one respect: their minds were unique. Perhaps comparison was valueless here, as the ship's plant was the first to be exposed to muitiple bonding on such a large scale. Simde always left the bonding feeling refreshed.

But this occasion was different. Suddenly Simde's mind was submerged by a green tide of unexpected force. He sent out a soundless cry for help. Neri, who was monitoring the bonding, quickly bonded with the plant herself and contrived to draw off some of the power. Almost at once, the plant responded and the pressure on Simde lessened and faded, to be replaced by the normal emanations, overlaid by what Simde could only think of as contrition.

'Break the bonding gently, Simde,' Neri said and he complied, sagging in the harness.

Neri broke her own bonding after a few minutes and blew gustily in relief.

'Let's go to my office.'

Once there, Simde asked, 'What happened?'

'The plant is hyper-sensitive, because of multiple-bonding, and I *think* it probed your mind to a deeper level than usual. As you know, contact is more of a "layering" than a penetration. Your tension over Noss must have opened you up and the plant poured in. It didn't mean any harm. Rather the reverse. You'll discover that for yourself at the next bonding.'

Atesor Seldolf, the ship's psycho-botanist, was going to be fully occupied on the voyage, but Neri kept the thought to herself. Simde had more than enough to contend with at present.

The bonding had upset Simde and he said, 'Are you sure that it's nothing more than that, Neri? Is the plant dangerous, in any way?'

'No. And I can say that, knowing how vital it is to the survival of you and the others. This plant is unique. It's the culmination of years of research and we have to expect that it will be different — but *not* dangerously so — from ordinary plants. After today, I think you'll have to get used to a more intense contact during bonding. You can adapt yourself to that.'

Reassured, Simde returned to the common room. Atira picked up some of his residual tension but she was discreet enough not to question him. She and the cubs were returning to Hasub, while Simde was going to the wheel. They went with him to the airlock where he put on a suit. Then, from an observation window, they saw him enter a small enclosed robot rocket sled and prepare to ride the crystal cord. He waved to them and set out for the wheel, five hundred miles ahead of the space ship.

(To be continued)

DOWN MEMORY LANE

(Continued from p. 2)

changes made in the Commissions was the creation of Commission 34 on Interstellar Matter. The Presidents of Commissions were empowered by the Executive Committee to form sub-committees to look into special problems.

The delegates had a number of social engagements including visits to the Observatory at Uppsala, and Sattsjobaden, a cruise to enjoy the Archipelago and visits to the ancient mounds of Gamla Uppsala. One of the highlights of the concluding Banquet was the speech by Prof. Stratton in eight different languages! The new office bearers of the Union elected were:

Arthur Eddington (President), G. Abetti, W.S. Adams, O. Bergstrand, W. Brunner and Ch. Fabry (Vice-Presidents) and J.H. Oort (General Secretary).

Meanwhile a comet, popularly thought to be a phenomenon portending change in governments, blazed brightly . . . . . .
(Tacitus AD 56-117)

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NEW DELHI 1985

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Associate Editor : A. RATNAKAR

THE AUSTRALIA TELESCOPE

J.A. ROBERTS
CSIRO Division of Radiophysics
Epping NSW, Australia

The Australia Telescope is a multi-element synthesis radio telescope being constructed by the Australian Commonwealth Scientific and Industrial Research Organization (CSIRO) as a national facility. Funded by the Australian Government, it is scheduled to begin operation in 1988, as part of the country's bicentennial celebrations.

The telescope will consist of two parts: a Compact Array and a Long Baseline Array. This arrangement allows zooming in from a broad picture made with the Compact Array to a detailed picture of a small region of the sky made with the Long Baseline Array. Radio photographs made with the Compact Array will have a resolution of about 1 arc-sec so they will show as much detail as photographs made with ground-based optical telescopes. The resolution of the Long Baseline Array will be fifty times greater; that is, such that an object the size of a coin could be resolved from a distance of several hundred kilometres.

The Compact Array is being built at Culgoora — on the radioheliograph site — renamed on Wild's recent retirement as the Paul Wild Observatory. The new array will consist of six antennas on a 6 km long east-west baseline. Five of the new 22-m diam self-propelled antennas will be on a 3 km section of rail track and the sixth antenna on a 75 m section of track 3 km further west.

When in use the antennas will be set down at 'stations': there are 35 stations on the 3 km section of track and two on the 75 m section at 6 km. The station locations were chosen to provide a pseudo-regular coverage of the u-v plane after 2, 4, 8, 12, 16 and 24 observing periods of 12 hours each. Both minimally redundant and redundant configurations can be obtained. After 27 x 12 hour periods all baselines from 15 m to 3 km, with an increment of 15 m, will be available.

Work at the Culgoora site is well advanced. The earthworks, including the 37 'stations' for the antennas, are complete, and 80% of the rail track is laid.

The telescope is designed to operate in a series of frequency bands ranging from several hundred MHz to 115 GHz. The bands have been selected to provide a good sampling of the wideband continuum radio emission from 'thermal' and 'synchrotron' radio sources and to cover the line emission associated with the most abundant atoms and molecules in interstellar clouds. Four different pairs of frequency bands are planned: 1.25-1.8 GHz with 2.2-2.5 GHz; 4.4-6.1 GHz with 8.0-9.2 GHz; 20-25.5 GHz with 42-50 GHz; and 84-98.5 GHz with 105-116 GHz. Feeds and receivers for frequency bands in the 1-10 GHz range are planned for 1988, and provision is being made for the other bands to be implemented later.

The contract for the antennas has been let to an Australian firm and the first antenna is due for delivery by November 1986. The final antenna at Culgoora is due by October 1987. The antennas are alt-az mounted with Cassegrain optics. The surface panels for the antennas are being produced by using new techniques developed by CSIRO from their experience in upgrading the Parkes 64-m antenna. Surface accuracies down to 0.15 mm rms can be achieved. It is expected that the overall aperture efficiency will be 0.5 at 50 GHz and that the central 15.3 m will have an efficiency of 0.3 at 115 GHz.

The feeds and the cryogenically cooled receivers are mounted in a turret which rotates to bring the required combination on axis. Very wide-band antenna feed horns, with high degrees of polarization purity, have been developed. The feed to cover the L and S bands (1.25-2.5 GHz) is over 1 m in diam and over 2 m long. New techniques are being exploited in the production of these large ridged horns. Linear polarization has been chosen for the feeds so as to permit the measurement of small degrees of circular polarization, and to simplify the design of the wide-band systems.

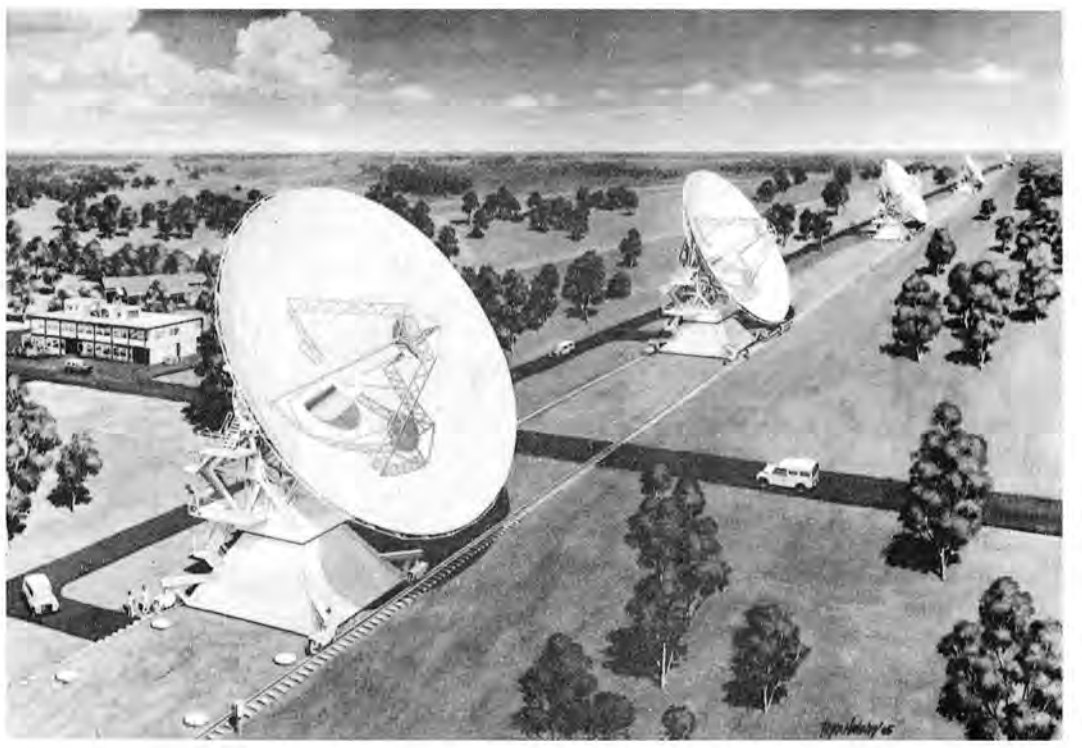
Cooled field-effect transistor (FET) amplifiers will be used for the initial receivers in the 1-10 GHz frequencyy range. Units for the 1.25-1.75 GHz band are in production. The design of the 2.2-2.5 GHz amplifiers is complete, and the multi-stage 4.4-6.1 GHz design is currently being finalized by using computer-aided design techniques. For the 8.0-9.2 GHz amplifiers an existing design will be used. These receivers are being built in-house by the CSIRO Division of Radiophysics.

The signals received by each antenna of the Compact Array will be converted to an intermediate frequency and digitized at the antenna, and then transmitted via optical fibres to the central correlator. This will use a specially produced VLSI chip designed by CSIRO for the purpose. The chip allows up to 32 parallel processes and so achieves the speed required to process up to eight products per baseline (four Stokes parameters at two frequencies), from 15 baselines at a (2-bit) bandwidth of 128 MHz. Over five thousand of these chips have been delivered. In the design of the correlator and related parts of the system, special attention has been paid to the spectral line capability, and to the ability to map large fields of view. The bandwidths available with 2-bit operation range from 128 MHz downwards by factors of 2 to 0.5 MHz. The number of channels (for each product and baseline) is limited to 16384 divided by the bandwidth in MHz and by the number of products — with a maximum of 8192 channels.

The Long Baseline Array links the Compact Array to the existing 64-m telescope at Parkes and to another new 22 m diam antenna to be built at the base of Siding Spring Mountain by December 1987. For the Long Baseline Array tape recorders (compatible with the US VLBA) will be used to record and transport the data, while the local oscillator signals will either be transmitted by the Australian satellite (AUSSAT) or will be provided by new high-stability oscillators currently under development in Western Australia. These arrangements will allow the ultimate extension of the array to include one of the NASA Deep Space Network antennas at Tidbinbilla, a telescope at the University of Tasmania, and other antennas overseas or in orbit.

The tape-recorded signals from the separated antennas will be replayed at a processing station at Culgoora, where the signals will be correlated using the same techniques as for the Compact Array. To be compatible with other VLBI networks provision will be made for simultaneous observations in the 2.2-2.5 GHz and 8.0-9.2 GHz bands. This will be achieved via a dichroic reflector for the 8.0-9.2 GHz band.

The Australia Telescope project is under the general direction of Dr Bob Frater with John Brooks as Project Manager and Dennis Cooper as Antenna Manager. An Advisory Committee, with members from Australia, the USA and the UK, is overseeing the project. When this project, costing A$ 40M+ (as of March 1985) is completed, Australia should be in a position to make very significant contributions to the study of the southern sky.



An artist's impression of the compact array of the Australia telescope

ANNOUNCEMENTS

For return transfer, from hotels to airport/railway station starting from 1400 hrs of 28 November 1985 until 1400 hrs 29 November 1985, transport arrangements are being made. Delegates and Registered Guests may please give the following information to "Information Counter" latest by 25 November 1985.

1. Name of Delegates/Registered Guest:
2. Name of hotel & room No.
3. Date of return journey:
4. Flight number/Train name & No.:
5. Reporting time/Time of departure:

(see also p.8)

EDITORIAL

NAUGHT FOR YOUR COMFORT

Last month, in the University of Glasgow, Scotland, where I work in the intervals between editing IAU General Assembly newspapers, I witnessed an intriguing sight. For ten nights, hundreds upon hundreds of people of all ages and all walks of life queued up outside the lecture theatres one hour before the doors opened to be sure of obtaining a place inside. Long before the speaker was scheduled to appear, the theatre was filled together with the overflow theatre. People were standing in the aisles or peering round the doors, hoping to at least hear the lecture. Many were turned away. And what was the subject of the lectures? Natural Theology.

Now traditionally Scotland for hundreds of years has had a reputation of being interested — some would say obsessed — in religion of the strict Calvinistic Presbyterian kind. But in modern times a more secular spirit has prevailed. Why then this extraordinary enthusiasm for natural theology?

The series of lectures, held annually, were funded by Lord Gifford and are therefore called the Gifford Lectures in Natural Theology. They have been given by many distinguished scholars in past years from various disciplines for the term "Natural Theology" is interpreted broadly. This year they were given by Carl Sagan.

And so part of the attraction was undoubtedly memories of his books and his famous COSMOS series on TV. Indeed after each lecture a queue formed for a book and programme-signing session. Nevertheless the interest was predominantly in his material and the way he treated it. He dwelt on the long history of astronomy, man's gradual realisation of the majestic scale of the universe in time and space, the human race's search for meaning, man's origins and the search for extra-terrestrial intelligence, the ecological problems threatening us, the exploration of the Solar System, the potential of the space telescope and other revolutionary advances in astronomical technology, above all, a realisation that the stars, in all their magnificence, are neutral.

I cannot say I agreed with Carl Sagan in everything he said. Nevertheless my conviction was strengthened, by the impact he and his material had on his audience, that our subject is one of absorbing interest to people of all ages not only in its major contributions to our understanding of the fantastic universe we inhabit one tiny corner of but also in its highlighting of the sheer drama of our position in it. For we are a race at its critical bifurcation point in history, the balance posed so delicately that the only certain statement about twenty-first century global civilisation we can make is that it will be vastly different from what it is now, either spectacularly better or infinitely worse.

There are still too many people about who think vaguely that even if God is largely out of fashion, benevolent beings from the stars will step in to save us if we compound our planetary mistakes to the point of no return.

It is probably not the least useful thing we can do as astronomers to point out that in the last analysis, the universe does not owe us a living; it is entirely up to us whether we sink or swim.

Archie E. Roy

DOWN MEMORY LANE — GLIMPSES FROM PAST GENERAL ASSEMBLIES

COPENHAGEN 1946

(NOT a General Assembly)

In order to rectify the disorganisation in International Astronomy arising from World War II, a meeting was held in Copenhagen in March 1946 at the invitation of the Royal Danish Academy of Sciences and Letters.

Thirteen of the IAU adhering countries were represented — Belgium, Czechoslovakia, Denmark, France, the Netherlands, Norway, Poland, Sweden, Switzerland, the UK, the USA, the USSR and the Vatican City State. The principal organisers were Dr J.H. Oort, the General Secretary elected in 1938. Dr Bertil Lindbland, Professor Harlow Shapley and Sir Harold Spencer Jones. Jan Oort was the only member of the Executive Committee elected in 1938 who could be present. The elected President, Sir Arthur Eddington, had died in 1944 and Spencer Jones had been co-opted in his place. Prof. Elis Stromgren and Dr Bengt Stromgren organised the Danish hospitality. The programme included a scientific meeting on interstellar material.

There was urgent business to be done. International cooperation on ephemerides had been maintained during the war years through the efforts of Lindblad in neutral Sweden and some circulation of publications had been possible. However, the great German observatories were in disarray and it was an urgent matter, with scarcity of qualified astronomers, that new arrangements be made. The newly-located Rechen-Institut at Heidelberg was able to carry on with *Astronomische Jahresbericht*, formerly in Berlin. Other responsibilities went to various countries. The great USSR commitment to Variable Star Catalogue work started at Copenhagen in 1946 and work on the ephemerides of minor planets and comets was also planned there. Of great importance for the Union itself was the decision to accept the standing Swiss invitation for the next General Assembly, to be held in Zurich in 1948. This was the beginning of the post-war series of IAU General Assemblies of which New Delhi 1985 is the thirteenth. Zurich 1948 was the occasion for renewal of professional contact and personal friendship that had been in abeyance for ten years. It was a cherished occasion for may of our fraternity of whom, now relatively few remain.

The most difficult issue at Copenhagen was the membership of Germany and Japan. It was generally accepted that both would soon become fully integrated into the IAU but officially, a state of war still existed and action could not be taken at that time. Otto Struve, in an article in *Popular Astronomy*, described the feelings of the conference in looking

(Continued on p. 8)

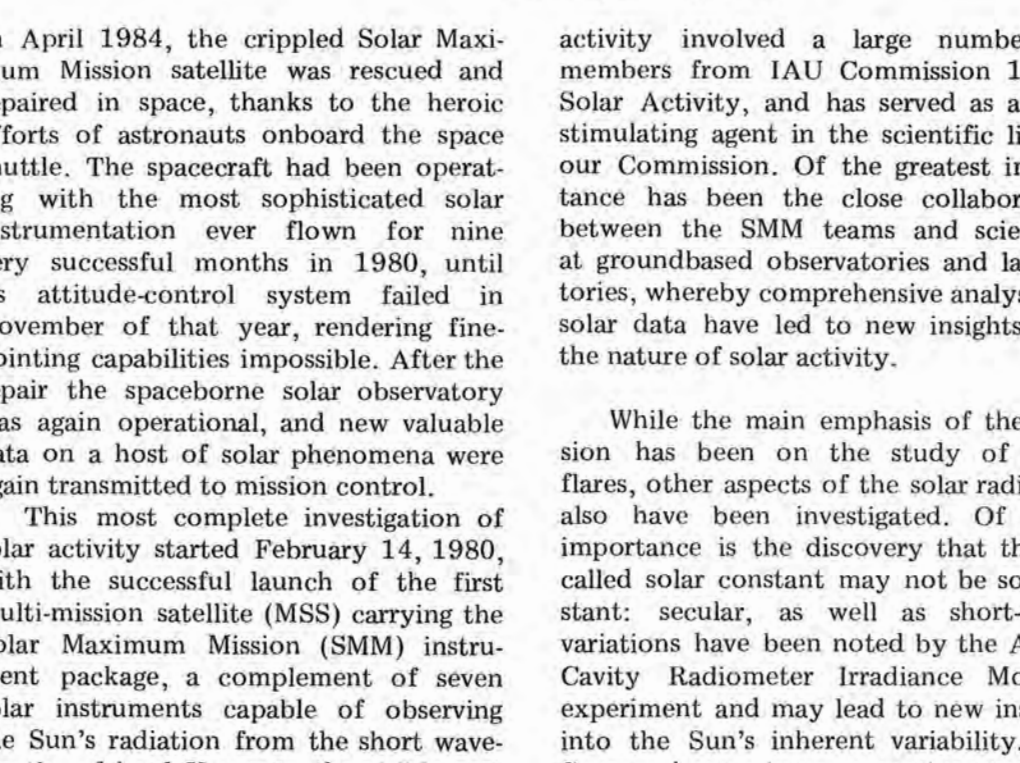
THE SOLAR MAXIMUM MISSION

E.A. TANBERG-HANSSEN
President, Commission 10

In April 1984, the crippled Solar Maximum Mission satellite was rescued and repaired in space, thanks to the heroic efforts of astronauts onboard the space shuttle. The spacecraft had been operating with the most sophisticated solar instrumentation ever flown for nine very successful months in 1980, until its attitude-control system failed in November of that year, rendering fine-pointing capabilities impossible. After the repair the spaceborne solar observatory was again operational, and new valuable data on a host of solar phenomena were again transmitted to mission control.

This most complete investigation of solar activity started February 14, 1980, with the successful launch of the first multi-mission satellite (MSS) carrying the Solar Maximum Mission (SMM) instrument package, a complement of seven solar instruments capable of observing the Sun's radiation from the short wavelengths of hard X-rays to the visible part of the solar spectrum. The table lists the experiments and the institutions involved, and shows the broad background of this collaboration, which is even more impressive when one remembers the close involvement of numerous co- and guest investigators from Europe, Asia, and Australia in addition to South and North Americas. This truly international research effort into the nature of solar activity involved a large number of members from IAU Commission 10 on Solar Activity, and has served as a very stimulating agent in the scientific life of our Commission. Of the greatest importance has been the close collaboration between the SMM teams and scientists at groundbased observatories and laboratories, whereby comprehensive analyses of solar data have led to new insights into the nature of solar activity.

While the main emphasis of the mission has been on the study of solar flares, other aspects of the solar radiation also have been investigated. Of great importance is the discovery that the so-called solar constant may not be so constant: secular, as well as short-term, variations have been noted by the Active Cavity Radiometer Irradiance Monitor experiment and may lead to new insights into the Sun's inherent variability. The figure shows two computer-generated pictures of activity on the solar limb observed with the Ultraviolet Spectrometer and Polarimeter experiment. In one case (left) a surge is ejected from a flaring region on the Sun, and we see the radiation associated with the 100,000 °C plasma. The right panel reveals the radiation coming from a plasma trapped in huge magnetic arches in the Sun's atmosphere.



TABLE

EXPERIMENT AND INSTITUTIONS INVOLVED

INSTRUMENT	AFFILIATION
Gamma Ray Experiment (Spectrometer) GRE	University of New Hampshire USA
Hard X-ray Imaging (Spectrometer) HXIS	Space Science Laboratory The Netherlands
Hard X-ray Bursts (Spectrometer) HXRBS	NASA Goddard Space Flight Center USA
X-ray Polychromator (XRP)	Lockheed Palo Alto Research Laboratory USA
Ultraviolet Spectrometer and Polarimeter (UVSP)	Mullard Space Science Laboratory, UK
Coronagraph/Polarimeter (C/P)	Rutherford Appleton Laboratory, UK
Active Cavity Radiometer Irradiance Monitor (ACRIM)	NASA Marshall Space Right Center USA
	High Altitude Observatory, USA
	Jet Propulsion Laboratory, USA

gASTRONOMY CORNER

MATTAR PULAO

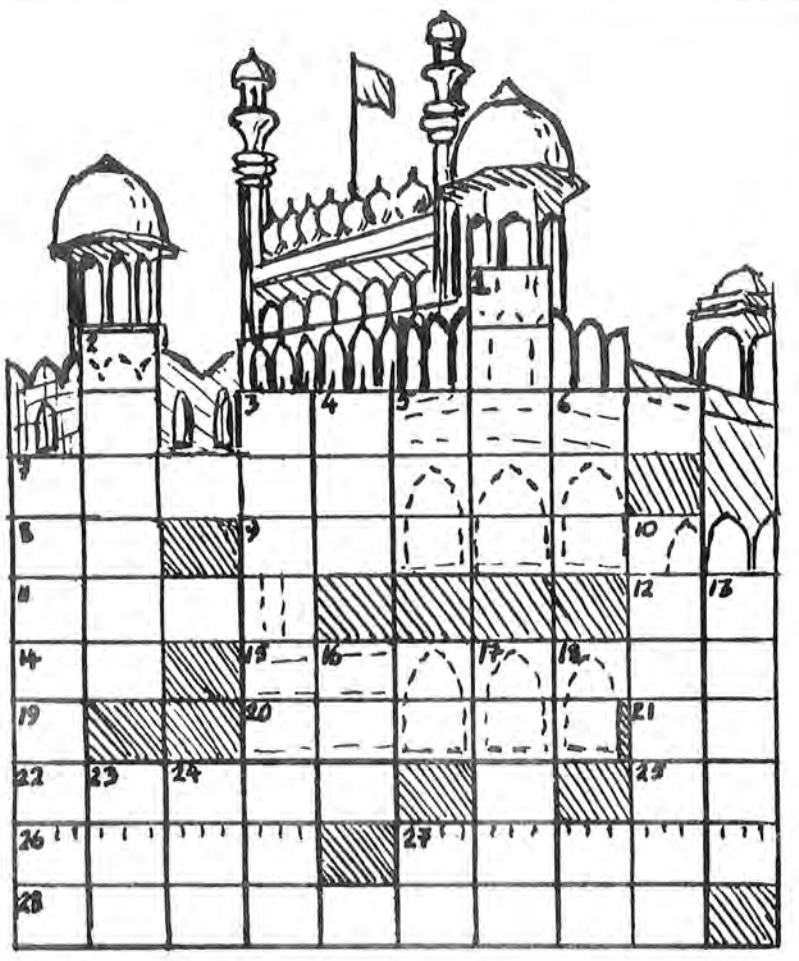
(A Popular Rice and Green Peas Preparation)

	Ingredients	Quantity
1.	Pulao rice	450 g
2.	Peas	450 g
3.	Fat	55 g
4.	Onions	55 g
5.	Cardamom	15 g
6.	Cloves	
7.	Cinnamon	
8.	Bay leaf	
9.	Salt	to taste

Method

1. Wash and soak the pulao rice.
2. Drain rice and slice the onions.
3. Shell peas.
4. Heat fat, fry the sliced onions till golden brown.
5. Remove onions, drain, Add spices.
6. Add rice and fry well. Add peas and continue frying for 2-3 minutes.
7. Add water and salt.
8. Cover and cook.
9. Finish off as for fried rice.

NB : Serves Eight.



RED FORT CROSSWORD

ACROSS

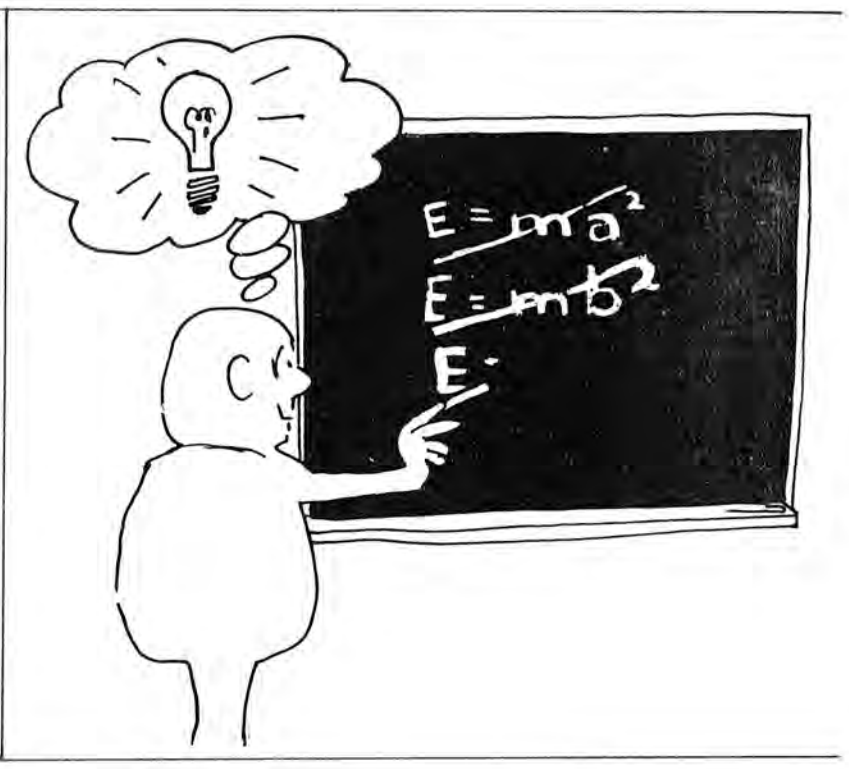
3. The song is ended but the .....lingers on (6)
7. As inevitable as death (8)
8. Small commercial (2)
9. Type of boat in reverse (6)
11. Requirement (4)
12. French astronomical measure (2)
14. A degree of divinity (2)
15. Entertaining? (7)
19. Begins the spectral classes (1)
20. Capital of Afghanistan (5)
21. Variable designation if harped on (2)
22. All satellites achieve this (5)
25. ID EST (2)
26. It comes to buildings and unlucky businesses in time (4)
27. To get up and go (5)
28. Superb memorial to the fallen (5,4)

DOWN

1. Flower are at their nicest in.....(5)
2. Commercial transaction completed (6)
3. Divine celestial river (9)
4. He may be in time for tea - if not we'll alter it (3)
5. There's many a slip between this and the cup (3)
6. Vitally important molecule (3)
7. Indian food cooked on slow fire (8)
10. Welcomed by almost everyone but not by most astronomers (7)
13. To concur (5)
16. Useful for prayer (3)
17. Add this to 'Kama' to improve closer relations (5)
18. It puts you out of sorts to add 'L' to this (2)
23. Do not walk to the nearest exit (3)
24. An intention to purchase (3)
27. Add 'E' to this to put on years (2)

A lovely little asteroid
In figure like a cute spheroid
Made passes bold at planet Mars
Very silly - he's the God of War.
He soon had her destroyed

C. SIVARAM



PUZZLE FOR PARTICIPANTS

ON ASTRONOMICAL COMPUTERS, BOARD GAMES, AND THE PHAISTOS DISC: A PUZZLE FOR PARTICIPANTS

H. PETER ALEFF

The Quantumgame Company
Cumberland, USA

According to a myth Plato tells, the Ancient Egyptian moon-god Thoth, the "Measurer of Times and Seasons" and "Counter of the Stars", gave the science of astronomy to mankind, along with the arts of reckoning and writing, and also with the board game (Phaidros, 274). The myth could preserve a memory: the changes of the Moon seem indeed to have inspired the first examples of notation as the precursor of writing, and the search for the rules behind the Moon's behaviour may well have led to the first mathematical operations more complex than counting on the fingers. This is probably why thoughtful Thoth added the board game — the need for counting aids more useful than fingers and toes in keeping track of the big lights in the sky must have caused the early astronomers to come up with more advanced computing hardware. Line-ups of sticks and stones were likely one of the solutions, soon to be followed by a portable version of the same basic calculator: some primitive pegboard on which twigs or pebbles could be moved along a track divided by marks.

These pegboards became gameboards when people began to use them not only for reenacting the actual race of the big lights along their track in the sky but also for attempts to predict their future positions and the resulting "what if" simulations. Anything unknown contains an element of randomness or chance, so the soothsayers needed a random number generator in their simulations. Simple two-sided dice (which still survive as heads-or-tails "decision-makers") have been found in many primitive cultures, and their marriage with the pegboard produced the great-grandfather of all board games, the race game. The throws of the dice drove different pegs along the track on the board where they still pursue each other today in the same race games, now called backgammon, pachisi, and the like.

Back then, the board game was not only a pastime for leisure hours. This gift from the moon-god served also as an analog device to simulate the motions of heaven and earth and came to be identified with the universe it represented. When people played their board games they animated a small-scale model of their world. The shape of this model varied from region to region, and Thoth the moon-and-sky-god had many other names in many other languages, but most of the ancient board games seem to have played the same role: The shape of the game board typical for a region was often the same shape which served as groundplan for the sacred architecture typical of that region, presumably again because this shape depicted the universe as the people in that region saw it.

GAMES FROM THE PAST

Much has been written about New World game boards, their calendrical use for keeping track of time and their role in architectural layout, e.g. as surveyor's marks for the sacred city of Teotihuacan. But no one seems to have pointed out before that the Old World contains many examples of similar parallels between gameboards, counting and calendar systems, and the groundplans of buildings dedicated to the rulers of heaven. The first Sumerian temples, the earliest monumental tombs in pre-pyramid Egypt, the Palestinian city of Megiddo whose earliest levels are much older than its biblical founder King Solomon, the former capital of Japan which later became Kyoto, or the two basic temple plans the Indian architects followed from ancient tradition — all these are just some of the examples in which the layouts of the most important building projects resemble the gameboards which their builders had devised as models of their world.

If so many emerging civilizations shared the concept of simulating the universe on their gameboards, and if they accorded it such a central position in their belief systems, then this idea must have been firmly entrenched long before it left all these architectural traces. It also must have been spreading for a very long time. The area dominated by this concept extended even much farther than that covered by, for example, the influence of the Gravettian, an Upper Old Stone Age culture which united vast stretches of Central and Eastern Europe some 25,000 years ago. The uniformity of Gravettian - style artifacts (including bones engraved with lunar notation) found in places as far apart as France and the Ukraine, demonstrated how well ideas can travel if given enough time. The still wider distribution of temples, tombs, and towns laid out to resemble their builders' gameboards may tempt you to speculate about the great age of this link between pondering the sky and playing on pegboards, or, in more modern terms, between cosmology and computing.

Much time seems indeed to have passed since homo sapiens first lived up to his name and began, unlike the animals around him, his wondering about how things work in the sky and his still ongoing attempt to figure it out. The English word "man" stems from the same root as the Sanskrit "man" = "to think", a word which also expressed the thinkers' quest for knowledge about the Universe since it shows up in terms such as the name of this newspaper — "Mandakini" = Celestial River = "Milky Way" — or in "Mandala", which literally means "circle" but is used in the Hindu tradition for any design which assists the viewer in visualizing some aspect of the cosmos and its structure.

In this sense, the early gameboards were Mandalas. The connection still survives here in India in the "Mandala of sixty-four Divisions" which is laid out like the board for the ancient spiral race game *Ashtapada*, the ancestor of the chessboard. As in the temple plans copied from this design, the four central squares of the Mandala symbolize Shiva, the god of cyclical destruction and renewal; on the gameboard, they are the destination

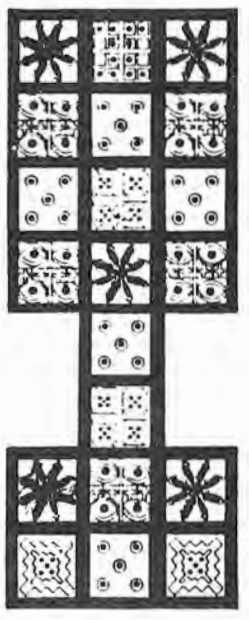


Fig.1

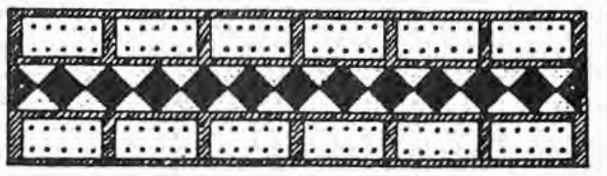


Fig.2

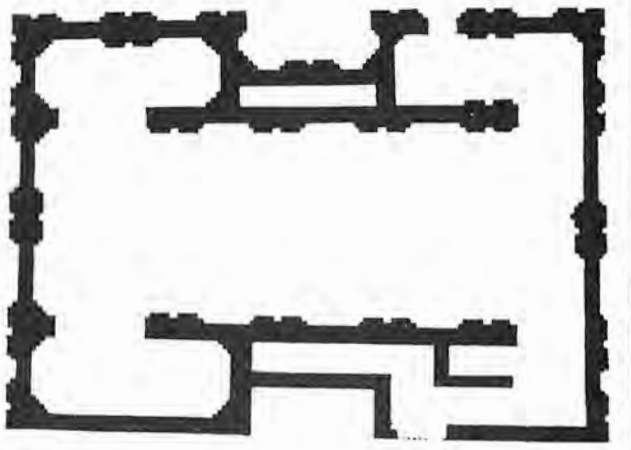


Fig.3

(1) Modern cribbage board.
(2) Sumerian gameboard inlaid with lapis lazuli, shell, and bone. From the Royal Graves of Ur, Mesopotamia, around 2500 B.C.
(3) Ground plan of the Northern Temple at Tepe Gawra, Mesopotamia, built around 3500 B.C. This small but very detailed shrine contained, as in a bud, all the features of the later monumental temples in the Sumerian cities of Ur and Uruk.

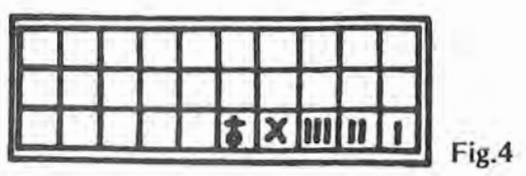


Fig.4

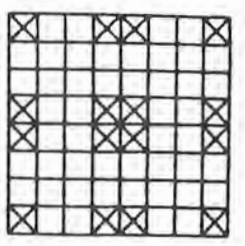


Fig.7

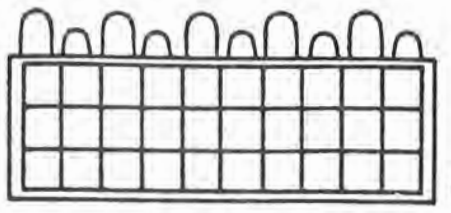


Fig.5

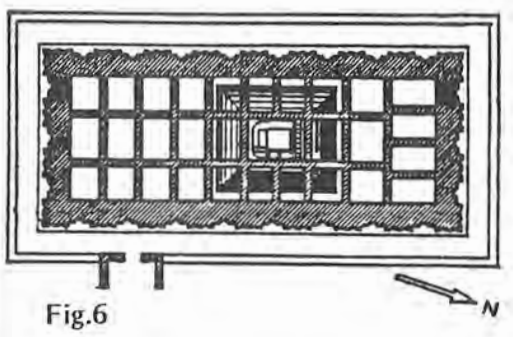


Fig.6

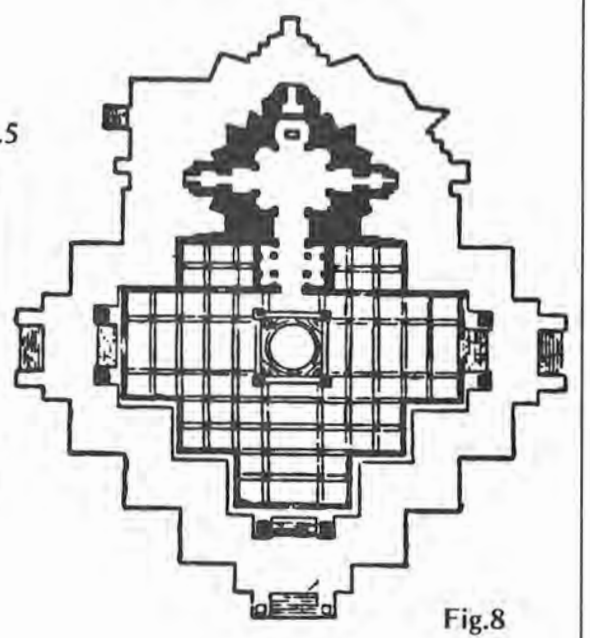


Fig.8

(4) A typical gameboard for the Ancient Egyptian race game of Senet. The thirty squares represented the thirty days of the Egyptian standard month. The fifth square from the end bears the sign for the "House of Death", followed by an X for "Difficulties". The Egyptians played Senet long before they invented the hieroglyphs, and this game remained popular long after the last pharaohs three thousand years later.
(5) The Egyptian hieroglyph "men" = "to endure" represents a Senet board with the gamepieces above since gameboards were instruments for computing duration. This hieroglyph already spelled the name of King Menes, the first king of Upper and Lower Egypt.
(6) The layout of the Senet board appears again in this ground plan of a typical Mastaba, the monumental tomb fashionable among the earliest rulers of Egypt to assure everlasting duration to their mummies. Even after the funerary style changed to pyramids and other later forms, the Senet board was still carved on the coffins and painted on the walls of the tomb chambers.
(7) The board for the spiral race game of Ashtapada which was played in India. The pieces entered in the middle of the sides and bore off in the center. This board became later the chessboard, and the crosscut cells lost their function but remained anyway. They even survived the later checkering of the board and are still to be seen on modern Indian chessboards.
(8) One of the two characteristic temple plans from India, here illustrated by the Great Temple at Baillur built in the twelfth century A.D. Visitors enter through the elaborate portals projecting from the middle of the sides of the basic eight by eight square and proceed towards the center, just like the gamepieces in Ashtapada. A design resembling this layout also decorates some of the tiles on the Sumerian gameboard in Fig. 2.

(contd. on p.5)

(Contd. from p.4)

of the gamepieces or "men" who strive to be reborn. The whole Mandala corresponded originally to the beginning of a new world cycle.

World cycles based on celestial cycles preoccupied the early skywatchers and thinkers very much. With their early headstart, they became expert at observing longer and longer periodicities in the race of the big lights, and by the time history dawned they had already worked out many of the lunar and solar cycles, including some which Neobabylonian and Classical Greek astronomers were thought to have discovered only much later. For instance, the 19-year Metonic cycle between new moons at midwinter solstices is already shown, together with several other cycles not discussed in this article, on a splendidly illustrated Bronze Age gameboard made more than a millennium before Meton.

THE PHAISTOS DISC

This gameboard came to light three-quarters of a century ago in the ruins of the palace at Phaistos on the Mediterranean island of Crete. It is a round disc of baked clay, slightly over six inches in diameter, with a spiralling track of irregularly shaped fields on each side. Each field contains two or more neat impressions from stamps made to print forty-five different signs. This disc was made around 1600 BC during the days of the Minoan civilization and is known as the Phaistos Disc, a famous archaeological puzzle because three generations of linguists have tried without success to read its pretty pictographs as a written message.

One of these pictographs is a rosette with eight leaves, a sign which decorated many ancient gameboards and which, unlike their other decorations, was always placed on the same fields — presumably because these were significant for the play. In the religions of both Ancient Egypt and India, the sun-god was born in a lotus flower with eight leaves, making this a symbol of birth, and since the same rosette often decorated coffins and funerary gifts it seemed also to mean death and the subsequent rebirth promised by most of the ancient religions. The eight leaves may have stood for the eight years it takes the Moon to catch up with the Sun so that the new Moon appears again near the midwinter solstice, the closest approximation before the more accurate 19-year cycle. This event marked the beginning and end of a "Great Year" period, and people believed that then the old Sun died and the new Sun was born to complete in turn the same cycle. Birth and death and rebirth, symbolized by the sun-god's flower, punctuated the sun-god's life, so it probably made sense to mark with this symbol the important field on the gameboard where this life was reenacted. (The same rosette still marks the squares of chessboards here in India).

One of the Phaistos fields with a rosette is clearly significant: at the centre of a spiral, it either begins or ends the track on that side. The rosette shares this field with a bald head and a "lollipop" which could also be a feather. This group of signs occurs again three fields farther out on the same spiral but nowhere else. These two fields are also the only ones to contain the bald head whereas a similar head but with a stiff crest of hair or rays appears a total of nineteen times on both sides of the Disc. Ancient sun-gods and sun-heroes were often portrayed with long hair because the hair was the symbol of the Sun's radiant power, and the loss of hair meant the loss of power. A well-known example is the biblical story of Samson whose name translates as "Little Sun"; he ruled for twenty years and then lost his hair and his power and died. (In the inclusive way of counting used, for instance, by the ancient Greeks, "twenty years" would have meant "at the end of nineteen years").

The goal in race games today is for the gamepieces "to bear off" from the last field, a term which stems from the same rootword as the "to be borne" in the rules of the same games until a century or two ago. In the Ancient Egyptian race game Senet, the goal was "to be justified", the expression used for the soul of the deceased who had been judged deserving of "going forth by day upon the earth again as a living soul" or to be reborn. The last field of the Senet board was called "the House of Horus" after the young god of the rising and reborn Sun, and the sundisc and falcon of Horus often decorate this field on the surviving Senet boards. Could the bald head with the birth-death-rebirth rosette at the centre of the spiral then depict the rebirth of the sun-god, preceded three fields earlier by his death?

This tentative meaning fits well with the location of the postulated death field three spaces from the end. If both sides are taken as one sequence, then the death field is the 58th from the beginning on the other side. The Minoan year, like the Egyptian, had three seasons, and 19 years had 57 seasons. If each field represented a season, then the sun-god would have died after the end of the 19-year cycle to which the 19 crested heads seem also to refer. This parallels the location of the death square in Senet in field 26, since the Egyptian calendar brought years and moons back together after 25 of their 365.0 day civil years which very nearly equal 309 mean lunar months. Every 26 years, the Egyptian priests killed the sacred Apis Bull in whom they saw a reincarnation of the sun-god, and Pliny the Elder relates in his Natural History (VIII, 72) that the mourning worshippers went with their heads shaven until they found the new Apis.

THE GAME OF THE GOOSE

That Phaistos 58 with the bald head is a field of death seems further confirmed by 59. The first thing in the afterworld, before the Hall of Judgment and the entrance into Paradise, was in the Egyptian and many other religions a dangerous maze where assorted monsters threatened the soul with great distress. The first square after death in Senet was unlucky; the pieces which arrived on it "drowned" (presumably a setback as in some other race games), and its decoration was either the sign for water or an X, the hieroglyph for "damage" and "difficulty". In the first Phaistos field after death, the sun-head has fallen down the only other time it does not stand fully upright is in field 38, or twice 19), and the two "T-shirts" are upside down compared with all the other occurrences of this sign. The upside down position is and was a universal symbol of distress, and in this case was probably meant to show the difficulties the sun-head encountered right after dying. The grouping of signs from 59 occurs one more time, twelve fields earlier in 47, but this time the T-shirts are right side up. This fits the gameboard interpretation as a graphic message for a setback of the gamepieces by twelve fields, similar to the twelve-field setback in the "Game of the Goose", which has also a "Death" field in 58

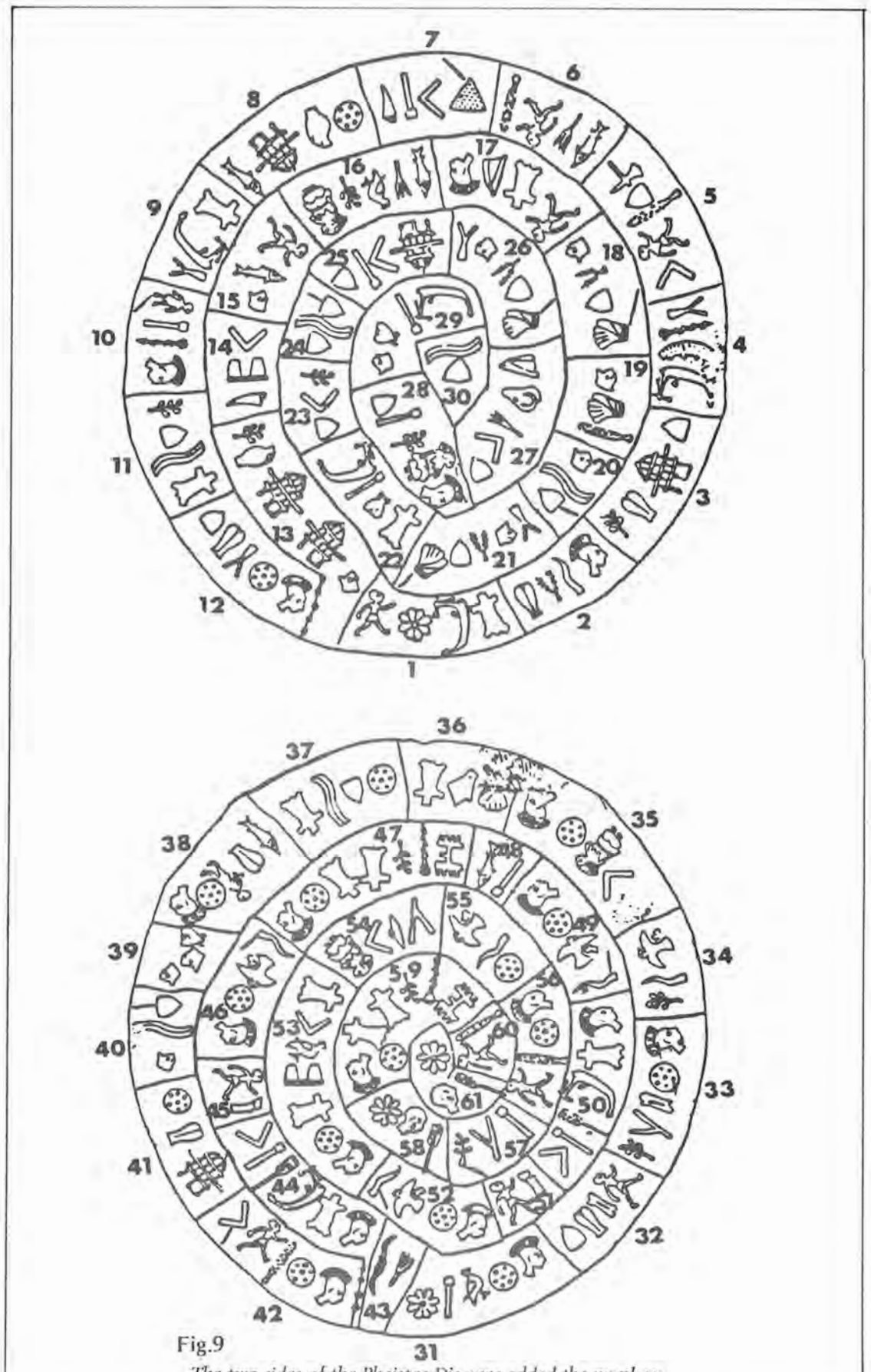


Fig.9

The two sides of the Phaistos Disc; we added the numbers.

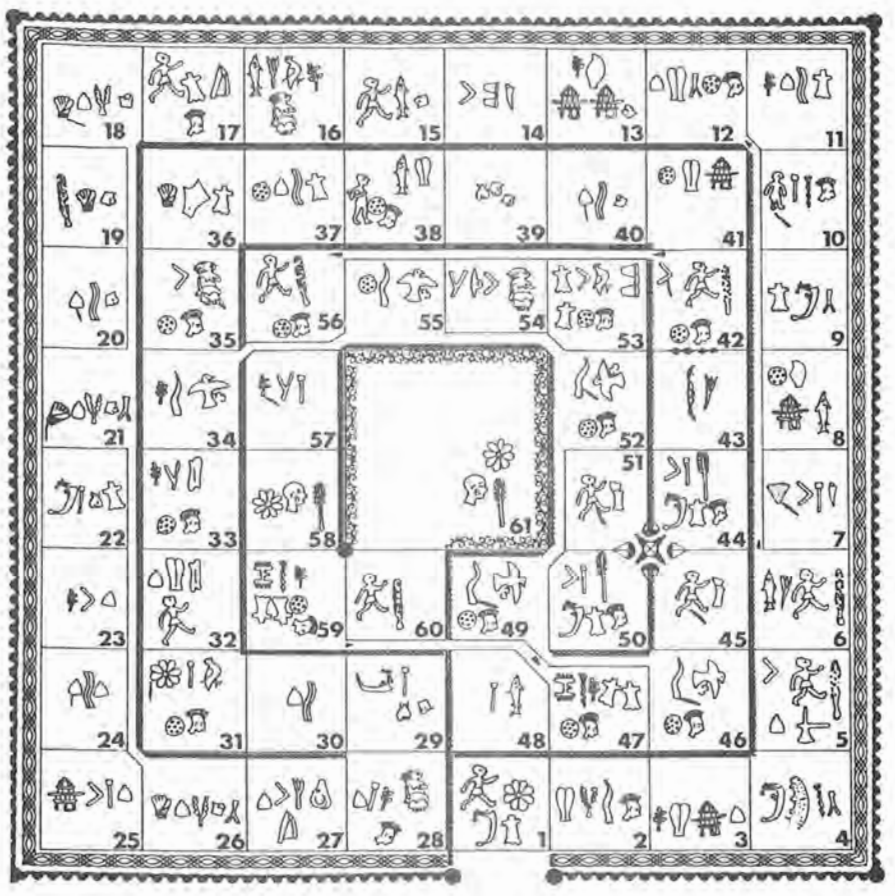


Fig.10

The Sequence of Fields from the Phaistos Gameboard

This track makes two U-turns, just as on the two sides of the Phaistos Disc, and yields a design similar to that of the labyrinth, which was so often associated with Crete, King Minos, and the Minotaur.

(contd. on p.6)

(contd. from p.5)

and which is now a children's dice game popular in many countries.

The T-shifts seem to express distress not only through their position: they resemble the Egyptian and Mycenaean body armour corselets which the early Greek Pylos tablets, less than four centuries after the Phaistos Disc, call "thorax". "Thorax" is a loan-word in many European languages and was possibly one already in Greek since objects copied from other countries, as the corselet probably was from Crete, often keep their original names. A syllabic value for the corselet sign could then be "thor" or "tar", a close linguistic equivalent. "Tar" seems to have been the Minoan word for "west", preserved in place names such as Tartessos at the western end of the Mediterranean, or Tarrha, the principal port of western Crete. A meaning of "west" for this sign fits in with the theme of the sun's travels, overall as the corselet is often combined with the sun-head and with the ship, the Eygptian symbol for divine travel (to the point where the Egyptians carried the statues of their gods in barges even if the whole procession went over dry land). When the corselets are doubled as in the field after death, the "tar" becomes "tar-tar" or "Tartarus", the pre-Greek word for the dark and dangerous underworld after death which was believed to lie far to the west where the Sun died, and through which the sun-god had to pass before he could be reborn.

If the rosettes paired with the bald head marked the death and rebirth of the sun-god, then one of the other two fields with rosettes would probably have represented his birth, and the other one presumably his initiation, a spiritual rebirth. The Knossos tablets, a couple of centuries after the Disc, show that the initiation of the king was a major festival; his role model the sun-god would have followed the same curriculum. Both these fields of postulated new beginnings are located, one on each face of the Disc, where the spiral towards the centre leaves the circle around the periphery; they must thus mark the entrances to the two tracks. Various scholars have affirmed that the tracks begin at the dotted lines in the outer circle and form an uninterrupted spiral to the centre, but there is no objective reason why the dotted lines could not mark the ends of the counterclockwise outer circles where the tracks each make a U-turn and only then spiral clockwise to the centre. U-turns were a common feature in various ancient scripts written "as the ox ploughs", changing their direction after each line, and U-turns were also popular in board games: U-shaped markings on a Senet board confirm that the pieces turned at the end of each row to continue their journey in the opposite direction just as Sun and Moon do at their extremes on the horizon, and just as the gamepieces in Senet's direct descendant Backgammon still do today. Here in India, all the race games on square boards still being played feature a counter-clockwise outer circuit "against the sun" followed by a U-turn and a clockwise spiral to the centre, just like the proposed tracks on each side of the Phaistos Disc. (These square game-boards all have odd numbers of squares; the shape of the track on those with even numbers, such as the 8 x 8 *Ashtapada* boards, seems no longer to be known).

Most gameboards in Ancient Egypt were fashioned with tracks on both sides, and the Minoans could also well have completed a race on one side of the Disc before flipping it over and playing on the other side. However, the Phaistos fields seem to have formed a single sequence with 19 sun-heads and 3 x 19 field before the death of the Sun, so other versions of this gameboard are likely to have existed in which the tracks were joined end to end. A tentative reconstruction of such a continuous version might be based on the assumptions: that the track had two U-turns as on the two sides of the Disc; that it was wound up compactly as on the Disc and proceeded towards the centre; and that the entrance was in the middle of a side as in just about every ancient temple or palace.

A CHALLENGE TO PARTICIPANTS

These assumptions produce a labyrinth-like path which, like the Cretan labyrinth designs, can be fitted equally well into a circle as into the square on this page. This path shows several curious features which allow further decipherment based on internal evidence and a few clues from astronomy and mythology. Since deciphering is more fun if you find the solutions yourself, we are presenting this labyrinth gameboard as a Cretan crossword puzzle, and we invite you to send us your solutions. The prize we offer for each of the nineteen most complete interpretations of this puzzle is a copy of "The Quantumgame", a modern update of the age-old astronomical board game. The 20-page booklet which comes with the Quantumgame contains further details about ancient board games, including the one on the Phaistos Disc. Please address your entries to the author c/o The Quantumgame Company, Old Sneech Pond Road, Pole 188, Cumberland, Rhode Island 02864, USA. Entries must arrive before the end of February 1986 to be eligible. (If you prefer instead to purchase a Quantumgame and booklet, you can send U.S. $ 39.95 for your copy, surface postage prepaid to any country).

Here are a few clues to get you started on the puzzle:

1) A feather was in Ancient Egypt a symbol for the soul of the decreased.

2) The soul of pharaoh ascended after his death to the northern circumpolar stars, to dwell there among the "immortal" constellations which never set below the horizon.

3) The emblem of the young sun-god Horus was a falcon, and that of his evil twin brother Set a serpent. Horus grew up to become his own father Osiris, the old and dead Sun. Set killed Horus-Osiris on the 26th of the month of Thoth. 2 x 26 = 52. Osiris went into the sunless underworld and then was resurrected to life. His resurrection festival was celebrated with a procession of 34 gods in 34 papyrus boats.

4) The Egyptian goddess Bast represented the light part of the Moon and was represented as a cat. Her counterpart, the goddess of nightsky and darkness Neith, had a shield as her symbol. The standard month had 30 days and began with the Moon invisible.

Good luck, and enjoy the puzzling!

INDIA'S GIFT TO SCIENCE

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Our colleagues in Commission 41 can perhaps tell us why modern science blossomed in Europe in the late sixteenth century. From my amateur point of view, I believe many factors came together. An essential part of Europeans' success was their readiness to borrow ideas from other peoples. One of these ideas, that must surely interest us while we are in India, was the number symbols that we usually call "Arabic" but should call "Indian" numerals. Some time ago I read *Number Words and Number Symbols*, an English translation (MIT Press 1969 and 1977) of *Zahlwort und Ziffer* by the German scholar and mathematician Karl Menninger (*not* the American psychologist of the same name). It found it fascinating to read and have drawn heavily on it for this note.

Computing with Roman numerals was not as difficult as we may think. There were many aids - most importantly the counting board - but could Kepler really have computed the orbit of Mars without the Indian numerals? I have often marvelled that he did it without logarithms, whose invention by Kepler's contemporary, John Napier, Menninger believes was also stimulated by the new numerals. Imagine the *Astrophysical Journal* or the *Henry Draper Catalogue* if all numbers had to be written out or expressed in Roman style. Without Indian numerals (or something like them) modern science would be just about impossible.

Indian numerals have three important characteristics: (i) distinct symbols for the first nine natural numbers; (ii) place-value notation that assigns a precise meaning to (for example) the sequence 123; and (iii) the zero. Europeans were feeling their way towards (ii) but all the three things came together for the first time in this country, perhaps in this very region. Scholars dispute whether these were entirely Indian ideas, or whether Greek and Babylonian influences, brought by Alexander the Great, also helped. Hindu and Jain cosmological myths display a great love of numbers for their own sake; surely a people who produced such myths might well make an important advance in representing numbers. Place-value notation probably developed around 200 B.C. (the nine number symbols are older). The first known inscription containing a true zero was found in Gwalior (not so very far from Delhi) and can be dated to the year we now call A.D. 870.

Indian numerals first reached Europe (in Spain) around A.D. 1000, probably by trade routes through Alexandria and the Arab empire - but this is uncertain. They came without the zero and, their advantage being thus obscured, they did not spread. Around A.D. 800. Al-Khwarizmi had introduced them to Baghdad. His name gave us our word "Algorithm" which first entered European languages as a synonym for computing with Indian numerals. His book was translated into Latin (again in Spain) during the 12th century. A century later John Hollywood (Sacrobosco) in Paris also wrote about the numerals. The key figure, however, was Sacrobosco's contemporary, Leonardo of Pisa (Fibonacci), whose book *Liber Abaci* popularized the new numerals amongst Italian merchants and bankers. The latter found the numerals too convenient to ignore, even though the city council of Florence passed a law in 1229 that books must be kept in the old system - to reduce the chances of fraud. Trade spread the numerals north of the Alps. Astrologers also helped to spread them, paradoxically because the numerals were mysterious and secret signs.

Europeans were puzzled by the zero. Menninger says it was "something that must be there in order to say that nothing is there". The puzzle long delayed general acceptance of the new numerals. Indians spoke of the zero by using the Sanskrit word for "empty". Arabs translated literally into their own language, and French "chiffre", German "Ziffer" and English "cypher" all derive (through Italian) from the Arab word. Many of these words have a double meaning: either "zero" or "numbers" in general. This shows the confusion that the concept "zero" caused in many minds. Printing (another European borrowing from the East which helped the development of science) eventually popularized the new numbers, not long before Kepler, Napier and the scientific revolution.

Inside our digital computers, only one of the nine symbols is used. The all-important zero is kept, however, and place-value notation has become, if anything, more significant. Even the word "algorithm" has been revived. Our debt to ancient India thus is made more obvious. Menninger says of the world-wide adoption of Indian numerals: "This was a victory of an alien culture, to be sure, but also a victory for the mind of man..." At this first General Assembly of the IAU in India, when many of us are in the country for the first time, we should pause to thank our hosts for the essential contribution their ancestors made to that victory - without which there would be no IAU.

THE SOLAR NEUTRINO PROBLEM: A HOTEROTIC G-STRING SOLUTION

Recent work in particle physics suggests a natural solution to the well-known solar neutrino puzzle. According to New Unified Theories of fundamental particles (≡ NUTS), gravitating material is held together by hoterotic G-strings. All the remaining forces and families of fundamental particles may be understood if the basic dimensionality of physical space is 10, of which dimensions we are privileged to sense only 3. For many years, solar model investigators have been predicting an electron-neutrino counting rate of ∿ 7 SNU's. Recognizing that these 7 SNU's must, in equipartition, be shared among the 10 available dimensions, it is now clear that the fair share for us to detect in 3 dimensions is merely ∿(3/10) x 7 = 2.1 SNU's: *precisely* Davis's result!!

Thus the solar neutrino problem is at last solved. Stockholm, here we come.

(The author, in an attack of rare modesty, wishes to, but may not [because of style], remain anonymous).

THE VERY LONG BASELINE ARRAY

K. KELLERMANN
NRAO, Charlotsville, USA

One of the most challenging tasks in radio astronomy has been the quest for improved angular resolution. Because of the long wavelengths involved, it is difficult to obtain resolutions much better than about one arc-minute, even using the largest radio antennas. For this reason radio astronomers long ago turned to interferometers and arrays of antennas to give diffraction-limited images corresponding to the overall dimensions of the array rather than to the size of the individual elements. The Very Large Array (VLA) contains 27 antennas, each 25 m in diam, spread over 35 km of the New Mexico desert. Operating at short centimetre wavelengths, radio images better than one arc-sec, or comparable to the best optical pictures, are routinely obtained, and a wealth of detail in the radio emission from galaxies, planets, and interstellar space have been recorded. But many radio sources, including the active nuclei of galaxies and quasars, stellar radio sources in our own Galaxy (binary-stars, supernovae, flare stars, pulsars, the Galactic Centre, SS-433, etc.) are far smaller than the resolution limit of any existing radio array.

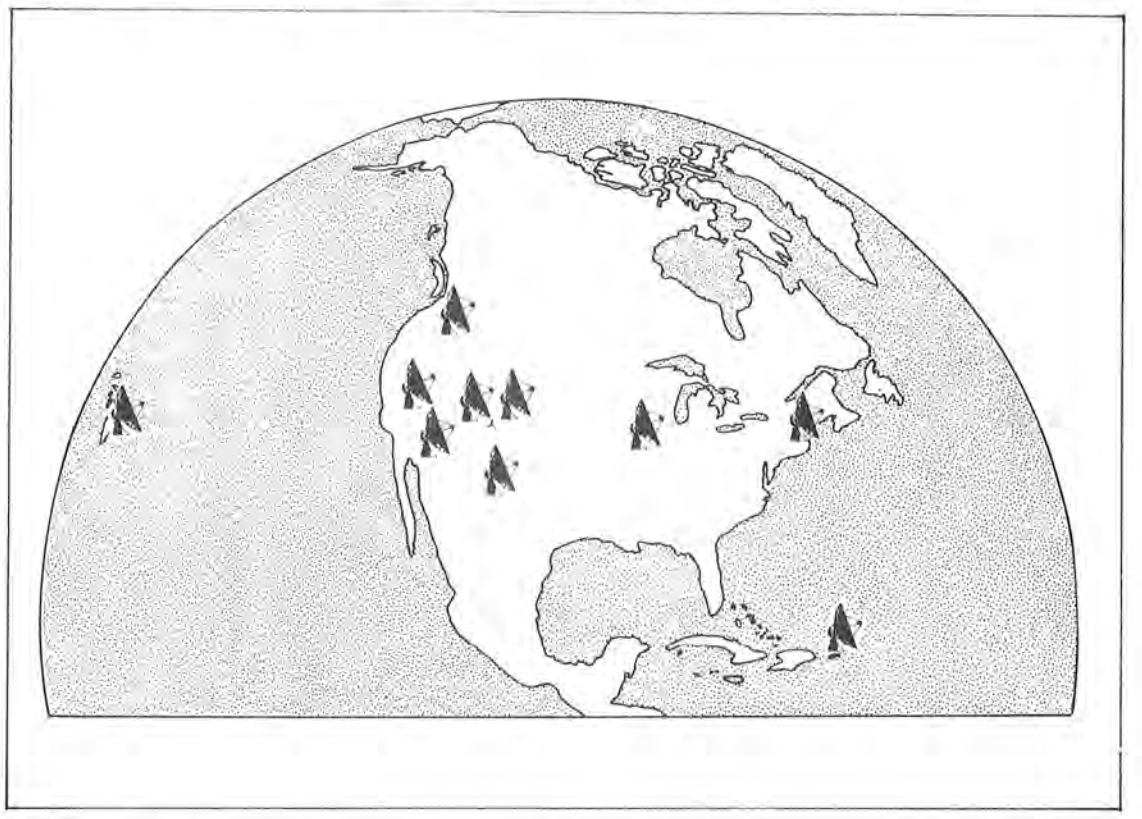
To provide detailed radio images of these very compact radio sources, American radio astronomers have just begun the construction of the Very Long Baseline Array (VLBA) consisting of ten, 25-m diam antennas stretching from the island of Saint Croix in the Caribbean to Hawaii, 8000 km away. When completed the VLBA will give high-quality radio images with angular resolutions better than one-thousandth of a second of arc, corresponding to a linear resolution of about one metre at the distance of the moon, one AU across the Galaxy, or a few parsecs for the most distant quasars. The first antenna is being constructed in New Mexico, and will be completed by the end of 1986. It will be followed by an antenna on Kitt Peak, Arizona, a second New Mexico location, and in the states of Washington, Texas, Iowa, California, and Massachusetts, as well as the two island sites. The location of each antenna, which was selected after an exhaustive study, has been chosen to provide the nearly optimum distribution of antenna pairs needed to obtain high-quality images.

Each of the antennas will be linked via dedicated telephone lines to a central computer located in Socorro, New Mexico, where a single operator will control the whole array as well as monitor the operation of the antennas and instrumentation at each site. The location of the Socorro control centre was chosen to simplify the coordination of the VLBA with the VLA to give a wide range of angular resolutions from what will effectively be a single facility.

Although there will be a direct electrical correlation between the control centre and the individual elements, ordinary telephone lines cannot handle the high data rates from the digitized signals which may reach as high as 512 megabits per second from each antenna. Instead the data will be recorded at each antenna using a high-speed recording system being developed at MIT's Haystack Observatory. Each tape, which will hold more than 10^{12} bits of information, will then be transported to the Socorro control centre where they will be replayed, and correlated in a specialized correlator system which is being developed for the VLBA, and which will handle up to one billion arithmetic operations per second, a speed which exceeds the capability of the fastest commercial computer. At each antenna, hydrogen maser frequency standards will provide coherence among all the antennas, and will be used to synchronize the tape recordings with an accuracy better than 1 μs clock error per hundred years. By installing the specialized recording and timing equipment, other radio telescopes throughout the world can also be used to further extend the sensitivity and resolution of the VLBA.

A large digital computer will be used to Fourier transform the correlator output and to correct the distortions due to atmospheric phase fluctuations, and will provide diffraction-limited images corresponding to the overall extent of the VLBA.

The VLBA is being built and will be operated by the United States National Radio Astronomy Observatory with funds provided by the (US) National Science Foundation. When completed between 1990 and 1993, the VLBA will not only provide a dramatic new capability for astronomical research, but by providing accurate measurements of the separation of the individual antennas it will have important applications to geodetic and geophysical research as well.



NEW RADIOTELESCOPE FOR MILLIMETRE WAVELENGTHS

DAVE MORRIS
IRAM, Grenoble, France

European facilities for observations at millimetre wavelengths took a big step forward this year with the opening of the IRAM (Institute for Radio Astronomy at Millimetre wavelengths, Grenoble) 30-m diam radio telescope.

The telescope, obtained from ARGE (a consortium principally of Krupp and Mann) in August 1985, has been used for a restricted series of astronomical observations since May 1985. Since then several groups of European astronomers have made observations in the 3 mm waveband and some of their results will be reported at this IAU Assembly and in Goa.

The design and initial stages of construction of the telescope were supervised by the Max Planck Institute for Radioastronomy in Bonn, West Germany; later work and commissioning were supervised by IRAM. The 30 m telescope is the first of two large instruments which will be operated by IRAM for France and West Germany, which are each funding 50% of the capital investment and operating costs. The second instrument is a millimetre wavelength synthesis array at present under construction by IRAM in the French Alps. It will consist of 3 or 4 moveable telescopes each of 15-m diam. The two instruments, 30-m telescope and array, will be complementary. The 30-m telescope will allow moderate resolution observations (beam 10 to 30 arc-sec) at high sensitivity, whereas the array will provide much higher resolution (down to about 1 arc-sec) for detailed studies of selected objects.

The 30 m diam telescope is designed to operate down to about 1.2 mm wavelength and has therefore been placed at a high elevation site (2790 m) near Pico Veleta in the Sierra Nevada mountains of southern Spain (45 m from Granada, latitude 37 degrees North). This site is quite dry — typically 2-4 mm of precipitable water — and allows year-round observations. The very best conditions of atmospheric transparency occur in winter time between storms. Although the storms are of short duration they can be severe with heavy icing. Since the telescope is free standing without any protecting dome, special measures are necessary to protect the structure and maintain the surface accuracy and pointing performance. The external surfaces can be heated when necessary to prevent ice deposition and the critical parts of the structure are temperature-controlled to within 1°C. These measures, together with a very rigid construction, should enable the deviations from a best fit paraboloid to be kept within 0.1 mm (rms) under all conditions of day and night when winds are less than 12 m/s (about 80% of the time). A fast response digital "state" controller will maintain correct pointing of the telescope to within 1-2 arc-sec.

Present performance is approaching these design goals and at the moment about one-quarter to one-half of telescope time is devoted to further optimising the performance and commissioning new auxillary equipment. Tracking accuracy is now better than 1 arc-sec in winds up to 10 m/s and the absolute pointing has an rms of 2-3 arc-sec over most of the available sky. Under calm conditions, at intermediate elevations (45 degrees), the rms surface accuracy of the main mirror is about 85 μm. This result has been derived by radio holography at 22 GHz and is confirmed by efficiency measurements which yield 44% at 86 GHz and 25% at 230 GHz.

The telescope optics is basically Cassegrain with Nasmyth focus. This is a four-mirror system with hyperbolic secondary followed by two plane mirrors to direct the received energy to a large stationary (in elevation) receiver cabin where several receiving systems can be operated simultaneously. The main mirror panels and the third and fourth plane mirrors are of aluminium honeycomb construction. The hyperbolic secondary mirror is of carbon fibre reinforced honeycomb for reduced weight. At the moment only a 3 mm waveband cooled Schottky receiver is in routine use; however, it is gradually being replaced by an SIS receiver. The 1.3 mm waveband will be available next winter and will be covered by a cooled Schottky receiver. In the long term this too will be replaced by an SIS receiver being developed at IRAM. A liquid Helium-3 cooled bolometer has undergone initial tests on the telescope and it is hoped it will be available for routine use next year for observations near 1 mm wavelength.

Several spectrometers are to be provided. At present two filter banks (256 x 1 MHz and 256 x 100 kHz) are in routine operation and a spectrum expander enables a resolution of 6 kHz to be obtained. A 2048-channel 2-bit autocorrelator is under construction in cooperation with the University of California, Berkeley. So far, 1024 channels have been completed and are under test at the telescope.

For continuum observations, beam switching is possible by using rotating sector choppers (6 Hz). Eventually the 2-m diam secondary mirror will be movable to allow slower switching (5 Hz maximum) with a throw of about 2 arc-min.

SIDELIGHTS FROM DELHI IAU

"*Mandakini's* science reporters are so busy with their *Paper* that they have no time to know what's happening in the conference" — So said a conferee in confidence to the *Paper*.

"You remind me of interferon ... failing to live up to your early promise." — A delegate speaking to *Mandakini*.

Scientific understanding is the integral of a curve of learning; science therefore in some sense comprehends its history within itself.

— *Sir Peter Medawar*

THE MANDAKINI SERIAL

BETWEEN THE TIDES

DONALD MALCOLM

FIVE

THE SLED accelerated and soon the ship was falling behind. He put out the interior light. There, off on the starboard side, hung the shimmering tendril of crystal. All his life, he had watched the wheel and the crystal cord grow.

The sleds usually had a few occupants abroad, service engineers, fabricators and so on, but not on this occasion. As the ship dwindled, he was alone with his doubts, his fears, his insignificance when measured against the immensity of the venture now so near to starting. He couldn't leave Atira and the cubs behind. But was he right to risk their lives? Anything could go wrong and they would all be doomed. He looked out at space, with its multitude of stars, as if seeking an answer, and found no solace in those coldly burning shards of light.

His thoughts of the project were continually misted by the images of Noss and Irah and the trouble they were in. He didn't know how it was going to be resolved. Noss had always been such a predictable man. But illness, and betrayal, could change people. At a time when he couldn't afford to be, Simde was irritated and worried by his inability to help Noss.

He noticed that he was drifting away from the cord. He checked the simple instruments of the sled. The controls weren't responding. He mastered an incipient surge of panic. Then the motor cut out. The sled was gradually slipping farther away from the lifeline. Immediately, Simde sent out a distress call and this was answered by the radio man on the station in orbit near the wheel. The transmission crackled.

'It's flare activity,' the man explained. 'We'll send another sled out from the ship to take you in tow.'

'Have I time to reach the wheel? I don't relish getting caught out here during a flare eruption.'

'There's no actual flare in progress, Simde Yorea. But due to the increased frequency in the past year, the level of radiation around Hasub is much higher than normal.'

For a time, Simde was occupied in providing readings and measurements to enable the other sled to find him. And then silence. Simde had put on the interior light at the beginning of the emergency and now he put it off again. He felt as if he were under the sea. Diving was one of his pleasures. Until the other sled turned up, apart from a regular signal, his time was his own. Leisure was something he had come to cherish recently, so little did he get of it. The circumstances could have been better. And Atira would be worried, although she would have been told of the breakdown.

Eventually his sled was found and taken in tow and he continued his journey to the wheel. With nothing else to do, he contemplated the great annular crystal expanding in the sky. The half segment in sunlight glowed with a subdued cyclamen colour. As it rotated like a dream in motion, sporadic sparks of scarlet fire flashed, as if it were an anvil being struck by a hammer of light. The space station, containing workshops and other facilities, orbited nearby.

A service shuttle had docked at the station just ahead of the sleds. Two engineers took the faulty sled to the workshops. Simde thanked his rescuer, then, when he reached the radio room, the operator who had connected him with Hasub. After he'd spoken to Atira, he went to the station commander's office and was surprised to see Noss there. He looked ill. His expression prevented Simde from commenting. Simde greeted the commander, Jaay Hucogum, a lifelong friend.

'This lazy existence up here must agree with you. Jaay.' Simde smiled, nudging the commander's paunch.

'It does — except when it's disrupted by people trying to sneak off with sleds. I'll be as interested as you are to find out what went wrong. As you know, maintenance is very regular and strict.'

Simde set him at ease. 'Not everything can be accounted for. Don't worry.'

He turned to Noss. 'What brings you up to the wheel, Noss?'

'An inspection of the electro-magnets. I'm going over now to look at them. Do you want to come?'

Simde sensed the urgency in Noss's apparently casual invitation, and the commander said that his business could wait, so Simde and Noss returned to the hub and boarded a sled. They headed for the crystal wheel. Simde guided the sled to the hub. The crystal was magical, every conceivable hue and tint and shade ensnared in its sparkling surfaces. As they proceeded along an access tunnel, they would find themselves stepping into a blinding copper and saffron pool or drawn into a terrifying hole of sable and greenish-purple. Nothing seemed real.

At last they emerged on the rim and the graceful curves of spectrumed crystal fell away on either side. They were standing on a frozen rainbow.

Simde heard Noss's voice in his helmet radio.

'When I come here, I realize just how incomprehensible nature is, and yet I'm proud to be a minor part of the pattern. I often wonder if, a galaxy away, perhaps another being is gazing out at the stars and trying to make sense of it all.'

As Noss began his inspection, Simde said, 'Did you go to the healer?'

'Yes.'

'And?'

Noss straightened up and looked at Simde.

'I'll stop soon. It could be now, tomorrow, but certainly not more than twenty days. They can't do anything. I've caught some new variant of the disease, one that can remain undetected until it has a hold too strong to be broken. But I'll not stop until I see the ship leaving on its journey and I know that I have done my work well.'

The dark blaze of space and the timeless rainbow of crystal seemed to recede until Noss filled the whole of Simde's vision. Pulses of memory beat across his mind, recalling things about Noss that he thought he had forgotten. There was nothing to say and Noss didn't expect it. Everyone stopped. But Noss — And in this way. Simde felt a gout of hate against Irah, for having stopped Noss. The emotion faded at once. Hate had no comfort for Simde. He knew that Noss would not understand. Noss had no room in his heart for anything but love. For that reason alone he was vulnerable and would stop.

Noss had moved along the crystal's rim, leaving Simde behind. Almost as if he could read it, he knew what was in Simde's mind. They had been friends and colleagues for a long time and had a fine comprehension of each other's philosophies. He had no fear for Simde. Perhaps he should have some for himself. Was stopping so very bad, coming, as it did, at the culmination of his life's work? For a man like him, it was a sound, logical conclusion. He had never maintained illusions about anything or anyone, except Irah. And even with her, after their first joining, he had felt briefly cheated. He had made a mistake and he would not compound it. Now the debt was due.

Noss completed his inspection and went back to where he'd left Simde.

'Everything's all right. Let's go home.'

A wavering glimpse of colour reached Simde's eyes. The planet was coming. Soon it would be at opposition and the venture would begin. He caught something of Noss's perspective. Everything was all right. Noss, himself, the others: no one mattered. The drama would sweep them all along.

(To be continued)

ANNOUNCEMENTS

WISH THEM A HAPPY BIRTHDAY

24.11.1985

Dr Cecylia Iwaniszewska	Poland
Dr Richard McCray	USA
John S Neff	USA
Dr Jeffrey D Scargle	USA
Dr Roberto H Mendez	Argentina
Dr Richard Durisen	USA
Dr John Parker Oliver	USA
C R Subrahmanya	Australia
Bruno Marano	Italy
Philip Allan Charles	UK

CULTURAL PROGRAMME

The Concert of Instrumental Music scheduled to be held at the Convention Hall, Hotel Ashok, will now be held in the Main Hall 'A' of Vigyan Bhavan at the same time, i.e. 1900 hrs on Tuesday, 26 November.

The Concert will be for two hours.

ALTERED MEETING SCHEDULE: VIGYAN BHAVAN

Date: 25.11.1985

Room	25-1	25-2	25-4
B		Comm. Pres.	
I	6/1	20/6	
J	4/5		
L			46/7

THE INSTITUTION OF SURVEYORS

The Institution of Surveyors and the Survey of India extend a cordial invitation to all interested scientists to attend a lecture by Prof. Ivan I. Mueller, Vice President of the International Association of Geodesy on Monday 25th November, 1985 at 1600 hours on the following topic :

"Applications of Space Techniques in Geodynamics — Trends & Prospects".

The lecture will be held in the CSIR Science Centre, Lodhi Estate, New Delhi, and its duration will be about 1½ hours.

Guests are required to take their seats by 1550 hours due to restriction of space.

Col. (Dr.) M.G. ARUR
for Hony. Secretary
The Institution of Surveyors

PROFESSOR SIR WILLIAM McCREA

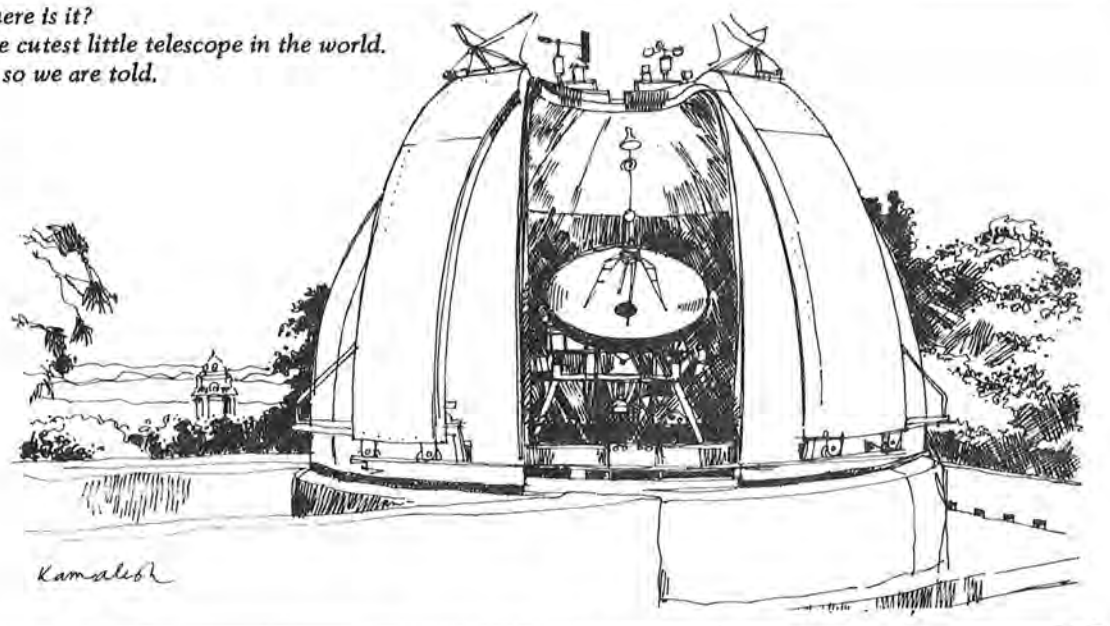
Unfortunately, Bill McCrea is unable to be at this General Assembly, but he sends his greetings and best wishes to all his friends and colleagues.

DOWN MEMORY LANE

(Continued from p. 2)

forward to the time when astronomers from all countries would co-operate on a basis of equality and mutual friendship. It was probably Shapley's enthusiasm for the Copenhagen meeting that was the most important single factor in ensuring progress at that critical time. We probably still benefit from the foresight of those few astromers, who, in adverse conditions of travel and accommodation, took this initiative so soon after World War II.

Where is it?
The cutest little telescope in the world.
Or so we are told.



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BALLOON-BORNE ASTRONOMY IN INDIA

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Tata Institute of Fundamental Research
Bombay

Introduction

Balloon-borne astronomy has a long history in India. Prof. Millikan had conducted experiments, around 1940, from Bangalore using rubber balloons to carry particle detectors to high altitudes. In 1948 the Tata Institute of Fundamental Research (TIFR) under the leadership of Dr Homi Bhabha, started a regular programme of studying the nature of cosmic rays using rubber balloons. Since these early beginnings, balloon-borne astronomy has been pursued in India without interruption and with increasingly advanced techniques. Beginning with the study of the highest energy radiation 'Cosmic Rays' using passive nuclear emulsion detectors, its scope was first extended to the observations of the softer γ-ray and X-ray radiations and then to the observations of the far-infrared radiation using telescopes oriented to a fraction of a minute of arc. Some of these observations have been made as collaborative efforts of Indian and foreign scientists. In this article we shall briefly describe the research carried out in the three areas of cosmic ray, X-ray and γ-ray astronomy and far-infrared astronomy. However, before this we shall have a look at the growth and the present state of the facilities for balloon-borne experiments in India.

The Balloon Facility of TIFR

Balloon flying for cosmic ray experiments was started at the Tata Institute of Fundamental Research in 1948. During the early period (1948-1955) clusters of rubber balloons were used to carry the instruments to stratospheric altitudes; these flights were carried out from a number of stations spread between Srinagar in the north and Madras in the south.

The rubber balloons could not provide long-duration flights at the ceiling altitude, nor could they carry heavy payloads. In order to overcome these limitations, it was decided in 1955 to develop the technique of constant volume polyethylene balloons. The problems associated with the fabrication and launching of these balloons were solved by 1959 and regular flights of plastic balloons have continued since then. A technical problem faced in this connection at our low geographic latitude is worth mentioning. The disastrous effects of the brittleness of the balloon-film occurring at the extremely low tropopause temperature (below -80°C) were ingeniously bypassed by developing a tinted film which kept relatively warm due to its high absorptivity for the solar radiation. For night flights, a balloon film capable of withstanding the tropical tropopause temperature is being developed.

Till 1969, the balloons were fabricated and the technical development work was done at the campus of TIFR in Bombay, and the balloons were launched during the yearly campaigns from the campus of the Osmania University in Hyderabad. In 1970 a permanent base was established in Hyderabad for balloon flight operations. Balloons carrying payloads of up to about 1000 kg have been launched successfully, and instruments have been carried to altitudes of up to about 40 km from this base. The average number of balloon flights conducted is 8 per year; out of these, about half are for astronomical observations.

This balloon facility has been used by various institutions in India for research in astronomy, meteorology and other areas. Several collaborative balloon programmes have been carried out with scientists from Canada, Japan, the UK, the USA, the USSR, West Germany and the other countries.

Cosmic Ray Research

The nuclear component of cosmic rays not only carries the information on the chemical and isotopic composition and the high energy process taking place in the regions of its origin, it also brings along information on the matter distribution in the interstellar space through the effects of the nuclear interactions and the energy loss suffered by it during its journey. The electron component, in combination with the radio background observations, provides information on the magnetic fields in Galaxy.

The low geomagnetic latitudes of India provide a natural rigidity filter convenient for the study of high energy (>10 GV rigidity) cosmic rays. The Tata Institue of Fundamental Research and the Physical Research Laboratory (PRL) have used balloons extensively during the fifties and sixties for studying the various components of cosmic rays.

Important Results Obtained

(i) The electrons and positrons above 10 GeV energy were detected for the first time and their energy spectrum was measured using nuclear emulsion. At such high energies the electrons suffer severe energy losses in their interactions with the inter-stellar magnetic and photon fields, and these measurements provide direct clues to the time spent by the cosmic rays during their travel from the sources.
(ii) The odd-charge nuclei were found to have a low abundance compared to the even-charge nuclei throughout the charge range 6-20.
(iii) The nuclei in charge range 15-20 were found to be very low in abundance in comparison with nuclei of the higher and the lower charges.
(iv) The energy spectrum of nuclei was determined.
(v) The rigidity spectrum of He nuclei was measured in the range 15 to 100 GV with a magnetic spectrograph, and an upper limit was placed on the abundance of antihelium nuclei.

Most of the results were obtained with passive nuclear emulsion particle detectors and the use of active electronics detector systems played a crucial role in the development of telescopes used for later observations described below.

X-ray and γ-ray Astronomy

The high rigidity cut-off at low geomagnetic latitudes provided an important advantage, for the X-ray and γ-ray astronomy, in the reduced atmospheric background. To take advantage of this and the better accessibility of some parts of the sky, programmes of X-ray and γ-ray astronomy were started at TIFR and PRL in 1967. These observations have been carried out using pointed telescopes carrying crystal-scintillator and proportional counter detectors with passive collimators; some of these observations have been done in collaboration with foreign scientists. Some of the results obtained are listed below.

(i) Flaring in hard X-rays (> 20 keV) was detected from Sco X-1 and the spectrum of flare X-rays was measured.
(ii) The first evidence of flaring and rapid intensity variations in hard X-ray emission from the black-hole candidate Cyg X-1 was found, and an absence of regular pulsations was established.
(iii) In collaborative experiments with Japanese scientists, correlated optical and hard X-ray variations were detected from Sco X-1 and the size of hard X-ray source in the Crab Nebula was measured during its occulation by the Moon in 1975.
(iv) Cyclotron X-ray lines were observed from Her X-1 and Crab plusars in a collaborative experiment with Italian scientists.
(v) Hard X-rays were observed from the quasar 3C273 in collaboration with Canadian scientists.
(vi) Low energy cosmic γ-ray background was measured in the 1-10 MeV energy range.
(vii) Emission of γ-ray in energy range 5-100 MeV was detected from the Crab Nebula and CG 195+04 in a collaborative experiment with Russian scientists.

Large-area (up to 0.5 square metre) telescopes are now being used for observing hard X-rays from pulsars and active galactic nuclei.

Far-Infrared Astronomy

By the late sixties a firm base in the techniques of balloon-borne experiments had been established in India. This favou-

(Continued on p. 4)

EDITORIAL

EUREKA! . . . . . I THINK?

Legends encrust the memories of great and famous men and women. They embody certain aspects of the truth, they are often works of art sculpted from the rough matrix of events in the life of the famous then polished until they reflect our expectations of how our hero or heroine should have behaved. This is in no way a denigration of the great; it is a tribute to their essential stature that such processes begin.

Many scientific legends are doubtless distortions of the truth. Galileo did not invent the telescope and it is doubtful if he ever dropped objects of various densities and weights off the Leaning Tower of Pisa. There is probably no more truth in that than the oft-repeated myth that the Town Council of Pisa has decided to put a clock in the Leaning Tower because what's the use of having the inclination if you haven't got the time.

We all know that Newton thought of the Law of Gravitation because, seated in his family orchard at Woolsthorpe, he saw an apple fall and asked one of those peculiarly stupid questions that only geniuses think of. "Why did it fall down and not up?" He said himself that this was how it all began and certainly in the rooms of the Royal Astronomical Society there is in a glass case a section of a bough said to be - no, not from the same tree, that would be *too* much! - from a tree in the same orchard. I have lingering doubts about this - it reminds me of the Museum of the History of Science whose proudest exhibit was the skull of Newton - as a young child.

Again, is it true that the first stirring words spoken by Neil Armstrong standing on the Moon's surface were: 'A small step for a man; a giant leap forward for mankind!'? 'Fraid not. Some legend-squashing misfit told me these words were said on the ladder! The first words spoken by a man standing on the Moon's surface were: 'It's a dirty gray colour. I can kick it around a bit", which when you come to think of it is probably more characteristic of Man's reaction when he gets a bit of new territory. But I digress.

A scientific legend exists that is widespread among non-scientists and which, I have a sneaking suspicion, many scientists do little to squash because it bestows upon them a kind of mystique. It is the myth of the effortless breakthrough, the blinding light of theoretical illumination switched on by a great brain at sight of the problem . . . . .the 'Eureka!' factor. You turn up at your office or laboratory or observatory, consider the next tricky bit of research and before lunch or dawn, as the case may be, a brilliant solution or discovery has been made. No sweat.

Nothing of course could be further from the truth. We know that even for the best of us it seems to be necessary to serve our full stint of toil and tussle, frustration and irritation, attacking the problem from all angles in every conceivable way, our attendant emotions plummeting from high hopes to deep despair and back again, spending endless hours at it (no 9 a.m. to 5 p.m. rules here) until it obsesses our daylight and nighttime thoughts and threatens domestic harmony. Only by paying this tribute will that rare and exquisite satisfaction, that peak of consciousness joy be granted of the moment of discovery. We treasure that moment. It comes but rarely to us in our scientific career. Soon after, the usual doubts sidle in. Am I really the first to discover this? Where will I find it in the literature? And if it isn't there? Then, I wonder what's wrong with it? And, if you're like me, more often than not, you find out. But if, having tested it exhaustively, it still stands up, then that deep satisfaction returns. And life is sweet indeed.

There are few callings in which such indiscribably sublime moments can arise. Science is one of them and in its oldest offspring astronomy, we have the good fortune to be active at a time when the number of such moments seems to be maximised.

For myself, when I make one of these breakthroughs now, I have learned to take time off for lunch or dinner or to sleep on it. That way, I'll at least have a few hours of glowing satisfaction before disillusionment sets in after checking it.

Archie E. Roy

DOWN MEMORY LANE – GLIMPSES FROM PAST GENERAL ASSEMBLIES

VII GENERAL ASSEMBLY, ZURICH 1948

After a lapse of almost ten years, the Union had its General Assembly (seventh) in Zurich in August 1948.

Apart from the various meetings of the Commissions, there were symposia on 'The Abundance of Elements' and 'Stellar Spectra'. Dr E.P. Hubble of the Mount Wilson Observatory, in an informal talk, outlined the construction and projected programmes of the 200-inch telescope.

Dr H. Shapley, President of Commission 39, presenting the report of this Commission, pointed out that it was agreed by the members of the Commission that the location of any new international observatory should be between 10° and 40° south latitude. He also gave the required specifications for the site.

It was proposed by the Executive Committee and recommended by the Union that publications in astronomy in any language should carry an abstract in one of the widely read languages.

An organ recital, a serenade and excursion to Lake Zurich were the highlights of the social engagements.

B. Lindblad became the next President, O. Struve, V.A. Ambartsumian, and P. Swings the Vice-Presidents, and B. Stromgren the General Secretary. The venue of the next assembly would be Rome.

Tycho Brahe "sees" the sun rising from below the fixed horizon. Kepler "sees" the horizon rolling beneath the stationary sun. To see the sun as Kepler sees it is to have effected a Gestalt-shift. Quoted by John Losse *(A Historical Introduction to the Philosophy of Science)*

PHOTONS, GALAXIES AND STARS

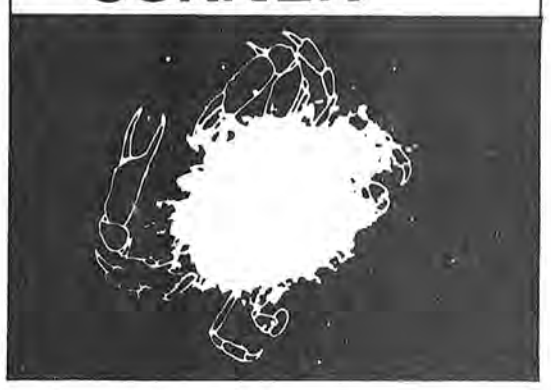
Selected Papers of Hanbury-Brown

Professor Robert Hanbury-Brown was the first distinguished scientist invited by the Indian Academy of Sciences to occupy the prestigious Raman Chair established by the Academy in 1972. In order to commemorate his visit to India, the Academy has published a selection of his papers in astronomy and astrophysics. Entitled *Photons, Galaxies and Stars*, the volume was formally presented to Professor Hanbury-Brown by Professor S. Ramaseshan, President, Indian Academy of Sciences, at Vigyan Bhavan on 21 November. The book consists of 28 papers, including the well-known ones, viz. 'Radio emission from the Andromeda Nebula', 'A new type of interferometer for use in radio astronomy', and 'Interferometry of the intensity fluctuations in light'.

What should interest even those outside the realm of astronomy are four lectures in which the author gives his insights into: Star-size measurements, Bosons & stars, Control of science, and Science & faith.

Running into 426 pages, the volume is priced US $15.00 (individuals) or US $30.00 (institutions) plus $6.00 for airmail postage). Copies are available from Indian Academy of Sciences, P.B. No.8005, Bangalore 560 080.

gASTRONOMY CORNER



RAJMAH

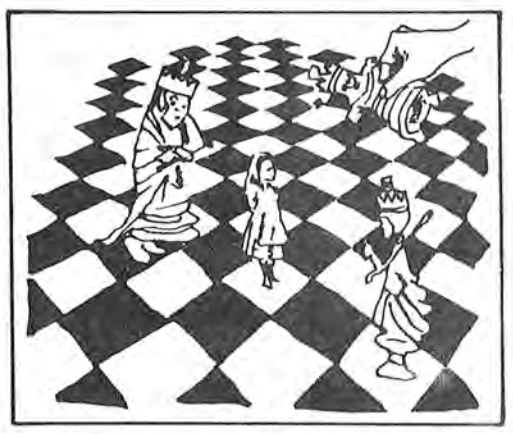
(Kidney Bean Curry - An Indian Side Dish)

	Ingredients	Quantity
1.	Red kidney beans	250 g
2.	Onions	75 g
3.	Fat	25 g
4.	Turmeric	1/2 tsp
5.	Chilli powder	1 tsp
6.	Coriander powder	1 tb sp
7.	Ginger	10 g
8.	Garlic	a few flakes
9.	Salt	to taste
10.	Ground *garam masala* (mixed spices)	5 g
11.	Tomatoes	100 g

Method

1. Soak the beans overnight.
2. Boil in salted water till tender retain liquor.
3. Grind ginger and garlic along with chillies and turmeric, fry in hot fat.
4. Add beans along with boiling liquor.
5. Cook till gravy is thick.
6. Heat fat, add sliced blanched tomatoes and ground *garam masala.*
7. Add to the beans, simmer a while and serve hot.

NB : Serves Four.



There is no less wit nor invention in applying rightly a thought one finds in a book than in being the first author of that thought. — *Pierre Bayle:* Works II.

Is not this a fine definition of applied, rather applicable, research? — Editor

WISH THEM A HAPPY BIRTHDAY

25.11.1985

Dr Klaus Fricke	FRG
Ruth E Hedeman	USA
Erik H Olsen	Denmark
Prof. Dieter Reimers	FRG
Dr Campbell M Wade	USA
Prof. Aden B Meinel	USA
Mr Denis W Beggs	UK
Dr Halil Kirbiyik	Turkey
Prof. Dr N P Groushinsky	USSR
Dr Edward B Newell	Australia
Dr Octavio Cardona	Mexico
Dr Katalin Olah	Hungary

Just ten days before the IAU's XIX General Assembly was to open in New Delhi, one of the fiercest battles — not on the battleground but on a chessboard and in a game in which ancient India distinguished herself as in astronomy — came to a grand finale. And the battle was an all-Soviet affair — between Kasparov and Karpov (or should we reverse the order because Karpov was the reigning monarch?) Chess enthusiast and science writer Subbiah Arunachalam gives a star-view of the battle of wits. — Ed.

GARRI KASPAROV, the NEW KING

Subbiah Arunachalam
Publications & Information Directorate (CSIR), New Delhi

Garri Kasparov, the 22-year old Grandmaster from Baku, Azerbaijan, became the youngest ever world chess champion when on November 9, he inflicted a crushing defeat on the reigning champion Anatoly Karpov, 12 years his senior.

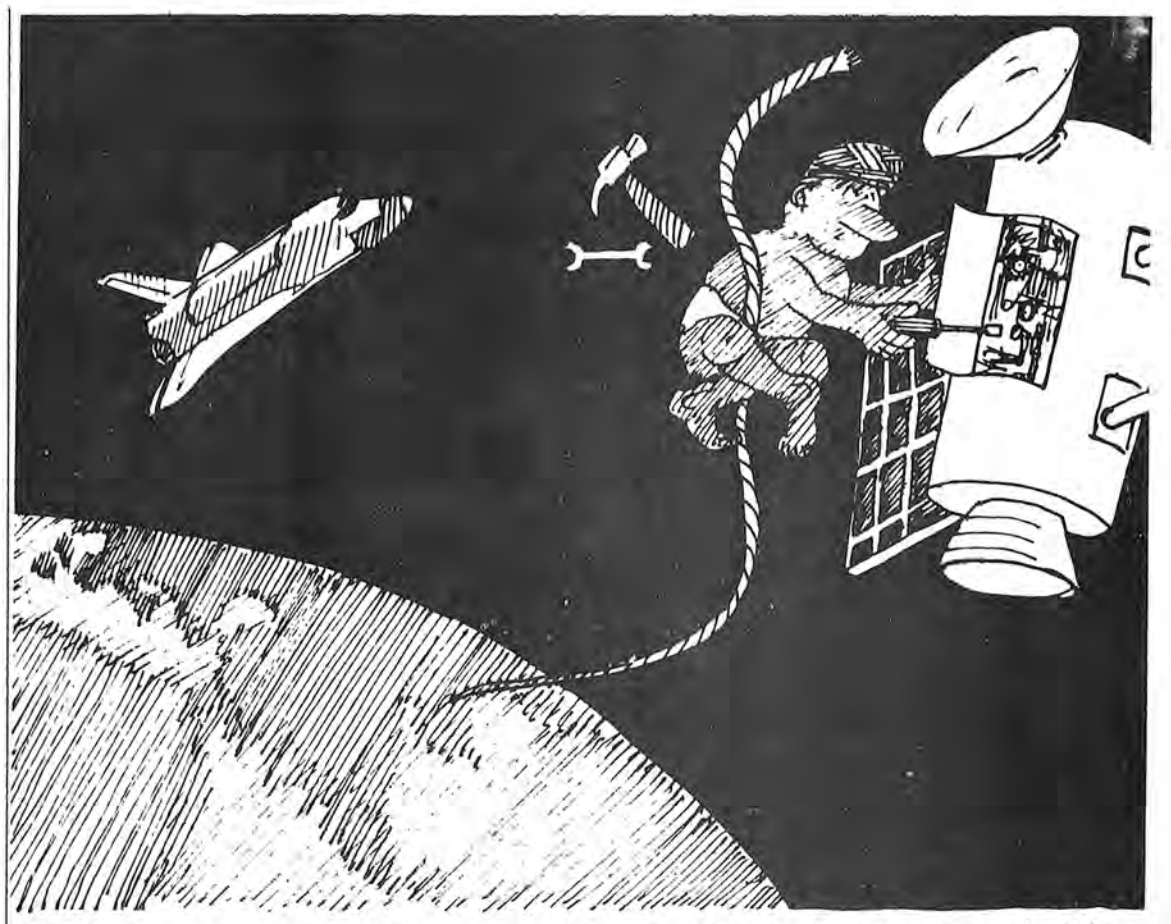
The title match which commenced in September 1984 soon turned out to be an event of considerable significance and news of the duel spilt into the front pages of newspapers worldwide. Like the Fischer-Spassky match of 1972 and the Fischer-Karpov duel of 1975 (which never took place), the 1984 title match attracted the attention of even those who have never played the game of chess. After 159 days and 48 games, the match was abandoned. Although Karpov led Kasparov at that stage by five wins to three and needed only one more win to clinch the issue, it was widely felt that had the match been continued Kasparov would have won the title.

The rematch, described by many in the Press as the grudge match, commenced in early September with a facile win for the challenger. That Kasparov should have opted for the Nimzowitsch Defence — an opening in which Karpov is regarded an expert — was proof enough that he had something up his sleeve. That Kasparov actually won that game indicated that he was much better prepared this time than the last when he trailed 0-5 before reducing the margin to 3-5.

But by game 5, Karpov reversed the table and had taken a one-point lead. The seventh game, which will remain an analyst's delight for a long time to come, was rich in the number of unexpected moves and sharp turns. It was one of the most spectacular games played in recent times. The rivals explored little-studied versions very early in the game, and because of the novelty of the positions they had to spend a lot of time athinking. Kasparov took 18 minutes over his seventh move! In contrast, in a later game when he had the advantage of a two-point lead he played his first 19 moves in just 19 minutes — probably a record in a world championship game.

In the sixteenth game, a gem of a game that brought in full view Kasparov's combinative skill and penchant for positional play, the challenger outplayed the champion to take the crucial lead which he never surrendered. In the last eight games, Kasparov won twice and Karpov once. The final tally was: Kasparov, five wins; Karpov, three wins; and 16 drawn games.

Both Karpov and Kasparov were boy prodigies who took Mikhail Botvinnik's correspondence course while still in school. Both had a brilliant academic career and won several tournaments including the world junior championship early in life. Karpov became an International Grand Master when he was barely 19 and Kasparov at 17. Before the title match began they had met thrice, all the games ending in draws. Their first ever encounter, however, was when Grand Master Karpov defeated schoolboy Kasparov in a 'simultaneous'.



"If this catches on, it's going to put NASA out of the satellite repair game!"

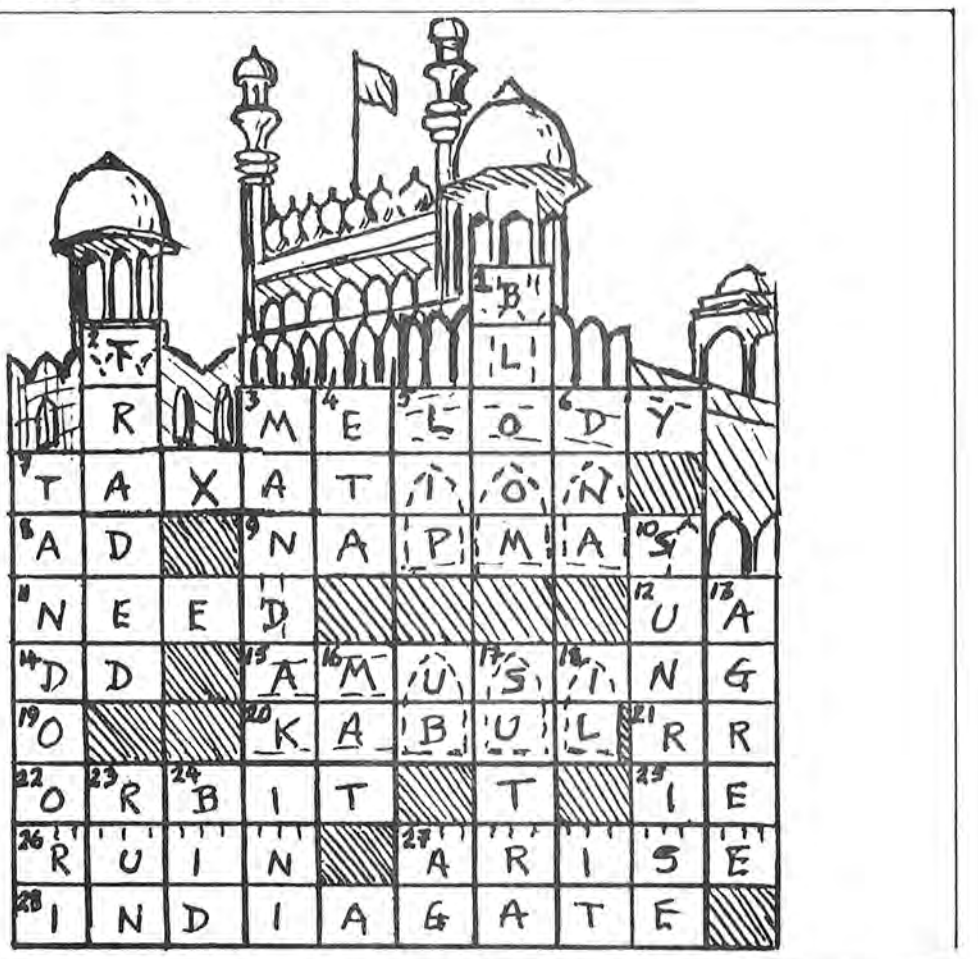
Garri's road to the title match began in 1981 when he played and came first in the Moscow Interzonal where he had to match wits with Mikhail Tal, Ulf Andersson, Yefim Geller and Alexander Belyavsky, among others. In the challengers' matches he crushed convincingly Belyavsky (4 wins - 1 loss), Victor Korchnoi (4-1) and Vassily Smyslov (4-0) to earn the right to face Karpov.

Greatly influenced by Capablanca's games, Karpov is a perfectionist known for his breathtakingly dashing attacks and subtle positional manoeuvres. Kasparov, influenced by Alekhine's games and later by Mikhail Tal's style of preferring complicated situation, is an artist: "I am for beautiful, inspired chess, which is very close to art and thus giving chess fans real aesthetic satisfaction".

Interestingly, these are the only two players to have crossed the 2,700-point mark in Prof. Elo's system of evaluating the strength of chess players. Barring the temperamental genius Bobby Fischer, there is none today in the world who can be considered to be of the same class as Karpov and Kasparov.

The Champion

The series of 24 games that they played had produced many innovations and had advanced chess theory considerably. Chess lovers will have another round of aesthetically satisfying and hard-fought chess when Anatoly Karpov decides to use his privilege of a return match in the next few months. But I, for one, would like to see Kasparov taking on Fischer. I bet it would be the match of the twentieth century.



THE MANDAKINI SERIAL

BETWEEN THE TIDES

DONALD MALCOLM

SIX

THE Judgement had been made and the Sentence passed. Now was the time to carry it out. Irah and the four men who had joined with her, stood within a circle of Custodians. Outwardly, she was the calmest of the group. Only her green eyes betrayed her turmoil. She started impassively at the small square machine, sitting on a table flanked by two Custodians. A bright light shone down on the machine, casting the rest of the area in darkness. Behind the machine sat the High Custodian.

The first man walked forward bravely. He was already as good as stopped,so what did this matter? He placed his hands in the slots in the machine and felt the clamps grip his wrists. The embrace was brief. When he was permitted to withdraw his hands, they looked no different. But the radiation had done its work of destroying the sensitive nerves of the sex and feeding digits. Before the Execution of Sentence, the five had been allowed to use a psycho-food plant. Now he knew that he had left to him thirty-one days, no more. The ultimate penalty had seldom been extracted, but no one had ever been known to last the full time. They always stopped themselves.

The next two men were as brave as the first one. All three had gone so far in degradation and perversion that what awaited them was strangely fascinating and desirable.

The fourth man was young, hardly more than a youth, without parents, and perhaps not as culpable as the others. At the Judgment, Irah had admitted freely that she had enticed him. The three older men agreed that they had persuaded and tricked the young man.

The High Custodian had listened to all the evidence, of the other accused and the youth's friends. He was still clean, untainted. However, the High Custodian, despite the stringent ethics of his position, had been determined from the outset to make an example of them all, without exception, and had sentenced them accordingly. There was no appeal. And there was only one way the Sentence of Execution could be commuted. Someone else had to offer himself, or herself, as a substitute.

No one had offered. So now he was here, in the Hall of Execution of Sentence, about to face the machine. His legs failed him and two Custodians had to support him. One took his hands and was about to force them into the slots, when a voice told him to release the youth.

Noss stepped past the Custodians. They didn't know what to do. The ceremony of Execution of Sentence had never before been disrupted. From the shadows beyond the machine, the High Custodian demanded. 'Why do you violate this ceremony, Noss Sidl?'

'I had come to offer myself as substitute for him.'

The intended victim had collapsed before the machine, too afraid to believe what he heard.

'But his crime was against you.'

Noss answered: 'The Judgment was unjust and should never have been given.'

The stopping of brain cells could have been detected in the Hall. There was nothing that the High Custodian could say. Noss's action precluded comment.

'He should not be here, awaiting Execution of Sentence. We are all guilty of what has become of our society, of which he is a product. We haven't cared enough about other people, what they did, or thought. Perhaps it is not too late for someone to start caring. I offer myself as his substitute. Have I your permission?'

It was a formality, and the High Custodian was reluctant to comply.

'Because of what he, and they, have done, you will soon stop. This gesture will cause you great pain and discomfort for the remainder of your time.'

'Thank you for your concern, High Custodian. It is my wish.'

'So be it. Release the prisoner. It is recorded that Noss Sidl is his substitute. Do you wish to bond?'

'I have no need of it, High Custodian.'

'Then let Execution of Sentence proceed.'

The young man tried to thank Noss, who said: 'Make good use of your life.'

Noss asked the High Custodian if he might talk to Irah and this was granted. She was a broken woman. When Noss appeared, she had hoped, in some twisted way, that he had come to substitute for her. Noss read it in her eyes. He extended his right hand. She faltered, then put out hers and their digits touched.

'Had we been bound by hate, instead of love, I might have substituted for you, Irah, knowing what your life would have been, that of an outcast. But because I love you, I will not. I know that you understand. Come, we'll go forward together. Let me help you.'

She put her hand on his arm and they went to meet the machine.

SIMDE was anxious and angry when he heard of Noss's sacrifice. He was concerned for his friend. The last days should have been as easy as possible. His anger was selfish and he didn't try to hide it from himself. Although the first stage of the project was almost finished, and Noss had done all, and more, that was required of him, Simde thought of him as the essential spirit of the project, ensuring its success. It was irrational, but if Noss were to stop sooner because of what he had done — Simde didn't want to think about it.

There was a further complication, only in Simde's mind. After the Execution of Sentence, Noss and Irah had gone back to live together. It was a sensible arrangement, the only one. At first, Simde didn't want to concede that. He couldn't understand why Noss could do that, why he didn't hate Irah even a little. She had stopped him twice over.

Simde and Atira were out on the terrace, watching the sun westering amid a shoal of slow indigo and dull bronze clouds.

Atira said, 'Love is a much stronger and more destructive force than hate. Men can't see that. Women can. Noss still loves Irah, so he has to destroy her in order to protect her.'

She turned towards him. Lingering rays of sunlight enmeshed in her hair, framing with a halo her shadowed features, out of which her mauve eyes shone like twin stars.

'Could you stop loving me, despite anything I might do to you? Noss and you are very much alike, although neither of you realizes it.'

The sky was flushing with deep red and purple, shading into black. It was one of the few remaining sunsets they'd see on Hasub. Patterings of cold wind played across the terrace, making Atira shiver. Going indoors, they went to see the cubs, then retired to their own room.

Deep in the soil, the food plant could feel the steady spread of the blight along its roots.

(To be continued)

POESIA HOMENAJE A LA ESPOSA DEL ASTRONOMO

(The poetry was written by Agustin Embuena, in homage to the long-suffering wife of the astronomer, on the occasion of the "V Jornadas Nacionales de Astronomia", held at Sevilla (Spain) 1983).

En las «V Jornadas Nacionales de Astronomía» y durante la cena de hermandad, se rindió homenaje a la «sufrida esposa del astrónomo»; durante la cena el periodista y actor teatral (amateur) Eulogio Serrano, recitó una poesía original de Agustín Embuena, locutor de Radio Nacional de España, la cual publicamos a continuación:

¡Brindo!
Por estas mujeres bellas,
esposas con arrebol
de los que ahoran estrellas...,
teniendo en su casa un sol.

Por ellas, que son consuelo
de paz que dan y reciben...,
y resultan ser el CIELO
de los que en las nubes viven.

Por ellas, que por su mal,
ven que su marido habita
en un mundo sideral
que sus afectos marchita.

¡Brindo por vosotras!
Mujeres que haceis acopio
de ternura, mientras ellos
se pegan al telescopio
buscando extraños destellos.
Mujeres que, en fiel afán,
pensais con dudas no vanas:
« Ay, Señor! ¿Qué mirarán...
habiendo tantas ventanas?

Y ellos, quietos en su nube,
buscando paisajes necios,
sin ver que la vida sube,
que vuelan alto los precios,
que todo es dura ascensión
y en este planeta ya harto
no baja ...., ni la tensión
que vuela en pos del infarto.

¡Brindo por vosotras!
Mujeres que, un dulce dia
os casasteis sin sentido
con él ... y la astronomia,
vuestro segundo marido.
Mujeres que sin querella
veis con paciencia sublime
como el va tras una estrella...
como un productor de cine.

Mientras vuestra alma suspira
con amor tristón y lacio,
está él mira que te mira
los secretos del espacio.

¡Brindo por ti!
Mujer piadosa y práctica
que ves al hombre elegido
perdido en una galáctica
que le ha robado el sentido.

Esposa como ninguna
que a una esperanza se aferra,
viendo a su esposo en la Luna...
aunque reside en la Tierra.

¡Quiero que sepáis!
Que a vosotras este día,
con respeto y vasallaje,
os rinde la astronomía
un merecido homenaje.

Sabed en este momento
que sois siempre en vuestro hogar...
lo mejor que el firmamento
nos podía regalar.

¡Choquemos nuestros cristales
ofreciendo igual que rosas,
expresiones siderales
de amor, a nuestras esposas!

BALLOON – BORNE ASTRONOMY

(Continued from p. 1)

rable circumstance encouraged us to start a programme of far-infrared astronomy in 1973 at TIFR. A 75 cm aperture telescope was developed with a pointing accuracy better than half a minute of arc and with a capacity to map sources with a resolution of about a minute of arc. Subsequent to this, a larger, 100 cm aperture, telescope has been developed. Photometric observations have been made in the wavelength band 40-200 μm. Some of the results obtained are listed below.

(i) The brightness temperature of Saturn (disc plus rings) in the wavelength band 70-120 μm was measured in 1980 when the rings were seen nearly edge-on from the Earth. This observation was used, in combination with the earlier observations during the other phases of the rings, to derive the brightness temperatures of the disc and the rings.
(ii) Several HII regions have been mapped in the photometric band 100-200 μm.

To conclude we can say that several of the observational bands inaccessible from ground have been explored by balloon-borne astronomy in India. This endeavour, which started four decades back, continues to hold promise of exploration in new areas.

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IAU

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XIX GENERAL ASSEMBLY
NEW DELHI 1985

NO. 8 : TUESDAY 26 NOVEMBER

Editor : ARCHIE E. ROY
Associate Editor : A. RATNAKAR

THIRD INVITED DISCOURSE

The last of the three invited discourses was devoted to 'something which astronomers cannot see at any wavelength': Dark Matter in the Sky—almost symbolic of the frontiers of human ignorance. (The IAU conferees would surely be familiar with the title *The Encyclopedia of Ignorance).* Prof. Vera Rubin was the learned speaker of the evening, who was introduced by Prof. Manuel Peimbert, of the University of Mexico, who is also a Vice-President of the IAU.

In his introduction, Prof. Peimbert, said that Prof. Rubin (who has been associated with the Department of Terrestrial Magnetism of the Carnegi Institution of Washington for more than two decades and also with the Mt Wilson and las Campanas Observatories) and her coworkers have done an outstanding piece of work, proving that virtually all the rotation curves of spiral galaxies are either flat or rising out to the visible limit, which implies that the mass distribution in galaxies is not concentrated towards their centres. This, Prof. Peimbert said, is a 'paramount result with wide repercussions on the study of galaxies and cosmology'. Prof. Peimbert also spoke highly of Prof. Rubin's outstanding abilities not only as an astronomer but in human relations, especially the zeal with which she attends to all the mail she receives — a task which many scientists loathe to do He also spoke of the IAU President's special praise for this aspect of the Union's astronomers.

Prof. Rubin began with an historical account. In 1933, Fritz Zuriky had pointed out that the motions of individual galaxies in clusters were so high that clusters should be coming apart, which is not the case. He, therefore, had postulated that clusters contained dark matter which we could not see. He called this the "missing mass".

During the last decade, Prof Rubin went on, astronomers have learned that individual field galaxies too contain dark matter. This knowledge comes from the study of velocities of stars and gas in the outer regions of galaxies. In a galaxy, all the stars orbit in concert about the centre, and thus act as probes of the gravitational potential of the galaxy. Astronomers had long thought that the mass of a galaxy must be as centrally concentrated as the light it emits. Hence, outer stars should be orbiting slowly, just as in the solar system where the outer planets orbit more slowly than the inner ones. But radio and optical studies all show that stars are responding to the gravitational attraction of a mass we do not see. Prof Rubin asked: Where is it? How much is there? What is it? These are the questions we wish to answer.

She also provided the probable answers. She said, it is dumped about galaxies, it extends beyond the optical galaxy, and it becomes a layer fraction of the mass at large distances from the centre. It is probably a spheroid of dark matter surrounding each galaxy.

It is also located in clusters of galaxies. In the Virgo cluster, the central elliptical galaxy M87 has a hot halo, observed with X-ray telescopes. The mass of gas estimated at 10^{12} $M_{\odot}$, would escape from the galaxy, unless the galaxy has a mass of about 5×10^{13} $M_{\odot}$. It is not yet well established if elliptical galaxies with lower mass, not in centres of clusters, have massive halos.

How much is there? She went on. All studies of dynamics — stars and HI in galaxies, galaxies in pairs and groups, and in clusters — suggest that there is at least 10 times as much dark matter as luminous matter. These studies all give Ω, the ratio of the observed density to the density which will just half the expansion, $\Omega \leqslant 0.2$. In conventional Big Bang nucleogenesis, this is just about the upper limit to normal matter ("baryonic") in the Universe.

However, theoreticians agree that $\Omega = 1$ is likely on several grounds; it is easier to form superclusters, clusters and galaxies and the large voids seen between them. Hence, if $\Omega = 1$, non-baryonic matter, i.e. exotic particles, must be the "stuff" of which dark matter is made.

Prof. Rubin said, thirty years ago, observational cosmology consisted of the search for 2 numbers; one representing the rate of expansion of the Universe at the position of the galaxy, and the other, deceleration parameter. Twenty years ago, the discovery of the relic radiation from the Big Bang produced another number, 3K. But the past decade has seen an enormous development in both observational and theoretical cosmology. The Universe is known to be immeasurably richer and more varied than we had thought. There is a growing acceptance of a Universe in which most of the matter is not luminous. Nature has played a trick on astronomers, who thought we were studying the Universe. We now know that we were studying only a small fraction of it that is luminous.

So tonight, Prof. Rubin concluded, we have been telling a story, a study we are just beginning to learn about. We can understand a little about the early Universe, and we can attempt to predict its future history. Most of the answers still elude us. We have a great deal to learn.

Ever since women and men have been looking at the stars, some have been asking questions like those asked by the Indian poets in the *Rg Veda*, in the first millenium B.C.

Prof. Vera Rubin's learned discourse was elegantly illustrated with well-designed slides. Her lucid style of presentation enabled even non-astronomers to get a fairly good grasp of the theme of the lecture — a quality which distinguishes all great scientists, namely, to put across even highly technical matter in such a way that the uninitiated can comprehend the message.

What was gratifying is that out of the three invited discourses two were no doubt by men astronomers but one of them was read out by a lady astronomer, Prof. A.G. Massevitch, and the last was not only by a lady astronomer but it was also presented by her. This trend, in some sense, is in partial fulfilment of Dr R. West's endeavour that IAU would in future see to it that the participation of the women in the Union would reach a desirable 50 per cent.

SCIENTISTS — THE STRANGE BREED

How strange that scientists who are obsessed with reductionism and 'objectivity' still take recourse to teleological expressions in their writings!

Reading maketh a full man; conference a ready man and writing an exact man. —Francis Bacon, an advocate of the experiential method in science.

ANNOUNCEMENTS

COMMISSION 40
November 26, 1985 — Session 2
Reports from Observatories :
Extragalactic Research
Room G Chairman : R. Strom

Report from the MPIFR	R.W. Wielebinski
Edge-on galaxies	S. Sukumar
The giant radio galaxy MSH 05-22	C.V. Subrahmanya
New results from the VLA: 3C 75, Cygnus A, M87	F. Owen
Entrainment and evolution of radio jets	D. De Young
327 MHz WSRT observations of the Perseus cluster	A.G. De Bruyn
The Cambridge-VLA rotation measure survey	J.P. Leahy
The MG survey	B.F. Burke
1144-379: a rapidly variable BL Lac source	D. Bramwell
VLA observations of rapid variability in OJ287	D. Roberts
Report on VLBI at the MPIfR	E. Preuss

WISH THEM A HAPPY BIRTHDAY

26.11.1985

Dr Ralph C Bohlin	USA
Dr B van Leer	Netherlands
Prof Jan K Trulsen	Norway
Prof. I N Minin	USSR
Lewis E Snyder	USA
Roberto Fanti	Italy
Dr Alan C H Edwards	UK
Dr Edward L G Bowell	USA
Dr Bruce F Smith	USA
Richard Alan Perley	USA
Bradley Michael Peterson	USA

A busy day ahead

EDITORIAL

THE DAY WE WENT TO AGRA

I thought, with all the things to do in producing the great work, I would not manage to take time off to go to Agra. But Mr Ratnakar and Mr Banerjee and the others conspired to push preparations so far forward on Saturday that I, most reluctantly, let myself be persuaded to be taken to Agra on the strict understanding that Mr Ratnakar would mind the shop. Like the famous Windmill Theatre of London's wartime boast, we never close. But I digress. In any case, I thought, some story, piquant or serious, of potential interest to the readers of *Mandakini* might break there, so perhaps in a spirit of duty I should tear myself away from the office and be on the spot when hordes of IAU participants from all over the world converged on possibly the most famous tourist attraction in India — the Taj Mahal.

It lives up to its reputation, indeed it surpasses it, that exquisitely beautiful manifestation of an emperor's devoted love for the woman Mumtaz who was his wife. In its sublime and poetic harmony it epitomises the most terrible truth of life that no matter how powerful we are, time's fell hand cannot be withstood and everything we hold most dear must pass away.

Triggered by Shahjahan's anguish and love, the architects, skilled craftsmen, artisans and labourers created in years of toil out of multi-coloured marble, precious stones and other carefully-chosen materials, that masterpiece rightly acknowledged as one of the world's great art treasures.

And then, when it was finished, my guide said, so that no other like it or surpassing it in beauty could be created, Shahjahan had the hands of the craftsmen cut off.

It doesn't really matter if the story is apocryphal. If the particular atrocity did not take place we have in the history of our strange race more than enough black pages to take its place. But I stood there after hearing my guide's words and thought again of Pope's "Essay on Man" and in particular his words:

"Born on this Isthmus of a middle state
A being darkly wise and widely great
He hangs between; in doubt to act or rest
In doubt to deem himself a God or beast,
In doubt his mind or body to prefer,
Born but to die and reasoning but to err,
Sole judge of truth in endless error hurled
The glory, jest and riddle of the world."

I don't know what impression you took away from Agra but for me it was one of sadness, sadness that our history is of a race that creates such sublime works of art in all spheres of human endeavour only to trample so many of them back into the dust from which they were wrought.

Archie E. Roy

JOINT DISCUSSION II

LONG-PERIOD ECLIPSING BINARY STARS AND RELATED OBJECTS

R.D. CHAPMAN

Joint Discussion II, entitled Long-Period Eclipsing Binary Stars and Related Objects, met on 21 November in Room L, a meeting area carved out of a lounge in the Annexe. Despite the less than ideal surroundings, the meeting was well attended and the discussion was lively. The proceedings moved to better surroundings after lunch, but the high tone of the meeting had already been set.

The enigmatic binary system Epsilon Aurigae was the topic of several invited and contributed papers. The system consists of a F-type supergiant star and a secondary object which orbit one another in a period of 27.1 years. The opening paper by R. Stencel (presented in his absence by R. Chapman) was a review of the photometric observations of Epsilon Aur. A campaign to conduct photometric observations of the recent eclipse was supported by groups all over the world, including the amateur-based IAPPP. A comparison of observations made during this eclipse with those of previous eclipses shows evidence for secular changes in the secondary over orbital time scales. Furthermore, inclusion of infrared and ultraviolet wavelengths has proved the eclipse to be non-gray. The analysis of infrared photometry at 2,10,25 and 60 μm shows the temperature of the secondary to be 500 K, though discussion after the presentation and later papers indicate the errors on this temperature are large and 500 to 1000 K might be a better conclusion.

D.Lambert (USA) reviewed spectroscopic observations at infrared, visible and ultraviolet wavelengths. A good diagnostic line for the secondary is the KI line at 7699 Å. The line is weak or absent in the spectrum outside eclipse, but is clearly present during eclipse. Its Doppler shift as a function of eclipse phase demonstrates the rotation of the secondary which Lambert took to be a dish with an opaque inner part and a gaseous extension, which is asymmetrical between its ingress and egress portions. A characteristic of the photometric light curves is a mid-eclipse brightening, which has been seen weakly in earlier eclipses but was strong in this eclipse. Lambert asserted that this brightening is probably due to the pulsation of the primary, an assertion that brought a strong response from R. Wilson of the US who believes it to be due to a central hole in a tilted disk. Lambert also discussed the significance of the discovery of CO at 2.3 μm, and of the many UV spectra obtained at this eclipse. He concluded that the mass of the system is significantly lower than was previously thought.

Ferluga of Italy presented a data-processing technique to separate the underlying stellar spectrum from lines due to the gaseous component of the eclipsing body in Epsilon Aur. Using the technique he obtained shell spectra at ingress, totality and egress. The shell lines are strongest during egress. He presented a model which consisted of a titled disk made up of an opaque dust disk at 1000 K, a gaseous shell at 7000 to 9000 K and a central hot star.

Kitamura of Japan presented a technique that he and his colleague used to correct the eclipse spectrum for what they feel is scattered light. These corrected spectra show three components in the Hα lines — a broad absorption due to extended gas; absorption whose wavelength moves from violet to the red as a function of eclipse phase due to rapidly rotating gas; and a broadening to Hα near mid-eclipse. They infer a Keplerian velocity for the disk and derive a mass. Like Lambert they find that a lower mass best fits the observations. Clearly, observations made during this last eclipse have added immensely to our understanding of this baffling system. No one questioned that the secondary is a disk of some sort, with a complex structure. Defining that structure may have to await another 27 years for the next eclipse.

K.C. Leung (USA) discussed two long-periods systems with supergiant components that have light curves similar to ωUMa stars β Lyr.$\rho\omega$ Pup is a supergiant contact binary and with a 150-day period and HD 104901B is a supergiant semi-detached binary.

R. Webbink (USA) discussed mass transfer in long-period systems. He described quasi-conservative mass exchange, where mass ratio of the two stars is reversed, and common envelope evolution in which the mass exchange becomes unstable producing a common envelope leading to binary orbit decay. In the second case an initially wide pair ends up as a short-period binary. The interface between the two evolutionary schemes occurs roughly at a period of 100 days. Algol binaries are explained by conservative mass transfer.

Sahade (Argentina) discussed a number of binary star systems that may be related to Epsilon Aurigae. They all have secondaries that are more massive than the primary star. He then proceeded to lay out the characteristics of the group. He asked several tantalising questions: Are these stars "pre-Algols"? Do stars like Epsilon Aurigae become Zeta Aurigae stars? He also discussed symbiotic stars, which are well observed by IUE as a group and show high-temperature resonance lines. Some workers feel symbiotics are in the second state of mass loss. Can close binaries be classified by high-temperature lines? Shade suggests the answer is no.

Chapman discussed observations of Zeta Aurigae stars. The chief new finding for these systems is the presence of an interaction shock where the strong wind from the K-star meets the B-star secondary. Study of the shock in detail may help quantify winds of late B-stars. Chapman described the newly discovered member of the groups 22 Vul.

A. Batten of Canada gave a brief presentation on the system Delta Sge which consists of a MII star and a main sequence star. The system shows atmospheric eclipses.

S. Kwak of Canada gave an invited paper entitled 'Theory of Mass Transfer, Interacting Winds and Accretion". He presented a model of the symbiotic nova HM Sge based on interacting winds. The M star has been losing mass for a million years or more in a 75 km/sec wind, building up a substantial shell. Then an outburst led to a 2000 km/sec wind which interacted with the old wind producing inward moving and outward moving shocks. He described how to test the model using radio observations and high resolution optical spectra.

R. Wilson (US) expanded on his titled disk model by accepting the suggestion that there is an embedded close binary within the disk. He wil produce detailed calculations based on the new model later.

R. Koch (USA) discussed the VV Cephei system. The theoretical light curve suggests the M star is smaller than previously thought while polarisation studies suggest a larger M star. Koch suggests the M star has R$\cong$ 5 au.

R. Koch summarized the day's activities. It is an indication of the quality of the programme which Y. Kondo and R. Stencel organized that the conference room remained full to the bitter end.

JOINT DISCUSSION VI

EVOLUTION IN YOUNG POPULATIONS IN GALAXIES

Three years ago, in Patras, we discussed the old population in the galaxies: halo stars, globular clusters, nuclei of galaxies. Knowledgeable and inspired experts gave us their views on how things were 10 billion years ago and how the structure of present day objects can show this. It was an interesting day and its results, published in *Highlights of Astronomy*, Vol 6, have been referred to frequently during the last years.

Now we move forward in time, 3 years for us and some 10 billion years for the galaxies, and on Tuesday we discuss the young populations. Several commissions (25, 28, 33, 34, 37 and 45) are supporting the joint discussion and we have managed to get a programme which should put many of the current ideas of star formation under debate.

In Patras the stellar component was the issue; now we have to discuss the gaseous and the dust components as well. With young population we shall mean not only the recently formed stars but also the medium out of which they were formed. Both in Patras and here the structures of the galaxies and our knowledge of these structures are part of the topic.

By a strange coincidence, Tuesday the 26th is also the day when one of the giants in galactic research would have become 90 years old had he still been alive. Bertil Lindblad would doubtless have enjoyed many of the highlights of the discussion of young populations in galaxies. I am also certain that his critical mind would have questioned some of the things we are going to hear.

—Gosta Lynga
Chairman, SOC, JD VI

HISTORY OF A DEPLACEMENT OF A MEETING

The history of nucleosynthesis in the galaxy can be retraced in studying the chemical composition of low-mass stars. These stars, being nucleosynthetically very inactive, have conserved the chemical composition of the interstellar matter in which they have been formed; therefore their abundance determination can contribute substantially to the knowledge of the chemical evolution of the Universe.

There is however a difficulty: to discuss the chemical history of the galaxy with the help of low-mass stars, specialists of different branches of astronomy have to be put together. The General Assembly in New Delhi has offered a splendid opportunity for the happening of such an event. Some specialists in Cosmology, Nucleosynthesis, Photometry and Spectroscopy will come together and serve the above subject. There was a second difficulty: how to find for these specialists two "IAU UNITS" in which everybody was free from other duties.

Only Mrs Manning knows how many times dates and hours have been changed for this meeting. We take the occasion to thank her for her very kind patience.

Definitively, we have decided that the meeting on:

'Nucleosynthesis in the Galaxy from Studies of Low Mass Stars' will be held in the two afternoon sessions of November 27 in Room G.

—Giusa Cayrel de Strobel

THE BIRTH PANGS OF *MANDAKINI*

P.S. SHANKAR and
SUBBIAH ARUNACHALAM
Publications & Information Directorate (CSIR), New Delhi

Do you want to know how your daily newspaper *Mandakini* reaches Vigyan Bhavan every morning well before you arrive? We guess you would, since you like to receive and read every day till the great Meet comes to a poignant conclusion on November 28.

Material flows into the Editor's desk round the day till late in the evening. Some are illegibly written and some elegantly IBM-composed. Part of it, at this stage, is still in the minds and notebooks of the reporters! Within minutes of arrival, each script receives the attention of either the Editor or one of his three colleagues in the editorial team. A decision is made on whether to carry or leave out the item, and the accepted scripts are copy-edited and passed on to the composing room. Within minutes the composed copy is ready for proof correction. After corrections are made, a final decision is made on what to include in the day's paper; of course, this depends on the space available, the number of ads, the number of illustrations, etc. It is now that the detailed exercise of designing and laying out the pages begins. There are always problems of unbalanced pages, and appropriate fillers are chosen. Often it appears that fillers — late-second decisions — turn out to be gems. Equally important, killing matter or adding, at this stage, often leads to a finer, final script.

Once the final layout is ready, it is rushed to INSDOC, some ten kilometres away, where the day's paper is printed by the photo-offset process. By now, usually, it's well past 2200 hours.

To be honest, a large part of what goes into a day's paper would have been decided a couple of days ahead of the dateline. Which is to say that a great deal of planning is the fulcrum on which everything hinges.

With the hub of activity shifting to the Hillside Road campus the calm of the surroundings is broken, much to the annoyance of the sleepy security staff, what with the platemaking machines going into producing whirling noise, after the silent dark rooms of photography have 'negatived' the pasted-up pages. A most delicate process between the film-making and platemaking stages is the 'mounting' operation, that is the sandwiching of halftone and line-drawn illustrations in film form on to the text '-ves'.

On to the machines now go the plates and the printing machines rolling churn out the printed sheets when the machine men have gone through what is called make-ready stage.

Oh goodie!
They've printed my article.

You now see a gang of half-sleepy and yet alert men gathering the pages printed and folding into page sizes and making bundles of these into 200-each packets for Ratnakar to carry them all the way to Vigyan Bhavan in the early hours of the day.

And the final, printed copy does carry what are called 'printers devils', which could as well be publishers' (editors included) devils.

The heart of all this exciting printing process is a man who prefers to be unnamed — the back-bencher who deserves to be on the dais.

Footnote : The title is an afterthought; originally, we had used 'How is Mandākini *born?' So it is that you find no 'pangs' mentioned.*

Aspiration

Raise the head;
Take stars for money

— George Herbert:

PROTON DECAY EXPERIMENTS IN KOLAR GOLD FIELDS

V.S. NARASIMHAM
Tata Institute of Fundamental Research
Bombay, India

Proton, the lightest among the family of baryons, was considered to be absolutely stable until the early 70's and a law of conservation of baryon number was enunciated to account for this empirical fact. Sporadic attempts to test the validity of this law resulted only in improving the limits on the lifetime of protons to about 10^{29} years. It was Sakharov (1967), who first invoked proton decay in explaining the outstanding puzzles of astrophysics, i.e., the matter-antimatter asymmetry and the large photon to baryon ratio (10^8) in the universe. However, it is the advent of quark models and the quantum chromodynamic description of strong forces coupled with the amalgam of weak and electromagnetic interactions that brought forth the grand unification theories (GUTS), which invariably lead to proton decay as their unique signature. Pati and Salam (1973) used the integral-charged quark formalism and subsequently Georgi and Glashow (1974) proposed the SU(5) model (with fractionally charged quarks) as a GUT scheme. The underlying principle is to group quarks and leptons together into multiplets and treat them on par so that there is free interchange between quarks and leptons by emission and absorption of hypothesised gauge bosons X.Y. In the standard model, for example minimal SU(5), the unification sets in at energies $\sim 10^{14}$ GeV and the masses of the mediating gauge bosons are also of the same order of magnitude. The distinction between quarks and leptons, as well as the very wide differences in the strength of the three forces in the low energy regime, are considered as the manifestation of spontaneous symmetry breaking below the unification energy. The most important prediction of the GUTS, and probably the only one that can be tested at laboratory level, is the decay of protons as well as of bound neutrons. In minimal SU(5) theories, the lifetime of protons is estimated as $10^{30} - 10^{32}$ yrs, the uncertainty arising primarily from the estimates on the masses M_X, etc. Furthermore, the dominant decay schemes are $p \to e^+\pi$, $e^+\omega^o$, etc., for protons and $n \to e^+\pi^-$, $e^+\bar{\rho}$, etc. for bound neutrons. This theory predicts a grand desert of physics between 100 GeV and 10^{14} GeV, the regions where electro-weak and grand unification set in respectively. On the other hand, the supersymmetric GUTS, which have been discussed prominently in the past few years, have low unification energy and it is predicted that the desert will bloom with the proliferation of particles; in particular it envisages new SUSY partners for each of the known elementary fermions and bosons. These theories predict nucleon decay into modes dominated by strange particles, eg

$p \to \mu^+ K^o$, $\bar{\nu}K^+$ and $\eta \to \bar{\nu}K^o$, etc.

but the mean lifetime could be as high as 10^{34} years.

Kolar Gold Field (KGF) Experiments

There has been a long history of cosmic ray experiments in these mines spanning over a period of 25 years to study the penetrating component at a variety of depths down to 3 km. The mapping of intensities of muons and the study of neutrino interactions over this period have shown clearly that a deep-mine experiment has great advantages in identifying very rare signals such as proton decay. In 1964, small area detectors were operated at a depth of 3000 m and the null result from this experiment (Menon et al. 1963) was used to set a lower limit of $\sim 10^{27}$ years for the lifetime of protons. During the years 1965-1970, a large array of detectors was used to study the natural neutrino interactions at a depth of 2300 m and it was possible to push up the limits to 10^{30} years from these data (Cowsik and Narasimham 1980). With the predictions on the proton lifetime hovering around the limits obtained from experiments in KGF as well as in other mines in the world, it was but natural to build a massive and dedicated detector deep underground in these mines.

Search for proton decay is meaningful only if the experiment satisfies certain minimum criteria: (a) massive detector, say 100 tons, containing a large enough sample of protons and neutrons, (b) very low background from cosmic rays and (c) good energy as well as spatial resolution of the secondary particles. The KGF experiment, a collaboration between the TIFR, Bombay, University of Tokyo and Osaka City University, Japan, is the first in a series of such experiments being conducted around the world.

The detector, with a total weight of 140 tons (8.5×10^{31} nucleons) has been operated over the past 4½ years at a depth of 2.3 km underground. This site is endowed with two major advantages: (a) the great depth cuts down the cosmic ray muon background to as low a rate as 2/day and (b) being near the geomagnetic equator, the neutrino background is minimal as compared to experimental sites in the northern hemisphere in the USA, Europe, etc. The detector is made up of 34 layers of proportional counters, arranged horizontally in an orthogonal geometry, with thin (12 mm) iron plates in between the layers. This can be considered as a fine-grain calorimeter in view of the facility to measure ionisation in individual counters. The timing measurements allow identification of μ^+ decay signal in a fraction of the events. The spatial resolution is about 10 cm and the energy is determined from the range plus ionisation to about 20% accuracy.

In about 4 years of live-time of the detector, approximately 3000 events comprising muons (95%) and neutrino events (5%) were recorded and most of them are recognised as such. The decay signal however should have its vertex inside the detector and for an unambiguous identification, it should have all the decay products confined to the interior of the detector. There are 21 such confined events so far in this experiment but a major fraction of them is due to low energy neutrino interactions giving rise to muons, electrons and hadrons.

Proton Decay Signals

The total visible energy of a nucleon decay event inside an iron nucleus depends on (a) the decay scheme, e.g. 940 MeV for $p \to e^+\pi^o$, 450 MeV for $p \to \bar{\nu}\pi^+$, (b) the nuclear effects by which some of the hadrons are absorbed and re-emitted, and (c) the energy resolution of the detector. The energy distribution plot for confined events does not show any peaks and thus one is forced to look for specific properties which distinguish the decay signal from the background of neutrinos. For example, the momentum conservation dictates that decay products cannot have an overall momentum greater than the Fermi momentum of 250 MeV/c inside an iron nucleus and hence a typical 2-body decay will have back-back configuration of tracks. Such considerations (Krishnaswamy *et al.* 1982) led us to the identification of 4 events among our sample of confined events as plausible candidates for nucleon decay with the following decay schemes:

(1) $p \to e^+\pi^o$ (1 event)
(2) $p \to \bar{\nu}K^+$ (1 event)
(3) $p \to \mu^+K^o$ (1 event)
(4) $n \to \bar{\nu}\eta^o$ or e^+K^o (1 event)

Among these, the third event stands out with clear track configurations and small momentum imbalance. The overall background, at 90% confidence level, is less than 1 event for all the 4 decay modes put together. This leads to a lifetime of nucleons of $\sim 10^{31}$ years. However we consider this only as suggestive and not conclusive as yet. It is clearly necessary to increase the number of such candidate events and improve their quality in terms of track and energy resolution to isolate the decay signal unambiguously from the neutrino background. To this end, a new detector is installed at Kolar Gold Fields at a depth of 2 km and it is being made ready to take data by the end of 1985. This detector has a total weight of 350 tons, with a veto shield around it and is capable of providing high-quality data.

Status of the field and prospects for future

Four other detectors have been taking data (Koshiba 1984) in different parts of the world since 1981. The experiment under Mt Blanc in Italy is similar in design to that at KGF but with a higher spatial resolution. The other three use the principle of Cerenkov radiation of charged particles in water. The biggest such detector is in a salt mine, Cleveland, USA, with 8000 tons of water, whereas the most sensitive one is at Kamioka in Japan with 3000 tons of water. All detectors have some candidate events for nucleon decay into a variety of decay modes with varying degrees of background contamination.

To summarise the results briefly, no evidence was seen for the most dominant decay scheme of SU(5) scheme, i.e. $p \to e^+\pi^o$ in the massive water detectors, whereas 2 events were noticed in the small iron calorimeters at KGF and Mt Blanc. There are at least 4 events of the type $p \to \mu^+K^o$ in the total world sample — a decay mode preferred in the supersymmetric GUT models. In view of the divergent results from different detectors, it is clear that a new generation of experiments is required incorporating novel features that can distinguish nucleon decay from the neutrino background. The phase II KGF experimnt, a 900-ton detector at Frejus tunnel in France, a 1100-ton drift chamber array in Soudan mine in the USA, and the improved versions of water detectors in the USA and Japan are some of the current attempts to achieve this goal. The question of proton decay, while awaiting an experimental answer, continues to be the outstanding clue to the unification theories. On this will hinge the progress towards understanding, at least qualitatively, the puzzles of astrophysics mentioned earlier as well as the evolution of matter in the early universe.

NEW COMMISSION OFFICERS' SELECTION

Arthur N. Cox.
President, Commission 35

Commission 35 has been using an interesting system for selecting its new Vice President and its Organizing Committee members ever since the Montreal General Assembly. Well in advance of the deadline for Commission nominations for the next Vice President, the current President solicits nominations for both the Vice President and Organizing Committee members. The President will prepare a ballot and send it to all members, about 250, for vote. This ballot will list only members willing to serve in the leadership of the Commission. Then the recommendation to the Secretariat of the Commission preference for the next Vice-President is made with confidence that the active workers in the field have supported the action.

The normal succession of the Vice President to become the President is a common practice of the IAU Commissions. It has operated well for Commission 35 since the Hamburg General Assembly in 1964. Involvement of the Vice President in operations of the Commission is always recommended so that his term of three years as President can go smoothly.

The members of the Organizing Committee can be selected by the internal rules of a Commission without any special approval by the Executive Committee. Nevertheless, the same procedure for selection ensures that only active and respected members represent the Commission. The vote this last summer for three replacements for Organizing Committee members, who have now served their six years, required actually four to serve because Professor Maeder, the new Vice President, also will be leaving the Organizing Committee. When the ballots were counted there was a tie in the number of votes, and five were ultimately selected!

While the voting for Commission members' preferences is a rather long and intricate task for the current President, the leadership of the Commission is ensured to consist of active researchers with international reputations.

It is *understanding*, not mastery, that should be the ambition of scientific research. — Sir Peter Medawar in *The Hope of Progress*

Ex Umbris et Imaginibus in Vertitatem!
(From shadows and symbols into truth.)

—*John Henry, Cardinal Newsman*

IAU COLLOQUIUM 87

HYDROGEN-DEFICIENT STARS

P.W.HILL
University Observatory
St. Andrews, U.K.

About 50 participants met in the palatial splendour of the Lalitha Mahal Palace Hotel, Mysore, from 10 to 15 November 1985 for the first IAU meeting ever to be held in India, Colloquium 87 on Hydrogen-Deficient Stars and Related Objects. The meeting aroused considerable local interest; one newspaper reporter is said to have asked 'what could be done to correct this hydrogen-deficiency'!

From their galactic distributions and velocity dispersions the various groups of hydrogen-deficient stars are seen to cover a wide range from the rapidly rotating intermediate helium stars of Population I to the extreme helium stars and cool hydrogen-deficient stars which show characteristics of Intermediate Population II. Related objects are some of the sub-dwarf O stars, central stars of planetary nebulae and helium white dwarfs.

Abundances and pulsation properties connect the R Cr B variables with the hot extreme helium stars (17 now known) which have $n_H/n_{He} < 10^{-3}$ and are also carbon-rich. The latest radial pulsation models for R Cr B stars fit the observations well for T_{eff} = 7000 K and I $M_\odot$ consistent with spectro-scopic analyses. Variability on a small scale appears to be a general property of the extreme helium stars changing from radial pulsation for the cooler ones of type A to non-radial for the hottest late O type. The evidence points to blueward evolution of constant luminosity of these stars of 1 $M_\odot$ or a little less from the Hayashi limit in the red giant region. This is supported by the observed period decrease rate for some R Cr B stars. Problems with this scenario are due to the absence from the hot extreme helium stars of the dust shells around the R Cr B stars, revealed by ground-based infrared and IRAS observations. However, the hydrogen-deficient carbon stars, similar in T_{eff} to the R Cr B stars, do not have dust shells, while there are two R Cr B type variables with dust shells and spectra apparently like the hot helium stars although with emission lines. The soot-puff model for maintenance of the R Cr B dust shell now seems to be well established, with a puff in the line of sight causing the characteristic decline. Many theories of the origin of these stars were considered, most failing to produce the observed abundances or lifetimes. The most favoured origin results from the coalescence of two white dwarfs in a binary system. The four known helium stars in binary systems have a different evolutionary history, being nitrogen-rich and carbon-poor and owing their abundance anomalies to mass transfer.

About 20-30% of the sub-dwarf O stars and central stars of planetary nebulae appear to be hydrogen-deficient and in many cases carbon-rich. These occupy overlapping regions of the log g-log T_{eff} diagram which has been found to be the best way to represent observed properties when distances are uncertain. They may be the evolutionary successors of the sequence of hydrogen-deficient stars but the connection is not yet clear. One central star is known to pulsate and may be intermediate between these and the hot pulsating hydrogen-deficient white dwarfs. One interesting similarity between the hydrogen-deficient central stars and the DO/DB white dwarfs is the apparent absence of any stars in the T_{eff} range of about 30,000-50,000 K in both groups.

The coolest magnetic DB white dwarfs may represent the final evolutionary state of the high mass intermediate helium stars. Careful analysis is needed to identify these early B stars with abundance ratios n_H/n_{He} from 3 to 0.1. They split into a low mass non-rotating group for which the helium enrichment could be evolutionary and a high mass rotating group of possibly main sequence stars with magnetic fields which appear to form a continuous temperature sequence with the helium-weak and Ap stars. It was demonstrated that the apparent helium enrichment is due to the interaction of diffusion with the stellar wind and magnetic field in the limited temperature range of the intermediate helium stars which therefore properly belong to the class of upper main sequence chemically peculiar stars.

One evolved star which fails of fit any category is the hot radially pulsating helium star V652 He with more hydrogen than the extremes and less than the intermediates. Although of similar mass, 0.7 $M_\odot$, it is less luminous than the extreme helium stars and, moreover, is carbon-poor and nitrogen- and silicon-rich. This is either a unique object or as in a very rapid phase of evolution as demonstrated by its period decrease rate. It poses a major problem for pulsation theory as the excitation mechanism is unknown.

The meeting brought together experts in a number of different areas and gave us all a much clearer picture of the phenomenon of hydrogen-deficiency and the relationships between the various groups of hydrogen-deficient stars. Clarification of this picture will be obtained by future studies of the nature of the variability and in particular by new abundance analyses with the new generation of high resolution spectrographs with lunar detectors.

All the participants and other workers in the field must be indebted to Dr N. Kameswara Rao of the Indian Institute of Astrophysics, Bangalore, who initiated the idea for this colloquium during the IAU General Assembly in Patras. We are grateful to him and his Local Organizing Committee for the excellent arrangements in Mysore and also to those organisations which assisted the meeting with financial sponsorship.

Books must follow sciences and not science books. —*Francis Bacon*

SUPERNOVAE

(JOINT DISCUSSION VII:
Wednesday, 27 November)

VIRGINIA TRIMBLE
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University of Maryland
College Park MD 20742 USA

Practising astronomers, at least those of us who teach elementary courses, typically know that supernovae release lots of energy; end the lives of massive stars; make pulsars, cosmic rays, and supernova remnants; were discovered by Baade and Zwicky; come in two types (Type I events, which occur in Population II, and Type II, in Population I); and are somehow involved in stirring up the interstellar gas as well as "polluting" it with heavy elements. This level of knowledge is sufficient enough for you to appreciate the talks that make up Joint Discussion VII (Supernovae, November 27) and the session of the SN (Supernovae) Working Group (November 20, Session IV).

Twenty-nine speakers from nine different countries are currently scheduled to address topics ranging from supernova progenitors, through models and observations of the events, to the effects of pulsars and remmants and the use of supernovae in cosmological investigations. Officially, the Joint Discussion will consist of review talks and the Working Group session of contributed papers, but the distinction is somewhat of an artifical one for supernovae or any other "hot" topic, where the most obvious reviewer is a person who is currently working on the problem. Clearly, I cannot predict what most of the speakers are going to say. What follows, therefore, is an outline of our present understanding of supernovae and their importance, with some suggested areas of work where I think progress can be expected.

Over the past 15 years, models and observations have come together to indicate that Type II supernovae result when the iron core of an evolved, massive star collapses. The cause can be photodisintegration of the iron, or electron captures, and the gravitational potential energy released by the collapse to neutron star densities ($\sim 10^{53}$ ergs) powers the supernova explosion. Type I events, on the other hand, mark the explosive burning of about one solar mass of carbon (etc.) to iron (etc.) under degenerate conditions, either in moderate-mass single stars, or in accreting carbon-oxygen white dwarfs with close binary companions. The nuclear energy (10^{51} ergs) released then powers the event. Detailed models based on these ideas provide good fits to the observed spectra, light curves, and progenitor populations of the two sorts of supernovae, as long as the collapsing massive stars have extended, hydrogen envelopes and the others are fairly compact. The models predict that Type II events (at least, the most massive ones) should contribute large quantities of O, Ne, Mg, Si, etc. to the interstellar medium, and perhaps some Fe as well, while each of the Type I events obviously produces nearly 1 $M_\odot$ of iron and small amounts of other heavy elements.

The outstanding problems for the two types are rather different. For the Type II's, known stellar populations seem to provide plenty of progenitors, particularly since a recent set of stellar evolution tracks (Bertelli *et al.*, *AAp* 150, *33*, 1985) has lowered the minimum mass capable of non-degenerate carbon ignition and hence of Fe core formation from 8-10 to about 6 $M_\odot$. But we do not understand just how the available energy from core collapse is transferred to the hydrogen envelope that must be ejected. Core bounce, when nuclear densities are reached, sends out a shock. This, however, has some difficulty in reaching and ejecting the envelope, much of its energy being used up in neutrino emission and disintegration of heavy nuclei. W. Hillebrandt (FRG), K. Sato (Japan), J.R. Wilson (USA), and S.A. Bludman (USA) will be addressing possible ways of getting shock ejection.

A second problem is the seeming rarity of neutron stars (pulsars) in galactic supernova remants. The difficulty is compounded by uncertainty in deciding which type a given remnant belongs to. G. Srinivasan (India) will be talking about the connection between supernovae and pulsars.

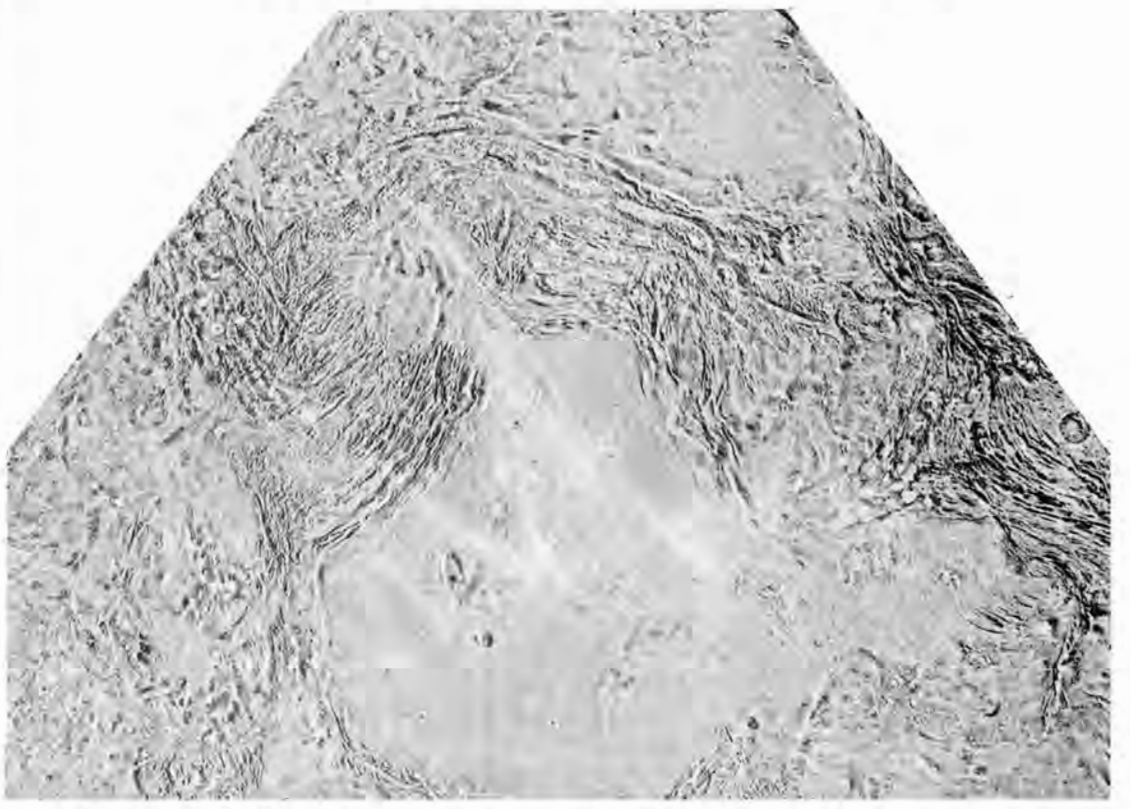
Among the Type I's the basic physics seems to be under control; degenerate carbon burning produces the right amount of energy in the right form — heat! But there is a problem in identifying enough progenitors that can produce degenerate C-O cores sufficiently massive to ignite. This is particularly so for SN I's in the outer reaches of elliptical galaxies, because roughly a Chandrasekhar mass (1.4 $M_\odot$) is required, and single stars so massive have long since died there. Hence the enthusiasm displayed recently in the supernova community for assorted binary progenitors, in which two lower-mass objects accrete or merge to provide the necessary mass. K. Nomoto (Japan) will review the problems of supernova progenitors, which have become so much the worse with the recent realization (Saio and Nomoto, *AAp* 150, *L21*, 1985; Nomoto and Iben, *ApJ* 297, *53*, 1985) that the merger of two white dwarfs probably leads to core collapse rather than carbon deflagration.

SN I products also require some clarification. Given the apparent event rate (one per 50-80 years in a typical bright galaxy) and a solar mass of Fe from each, we should be drowning in iron. Clearly, it helps if some of the carbon is only partially burnt, but one then risks not producing enough energy to make the light and expansion velocities we see. The exact amount required obviously depends on how bright you think SNI's are, that is, upon your choice of extragalactic distance scale. This leads directly to a third Type I problem, which is of our own making and comes from attempts to use the events as distance-indicators for cosmology.

Are all Type I supernovae of the same intrinsic brightness? If so, then they will be marvellous standard candles, owing to their enormous luminosites (M_V = -17.5 to -20 will cover everybody's models and distance scales). Or, if not, are there at least markers by which we can identify subtypes of different luminosity? N. Bartel (USA) and P. Kronberg (Canada) will talk about supernovae in other galaxies and their cosmological applications. A. Fillipenko (USA) will address observations of a possible/probable new subset of peculiar SNI's, less luminous than average, but also spectroscopically distinct.

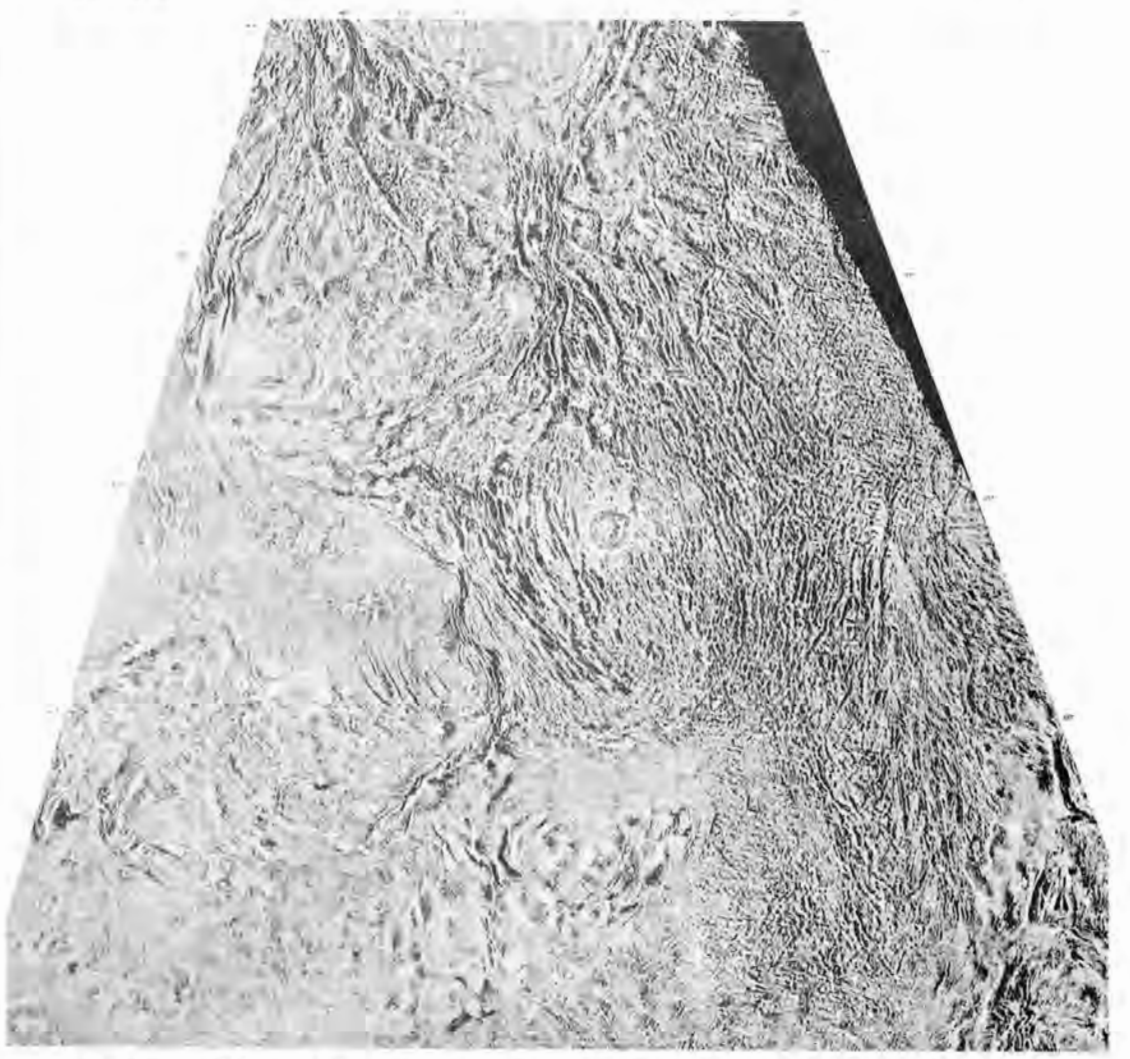
I do not have space here to mention a number of other puzzling supernovae problems or of the speakers who will be talking about, and perhaps solving, them. You will have to come and listen for yourself!

VENUS UNVEILED



Radar map of Lakshmi Planum *Region produced from December 1, 1983 - January 25, 1984 radar observations.*

(Photo courtesy : *Institute of Radioengineering and Electronics, USSR Academy of Science).*



Radar map of Maxwell Montes region produced from December 30, 1983 - February 1, 1984 radar observation.

(Photo courtesy : *Institute of Radioengineering and Electronics, USSR Academy of Science).*

ANNOUNCEMENTS

ALTERED MEETING SCHEDULE:
VIGYAN BHAVAN

Date : 26.11.1985

Room	26-1	26-2	26-3	26-4
I	6/1	US Solar Eclipse'88	Indian VLBI Study Group	35/6

Special Programme
for Registered Guests

A trip to a temple (Birla Mandir) for registered guests has been arranged. Buses will leave Vigyan Bhawan at 1430 hrs on 26 November. Interested persons may please give their names to Mrs Mitlesh Saxena.

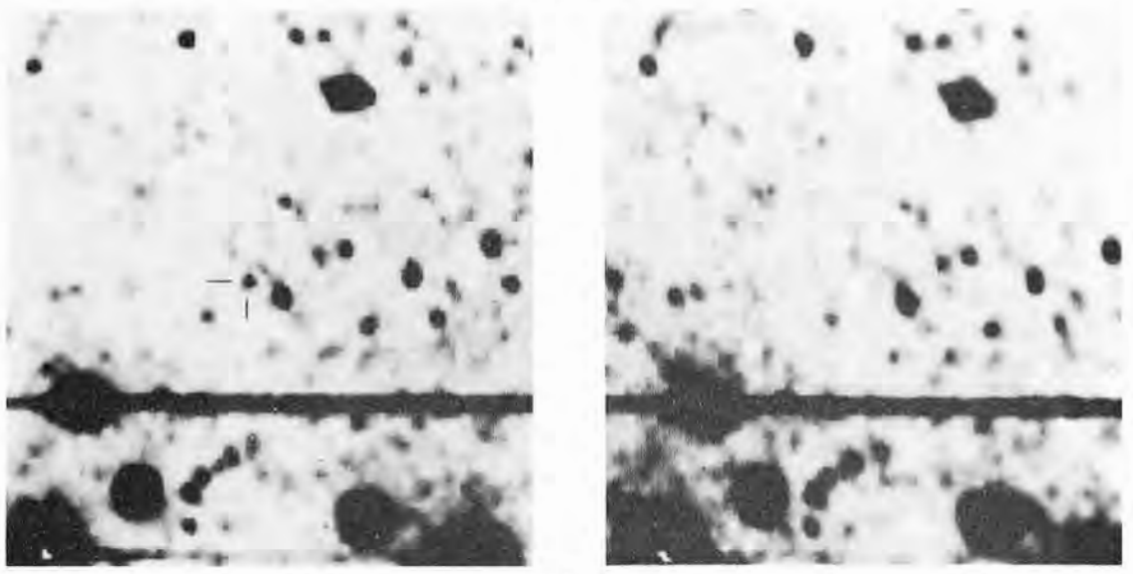
The Indian Association of College Going Scientists, Delhi, requests your presence at a lecture on 'Pulsars' by PROF. ANTONY HEWISH (Noble Laureate Physics 1974) of Cavendish Laboratory, University of Cambridge, UK, on 28 November, 1985 at 1.30 pm in the new physics lecture theatre of St Stephens College, Delhi.

NOTICE

Concert scheduled at Ashok Convention Hall will now be held in Main Hall "A" Vigyan Bhawan at the same time 7.00 - 9.00 pm on Tuesday, 26 November, 1985.

FIRST RR LYRAE STARS IN M31 HALO

SIDNEY VAN DEN BERGH
Dominion Astrophysical Observatory
CANADA



The first confirmed RR Lyrae variable in M31 near maximum and near minimum; the mean magnitude of this variable is slightly fainter than B = 25

On his first exposures of the Andromeda Nebula with the 200-in telescope, Walter Baade had expected to find swarms of cluster-type variables near the plate limit. The fact that these objects did not show up on his plates provided the first evidence for the need to revise the extragalactic distance scale. A few weeks ago the missing RR Lyrae stars were finally found, some three magnitudes fainter than Baade expected them. Using a CCD detector on the Canada-France-Hawaii Telescope in sub-arc-sec seeing, C.J. Pritchet (University of Victoria) and Sidney van den Bergh (Dominion Astrophysical Observatory) have detected 18 RR Lyrae suspects in a field in the halo of M31. For one of these objects, which is on average slightly fainter than B = 25, a period of 0.599 days has been determined from observations at 16 different epochs. The figure shows a photograph of the first confirmed RR Lyrae star in the Andromeda Nebula.

COLLECTOR's ITEMS!

A limited number of back issues of *Mandakini* and the IAU Souvenir Post Card (which should, of course, become collector's items) are available at *Mandakini* office (Room 213).

When beggars die, there are no comets seen: The heavens themselves blaze forth the death of princes.

William Shakespeare (1564-1616)

THE IAU OVER THE YEARS

Year	President	Gen. Secretary	No. of Commissions	No. of Members	G.A. held at	Approx. No. attended
1922	B. Billaud 1919-22 France	A. Fowler 1919-25 U.K.	32	207	Rome (Italy) (1) 1922	83
1922-25	W.W. Campbell U.S.A.	A. Fowler 1919-25 U.K.	30	244	Cambridge (U.K.) (2) 1925	189
1925-28	W. de Sitter U.K.	F.J.M. Stratton (1925-38) U.K.	27	288	Leiden (Holland) (3) 1928	261
1928-32	F.W. Dyson	F.J.M. Stratton (1925-38) U.K.	30	406	Cambridge (USA) (4) 1932	203
1932-35	F. Schlsinger U.S.A.	F.J.M. Stratton (1925-38) U.K.	35	496	Paris (France) (5) 1935	317
1935-38	E. Esclangon France	F.J.M. Stratton (1925-38) U.K.	45	554	Stockholm (Holland) (6) 1938	293
1948	A. Eddington (1938-43) U.K.					
	H. Spencer Jones (1943-48) U.K.	J.H. Oort (1938-48) The Netherlands	56	611	Zurich (Switzerland) (7) 1948	279
1948-52	B. Lindblad Sweden	B. Stromgren Denmark	57	809	Rome (Italy) (8) 1952	434
1953-55	O. Struve USA	P.T. Oosterhoff The Netherlands	58	888	Dublin (U.K.) (9) 1955	597
1955-58	A. Danjon France	D.H. Sadler U.K.	58	1127	Moscow (USSR) (10) 1958	820
1958-61	J.H. Oort Pays-Bas	D.H. Sadler U.K.	58	1289	Berkeley (USA) (11) 1961	765
1961-64	V.A.Ambartsumian USSR	D.H. Sadler U.K.	36	1630	Hamburg (W. Germany) (12) 1964	1160
1964-67	P. Swings Belgium	J.C. Pecker France	38	2009	Prague (Czechoslovakia) (13) 1967	1835
1967-70	Otto Heckmann Germany	L. Perek Czechoslovakia	39	2590	Brighton (U.K.) (14) 1970	2255
1973			Extraordinary		Poland	
1970-73	P. Stromgren Denmark	C. de Jager The Netherlands	40	3188	Sydney (Australia) (15) 1973	840
1973-76	Leo Goldberg USA	G. Contopoulos Greece	40	3805	Grenoble (France) (16) 1976	2134
1976-79	A. Blaauw The Netherlands	E.A. Muller Switzerland	39	4513 (1.1.79)	Montreal (Canada) (17) 1979	1965
1979-82	M.K.V. Bappu India	P.A. Wayman Ireland	40 (31.12.82)	5201 (31.12.82)	Patras (Greece) (18) 1982	1750
1982-85	R. Hanbury Brown Australia	R.M. West Denmark	40		New Delhi (India) (19) 1985	

A serious moment in an LOC discussion

THE MANDAKINI SERIAL

BETWEEN THE TIDES

DONALD MALCOLM

SEVEN

THE TIME of the launch was drawing near. The days passed quickly for Simde, responsible for the final preparations. The ship was ready and the engines had undergone their last tests and would not be used again until land-fall was made on the planet, which was now predominantly bright in the night sky.

Simde and Noss were now almost constantly in each other's company during working time. Noss had insisted on carrying out his duties. Surprisingly, he showed only slight changes, physically. But then, he was one of those people who altered little after attaining adulthood. Simde was always alert for some sign that his friend was weakening. Noss never gave him one. He accepted Simde's attention in the spirit in which it was meant, and was tolerant. This was the one major part of Noss's life that he hadn't planned. It was very unfortunate that it was going to stop him, a much more painful stopping than he had anticipated. His agony was intense. And now that he had taken the youth's Execution of Sentence, nothing the healers could give him would alleviate the pain. It would overcome him ultimately. But he was determined that he would not stop until he saw the ship leave orbit.

It was ironical to Noss that the time since he and Irah had taken the Execution of Sentence had been the happiest in their lives. After Noss returned from work, they spent the evenings together, discovering anew the pleasures of simple things. One day, Noss left the site and went home and took Irah to the lake. They walked along the beach, talking now and again, examining strange objects, letting their minds and bodies attune to the rhythms of nature.

Irah, like Noss, had found strength and courage from within herself. It was more difficult for her. She was young. In that moment after Execution of Sentence, she had stared at her hands and, for the first time in her life, acknowledged that she would not still be here when the stars went out. Almost, that truth had stopped her on the spot.

Then Noss had taken her hand and they had left the Hall and the High Custodian and the machine and gone home. Now, Irah lived every day as if it would be her last. Soon, one of them would be. Atira was always available if she was needed, although she had many preparations of her own to make, Irah was secretly pleased to discover that she didn't need Atira as a prop and it raised her stature in her own eyes.

Atira brought the cubs to see her and, while their visits recalled her own barrenness, she cherished the times she had with them. No one had told them about Irah. Simde and Atira had never even contemplated depriving them of their view of Irah and for that she was grateful. If only she and Noss—

Noss had been talking to her and, in her reveries, she hadn't heard him.

'Are you back from wherever you were?'

She smiled at him.

'I was saying that this is where we'll come on the day of the launch.'

She looked directly into his eyes.

'I know that already.'

He halted.

'How could you know, Irah? I've just thought of it.' Irah shook her head and her hair swirled in the slow air.

'No. Your mind has had this planned, perhaps for a long, long time. Now you've put it into words.'

'How well you know me.'

As they resumed their walk, neither voiced their thoughts on the outcome of their lives had they tried to know each other better.

Neri Falrac, the psycho-botanist, had arranged one more bonding with the ship's food plant, three days before the launching. As on previous occasions, the travellers, after having been passed by the healers, were gathered aboard ship. Noss, who had come up on the shuttle with some of the people, was talking to Simde. He was going to the wheel for one of his inspections. Noss insisted that the regular inspections of everything associated with the project, as provided for in the original plan, be made.

Simde, with four others to be bonded before him, went with Noss to the lock and saw him off in a sled. He had just returned to the common room when Neri came in, obviously agitated. She signalled him to go outside.

'Neri—

She stared up at him, but she could have been looking into space.

'Lif Nerod has stopped.'

Black disbelief clouded Simde's mind. He gripped Neri's shoulder and she twisted away.

'During the bonding?'

'Yes.'

He recalled his own recent experience.

'You assured me that the plant was all right—'

He paused as two men came towards them.

'We can't discuss this here. Let's go to the plant room. Is he still there?'

He was striding along and Neri had difficulty in keeping up with him.

In the room, he looked at the cub, not much older than Rogdon, sagging in the harness. Simde stood gazing at the peaceful face, not knowing what to do. This could mean the end of the project, when it was so close to success in its initial phase, Noss, Irah, Lif. The project had begun to exact its sacrifices. What could save it, now? Lif's parents would certainly withdraw and their decision might influence some of the others. If the complement of the ship was depleted too much, then the project could not go ahead. The soft sound of Neri's weeping brought him back to the present reality.

He said gently. 'Neri: have Lif put into a side room and laid out. I'll go and see Enomice and Nekk.'

First of all, he would have to talk to Atira. He badly needed her support. She saw him as soon as he entered the common room and, sensing that something was wrong, came at once to his side. He told her about Lif. She said nothing but he could feel her love encompass him.

Enomice and Nekk were in a group by one of the ports. She had always been the more enthusiastic about the project and had carried Nekk along with her. As Simde started across the room, Enomice glanced over the shoulder of the woman she was speaking to, and saw him. She broke off in mid-sentence, the dawning knowledge in her eyes like acid, dissolving his resolution. He forced himself not to falter. By this time, conversation had ceased and he was the centre of attention.

'Nekk ... Enomice ... may I speak to you?'

Simde tried to avoid Enomice's look of pleading; but he couldn't.

She said, very, very quietly, 'Lif.'

Nekk and Atira helped her from the room.

In the corridor, Enomice said, 'Lif has stopped, hasn't he?'

Simde could only shuffle helplessly.

Atira said, 'Yes.'

'Take us to him.'

Nekk, suddenly, seemed to comprehend what was happening.

Snarling, he pushed Simde against a wall.

'This project of yours stopped Lif, just as it would have stopped us all, had we gone. You and your company, with mad schemes of reaching another star, no matter what the cost, in kind, in people. Lif, oh, Lif—'

Enomice held him briefly, then they went to see Lif. Neri and a healer were there. She had regained her composure. While Enomice and Nekk sat by their cub, Neri showed Simde three tiny black capsules.

'I found them in the plant room,' the healer whispered. 'I've never seen this type before. It — or they — stopped him almost immediately. I'd say that they were his first drugs. And his last. He certainly took a dose after the check on Hasub. He must have taken it while he was in the plant room.'

'And the plant reacted.'

'Yes. But the plant didn't stop him. It *rejected* him.'

Simde was relieved. He looked at Enomice and Nekk. He had to tell them.

The healer said, 'I know what you're thinking, Simde Yorea. Let me tell them. You are too emotionally involved. Perhaps you'd better see the other crew members. Emphasize that the psycho-food plant was not to blame.'

'Yes. Thank you.' Simde's thoughts had been drifting away and there were visions in his mind about his own cubs.

'I'm going to bond with the plant.' Neri said and they went out together. 'I suggest that we suspend the remainder of the bonding for today?'

Simde agreed. Atira had remained with Enomice, and Simde had an uncomfortable meeting in the common room. No one was hostile; but their questions were incisive. Thankfully, he was able to get away and be alone. His belief in himself and the project was weakened. However, he knew that he would go on, as long as Atira and the others supported him. He wondered what influence the stopping of Lif would have, once the travellers had the opportunity really to think about the possible implications. He was beginning to reassemble his jumbled thoughts when an announcement came over the address system, saying that Noss wanted to speak to him. *(to be continued)*

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IAU

mandākini

XIX GENERAL ASSEMBLY
NEW DELHI 1985

NO. 9 : WEDNESDAY 27 NOVEMBER

Editor : ARCHIE E. ROY
Associate Editor : A. RATNAKAR

A TRAVELLING TELESCOPE

D. McNALLY
University of London, London, UK
and
R.M. WEST
ESO Garching, B Munchen, FRG

In the course of consultations with colleagues from countries where astronomy has not yet gained a firm foothold, one item which contantly recurred was lack of opportunity to gain direct experience of modern observing techniques — in optical, infrared and radio astronomy, to mention only three. They find themselves in a "Catch 22"-situation — without experience they cannot credibly formulate proposals for such instrumentation and without the instruments they cannot gain experience. While extended visits abroad can alleviate the problem to some extent, such visits are rarely available for technical staff in developing countries. If the developing countries cannot come to the technology then the technology must come to the developing countries. It was for such reasons that we created the idea of a 'Travelling Telescope'.

A requirement of such a telescope must be that it is *transportable*. A radio telescope cannot be carried onto an aeroplane. The trust must lie with optical astronomy. Clearly there are many suitable compact telescopes of excellent quality commercially available. Rather arbitrarily we thought in terms of an 8 inch catadioptic telescope. With it must go a sturdy tripod mount.

The next stage is 'control of the telescope'. Control of a telescope can be affected with modest computational resources. What is important is that an interface between telescope and computer exists. Many such projects have been undertaken in recent years and we should like to hear from claimants for the title of "Purveyor of Sophisticated Telescope Control with Minimal Computational Resource". However, such control might be stage 2 and we are considering only stage 1 here.

The instrumentation needed is fairly clear at this point. An adequate 35-mm camera body is a basic requirement as there is still much mileage remaining in astronomical emulsions. A simple 3-colour photometer (photo diode?) is an essential addition. Such an instrument also allows scope for input to the computer. Spectroscopy may be catered for in a number of ways, ranging from simple objective gratings, through direct vision instruments to more elaborate (but compact) devices capable of yielding spectral classification quality spectra. Commission 46 members, with whom the project was discussed in Delhi, suggest that inexpensive (uncooled) Reticon array recording might also be used.

But now we are perhaps proceeding too fast. Some of the instrumentation suggested needs development and that costs money which the IAU does not have. So it is natural to look for benefactors. Is there a company manufacturing fine telescopes and willing to supply a telescope and tripod? (Do not underestimate the publicity value!) Are there offers of camera bodies, computers?

But who will pay for the transport? We are optimistic (we would not be astronomers if we were not fatally so endowed) that we can persuade national airlines to transport the items free of charge.

Who will be able to use such an instrument? It would be our plan to use this instrument, for instance, in conjunction with the Visiting Lecturers Programme and with the International School for Young Astronomers. It would be essential that the telescope was in the hands of a competent instructor who would see to its erection, use and maintenance.

We believe such a project would be very valuable in supporting the already fine work being done in improving standards in astronomical science by Commission 46 and other commissions of this Union. We look forward to receiving your suggestions, help and benefactions (which should be forwarded to either Dr D. McNally at London University Observatory, Mill Hill Park, London NW7 2DS, *or* Dr R.M. West, European Southern Observatory, Karl-Schwartschild-Str.2, D-8046 Garching, (FRG).

ALTERED MEETING SCHEDULE
VIGYAN BHAVAN

27.11.1985

Room	27-1	27-2
F		4/4-16/9
G	29/6-45/11	29/7-45/12

FILM ON 'THE UNIVERSE'

This will be screened in Room A, Vigyan Bhavan on 27 November from 6 to 7 pm. All are welcome.

LIST OF IAU COLLOQUIA AND SYMPOSIA FOR 1986 & 1987

Symposia no.

121 : "Observational Evidence of Activity of Galaxies", Byurakan, Astrophysical Observatory, Armenia, USSR, June 3-7, 1986.

122 : "Circumstellar Matter", Heidelberg, FRG, June 23-27, 1986.

123 : "Advances in Helio- and Asteroseismology", Aarhus, Denmark, July 7-11, 1986.

124 : "Observational Cosmology", Shanghai, China, August 25-29, 1986.

125 : "The Origin and Evolution of Neutron Stars", Nanjing, China, May 26-29, 1986.

126 : "Globular Cluster Systems in Galaxies", Cambridge, MA, USA, August 25-29, 1986.

127 : "Structure and Dynamics of Elliptical Galaxies", Princeton, USA, May 28-31, 1986.

128 : "Earth's Rotation and Reference Frames for Geodesy and Geodynamics, Washington, USA, October 20-24, 1986.

129 : Tentative title : "The Impact of VLBI on Astrophysics, Astrometry and Geophysics", Tucson, USA, May 31 - June 3, 1987.

130 : "Evolution of Large Scale Structure in the Universe", Balatonfured, Hungary, 3rd week June 1987.

131 : "Planetary Nebulae", Mexico City, August 1987.

Colloquia :

92 : "Physics of Be Stars", Boulder, Colorado, USA, August 18-22, 1986.

93 : "Cataclysmic Variables", Bamberg, FRG, June 16-20, 1986.

94 : "Physics of formation of FeII lines outside LTE", Capri, Italy, July 1-4 or 8-11, 1986.

95 : "Second Conference on Faint Blue Stars", Tucson, USA, May 31 - June 3, 1987.

96 : "The few body problem", Turku, Finland, June 14-19, 1987.

Prof. Vera Rubin delivering the third Invited Discourse on "Dark Matter in the Universe" on Monday

EDITORIAL

THE LIGHT OF EXPERIENCE

Many non-astronomers — and quite a few in the trade — do not appreciate that the stars shine just as brightly during the day as during the night.

When I was a student at Glasgow University many years ago I was in the University Library one day mooching through the stacks and feeling my usual mild depression at the thought that even if I lived to the age of Methuselah himself I could not read even one per cent of the material there.

There is sense in the juxtaposition of these statements as you will discover if you read on, for on that particular day I was surprised to find the Proceedings of the Society for Psychical Research on the shelves. I dipped in and found that I recognised many of the names of the contributors -- Lord Rayleigh, Professor Charles Richet, Professor William James, Sir Oliver Lodge, Professor Gilbert Murray, Professor C.D. Broad and many other eminent physicists, astronomers, psychologists, philosophers, medical men and so on who had taken seriously enough to investigate them, alleged phenomena classified under the heading of psychical research. And what's more, were prepared to lay their reputation on the line in doing so.

My interest in such matters has remained to this day. Traditionally antagonistic towards this field of scientific study, the scientific establishment has found itself undergoing a curious change as its world of solidity has been cut away from under its feet throughout this century. Discovery after discovery has been made about this external world as it appears to our five senses, extended by our ever more ingenious mesuring devices, from the stupendously exciting and varied macrocosm of the universe to the equally stupendous microcosm of the Alice in Wonderland fields of sub-atomic physics. And as discovery has followed discovery, researchers of reknown such as Heisenberg, Planck, Dirac, Einstein, de Broglie, Bohr and others, in their attempts to describe in non-mathematical language the essential nature of reality, including the experimenter, have had to make statements increasingly familiar to those who have been exposed to the teachings of Eastern and Western mystics and physics and in addition have themselves practised in at least an apprentice way such disciplines as deep relaxation and meditation.

Lawrence Le Shan, an American psychologist and psychical researcher of long standing, whose little book *How to Meditate* is a beautiful primer on the subject, often plays a mean trick on audiences of sceptical physicists. He gives them a quiz of quotations concerning the nature of mind, reality, time, space and so on and asks them to vote on whether each quote is by (a) a physicist or (b) a mystic or psychic. They invariably score about 50% correct.

If we practise meditation or deep relaxation and not just read about it — whoever became a centre court Wimbledon tennis player reading the life story of John McEnroe? — and learn to relax and detach ourselves from the senses and calm the idiot chattering commentary of our conscious, then an 'internal' world of experience is revealed that makes sense of a host of statements made in the *Upanishads* and the *Bhagawad Gita*. For example:

> 'The wind turns a ship from its course upon the waters:
>
> The wandering winds of the senses
>
> Cast man's mind adrift and turn his better judgement from its courses.
>
> When a man can still his senses
>
> I call him "illumined" ' (2,67)

Certainly in the light of the experience within, a different viewpoint on reality is appreciated that is not at all perceived in ordinary everyday externally orientated life. The stars of the enlightenment within us shine during the day of the senses just as brightly as they do at night, but we cannot see them; it is only when we learn to eclipse the sun of our senses that they are perceived in all their splendour. And then they give us a view on reality that is strangely complementary to that which our scientific culture, after centuries of heroic endeavours to discover and understand the nature of the universe and our place in it, is describing.

It would be a pity if, seduced by the success of our scientific approach to our quest for knowledge, we neglected an older pathway to truth until it is so overgrown that all trace of it is lost.

Archie E. Roy

Prof. A.G. Massevitch presenting the second invited discourse on Venus aptly, we thought, on behalf of the scheduled speaker Prof. R.Z. Sagdeev (whose second name was inadvertently misprinted on 23 November, our apologies).

A footnote must needs be added to Prof. Messevitch's humorous and artful presentation, for she belied her statement that the English tongue was alien to her.

SPACE RESEARCH AT ORSAY

A decision has been taken to set up a new space astrophysics institute on the campus of the University of Paris — Sud at Orsay. This project, supported jointly by the CNRS, the CNES, and the French Education Ministry, will enhance the capability in the Paris area for carrying out major space programmes, which will benefit in several ways from its close ties with Orsay. In addition to the chance of collaboration with the many excellent neighbouring technical institutes, it will be possible to exploit directly the LURE synchrotron facility. Radiation from the LURE will pass directly into a new facility for the integration and testing of space instruments, where it will be used as a standard light source at all wavelengths. Although work on the building for the calibration facility is due to start at once, the completion of the institute will take a further two years. The Laboratoire de Physique Stellaire et Planetaire (LPSP) at Verriere-le-Buisson will form a major part of the new institute, supplemented by research teams from Ecole Normale Superiore and from other Orsay institutes, to an estimated total staff of 150. Alan Gabriel from the Rutherford Appleton Laboratory in the UK has been nominated as Director of the Institute, which is expected to come into formal existence in a year from now. In the meantime he will take over as Director of the LPSP.

Discussions are now taking place to define the scientific programme of the institute, for which the proposed name is L'Institut de Physique Spatiale d'Orsay (IPSO).

The programme is expected to have three main thrusts: solar physics using UV spectroscopy and helioseismology, the interstellar medium using IR techniques, and the study of solid bodies in the solar system. These will exploit the opportunities from space missions in the European Space Agency Programme, such as ISO, SOLO and FIRST, as well as those in the French collaborative programme, such as PHOBOS and VESTA. The scientific and technical working group, charged with planning for the future, is hoping to set up a limited presence on the campus at Orsay very shortly.

A GOOD ALTERNATIVE TO THE ORAL SESSION

The cluster commission (37) has again had a very fruitful session in a format that favourably contrasts to the usual long list of ten-minute papers. We had posters, which everybody looked at, discussed and made notes about during an hour of session time, not only during a coffee break. (By the way, our posters are still in the left foyer.)

These papers were then discussed in class by colleagues who had the time to penetrate the material themselves. The discussions were led by Caty Pilachowski in a most efficient way. She grouped the papers according to content and presented the titles, prompting comments from the auditorium. Occasionally, the discussion was widened into areas that did not directly appear on the posters, but that were of interest to the scientists in the room.

Instead of 120 minutes filled by 12 contributed papers, one after the other, we had 60 minutes of private study or discussions in small groups, followed by 60 minutes lively discussions. Both the posters papers and the discussions made a far deeper impression than ever so diligent listening would have made.

Why don't all commissions do it like that?

—G. Lynga

IAU COMMISSION 33

RESOLUTIONS

The following resolution was adopted by Commission 33 on 21 November 1985.

Whereas (1) many recent determinations of R_o (the distance of the sun from the centre of the Galaxy) and Θ_o (the circular rotation velocity at the sun) have departed from the commonly used values of 10 kpc and 250 km s^{-1} respectively,

(2) although these quantities are still not known with great precision, determinations reported in the last decade have led to mean values of R_o, Θ_o, and the Oort constants A and B, which form a physically reasonable set, and

(3) there are practical advantages in agreeing on conventional values which can provide a good basis for comparisons between the work of different astronomers, while being consistent with the best determinations available, to within their uncertainties.

Commission 33 recommends, on the basis of the conclusions of its Working Group on 'Galactic Constants', use of the values

$$R_o = 8.5 \text{ kpc}$$
$$\Theta_o = 220 \text{ km s}^{-1}$$

in cases where standardization on a common set of galactic parameters is desirable.

The estimated uncertainty in these values, based on the dispersion among recent determinations, is $\pm$ 1 kpc and $\pm$ 20 km s^{-1}.

The Commission makes no recommendation concerning A and B, but notes that the above values of R_o and Θ_o imply that the quantity $(A\text{-}B)$ = 25.9 km s^{-1} kpc^{-1}.

Poland Wielen
President, IAU Commission 33

WHAT IS SMC?

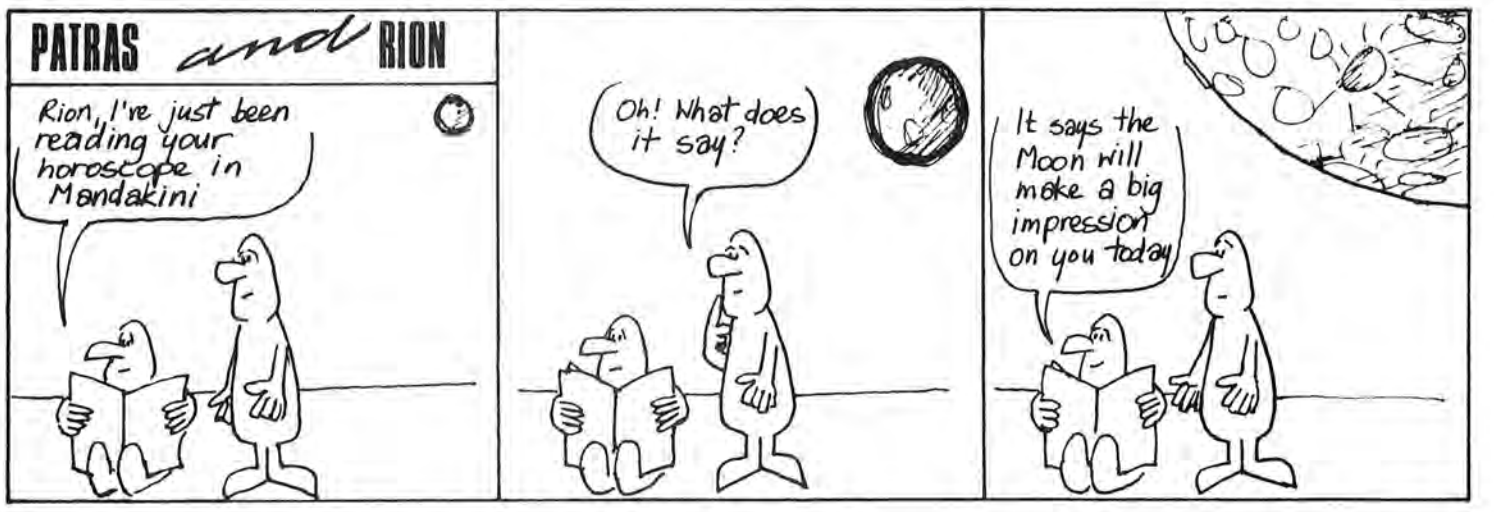
WG ON DESIGNATIONS OF COMMISSION 5 DECIDES

With the publication of the "First Dictionary of the Nomenclature of Clesetial Objects" by Fernandez, *et. al.* (*A & A* Suppl. 52 No.4 1983), it was assumed that the confusion over acronyms for various catalogued astronomical objects and for type of objects would be diminished. But alas, there remains much work for the WG on Designations of Commission 5. Recently, at IAU Symposium 115 on "Star-Forming Regions" held in Tokyo, there was an alarming proliferation in the use of SMC for "small molecular cloud". Do not fear — a member of the WG on Designations had infiltrated the symposium and at last took to the microphone: "SMC is the standard abbreviation for 'Small Magellanic Cloud', has the status of a constellation name, and is *not* to be used for 'Small Molecular Cloud'. Furthermore, the alternative LMC for 'little molecular cloud' is *not* suggested!".

Among the resolutions arising from the WG on Designations of Commission 5 during the current General Assembly is the following: "The IAU approved 3-letter abbreviations of constellations (including SMC and LMC) are to be used. They should not occur in any other usage."

—L. Dickel

gASTRONOMY CORNER



UPMA

(An Indian snack for Breakfast/Tea)

Ingredients

1 cup semolina
2 tblsps. oil or ghee
½ tsp mustard seeds
½ tsp urad dal (optional)
1 small onion chopped
1 carrot chopped into cubes
½ cup of chopped green peppers
1½ tsp. salt, Lime juice to taste
Chopped curry leaves (2-3 sprigs)
1 piece ginger cut into 2 or 3 pieces
2 cups water.

Method

1. Roast semolina lightly without any oil. Remove and keep aside.

2. Put the oil into the pan and heat it. Add mustard seeds and keep covered. When they make popping noises they are done. Now add the urad dal and fry till they are light brown. Add ginger, curry leaves, chopped onions and vegetables. Fry till they are half cooked.

3. Add the measured amount of water and salt and heat till it boils.

4. Now add the semolina stirring all the time. Cover immediately and keep it so for about 3-4 minutes. Uncover and stir again. Cover and keep on low heat for another five minutes. Taste to see if it is done. Add a little lime juice at the end and serve with 2-3 tsps. of ghee poured on top.

N.B. This is usually made in a wok. In addition to the above vegetables one could also add Peas, Potatoes, Beans, Tomatoes, Cauliflower, etc.

—Courtesy: Girija Srinivasan.

SOLVING KNOTTY PROBLEMS WITH STRINGS

D.N. Scham & M.S. Churner

Strings may be the answer to all the questions raised by modern astronomy, in fact, the answer to all questions. We show that apart from the flatness, smoothness, monopole, unemployment and solar neutrino problems, strings may provide the answer to the most serious problem facing inflation theorists today: a graceful exit from the field

"String
is a useful thing
Rope is thicker
But string is quicker"

—Spike Milligan

I. Introduction

Strings were first discovered (1) in ancient China, when they were found in cosmic showers during supernova explosions. The innovative chinese immediately put them to good use, tying up pigtails. As more uses were found, strings became all the rage. Hamstrings, pajamastrings, G-strings (2) and shoestrings were discovered in quick succession. Strings were eaten for dinner (3), strung out on musical instruments (4) and attached to foreign aid. It was clear that a revolution in knowledge had taken place, unparalleled since the invention of the wheel (5). After the initial boom the bandwagon slowly groaned to a halt as the use and study of strings reached stagnation. However, the last decade has seen a resurgence of the subject, with particle physicists, cosmologists, extragalactic astronomers and inflation theorists all demanding a piece of the string Action. Definition: A string is a one dimensional extended object described by the Action

$$S = S_1 + S_2 + S_3 + S_4,$$

where S_1 is the Nambu-Giotto Action, S_2 is the Spring Action, S_3 is the gluonic Action and S_4 is the Action going on in town.

Modern astronomy raises a number of questions that need answers. Strings may provide a neat way of tying things up (6).

II. Applications of Strings

1. *The Flatness Problem:* This is especially acute in the younger population Virginii stars. (This is not to be confused with the flatulence problem, which mostly affects the older population of heavyweight stars). This problem can be easily solved with a little string and sealing wax in the right places.

2. *The Monopole Problem:* Dirac (7) has shown how strings can be used to keep monopoles on a leash.

3. *The Solar Neutrino Problem:* Strings put stringent limits on the Solar neutrino flux. However, ordinary strings are ineffective against the Kolar Newstreamino flux (8) which is a case of the flatulence problem. Superstrings may help.

4. *The Water scarcity problem:* This can be solved by drawing the Megalithic clouds to the earth with strings and seeding them for rain. This operation is also expected to solve the unemployment problem.

5. *The Pulsar scarcity Problem:* The world is now faced with an acute shortage of Pulsars. The situation has been made worse by the extravagant attitude of the more affluent nations who throw away their used pulsars, like cigarette lighters. An economical solution to this problem has come from the third world with the suggestion (9) that pulsars be recycled.

While the frugal motive behind this suggestion is commendable the spin-up mechanism suggested in ref. 9 relies on accretion discomania and is therefore at variance with India's ancient heritage. Strings provide a clean way to spin up used pulsars: Magnetic flux tubes are wound around the neutron stars, like string around a top. When one star "blows its top", the companion is shot out, spinning madly. The details of this process are an elementary exercise in rotating electrothermomagnetonuclearhydrodynamics (10).

6. *Smoothness Problem:* When an astronomer turns his telescope to the sky, he is looking at the walls of the cosmic microwave oven we are cooking in. This is a problem, because the walls appear smoother than a baby's behind. The solution is to coat the walls with white, dielectric material. The composition and production of this material using strings and glue has been worked out by Partridge (11). Hence the exciting prospect of constructing the universe from bits of string and glue (12). Filaments: Strings can be invoked to explain the large scale filamentary structures which are either seen or not seen.

7. *Novae:* On 5 March 1979, a flare was reported in the direction of Cas A. The last time this happened, a W. Virgini star gave birth to a Sun. The recent event is more easily explained as a Cas A Nova. The Casanova Remnant appears to be expanding superluminally. However, this problem may be due to an erroneous distance estimate. It has been experimentally proved by Trial and Error (13) using strings and sealing wax that W. Virginni stars cannot be used as Standard Candles. This was rigorously proved from first principles by the Standard Candlestickmaker (14). Subsequently, Awl and Sundry (15) repeated the same analysis and arrived at the same conclusion.

III. Conclusions:

While strings do solve a number of problems in astronomy, the final explanation of all phenomena under the sun (and above it) must await the advent of Superstrings, whose action we are not worthy to extremise. We leave this to inflationary theorists, who are looking for a graceful exit from the flatulent phase.

Acknowledgement: We thank Professor Marilyn Monroe (16) for giving us a preview of her appendix.

Our discussion was entirely within the framework of the Standard Big Bang Cosmology. Needless to say, these problems cease to be, if one uses groanometric cosmology.

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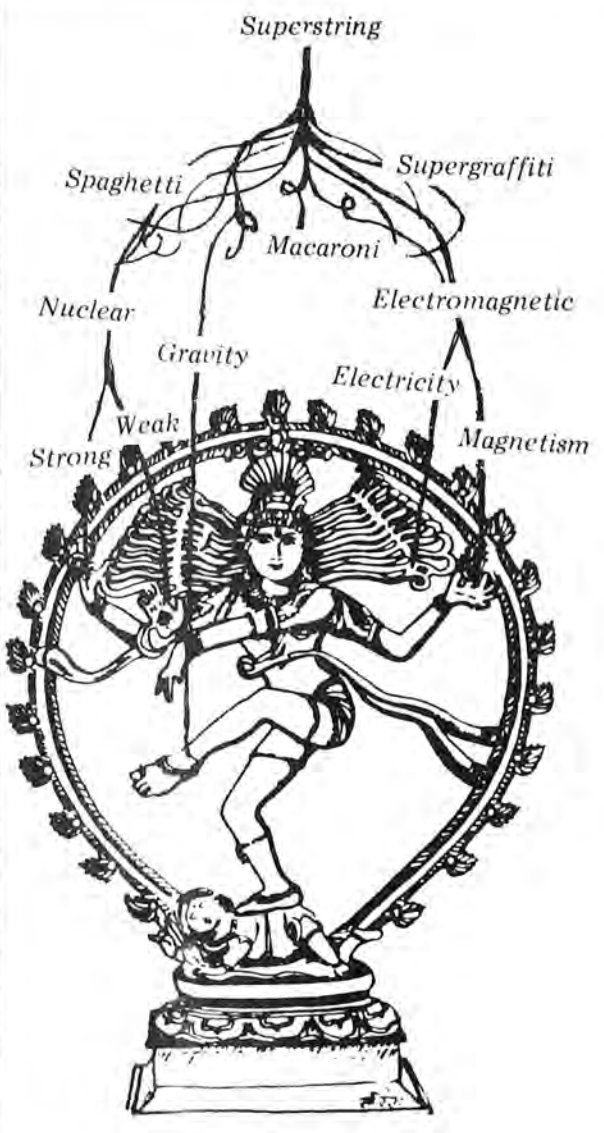


THE COSMIC DANCE

MANDAKINI INTERVIEWS

THE IAU's GENERAL SECRETARY

Dr. RICHARD WEST

Mandakini:
Have you had any regrets in taking up this job?

West:
It is with great humility that I would like to say I just am so very happy that I got the opportunity to do this. I have tried to do my best, but I still feel that the task is so overwhelming that nobody could ever do it the way he would really like to.

M: Have you found it a rewarding or enriching experience?

W Yes, extremely. If I had known what it would be I would still have taken it on, although, of course, I realise now that there is much more work in it than I ever thought.

M: Do you feel that perhaps the IAU is becoming too large, or is it still capable of meeting as a family gathering.

W: Yes, I think the IAU is still a family, and I think it will continue to be so, even though there are many more people now than before. For instance, in 1973 there were about 3000 members, now we shall have 6000 after this general assembly. So you are just doubling in 12 years. But, of course, this will most probably not continue. I do think it is a family, and so because in the past three years I have had personal contacts with quite a few of the people. I made an interesting experiment along these lines. We now have the member lists written up through the computer. There are 18 members on each page. Everything altogether makes up about 300 pages. So, I scanned through about 20 different pages at random to see how many of these people do I really know. It turned out that the mean was about 4 per page. So, 4 out of 18, that gives you somewhere between 20 and 25% of the IAU members. Personally, for any astronomer, this is just great.

M: Do you see any major trends in the directions in which the IAU should go?

W: Well, we are seeing a trend now which may be slightly different from what we had before. There are two kinds of activities perhaps in every scientific union, which are important. The IAU has put much emphasis on one of these all the time, but perhaps less emphasis on the other one. The first is the question of top science, frontline science, having scientific meetings, symposia, colloquia, regional meetings, and by having General Assemblies you promote top science.But, on the question of science in developing countries, if I may put it that way, or science for young people, perhaps there had been a little less emphasis in the IAU in the early days. We now see that this comes more into the picture. For the future, I think theIAU, will have one problem, namely that it becomes very difficult to handle IAU administratively in the same way as in the past. It is too much for one man, and especially so for a man who still at least tries to be a scientist.

M: As an astronomer does your holding an administrative post hamper your research work? Does it mean that you are totally cut off from the type of work you had been doing in the past as an astronomer?

W: No, I don't think you are cut off completely. It is just that you don't have the physical strength and the time to pursue your scientific interests as much as you would like to. You have to put it, how do you say, on a "low fire". Then, of course, the IAU system is very clever, namely that you know it is for a limited period, you learn it for three years, then you really get into the job and try to do it during three years, then suddenly you relax, and yet you have another three years to sit as an adviser in the Executive Committee, and hopefully help the people who are coming afterwards.

M: How does the IAU go about in encouraging countries where not much astronomy is done?

W: Well, there are several ways of doing so. Firstly, whenever there is a good scientific meeting sponsored by the IAU, we make sure that part of the money which is given goes to people who come from those countries and who would otherwise not have money to go to the meetings. Another way is, of course, to have people going through Commission 38, to spend some time, for study stays, so the IAU pays the travel for these people. Unfortunately, we don't have much money in that budget, but we have enough for at least ten people every year.

Thirdly, there are the International Schools for Young Astronomers, which earlier were done together with UNESCO. Now, it has become more of a pure IAU business. We have only had one such school during the past three years, not because we did not want to have more, but because there were some problems in getting it all ready in time. In the next triennium we might have two or even three schools. And finally, the fourth possibility is the Visiting Lecturer Programmes. We will have one in Peru, we almost have one in Nigeria, where it must start any time now, and we are discussing a third one in a third country, and I know at least three or four other countries which have expressed interest in having visiting lecturers and building up a nucleus of people in the country itself. That shows how interested the IAU really is in the problem.

M: Did you really have any definite progress in popularising astronomy in such countries?

W: Indonesia is an obvious example. They have really come a very, very long way. They had first a school for young astronomers; then they had , I believe, a regional astronomy meeting; then they had another school for young astronomers, and now they have close collaboration with several countries, in particular with Japan, for exchange of students and so on. I am sure that it would have taken more time for them to reach his level without the IAU. Nigeria is an even more obvious example. There has been one person in Nigeria who was interested, who became a member of the IAU, went to the meetings, and was able to have a school for young astronomers in Nigeria. He later applied for a visiting lecturer's programme, got it and, thanks to that, his radio telescope is working now, and this year Nigeria will become a member of the IAU. So you see the whole line of development.

M: You have already computerised the profiles of IAU members. The next stage, we believe, should be to hold teleconferences which should eliminate much of your expenditure. Do you have any such programme?

W: I think it will come. You know that there are certain places now where you can use telescopes with remote control. It is still something which does not work to perfection. Conferences of more than a few people via telelinks, I think, would be very difficult to have, and I cannot quite see that they will take over in the future. It is really the face-to-face encounter among astronomers, as you have it at the IAU meetings, that is the main way in which you promote science.

M: Do you think there is any discrimination against women in the IAU?

W: From the computerised files we have been able to establish that slightly more than 10% to 15% of the IAU members are women. Of course, this is far from the 50% which one would like to see. This may have something to do with the fact that astronomy is not necessarily a woman's profession by tradition. Certainly in the past there were very few women astronomers. But some of these women astronomers were very great astronomers.

In the future, as more and more countries will have education on the same level for both the sexes, the proportion of women in the IAU is bound to grow. It may take some time but it *will come*.

M: Thank you very much.

SYMPOSIUM NO.91 ON THE HISTORY OF ORIENTAL ASTRONOMY

JOHN A. EDDY
Commission 41 IAU

Seventy astronomers and historians from 19 nations met in New Delhi from 13 to 16 November for the Colloquium on the History of Oriental Astronomy. The colloquium was jointly sponsored by the IAU the International Union for History and Philosophy of Science, and the Indian National Science Academy.

The 45 papers that were presented dealt with the early accomplishments of Islamic, Indian, and Far Eastern astronomers, from prehistoric time to the era of extensive contact with the Latin West, in the late Renaissance. Of particular interest were issues of cross-cultural contacts and traditions: the transfer of astronomical knowledge and techniques within the ancient Eastern world, where astronomy was nurtured in its infancy and later kept alive through long centuries when in Medieval Europe the subject fell into decline.

Astronomy as a science of numbers originated simultaneously in Greece and in Mesopotamia, where in the 5th Century B.C. two distinct and powerful numerical methods were developed for calculating the positions of the planets. These nations then made their way to India, probably by maritime commerce, where they were combined and considerably advanced by an Indian culture that was already rich in a knowledge of the sky, and particularly empowered by early advances in mathematics. Two of India's enduring gifts to the world were the decimal system of numbers and the early development of trigonometry; these two were for millennia the most fundamental tools of mathematical astronomy.

From India early mathematical astronomy moved again westward to the lands of Islam and thence to Europe. Muslim astronomers worked out the details of trignometry, originally a device of astronomy, as a branch of mathematics. Throughout history, astronomy and mathematics have enjoyed a symbiotic relationship.

Astronomy in India in the time of the *Vedas* was generally related to religion and the timing of religious functions, demanding predictions of the times of new and full moons, solstices and equinoxes. As in many other cultures the earliest Indian astronomy was the science of time determination. In post-*Vedic* times astronomy became a science for its own sake, occupied with the motions of the planets and of the Moon, and the accurate determination of the tropical year.

Astrology and calendar-making were also behind the earliest astronomy in China, where an accurate luni-solar calendar was in use from at least the 14th century B.C. There astronomy and its tools enjoyed a longevity unequalled elsewhere on Earth: the earliest Chinese observatory was established by 2000 B.C., and it was not unusual for such structures, once built, to remain in continuous use for a 1000 years or more.

Chinese astronomical records extend back more than 3000 years, the most useful of which are described in detail in the calendrical chapters of the 24 Official Dynastic Histories of the realm. Beginning about 1000 B.C. a bureau of astronomers or royal observatory was established in each dynasty to keep a watch on the sky and to report to the Emperor all noteworthy events. Included were the particulars of solar and lunar eclipses and star occultations, the appearance of comets, novae, and supernovae, and records of naked-eye sunspots and of displays of the aurora borealis. These invaluable records have been used by modern astronomers to recover the history of the Earth's rotation and the changing orbit of the Moon, to pinpoint the circumstances of eight pretelescopic supernovae between A.D. 185 and 1604, to identify every appearance of Halley's Comet to 12 B.C., and to follow the course of solar activity since the first century B.C. Korean and later Japanese astronomers followed a similar regimen allowing modern checks on the consistency and veracity of the various records.

Our enduring debt to early Islamic astronomers is often acknowledged in the Arabic names by which the prominent stars are known. In fact, these Arabic star names are of two types: indigenous Arabic names and those transcribed by early Islamic scholars from more ancient Greek sources. What was more important to the science of the sky was the role of Arab astronomers in preserving the science of astronomy during the general hiatus of classic scholarship in medieval Europe.

Ptolemy's Almagest was translated into Arabic in the late 8th Century A.D. His star catalogue, listing 1026 stars in 48 constellations for the sky as it appeared in A.D. 137 became the basis for a number of subsequent, Arab catalogues of the sky. The most commonly cited of these are the star catalogue of al Battani, for epoch A.D. 880, that of al Sufi for A.D. 964, that of al Biruni for A.D. 1030, and the catalogue of Ulugh Beg, of Samarkand, for A.D. 1437. It was the work of Ulugh Beg who later inspired the Maharajah Jai Singh II of Rajasthan to build the monumental stone and masonry observatories that stand today in India in Delhi, Jaipur, Varanasi and other cities.

These structures, built in the early 10th Century and thought at the time to epitomize the art of positional astronomy, mark the end of the older phase of astronomy in the orient.

CHRISTENING THE MINOR PLANETS

"What's in a name?" The Bard may dismiss this inconsequential question by saying: 'A rose, by any other name, may smell as sweet.' Astronomers meeting in New Delhi do not rightly seem to care much for Shakespeare in christening minor planets and satellites and the like.

The naming of satellites and minor planets is engaging the attention of one of the commissions — Com. 20. Heated arguments on 21 November on the norms of naming at this Commission's session led even to the threatened resignation of chairman Tom Gehrels of a committee addressing this seemingly trivial task.

That no astronomical entities should be named after living persons — men or women, foul or fair — appeared to be the consensus of the yet-to-be concluded meeting of the commission. Two hundred years must elapse before the death of a person and the naming of a planet after him or her. For, then,'Time'-tempered wisdom prevails. Certainly, planets ought never be named after, dogs, cats and mistresses — the discussants seemed to club them all under the rubic 'animals' The male reporter of *Mandakini*, who was covering the session, felt aghast that feminists were utterly bypassed in the deliberations.

Political leaders' names should never pollute the celestial objects. This seemed to be a certainty. Elizabeth Roemer, the busy secretary of this commission, could spare a few of her precious minutes to talk to *Mandakini*. She expressed grave concern for citation flagrances in astronomy nomenclature. Hitler is an historical truth but then the name could tarnish our perceptions of a celestial object if it were named after him, wouldn't it?, asked some of the conferees. Recent instances of names brimming with political undertones and overtones were cited. The meeting revealed that a minor planet was named after Sakarov the Russian scientist.

What amazed the *Mandakini* reporter Shankar was why the IAU could not take a leaf from IUPAC in sorting out nomenclatural problems. The IUPAC's vision, i.e. of the chemists', seemed to go beyond the astronomers' (Sorry, the reporter is a chemist but is not paying any encomiums to his tribe). The beauty of the IUPAC's system does away with places, persons and the like in naming elements. The element with at. no.104 marks the beginning of a period of chemical history when new elements will be named systematically for the first time. The name of the element with at. no.104, for example, is "Un nil quad ium with symbol Unq (un=1; nil=0; quad=4; and 'ium' is the final suffix for any element. A further feature of the IUPAC nomenclature is that you can go up to element 999 (enn enn ennn ium—Eee). Elizabeth seemed impressed with this foolproof system, though the limit 999 in the context of Cosmos seemed beggarly meagre.

Yet a Crimean astronomer wanted a minor planet named after a Japanese astronomer (who died in 1949).

Does astronomy nomenclature still remain as primitive as when it was confused with astrology? The *Mandakini* reporter felt so. Elizabeth Roemer may have a different, acceptable answer to tell you when the Commission will have come to a unanimous decision before the XIX GA concludes.

Note: Element with at. no. 104 is kurchatovium. For ease of reading the new IUPAC nomenclature is spaced out but should be set solid.

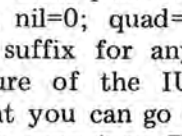
"Ye country comets, that portend
No war nor prince's funeral
Shining unto no other end
Than to presage the grasses fall"
Jonathan Swift (1667-1745)

A comet, which is a phenomenon, popularly supposed to herald the death of the highest rulers, began to rise in the sky.....
Suetonius (AD 69 - 160)

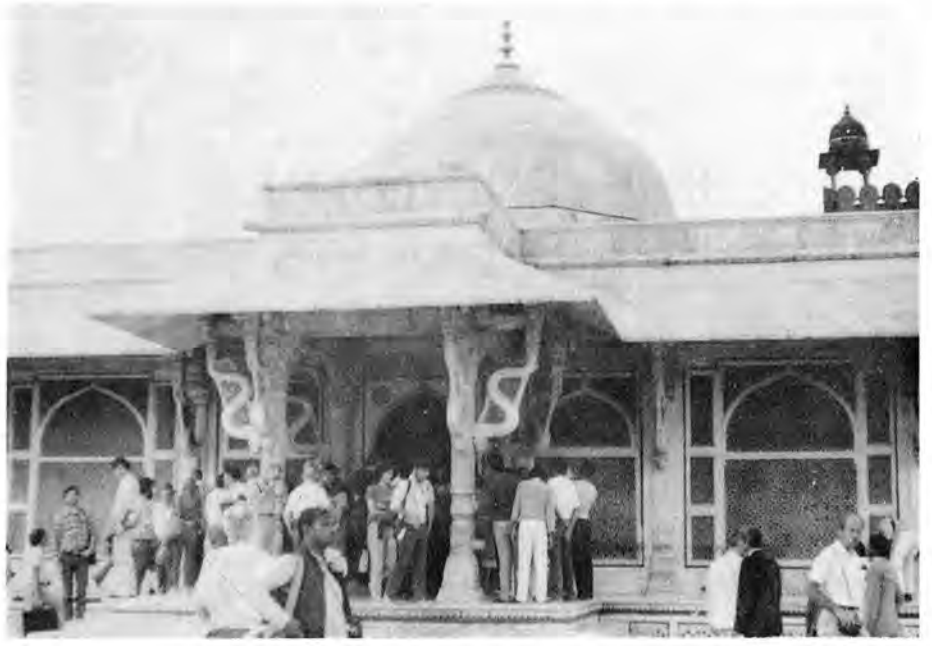
Astronomer

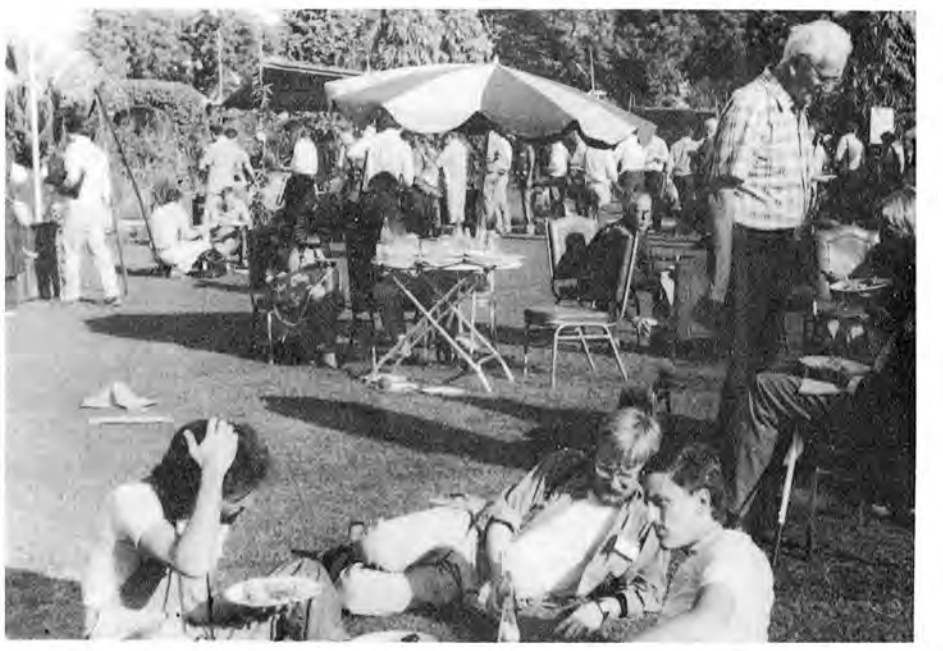
An undevout astronomer is mad.
—Edward Young: Night Thoughts (1742)

To talk in Public, to think in Solitude, to read and to hear, to inquire and answer inquiries, is the business of a scholar.
—Samuel Johnson: Rasselas VII



THE EVER-CHANGING PAGEANT OF THE IAU





COLLECTOR S ANGLE

MARGARET I. MORRIS
Department of Astronomy
Glasgow University, Glasgow, UK

Everyone reacts to any event in his or her own characteristically individualistic way. Some of the delegates attending this General Assembly will perhaps be looking forward to renewing friendships, some others will have been polishing their text and making ready their visual presentation, and yet others will be experiencing the excitement of visiting the ancient land of India for the first time.

My reaction is that of a collector of astronomical stamps and ephemera. Whenever the IAU meets I am always hopeful that the event will be marked by a special issue of stamps or perhaps a commemorative postmark. Such hopes are, more often than not, vain, so I am delighted that the Indian Post Office has decided to commemorate the IAU's 1985 New Delhi General Assembly.

At the same time, being unable to attend in person, I can turn to my collection to see what has already been produced by the host country. India's presence on my album pages is not large, but the collections are fascinating.

In 1974 a set of four stamps and a miniature sheet were issued with designs of Indian masks. The 20 p. denomination (p=paisa=1/100th of rupee) shows a resplendent Sun and the 50 p., a rather fierce-looking Moon. According to the information leaflet from the Indian Philatelic Bureau, these are paper masks used in the Ramlila, a dance drama performed on the banks of the holy Ganga (Ganges) in the ancient city of Varanasi (Benares).

A Sun symbol is also to be found on various postmarks, for example from Gwalior, flanked by two snakes.

Jasdan State produced stamps in 1942 with a Sun emblem, and the 1949 Archaeological issue of India included a 6 p. stamp depicting a huge horse from the Temple of the Sun at Konark (Orissa).

Perhaps the most delightful design is that from Jaipur State - the Chariot of the Sun. With variations, this was used on stamps from 1904 until 1947. The Sun God Surya is shown seated in his fiery chariot which has one wheel, taken to represent the revolving Sun. The charioteer is Aruna, the Dawn, and he drives seven bay mares, taken to represent the days of the week. On the stamps, one horse is shown with seven heads.

The Chariot first appeared on rather crude stamps of 1904, with only one horse and one head shown. The stamps were of three denomination: ½ a - blue, 1 a - red and 2 a - green. [Note: a = anna, 1/16 of a rupee]. Two types exist, also shades, and each stamp shows small differences, to the delight of the collector.

The next version appeared soon afterwards but this time in a horizontal format and printed by Perkins, Bacon & Co. of London using the line-engraved process. A contemporary philatelic magazine stated that these new stamps were ordered from England because "the philatelic demand could not be satisfied by the original primitive methods of manufacture".

However, in 1911 we find stamps of this design once again being printed locally - in the Jail Press at Jaipur. Apparently this small press was used for printing administrative reports and prison bulletins. Prisoners carried out the work under a civilian officer. These stamps were printed in small sheets of 6 and each stamp was different. Numerous varieties exist, including an inverted "¼", a missing stop after "State" and an extra large "J" in "Jaipur". Later issues in 1913 and 1928 were much improved.

Postal stationery (postcards and envelopes) also used the design of the Chariot of the Sun.

The most beautiful representation of this design is on the ¼ a. denomination of the set issued in 1931 to commemorate the investiture of the Maharajah Sawai Man Singh Bahadur (although he had acceded to the throne in 1922). The Chariot of the Sun appeared for the last time on the 8 a. denomination of the set issued in 1947 to mark the Silver Jubilee of Man Singh.

On the 1 a. denomination of this 1947 set is depicted the Observatory of Sawai Jai Singh II at Jaipur while Jai Singh himself is shown on the Rs.5 denomination of the 1931 issue, which was in 1936 surcharged 1 rupee.

As well as stamps, I collect postcards. Some of these have only an oblique connection with astronomy (such as the Taj Mahal by moonlight!) but others are more directly associated. Some charming designs depict astrologers. I have several cards depicting the observatory of Sawai Jai Singh II at Varanasi and a number of cards with the observatory of Jai Singh at Delhi which delegates will have the good fortune to visit. It is worth noting that another philatelic item, the meter mark of the XIX IAU 85 Secretariat, depicts the *Mishra Yantra* in a stylised form - the Assembly logo.

Sometimes an opportunity occurs which simply must not be missed. A few years ago I was offered a very interesting letter. At first I hesitated because it had no postal markings (having been handed to someone to carry home on the voyage to England); however, when I was able to read the text, the decision was immediate.

The letter is written by John Warren from Madras Observatory, 5 March 1807. (Capt. Warren was an officer with the 33rd Regiment of Foot who officiated as Director of Madras Observatory from 1805 to 1811 while the Director, John Goldingham, was on leave in England). It is addressed to Colonel George Harcourt and begs him to use his influence to obtain some additional equipment for the observatory.

Warren details the instruments which he found when he assumed charge of the observatory and comments that he has no means of taking zenith distances, nor a telescope with a micrometer to measure small angles. "Our observations are therefore confined to Transits and to Observations of Eclipses of various kind."

Stressing the importance of the site for observing stars not visible from Europe, Warren, had he the proper instruments, outlines the programme he would undertake - for example irregularities in the positions of Jupiter's moons, re-observing stars and correcting their declinations, studies of refraction and survey work.

Sad to say, his eloquent plea had no result and it was not until 1830 that the Madras Observatory acquired new instruments.

It is a delight to come across an old letter like this with such interesting contents. I have enjoyed trying to find out more about the background to it and acknowledge with gratitude the generous help received from Dr Jain and Dr Kochhar of the Indian Institute of Astrophysics, Bangalore.

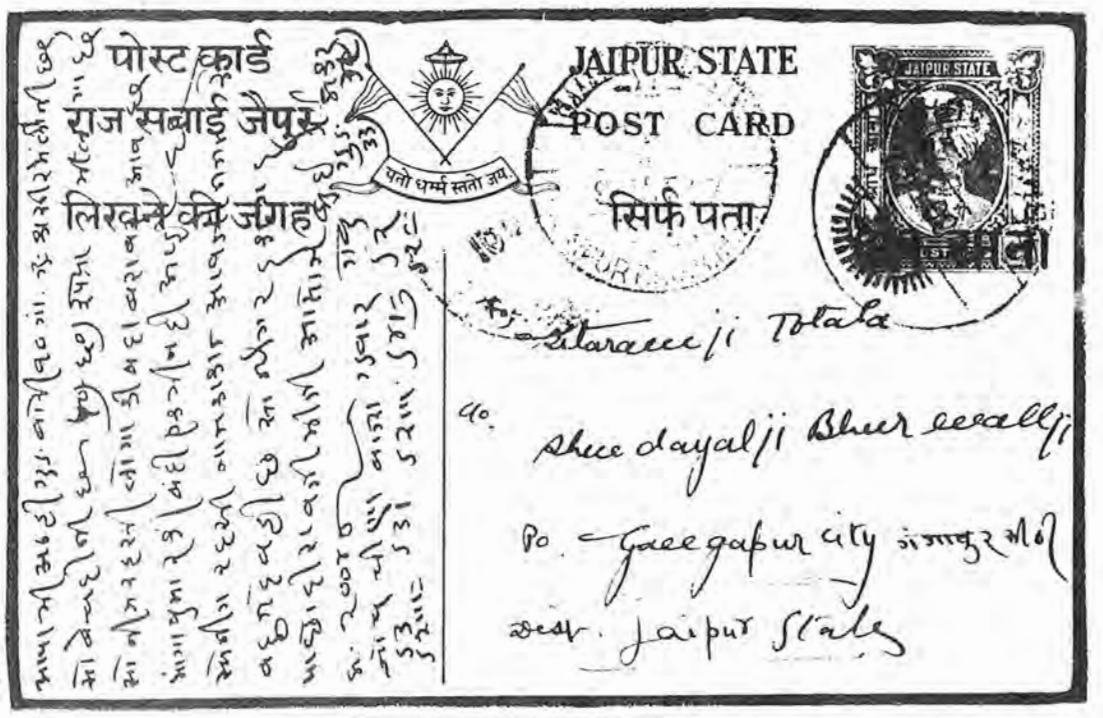


Fig. 1.

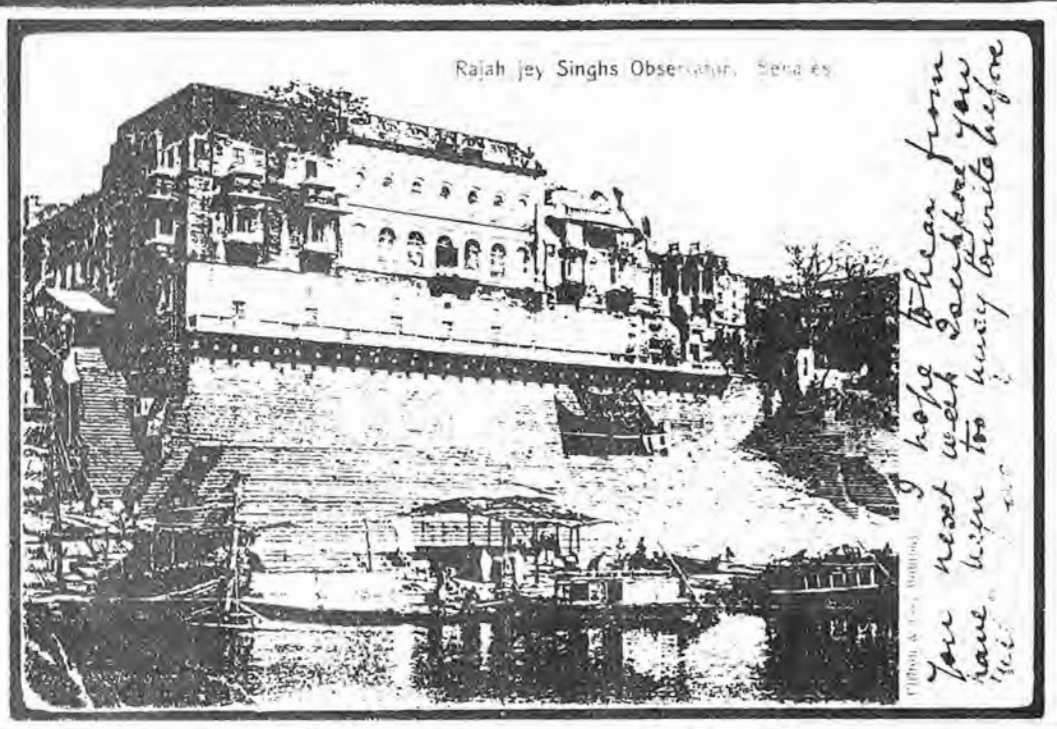


Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6.

Fig. 7.

Fig. 8.

Fig. 9.

Fig. 10.

1. Sun symbol on Jaipur State post card, dated 194 /; 2. "Rajah Jey Singh's Observatory, Benares" Publishers, Clifton & Co., Bombay. Black and white card. Posted in 1907; 3. Sun symbol on the stamps of Jasdan; 4. Jai Singh's observatory at Jaipur. The large sundial is shown; 5. Moon Mask; 6. Sun symbol as a postmark (on Jaipur stamps, dated 1943); 7. An early version of the "Chariot of the Sun" design; 8. The first and last rulers of Jaipur. Jai Singh, the astronomer who laid out the magnificent observatories, is shown at the left; 9. Sun Mask; 10. The most beautiful version of the "Chariot of the Sun" design from Jaipur.

COORDINATED MULTI-SITE OBSERVATIONS

JOHN R. PERCY
Secretary, Commission 27

The potential value of observations from two or more sites, using different techniques or frequencies, is well known. It was noted at Joint Discussion II, for example, that thanks to a coordinated "campaign", the recent eclipse of Epsilon Aurigae was studied in unprecedented detail. Furthermore, the availability of measurements from the radio to the X-ray region has made it possible to construct greatly improved models of this and related objects. At Joint Discussion III, several speakers noted that coordinated observations from different longitudes are absolutely essential in determining accurate and reliable pulsation periods in the Sun and other stars — particularly Delta Scuti and Be stars. The International Halley Watch is perhaps the most ambitious example of coordinated multi-site observations.

C. Sterken and J. Christensen-Dalsgaard have recently proposed that a new IAU Commission (or more likely, a working group) should be established to assist in organizing such coordinated observations. On 21 November, Commissions 12 and 27 cosponsored an informal discussion of this proposal. Several advantages were pointed out. A working group might publish a newsletter containing information on the success (or failure) of coordinated compaigns. It could circulate a list of astronomers and observatories which would be interested in and available for campagins (many "local" observatories have far more flexibility in scheduling than do the "national" ones). It might even be possible to set up a quasi-permanent network of observatories, somewhat analagous to the *ad-hoc* VLBI network in the USA. It might devise ways to simplify the simultaneous submission of complex proposals to several ground-based or space-based observatories. At the very least, the working group could keep the astronomical community aware of the problems (and solutions) in making multi-site observations, and could encourage and assist observers to do better planning. It was realized that the success of a working group depends on having some enthusiastic and active organizers, and that a formal administrative structure can sometimes do more harm than good.

In the end, no consensus was reached about what to do, and no decisions were taken. Nevertheless, the discussion was useful in that it demonstrated the great interest in and variety of opinions about the topic. Sterken and Christensen-Dalsgaard plan to organize a workshop on 'Coordinated Multi-site Observations' in 1987, somewhere in Europe, and would be happy to hear from prospective participants.

The aim of the written words is to be read and being read to be understood. —W.H. Johnson (Author of *If you must write;* no relation to the redoubtable Samuel Johnson).

Irrefutability is not a virtue of a theory (as people often think) but a vice."

—*KARL POPPER*

GALACTIC CONSTANTS

FRANK J. KERR
Astronomy Program
University of Maryland
USA

The currently used values for the galactic constants R_0, θ_0, A and B date from 1963. They are R_0 = 10 kpc, θ_0 = 250 km s^{-1}, A = 15 km s^{-1} kpc^{-1} and B = -10 km s^{-1} kpc^{-1}. The choice of this set of values were largely based on the paper by M. Schmidt in Volume V of the series *Stars and Stellar Systems*.

It has always been recognized that the main reason for adopting a conventional set of values is to provide a good basis for comparisons between the work of different astronomers and astrophysicists. The chosen values should be consistent with the best determinations available at the time, to within their uncertainties, and the set should be physically reasonable, e.g. they should follow the relationship $\theta_0 = (A-B)\ R_0$. Recently evidence has been growing that R_0 and θ_0 are very likely lower than the conventional values, and in fact a number of authors have been using somewhat lower values in their work. At present, however, there is no uniformity, and some of the advantages of having an agreed system have been lost.

At the Patras General Assembly in 1982, Dr R. Wielen, then Acting President of Commission 33, proposed setting up a Working Group to develop a critical review of the values of the main galactic constants, for publication before the General Assembly in 1985. It was not specifically charged to come up with a proposal for a revised set of values, although it could do so if it wished. This proposal was adopted, and F.J. Kerr and D. Lynden-Bell were appointed as Chairman and Vice-Chairman of the Working Group.

Since the one-day meeting, held at Groningen immediately before Symposium 106 in May 1984, the Chairman and Vice-Chairman have carried out more detailed work and have prepared an extended review of the subject. From their report and other considerations, the Working Group draws the following conclusions.

The mean values that have been obtained from determinations over approximately the last decade comprise a reasonably consistent set of values for the four galactic constants and their interrelationships. The results suggest that R_0 and θ_0 are both lower than the currently accepted standard values, but the spread of the individual determinations and the possibility of problems that could arise due to the existence of non-circular motions and departures from axial symmetry indicates that the quantities are still not known with very great precision.

However, astronomers have already lost confidence in the current values for the constants, and many are using lower values for R_0 and θ_0. There are great practical advantages in having widespread use of an agreed set of values, to enable comparisons to be more readily made between the results, both observational and theoretical, of different groups of investigators. It has been recommended, therefore, that astronomers should now use the following values, which are within the error range of recent determinations, and are equal to or close to values which are coming into de facto use:

R_0 = 8.5 kpc

θ_0 = 220 km s^{-1}

If a decision to change is not made now, three more years would elapse before the question can be addressed again.

The constants A and B have been closely studied also, but there is little need to prescribe standard values for these quantities, as they are not so widely used in large-scale comparisons. It was noted, however, that rounded-off values of the means of recent determinations are A = 14 and B = -12 km s^{-1} kpc^{-1}. A flat rotation curve requires $A = -B$, and a value of 13 for both A and $-B$ would be well inside the errors. However, it is not clear whether a flat rotation curve is appropriate for the local area in which the rotation constants are derived. No recommendation has been made for standardized values of A and B.

COMPENDIUM OF EXTRAGALACTIC RADIO CONTINUUM OBSERVATIONS (1980-84)

The Radio Astronomy Group of the Tata Institute of Fundamental Research (TIFR), Bombay, has prepared a compendium of radio continuum observations of extragalactic source (CERCO), from data published in 7 major astronomical journals during the last 5 years (1980-84). The compendium has well over 20000 entries, each corresponding to a published observation of a source and giving its IAU name, any other name, reference to the publication, telescope(s) used, frequencies of the observations and availability of a radio map in the publication. An attempt has been made to achieve a high degree of completeness and reliability, though total accuracy and completeness cannot be guaranteed. The journals covered are: The Astronomical Journal, The Astrophysical Journal & Supplement Series, Monthly Notices of the Royal Astronomical Society, Astronomy & Astrophysics & Supplement Series, Nature, Australian Journal of Physics, Soviet Astronomy AJ, and Journal of Astrophysics & Astronomy.

Depending on the response, it is intended to prepare during the coming months a number of copies of the Compendium on magnetic tapes and make them available to the international astronomical community (libraries and individuals). To recover the cost of production, each copy of CERCO magtape will be priced at about US $ 100/- (inclusive of postage), depending on the demand. A computer printout of CERCO will be available for US $ 70. The amount will be payable to the Tata Institute of Fundamental Research.

A copy of the computer print-out of the Compendium CERCO is available here for inspection. Those interested may contact the radio astronomers Miss Tapasi Ghosh or Miss Lakshmi Saripalli, or write to Dr Gopal Krishna (P.O. Box 1234, TIFR Centre, Bangalore 560 012, India) before the end of February 1986. — Prof. G. Swarup, Radio Astronomy Group, TIFR, Bombay.

A diller, a dollar,
A ten o'clock scholar
What makes you come so soon?
You used to come at ten o'clock,
But now you come at noon.
(Nursery rhyme: first printed version, 1784)

Diller and dollar may mean to suggest dilly-dally; noon was originally nine o'clock and there may be some playful reference to that.

IAU COMMISSION 31 (TIME)

DENNIS D. McCARTHY
Vice-President

Commission 31 is busy during this General Assembly discussing a number of issues. One of the most important is the proposed transfer of the responsibility of International Atomic Time (TAI) to the Bureau International des Poids et Mesures (BIPM) from the Bureau International de l'Heure (BIH). The Coordinated Universal Time (UTC) scale, which is the basis for most civil time in the world, differs from TAI by an integral number of seconds. It is expected that the IAU will continue to control the insertion of leap seconds through the BIH or a possible successor organization. These leap seconds are one-second adjustments to the UTC time scale made to bring UTC into a closer agreement with the time determined by astronomical observations (UTI).

Many members of Commission 31 have been involved during the past three years with participation in Project MERIT. Under this effort, observations were carried out by using modern observational techniques (satellite laser ranging, very long baseline interferometry, and lunar laser ranging) with the goal of establishing the potential of these methods for the determination of Earth orientation parameters (polar motion and astronomical time, UTI). The meeting of the MERIT/COTES working groups at Columbus, Ohio, in 1985 reviewed the results of the observational campaign and arrived at five recommendations. These are due to be discussed at joint meetings of Commissions 19 and 31 during this General Assembly. Copies of the recommendations can be obtained from George Wilkins, chairman of the Project MERIT Working Group or Ivan Mueller, chairman of the COTES Working Group. As a result of the MERIT/COTES projects, it is expected that a new international service will be formed to provide Earth orientation data to users. The details of this organization will be one of the items for discussion here in New Delhi.

Another of the MERIT/COTES recommendations suggests that the scope of Commission 31 be expanded to include responsibility for issues related to the definition and maintenance of celestial and terrestrial reference frames. According to the recommendation, his work would be carried out in conjunction with a similar organization from the International Association of Geodesy. Project MERIT has shown that observational techniques are now capable of providing data with accuracy which goes beyond some of the realizations of these reference systems. The issue of reconciling the observational accuracy of the modern techniques with the definitions, constants and realizations of these coordinate systems is an immediate requirement which will be addressed at this General Assembly not only by Commission 31 but by many other concerned commissions (*see*, for example, Joint Discussion 1, co-sponsored by Commission 31).

Scientifically, the Project MERIT observations have shown conclusively, for the first time, that the changes in the length of day are closely related to changes in the total atmospheric angular momentum. It now appears that most of the high-frequency variations in the length of the day are related to the atmosphere, but the exact nature of the mechanism involved is still being investigated.

In the last few years a large number of observatories have been participating in the formation of International Atomic Time and Coordinated Universal Time. In July-August 1984, 33 laboratories operated 140 commercial cesium clocks. Different methods have been used for the comparison of time scales during this time. They include Loran-C, portable clocks, television, satellite techniques, and very long baseline interferometry. Synchronization accuracy is now at the one to ten-nanosecond level.

Perhaps the most exciting development in the area of time synchronization is the advent of the operational use of the Global Positioning System (GPS) for time transfer. GPS time receivers have been introduced in the United States, France, the Netherlands, Federal Republic of Germany, Austria, Japan, and Australia. Time comparisons made possible with GPS now permit the active participation of laboratories in Japan and China in the establishment of International Atomic Time. Another exciting project is the LASSO experiment planned for June 1986, which promises to transfer time with an accuracy better than one nanosecond using laser satellite techniques.

As our ability to measure and synchronize time improves, the need to address some of the fine points of the relativistic effects on time also has arisen. Recommendations concerning these issues have already been made by the Consultative Committee for the Definition of the Second (CCDS) and the International Radio Consultative Committee (CCIR), and these, too, are scheduled for discussion at this General Assembly.

In addition to this activity, the members of Commission 31 are looking forward to reports on research from a number of investigators. At joint meeting with Commission 19, presentations will be heard concerning recent developments in polar motion, the length of day, and the effect of total atmospheric angular momentum on these phenomena. Together with Commissions 7, 8 and 19, a session will be devoted to predictions of Earth orientation. Commissions 19 and 31 will also hear reports on historical variations of the length of day and Dynamical Time as well as presentations on the geophysical aspects of Earth orientation. Another session is scheduled for discussion of the most recent developments in the area of time transfer and synchronization. The complete schedule of Commission 31 activities is posted on the bulletin board.

STOP PRESS

IAU's membership crosses 6000

The current total strength of IAU is 6027, the Union having admitted 935 new members, the Executive Committee of the IAU informed *Mandakini* around 1400 hrs on 26 November.

POSITIONAL ASTRONOMY IN INDIA

AMALENDU BANDYOPADHYAY
Director
Positional Astronomy Centre
(Govt. of India), Calcutta

The Positional Astronomy Centre which has been functioning in Calcutta since 26 April, 1980 was set up with the aim of development of the specialised field of astronomy concerned mainly with the computation of day-to-day positions of various celestial bodies. This is the only Centre of its kind in India which is one of the eight countries of the world to compute and publish such astronomical data. The others are UK, USA, USSR, France, Spain, Japan and China.

Origin of the Centre

The Indian Planning Committee recommended in 1945 the preparation of an Astronomical Ephemeris and Nautical Almanac for the development of astronomical and astrophysical studies in India. The Calendar Reform Committee formed in 1952 under the Council of Scientific and Industrial Research with late Prof. M.N. Saha, FRS as Chairman, recommended preparation of the Indian Ephemeris and Nautical Almanac incorporating therein along with the usual astronomical data, the National Calendar of India (the *Saka* Calendar) with timings of *tithis*, *nakshatras*, *yogas*, etc., calculated with most modern astronomical formulae and also with festival dates. It was decided that the work should be done by a special unit attached to a scientific department of the Government of India and accordingly a small section called the Nautical Almanac Unit was attached to the Meteorological office at Calcutta on 1 December 1955. The unit undertook the preparation of *The Indian Emphemeris and Nautical Almanac for 1958* which was the first issue published in March 1957.

The formal inauguration of the Positional Astronomy Centre as an independent Unit under India Meteorological Department took place on 26 April 1980.

Activities of the Centre

The centre is engaged in computing advance positions of the sun, the moon, planets, stars and details of eclipses and occultations (with particular reference to India and the neighbouring countries) which are annually published under the present title *Indian Astronomical Ephemeris*. The present volume for 1986 is its twentyninth issue. It also contains a new section on Indian National Calendar giving all astronomical data required for the preparation of *panchangs* and also the dates of festivals of different communities in India. Govt. of India and other State Govts. mainly depend upon this publication for fixing holidays for the festival dates.

Another activity of PAC is the computation of the timings of sunrise, sunset and moonrise, moonset for different latitudes and also for various places of India. These data are annually published in a booklet named *Tables of Sunrise, Sunset and Moonrise, Moonset*. There is considerable demand for this booklet by various Govt. departments especially the Army and the Air Force and also other public concerns. Timings of sunrise, sunset and moonrise, moonset for a particular city or location are taken from this booklet for publication in newspapers.

In India, *panchang* serves two distinct purposes: it provides a dating system to be used by the general public in civil affairs, such as dating of documents, letters, etc., and maintaining accounts; it also gives time of *tithis*, *nakshatras*, *yogas*, etc., and day to day positions of the sun, the moon, the planets and also other astronomical information. Dates and times of religious festivals of different communities and auspicious moments for other socio-religious functions, such as marriages, upanayanams, etc., are based on the duration of *tithis* and *nakshatras* and sometimes on planetary positions. But it has been observed that the calculations of *tithis*, *nakshatras*, etc., given by the indigenous *panchangs* are very often considerably in error, their ending moments differing from the correct timings sometimes by as much as 6 hours. The formulae used by these *panchang* makers for determining the position of the sun, the moon and the planets have thus been found to be greatly in error. The Calendar Reform Committee under the Chairmanship of Prof. M.N. Saha had recommended computation of astronomical parameters required for *panchang* making on modern scientific basis. According to this recommendation all astronomical data necessary for the publication of a *panchang* are at present computed with the help of electronic computers on the basis of most up-to-date astronomical formulae and the *Rashtriya Panchang* using the National Calendar is being published by this centre for serving as a model of a correct *panchang*.

The PAC also prepares monthly star charts for different cities showing relative positions of planets, the moon and the important stars. These charts with monthly astronomical bulletins are now published in leading newspapers and journals all over the country and the amateur astronomers, students and persons interested in star-gazing use these charts for observing and identifying the various celestial objects in the night-sky.

In ancient times, India was known for her advancement and contribution towards positional astronomy. In course of time, this development came to a standstill. Little is now known about our past achievements which are all recorded in allegorical language and concealed in stories and anecdotes, the full significance of which is difficult to surmise without intensive research. It is considered essential that our old astronomical works are carefully unearthed, studied and fully recorded for their exploitation for further development of positional astronomy. A programme of comprehensive study of ancient Indian astronomy by making analysis of the available old scripts in Sanskrit has been undertaken by the Centre. The English translation of the famous Marathi book on the history of Indian astronomy, viz. *Bharatiya Jyotish Sastra* by Late S.B. Dixit has already been published from this centre in two volumes.

An information service is maintained by the Centre to cater to astronomical queries bearing on both observations and calculations. The PAC is the only organisation in India where all calendarial problems, perpetual calendars and proposals of world calendar reform are referred to.

The Positional Astronomy Centre is entrusted with the implementation of the resolutions adopted by the Ephemerides Commission of the International Astronomical Union (IAU).

COMET HALLEY – AN EXAMPLE OF INTERNATIONAL COOPERATION

LUBOR KRESAK & JURGEN RAHE
IAU Commission 15

On February 9, 1986, Halley's Comet makes its 30th recorded perihelion passage of the sun, and its first passage during the space age. It was inevitable that this most famous of all comets would receive unprecedental attention during its present appearance.

Coordination of the various international efforts on the ground and in space is supplied by the International Halley Watch (IHW) and the Inter-Agency Consultative Group (IACG) of NASA, ESA, USSR, and Japan. The single goal of these efforts is to maximise the scientific results of the exploration of Comet Halley from the earth and from space, independent of language and political barriers.

Comet Halley was detected in 1982. At about 5AU, CN and O(1D) were discovered; at 3AU C_2 and C_3; and at more than 2AU H_2O^+ and CO^+; both ions appeared to be stronger in the anti-solar direction. All these species were detected at a distance which is about twice as large as usual. During the second part of November, S. Larson detected a sunward fan, as well as the beginning of jet activity. The brightness is presently about 5.5 magnitudes, and the comet is visible to the naked eye.

The first spacecraft to measure the comet, were IUE in September, and Suisei in November. With the IUE satellite, P. Feldman and co-workers detected OH, the dissociation product of H_2O. OH was also detected in the radio region by the Nancy radio astronomers in France. Six spacecraft are presently on their way to Comet Halley.

The European Space Agency (ESA) launched its Giotto spacecraft on July 2, 1985. Flyby of Comet Halley is scheduled for March 13, 1986, at a velocity of 69 km/s and at a distance of 500 km sunward from the comet's nucleus. This close targeting will be possible through the use of Intercosmos VEGA images IHW ground-based astrometric observations, and NASA's VLBI data.

The Soviet Union launched identical VEGA spacecraft on December 15 and 21, 1984. Their interplanetary trajectories allowed flybys of Venus on June 11 and 15, 1985, during which each spacecraft successfully released a lander and an atmospheric balloon to explore the planet. VEGA 1 will encounter Comet Halley on March 6, 1986, at a velocity of 78 km/s and with a miss distance of 10^4 km. VEGA 2 will encounter the comet on March 9, 1986, with its final aim point being determined by results from VEGA 1.

The Japanese Institute of Space and Astronautical Science (ISAS) has launched Japan's first two interplanetary spacecraft, one to study Comet Halley and one to monitor the solar wind environment in the comet's vicinity. Suisei, launched on August 19, 1985, on its interplanetary trajectory to study Comet Halley, will encounter the comet on March 8, 1986, at a velocity of 70 km/s and a miss distance of less than 10^6 km. The Sakigake spacecraft was launched on January 8, 1985, and will be within a few million kilometres of the comet in March 1986.

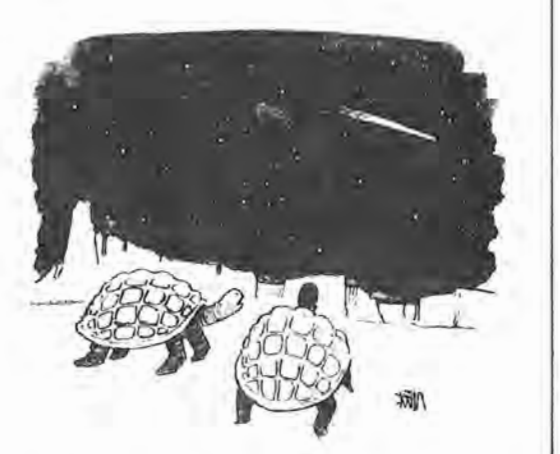
From 1978 to 1982, a NASA spacecraft, originally known as the International Sun-Earth Explorer 3 (ISEE-3), monitored the solar wind near the Earth-Sun Lagrangian L1 point. In 1982 and 1983, a series of manoeuvres in the Earth-Moon system culminated in a final close flyby of the Moon on December 21, 1983. This flyby sent the now renamed International Cometary Explore (ICE) spacecraft on an interplanetary trajectory to fly through the tail of periodic Comet Giacobini-Zinner on September 11, 1985, 18,000 km from the nucleus, at a velocity of 21 km/s. In March 1986, the spacecraft will monitor the solar wind some 3×10^7 km from Comet Halley.

Astro-1 is a collection of instruments designed for astronomical observations from low Earth orbit. Carried aloft by a Space Shuttle on March 6, 1986, the telescopes in the payload will study the comet for the available period during each orbit.

In earlier times, Comet Halley has been made responsible for the destruction of cities, the fall of empires, and the deaths of kings. This time around, it will be remembered for two things.

For completely new scientific results that will change our knowledge of Comet Halley, of comets in general, basic properties of our solar system and, perhaps, life itself. And it will be remembered as the one celestial object that promoted international cooperation in a truly 'worldwide" manner, on a scale never before achieved.

Most people will be disappointed by Halley — since the comet will remain quite faint. But they will not be disappointed by the scientific outcome and this exemplary international cooperation, which one should hope will be continued, not only in cometary research.



"It's only Halley's Comet again."

ANNOUNCEMENT

PLANETARIUM SYMPOSIUM

Planetarium Symposium at the Nehru Planetarium, New Delhi, on 28 November at 13-30 hours organised by Carl Zeiss Jena and C Z India.

In fact, it is as difficult to appropriate the thoughts of others as it is to invent.
— *Emerson:* Quotation and Originality

A NEW LARGE RADIO TELESCOPE: PUTTING INTO OPERATION

G.Ya. SMOLKOV
SibIZMIR, Irkutsk, USSR

In 1984, in East Siberia, construction work on the Siberian Solar Radio Telescope (SSRT) was completed. It has an angular resolution of up to 20" at 5.2 cm wavelength (Figure).

The problem-oriented SSRT is designed to study an extended, continuously and substantially varying object with a broad spectrum of structural scales. The SSRT is a 256-antenna cross radio interferometer, consisting of two mutually orthogonal 128-element arrays and is provided with the required receiving and computer facilities.

The baselines of the two arrays are 622.3 m. The antennas with parabolic dishes are spaced by 4.9 m. With the mirror 2.5 m in diameter, the field of view of the SSRT is about 70'. Owing to this, the SSRT has a uniform spectrum of spatial frequencies that is sufficient for separating from the radio brightness distribution details of all sizes ranging from the main components of active region structures (10" 20") to the radio diameter of the Sun. Therefore, the SSRT can be used to study any active region or any flaring process simultaneously with the diagnosis of the state of solar activity as a whole.

The diffraction maxima of the beam diagrams of the two arrays fill uniformly the sky. Therefore, the presence in the SSRT of two mutually orthogonal arrays permits observations of the Sun almost throughout 24 hours a day with high one-dimensional resolution of up to 17". The multi-beam diagram of the "cross" consists of pencil-shaped beams.

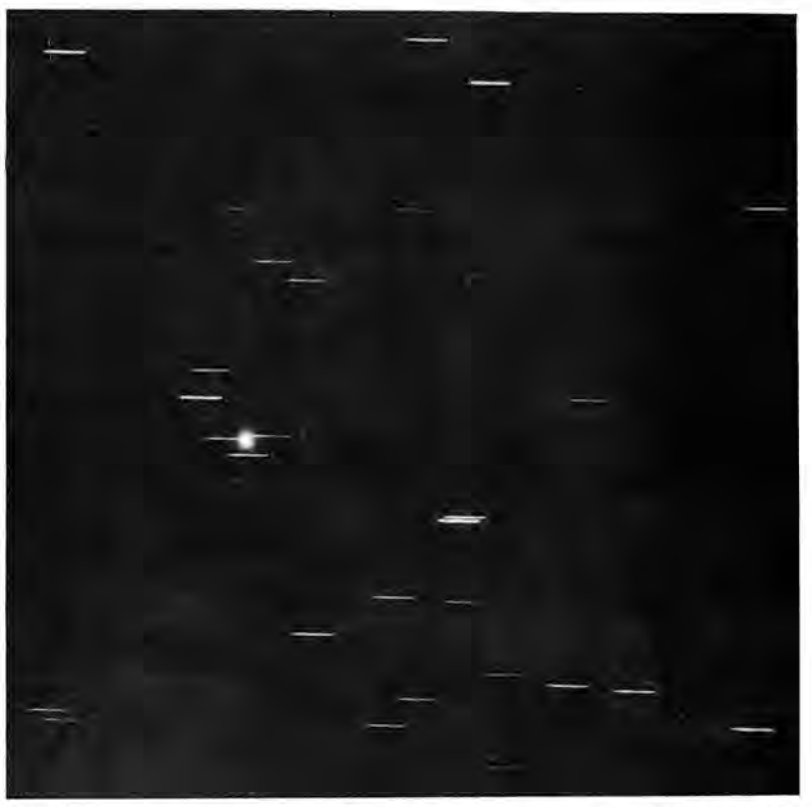
In order to obtain two-dimensional solar images, the SSRT is provided with: (1) parallel multi-frequency recording of radio brightness distribution in elevation angle with the aid of a 180-channel receiver complex with time constants which eliminate distortion of the radio image due to solar rotation and are sufficient for flare studies, and (2) scanning of the Sun every several minutes in azimuth as it is traversed by such fan-shaped beams of the directivity diagram in the way of its motion on the sky due to diurnal rotation of the Earth. The use of such a method of "frequency" scanning is based upon the dependence of the antenna directivity diagram orientation on wavelength and is achieved via connection of the antennas to a multichannel receiver unit through waveguides of equal electrical length. In this case, recording the distribution of the degree and sign of circular polarization offer the possibility of understanding the structure and dynamics of magnetic fields in the atmosphere of active regions.

The formation of a composite beam diagram of the SSRT is accomplished thanks to the adopted engineering and construction design solutions and to the use of the phase adjustment method (of antennas with the maximum possible electrical sizes and the greatest possible number of antenna and waveguide elements), from solar radio emission taking into account the non-uniform distribution of radio brightness across the solar disk. Simultaneous operation of the 256 antennas, the diagnosis of the serviceability and control of all systems' operation, interrogation of 360 outputs of the receiver complex, operative display and preprocessing of the observations are accomplished with the aid of a multiprocessor automation complex that is open for development and is capable of adaptation for solving new problems.

A step-wise commissioning was begun in Spring 1981. Daily recording of one-dimensional distributions of radio brightness during phase adjustment of the antennas from solar radio emission permitted us to start the study of spatio-temporal peculiarities of the development of active regions and flares. In doing so, a repeated recording of the known facts confirmed the correctness of the development and realization of the SSRT Project. In addition, we obtained new evidence of the structure and development of active regions which are accessible only to the use of the observational method with the aid of the SSRT: the rapid and considerable variability of microwave emission of active regions, microwave emission pulsations of active regions, with a period of several seconds, localization and displacement of flare processes with respect to sunspots, the change in structure and of sign of the circularly polarized emission of the active region as a consequence of a flare, and others.

Separation of the emission of individual details of active regions, study of their structure and development allowed us to begin searching for flare precursors and studying the properties of microwave emission with the aim of diagnosing the development of physical processes in the solar atmosphere. Using observations of active regions at the solar limb, we were able to distinguish an extended (into 30-40x10^3 km) and a compact (in a height of about 1000 km) component. Fast brightening of the microwave emission source evidences emergence of a new portion of magnetic field in the active region.

Already the trial observations of the Sun, made during adjustment and step-wise commissioning of the SSRT, have shown its high 'informativity'. The use of the SSRT in conjunction with the Sayan and Baikal (optical) observatories of SibIZMIR will permit a solution of challenging problems of the present-day solar physics and solar-terrestrial physics.



Did you predict this twin occultations? We did not; but we got it. Comet Halley photographed by K. Kuppuswamy at the f/13 cassegrain focus of the 1-metre reflector at the KAVALUR-observatory of the Indian Institute of Astrophysics. Nov 14.8, 1985. Exp: 25 min. 103 aD. No filter.

K.R. SIVARAMAN
Indian Institute of Astrophysics, Bangalore

DOWN MEMORY LANE

VIII GENERAL ASSEMBLY, ROME 1952

The Astronomical Union met at its VIII General Assembly during September 4-13 at Rome. Four hundred and thirty-nine delegates participated in the deliberations.

This was the second time that the Union was meeting in Rome, the first being thirty years before in 1922 when the first General Assembly met there. Prof. Colonnoetti, President of the Italian National Research Council, recalled in his address what Vitto Votterra, the President of the Organizing Committee in 1922, had stressed on the importance of the experimental evidence in astronomy. Prof. Abetti, who had attended all the previous General Assemblies and was also the Chief Organizer of the eighth assembly, highlighted the history of astronomy in Rome. He referred to the efforts of Father Secchi in the development of astrophysics at various places. The President of the Union, Prof. Lindblad, reviewed the events since the previous assembly at Zurich, and mentioned the difficulties the Union had gone through on some important issues like the venue of the General Assembly.

Four symposia were held during the assembly on 'Stellar Evolution', 'Astronomical Instruments', 'Spectra of Variable Stars', and 'Problems of Astrometry of Faint Stars'.

Dr Shapley spoke at an evening discourse on 'Magellanic Clouds and Galaxies'. Speaking on behalf of the Soviet delegates, Prof. Ambartsumian, one of the Vice-Presidents of the Union, stressed the efforts of the Soviet astronomers towards international cooperation in the field by way of their participation in the various activities of the Union, publication of their work in journals published in other countries and the exchange of scientific information. He mentioned that the spirit and cause of international cooperation had been seriously impaired by the unprecedented cancellation by the Executive Committee of the Union's agreed meeting at Zurich. He stressed that this incident was very unfortunate and was not in the interest of science but for other considerations. An invitation was extended to the IAU by him on behalf of the Soviet Union to hold the next assembly in their country. This was, however, withdrawn later in favour of Poland. There were invitations from seven other nations to hold the next General Assembly in their countries. In the end, it was a choice between Poland and Eire. Secret vote decided that it would be Eire. There were visits to the Observatory and the Astronomical Museum of Monte Mario and to the Old Roman Seaport of Ostia.

Dr Struve was elected as the next President, R.v.d.R Wooley, E. Rybka and A. Couder as Vice-Presidents and Dr Oosterhoff as the next Secretary.

WISH THEM A HAPPY BIRTHDAY

27-11-1985

Prof. Cesare Barbieri	Italy
Dr. Vojtech Letfus	Czechoslovakia
Forrest I Boley	USA
Dr William Martin	USA
Dr Roger Servajean	France
Dr Claudine Laurent	France
Dr Margarita Rosado	Mexico
Dr Peter Thomasson	UK
Dr Klaus Dorenwendt	FRG
Dr Donald Wayne Kurtz	South Africa

THE MANDAKINI SERIAL

BETWEEN THE TIDES

DONALD MALCOLM

EIGHT

SIMDE gave the room number to the video-communicator and Noss's image appeared on the screen.

'I'm in the radio room of the station, Simde. I want you to come as soon as you can.'

There were others present and Noss obviously did not want to discuss anything in public and he could glean nothing from his friend's expression.

'I'll come at once.'

He found Atira, told her where he was going, then commandeered a shuttle. When they were together in a private office — Simde, Noss and a crystallographer — Noss said bluntly: 'We think that the wheel's beginning to break up.'

Simde made a strangled noise and sat down abruptly, all the doubts and fears crowding in again.

The other man said: 'This has been a cumulative effect, over many years—'

Simde interrupted. 'All those inspections — what were they for, if this is happening?'

The expert took the outburst calmly. 'Until now, the crystal has been able to repair any cracks. However, the flare activity of the past year has been the most intense for at least a hundred years and the crystal can't withstand the hard radiation much longer.'

Simde slumped in the seat. He was going to be beaten. At the last malevolent flick of fate. His mind rebelled at the enormity of it. Long years of work and belief, started before he was separated, and now it was to be all for nothing. Coming on top of Lif's stopping, how could the project survive?

'Simde—'

Noss was speaking, but Simde didn't look up.

'I've done some calculations. I'm sure that the wheel will hold together for the short period of rotation required, and attain the velocity you need.'

'Lif has stopped,' Simde said, 'For all I know, the project might be stopped, too.'

'Couldn't you—'

'No.' Simde flashed at the expert. 'I must tell the travellers. They have a right to know and a right to decide what they want to do. The launch is the beginning of a new phase of the project. Everything must be based on trust.'

He stood up. 'I'm going to Hasub.'

They left in silence.

The first snow was falling like tiny rose-tinted flowers as Lif was taken to his final bonding. Many people followed as he was borne slowly along the tree-shadowed avenue to the ceremonial pool, which was the first stage in the conversion of a body into the nutrients that fed the growing psycho-food plants. It was a perfect cycle of separation and stopping. The pool was on a hillside, overlooking the fields where the food plants were raised and nurtured.

The procession emerged from the avenue as the snow clouds passed on and the sun shone. Enomice and Nekk accompanied the bearers to the edge of the flower-scalloped pool. After they had looked upon his face for the last time, they stood aside. The bearers lowered the litter into the water and backed away.

A quiet current caught it and wafted it across the pool to a skilfully disguised culvert. Enomice and Nekk gazed after the litter until it disappeared. The cycle had begun again with Lif.

As they turned away from the pool, a young stepped forward from the crowd. Simde did not recognize him. But Noss, standing beside him, did. It was the cub for whom he had taken the Execution of Sentence, Lezah Ewor.

He stood in the formal position, feet together, right hand extended. At a final bonding, it was traditional that, when parents had lost a cub, one who was parentless could ask to be adopted by them.

Simde was keenly interested in the outcome of the meeting. Enomice and Nekk had accepted the knowledge that Lif had stopped because he had taken drugs. Believing that was subtly different. Now they were confronted by Lezah Ewor, who had taken drugs, joined illicitly with the Irah and been reprieved from Execution of Sentence.

'Enomice Nerod. Nekk Nerod. My name is Lezah Ewor. I am with you in your sorrow. My parents have taken the last bonding and I am alone. I have offended against the customs and the laws and was given the Judgment by the High Custodian. I was saved by Noss Sidl from taking the Execution of Sentence. All this I admit before you. I have been cleansed'.

This caused murmuring among the onlookers. The process of cleansing was painful and dangerous, almost as bad as the addiction of the drugs themselves. Few took the cleansing. Simde understood now the physical and mental strain that Lezah was enduring. The effects lingered long after the cure was done. Even Enomice and Nekk, who, despite the tradition, resented the intrusion and its meaning, felt more favourable towards the youth.

'By the traditional right, I ask you to adopt me as your cub.'

His right arm, still fully extended, was beginning to shake. If they did not decide soon—

Enomice came forward and placed her hand against his in the ritual, and was followed by Nekk who, as usual, seemed uncertain. But he was quick enough to answer. 'We, Enomice and Nekk, accept you, Lezah Ewor, as our cub and give you our name.'

Simde and Noss offered themselves as his nominators, when the adoption was submitted to the High Custodian for formal approval. The new family conferred, then went to where Simde, Noss and Atira were standing.

'Simde,' Nekk said, 'we shall go on the voyage.'

'Thank you. I had hoped for this. Lezah will have to go up to the ship today and begin bonding with our food plant. I'll arrange it with Neri.'

'He is Lif, now.' Smiling, they departed.

Noss said, 'Can anyone doubt that I was right to take his Execution of Sentence. He will be good for them, and they for him.'

Arm is arm, they followed after the others.

The day of the launch had come. Farewells were subdued. There was little to say. Simde's food plant had stopped just after the last bonding. Soon the pathfinders would be gone and life on Hasub would enter a new, more urgent phase.

Simde and Noss stood at the base of the shuttle, watching the restrained activity around them. Irah was saying goodbye to Atira and the cubs and she knew within herself that she was severing one of her last links with life. For her there was no immortality.

The travellers began to board the shuttle. Irah came over.

'Simde, Safe journey.'

He embraced her briefly, as if the contact might suffuse her with life.

Noss took his hand. 'The wheel will do its job. Then you can do yours. Irah and I shall be watching the ship.'

The men held each other.

'I shall always remember you, Noss.'

'And I, you, Simde.'

He was the last to board the shuttle.

After it had taken off, Noss and Irah went to their airship and flew to the lake.

The travellers were all in their acceleration couches. When everything was ready, the signal was sent to the space station and in turn was relayed to the rocket motors on the crystal wheel. At first it maintained its somnolent rotation, then the rockets flared and it began to pick up speed, light flashing from its vast surfaces. Faster and faster it turned. The electro-magnets were activated in sequence, biting on the 500-mile long crystal cord and its cargo. In two minutes, the necessary escape velocity of eight miles a second would be reached — if the wheel did not break up. Second after second the velocity built up in the wheel.

Simde watched the numbers appear on the screen above his head. One minute. Acceleration was thrusting him against the couch. One minute, ten. Would the wheel hold? Our lives could be ticking away, Simde thought, but the numbers compelled his attention.

Aboard the station instruments monitored the condition of the wheel. Grimly, the commander studied the readings. The giant crystal wheel would disintegrate any second. When Noss had made his discovery, the station had been moved to a safe distance, in case segments came their way.

Noss and Irah were following the progress of the launch from the lake. The night was peaceful and the stars blazed messages of silence as if they might evoke a response in the watchers. The little boat rocked very gently.

Five seconds to terminal velocity. Pieces of the wheel began to fly off and some passed dangerously close to the cord. If that were cut, then the ship would be doomed. The final numbers seemed to take forever to appear in the window.

One—!

The ship was slung free from orbit, even as the crystal wheel began to disintegrate, torn apart by irresistible forces. Glittering fragments sped out in all directions, but confined mostly to the plane of rotation, like a careless scattering of jewels. Some would fall to Hasub. Others would be lost in the interstellar spaces.

They watched until the ship disappeared from sight. Then they touched hands for the last time and, bound in love. Noss and Irah stopped.

And the ship was gone, between the tides.

THE END

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IAU

mandākini

XIX GENERAL ASSEMBLY
NEW DELHI 1985

NO. 10 : THURSDAY 28 NOVEMBER

Editor : ARCHIE E. ROY
Associate Editor : A. RATNAKAR

CARBON FIBRE RADIO DISHES - WHY?

DIETMAR PLATHNER
IRAM, Grenoble, France

Carbon fibre material has often been described as the answer to a big number of technical problems including telescope structures. For its 15 m MM-interferometer dishes, IRAM (Institute for Radio Astronomy at MM-Wavelength, Grenoble, France) made feasibility studies, investigating in parallel, a more conventional, metal; and one using advanced technologies.

IRAM now knows a lot about influences from humidity, voids, creep, local stresses, temperature, vibrations; and one can conclude that the carbon-fibre composite qualities improve with ageing (under the conditions of typical telescope application!) which is also underlined by the 5-year guarantee from the contractor.

This led to the decision, because of the costs, to keep the telescope mount in a conventional steel design (contractor: ALSTHOM, Grenoble, France) and the high-accuracy dishes as the new technology all-carbon-fibre approach (main contractor: M.A.N. New Technology, Munich, FRG).

The outcome can best be summarised by the following worst-case error budget:

Source	μ rms	Conditions
Back-up structure		
- wind load	36.9	14 m/s: 50° wind attack angle
- gravity	10.6	van Hoerner optimised
- thermal	10.0	all thermal effects r.s.s. summed
Panels		
- manufacturing	⩽15	specified
- wind and gravity	4	14 m/s
- thermal	15	gradient and absolute effects r.s.s.
- measurement	20	
Total	49.4	r.s.s. summed

Without further modifications but accepting "softer" climatological conditions the error budget still can be optimised as shown below.

The standard IRAM unit can therefore be used without any cost increase for far-infrared observations. With its 15 m diam and 200 m of reflecting surface it will be the most powerful ground-based telescope in this wavelength range.

The carbon fibre reflector structures are built from the cheapest standard fibres but still offer a rather high Young's modulus in composite (130 KN/mm^2) and a weight far below steel which permits under equal stiffness requirements to reduce the overall weight to one-third and to increase the lowest frequencies by 1.7.

Source	μ rms	Conditions
Back-up structure		
- wind load	5	0-6 m/s
- gravity	5	van Hoerner optimised
- thermal	5	observation at night
Panels		
- manufacturing	10	expected serial production
- wind and gravity	2	0-6 m/s
- thermal	5	observation at night
- measurement	5	optimised by experience
Total	15.1	r.s.s. summed

As the IRAM design still uses a mixture of carbon fibre bars with steel fittings the overall thermal expansion coefficient is in general only one-sixth of steel and a tenth of aluminium, the absolute value being of the order of 2.5×10^{-6} deg^{-1}. This is however already slightly better than the glass used for the 5 m Palomar mirror and much better than Pyrex. It thus avoids operation under active thermal stabilization.

These considerations are, of course, also of particular interest in respect of the panel error budget contributions. Very good results can be obtained owing to the high degree of freedom in arranging the fibre geometry, which permits to tailor the mechanical and thermal "stiffness" in the top and bottom layers of the sandwich. They are made on cast-iron double-curved moulds by replica technique by using a 120°C curing process. The moulds have been machined to a surface accuracy of 5 to 7 μm rms, the replica error being about 2 μm rms. A typical panel size is about 1 m^2.

IRAM's project is nearing the end of production of the first reflector and expects the start of test operation in April 1986. The second reflector to be built is used as single dish submillimetre telescope by the ESO - ONSALA group at La Silla, Chile, by the end of 1986. The IRAM interferometer array is scheduled to be finished early 1987.

The site of the IRAM interferometers at Plateau de Bure, 120 km south of Grenoble at 2500 m altitude with (from left to right) cable car station, assembly hall or shelters and living quarters. Two steel mounts in foreground on their rail-track.

ATLAS OF THE SOLAR CHROMOSPHERE

A Photographic Atlas of the Solar Chromosphere has been brought out by the Udaipur Solar Observatory (India). It contains a list of interesting chromospheric events observed from USO during 1978-84 and photographic sequences of selected events, grouped into flares, mass ejections and filaments.

Those interested in getting a copy of the publication may write to:

Dr. A. Bhatnagar/Dr. Ashok Ambastha
Udaipur Solar Observatory
11, Vidya Marg, Udaipur-313 001
(India)

ANNOUNCEMENTS

THANK YOU

The National Organizing Committee and the Local Organizing Committee would like to thank the participants and their other visitors who came to the XIX General Assembly of the IAU. We are confident that your stay in Delhi has been an enjoyable one and that you will return to your countries with pleasant memories of your visit to India. Indeed we hope that you will come back to India at some future date and in a more leisurely atmosphere to see more of our country, its customs and its people. Our sincere best wishes and thanks go with you.

ACKNOWLEDGEMENTS

The National Organizing Committee gratefully acknowledges a major financial support from the Department of Science and Technology, Government of India, without which it would not have been possible to organise this General Assembly.

The NOC would also like to place on record its appreciation of additional financial support received from the following organisations: Department of Space (Government of India); University Grants Commission; the followings organisations of the TATA Group, namely Sir Dorab Tata Trust, Sir Ratan Tata Trust, the Tata Iron & Steel Co. Ltd., Tata Engineering & Locomotive Co. Ltd., Tata Electric Companies, Voltas Ltd., Tata Chemicals Ltd., Tata Tea Ltd., Indian Hotels Co. Ltd. and the Tata Oil Mills Co. Ltd., Walchand Nagar Industries Ltd.; Larsen and Toubro Ltd.; McDowell & Co. Ltd.; Hinditron Group of Companies; Indian National Science Academy; and Department of Atomic Energy (Government of India).

We would also like to place on record our warm appreciation of the work done by Mrs Deepti Bhagat and her colleagues in taking such good care of the delegates, particularly the arrangements made for their accommodation, transport and travel.

Our thanks are due to the Indian National Scientific Documentation Centre (Insdoc) and Publication and Information Directorate (PID) of the Council of Scientific and Industrial Research for their prompt assistance and cooperation in bringing out *Mandakini*.

Mandakini quotes from the XIX IAU President R. Hanbury Brown's

Man and the Stars:

"Why bother about science?" Because, "It is not enough to value science only for its practical uses or as an ornament of society; it is a pillar on which our culture rests."

EDITORIAL

GO BACK RICHER

I came to India shamefully ignorant of the country and its people to be the editor of *Mandakini*. But although I have been here only a month and the sum total of my ignorance is still colossal, I have learned a lot. I have learned a lot because I have been part of a dedicated team motivated by one ambition, to produce an IAU newspaper that would be remembered as the best ever.

I have so many to thank. *Mandakini* began a long time ago when Richard West asked me to be editor and our Indian hosts graciously invited me to India to do the job. In the following months I marvelled again at how many people, scattered over the surface of the globe, yielded most generously to my pleas for articles and, and busy though they were, supplied them. To them all, I say thank you, and if your article in the end was not printed, I apologise and can only plead that an editor's criteria for printing or not printing are often bound not by the article's merits but on questions related to the strange stringencies of newspaper production.

My good friend and associate editor Mr. Ratnakar put in an incredible amount of work long before I arrived in India and has continued to give unstintingly of his time and energy throughout *Mandakini's* existence. He has made life much, much easier for me and he has my thanks and deserves yours also.

Mr. Shankar, Mr. Basu and others have by their undertaking of endless editorial and reporting duties with cheerful and tireless skill put me deeply in their debt. And I shall also recall Krishna *et al*, typing away (when they were not roped into a bewildering variety of other duties) at manuscripts often quite illegible and producing fair copies for our editorial eyes.

How fortunate Mr. Ratnakar and I were to obtain the help of the Indian National Scientific Documentation Centre (INSDOC) of the CSIR in printing *Mandakini*, I began to suspect quite early on when we discussed with their printers the problems involved. Mr. Ramachandran and his colleagues listened most patiently and tolerantly to our naive suggestions before gently straightening us out. And then, during the days of production of *Mandakini*, in Room 217 at the Vigyan Bhavan and afterwards long into the night at the printing press out on Hillside Road, they and their people worked devotedly to produce each issue.

I shall never forget Mr. Banerjee and his compositors ('cold compositors' is the jargon for their profession, but how 'warm' were they!) in Room 217 creating the galleys, laying out the pages and poring over each page, determined to render it faultless before it went to the printing press. All these people I shall remember with gratitude and I will cherish the thought that I was part of their team.

But above all I shall remember with deep and abiding joy the kindness, the concern, the warmth of the friendship each one of them has shown me at all times and I will take home with me a great treasure of affection for the people of India.

Indeed, I venture to believe that my experience is not unusual and that many many IAU participants will depart enriched by their short sojourn here, that from this XIX General Assembly of the IAU in Delhi nothing but good can result, not only in the furtherance of the marvellous science we all love so much but also in the drawing together of the human family of all nations under the 'same sky' of Hanbury Brown.

And so, in this, the final ever editorial for *Mandakini*, I simply write "Thank you, India, very much indeed for having me as your guest".

Archie E. Roy

INTERNATIONAL COLLABORATION IN VLBI

R.T. SCHILIZZI
Radio Observatory
Dwingeloo, The Netherlands

Very-long baseline interferometry is ideally suited to international collaboration. The quest for higher and higher angular resolution at radio wavelengths has driven astronomers to use radio telescopes at the opposite ends of the Earth in global VLBI networks. Radio observatories in 18 countries take part, on a regular or occasional basis, in VLBI observations at wavelengths ranging from 92 cm to 3.6 mm.

There are two main networks in operation, the US VLBI Network, and the European VLBI Network, both of which provide observing opportunities on regional as well as international scales. The networks are voluntary associations, or consortia; of independent radio astronomy institutes with simple management structures to streamline operations. Policy decisions are made by a Consortium Board of Directors in the European case (the directors of the institutes concerned) and for the USA by Consortium members; observing programmes are selected by a Programme Committee in Europe and by referee review in the USA; and observations are carried out for the PI's by each individual observatory according to a schedule distributed by each network. Since many of the programmes are international, coordination is required between the two networks, and this is carried out by the network schedules on both sides of the Atlantic. Addition of other antennas in the world is currently an ad-hoc procedure for which the PI is responsible.

In order to enhance the possibility for international programmes, the consortia recently decided to fix the periods of the year when observations will take place in both networks and what observing frequencies will be available.

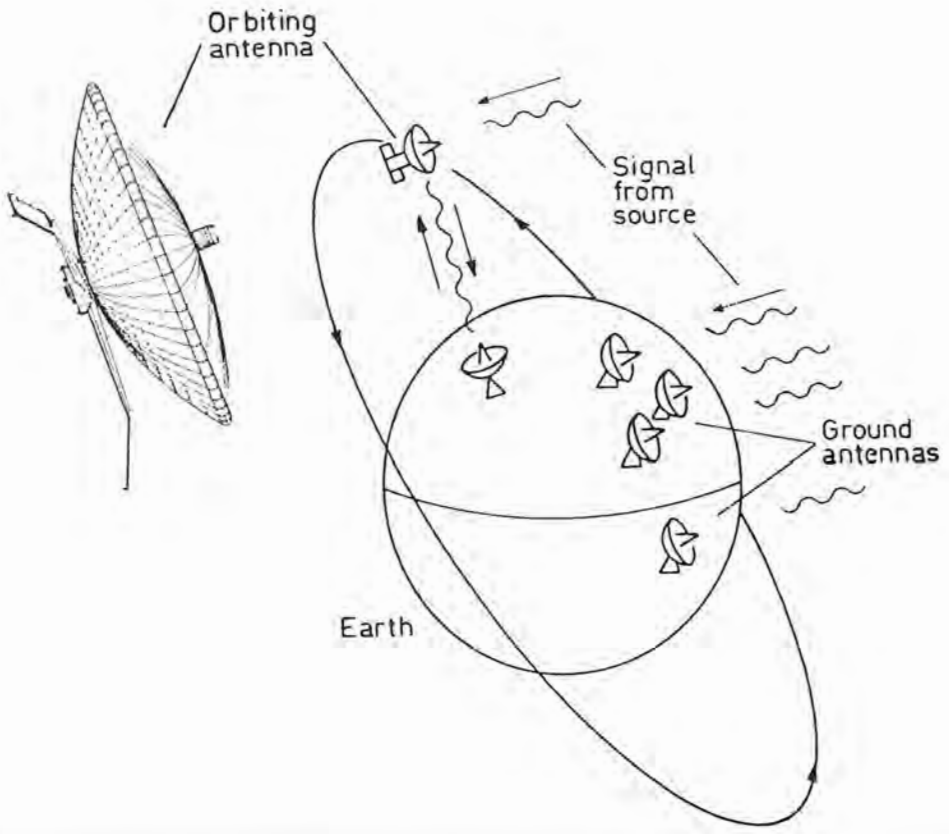
Another exciting possibility in international collaboration has recently emerged. This is to extend VLBI baselines even further by launching radio telescopes, or telescopes, into the Earth orbit to observe in conjunction with the ground-based VLBI arrays. Such a system will decrease the area of the resolution element in radio images by at least a factor of 10, and perhaps a factor of 100, while at the same time providing superb image quality.

In the USSR, approval has recently been given to a project named RADIOASTRON to orbit two 10-m diam radiotelescopes in one-day and half-day orbits. The first antenna is to be launched in 1992 and is seen as a precursor to a more ambitious project involving more than one satellite. The launch date of the second antenna is, in part, dependent on prospects for space VLBI programmes now under study in an ESA-NASA collaboration and in Japan.

The USSR and ESA-NASA concepts involve antennas deployed in space, equipped with receivers at 1.35, 6.00 and 18.00 cm, which match the ground networks; the Japanese concept is at an early stage of development, but will in any case involve a deployable antenna. The NASA-ESA concept, called QUASAT (QUAsar SATellite), envisages a 15 to 20 m diam antenna in an orbit with an apogee altitude of 12,500 km and a perigee altitude of 5700 km. Together with the global networks, in particular the US VLB Arry (See article in *Mandakini* No. 5) and the European VLBI Network, a radio interferometer is created with an effective diameter of 25,000 km.

If it proves possible to coordinate the second RADIOASTRON spacecraft and QUASAT, an effective diameter of 50,000 to 75,000 km can be achieved, yielding an angular resolution of 30 μarc-sec at the highest frequency. The Japanese radiotelescope would be a valuable addition to the fleet. COSPAR has established an Ad-hoc Committee on Space VLBI whose task is to study the requirements for coordination of the different space VLBI segments, and similarly to study the coordination of the space and ground segments.

Each mission is by itself of very high scientific merit. However, the combination in a multi-nation, multi-satellite VLBI system would enchance the scientific value, and at the same time provide an excellent example of international collaboration.



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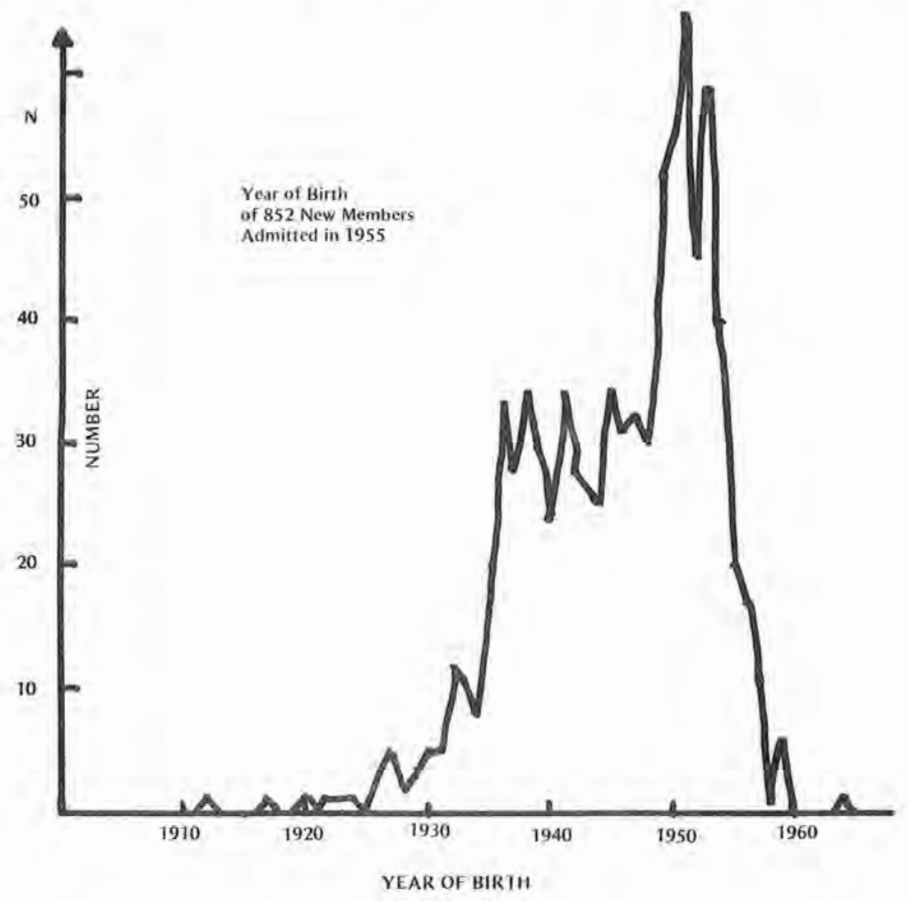

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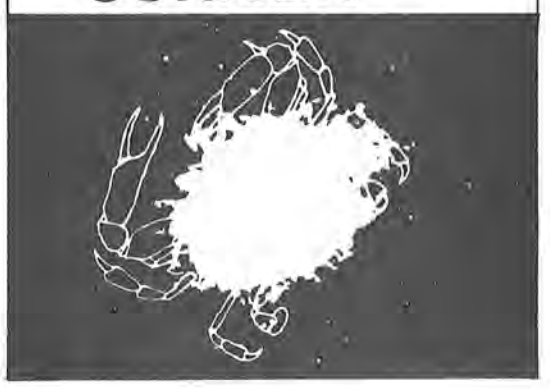


SHAHI TUKRA

(Bread & Milk Pudding - An Indian Sweet Dish)

	Ingredients	Quantity
1.	Bread	900 g
2.	Sugar	400 g
3.	Milk	1 litre
4.	Cardamom	25 g
5.	Saffron	1 g
6.	Almonds	50 g
7.	Fat	for frying

Method

1. Slice bread into about 20 slices, trim edges, cut into triangles and deep-fry in hot fat.
2. Boil milk and stir continuously till it becomes quite thick, and add saffron.
3. Remove from fire, add sugar and mix thoroughly.
4. Soak fried slices of bread in reduced milk for 10 - 15 minutes.
5. Remove bread slices from milk carefully and arrange in shallow dish.
6. Heat milk again and cook on low fire till it thickens further. Add crushed cardamom to thickened milk, sprinkle sliced almond on the arranged bread slices, and cover with thickened milk.
7. Serve hot or cold.

NEXIALIST SYSTEMS QUALIFICATION TEST

A Nexialist would appear to be a non-specialist in science and technology. At least so the following exam paper would imply.

Instruction: Read each question carefully. Answer all questions.

Time Limit: 4 hours

BEGIN IMMEDIATELY

History

Describe the history of the human race from its origins to the present day, concentrating especially, but not exclusively, on its social, political, economic, religious, and philosophical impacts on Europe, Asia, America, Africa and the Moon. Be brief, concise, and specific. Extrapolate trends to AD 2000.

Medicine

You have been provided with a razor blade, a piece of gauze, and a bottle of Scotch. Remove your appendix. Do not suture until your work has been inspected. You have fifteen minutes.

Public Speaking

2500 riot-crazed teenagers are storming the classroom. Calm them. You may use any ancient language except Latin or Greek.

Biology

Design a new species of life. Create it. Estimate the differences in subsequent human culture if this form had developed 500 million years earlier, with special attention to its probable effects on the English Parliamentary System. Prove your thesis.

Music

Write a piano concerto. Orchestrate and perform it with flute and drum. You will find a piano under your seat.

Psychology

Based on your knowledge of their works, evaluate the emotional stability, degree of adjustment, and repressed frustrations of each of the following: Alexander of Aphrodisias; Ramses II; Gengis Khan; Gregory of Nicia; Hammurabi. Support your evaluation with quotations from each man's work, making appropriate references. It is not necessary to translate.

Sociology

Estimate the sociological problems which might accompany the end of the world. Construct an experiment to test your theory.

Engineering

The disassembled parts of a high-powered rifle have been placed on your desk. You will also find an instruction manual, printed in Swahili. In ten minutes a hungry Bengal tiger will be admitted to the room. Take whatever action you feel is appropriate. Be prepared to justify your decision.

Economics

Develop a realistic plan for abolishing money. Trace the possible effects in the following areas: Cubism; the Donatist controversy; the wave theory of light. Outline the method for preventing these effects. Criticize this method from all possible points of view. Point out the deficiencies in your point of view, as demonstrated in your answer to the last question.

Political Science

There is a red phone on the desk beside you. Persuade the rulers of this world to abandon Newton's Third Law of Motion.

Epistemology

Take a position against Truth. Prove the validity of your position.

Cosmology

Explain in what form the missing 90 per cent of mass in the universe exists. Devise an experiment to detect it.

Philosophy

Sketch the development of human thought; estimate its significance. Compare with the development of any other kind of thought, for example that of dolphins or whales.

General Knowledge

Describe in detail. Be objective and specific.

Scientific Spirit

One that would peep and botanize
Upon his mother's grave.
— *Wordsworth:* A poet's Epitaph

May we modify to say his/her in this gender-free age? — Editor

"The world has gone mad today, And good's bad today ..."

— COLE PORTER, *ANYTHING GOES*

DOWN MEMORY LANE

Mandakini regrets the memory lane has to be discontinued with the recapturing of the Tenth General Assembly published today. The reason: we have run out of space. Hence the publication of "The IAU over the year" on 26 November, which is an abstract of abstract. *Mandakini* hopes the XX GA's paper makes up for our memory lapse.

DOWN MEMORY LANE — GLIMPSES FROM PAST GENERAL ASSEMBLIES

IX GENERAL ASSEMBLY IN DUBLIN, 1955

The Astronomical Union met in Dublin during August-September for its IX Assembly. About nine hundred astronomers participated in this Assembly.

The President of the Union, Dr.Otto Struve recalled in his address the purpose of the Union (as stated in Article 1 of the statutes)- "to facilitate the relations between astronomers of different countries where international cooperation is necessary or useful" and "to promote the study of astronomy in all its departments".

Mr. John A. Costello, head of the Government, welcoming the delegates hoped that the Assembly would be successful in its attempt to extend the frontiers of knowledge and would also contribute towards international peace.

In addition to the meetings of the General Assembly and the various commissions there were also joint discussions. The venue of the next Assembly was to be Moscow. The following were elected to the office: President — A. Danjon, Secretary — D.H. Sadler.

X GENERAL ASSEMBLY IN MOSCOW, 1958

Moscow was the venue of the tenth General Assembly of the Union held during August 15-29. Around eight hundred and twenty astronomers participated in this Assembly held for the first time in the Soviet Union. There were two symposia, one on "Earth's rotation and the associated problems of atomic standards," and half a dozen Joint Discussions. In the Joint Discussions, the topics discussed were: solar flares; artificial satellites; rockets and balloons; luminosity of Cepheids; and the formation of chemical elements in the stars.

It was decided by those working in the field that a different position for the galactic pole from that used during the past be adopted. The General Assembly empowered the subcommission charged with the selection of a better galactic pole, to decide on a final adopted position before the end of the year.

A sub-commission on the Magellanic Clouds was established as a part of Commission No.24 on External Galaxies. Preparation of charts of the clouds for observers, setting up of standard sequences of star magnitudes and colours in the clouds, and helping with the exchange of information among workers in the field are some of the tasks which came under the purview of this subcommission.

Some changes were made in a few commissions. Commission 36 was merged with Commission 29 and a new Commission (No.43) on "Magnetohydrodynamics and physics of ionized gases" was set up. A special trilingual newspaper was published for the benefit of the participants.

The new office bearers elected for the next term were: Dr. Oort (President), Dr. L. Goldberg, R.M. Petrie, B. Sternberk and R. Stoy (Vice-Presidents) and Dr. Sadler (General Secretary).

The next General Assembly, it was decided, would be held in Berkeley (USA) in 1961.

UTTAR PRADESH STATE OBSERVATORY, NAINITAL

Established in 1954, the Uttar Pradesh State Observatory situated at a distance of about 325 km. north east of Delhi at an altitude of 1950 metres has been engaged in researches in some selected fields of stellar and solar astronomy.

The observatory is equipped with a number of stellar telescopes of which the largest is a 1-metre telescope. These facilities have been used for photometric-studies of eclipsing binaries, RR Lyrae, Cepheids, S-Senti stars and other intrinsic variables. Energy distribution studies of various kinds of stars such as late type stars, Cepheids and Be stars are also being carried out. Another major field is the photometric study of open clusters. Occasionally, stellar occultations are observed photoelectrically and spectrophotometric study of comets is also undertaken.

The observatory is planning to acquire a moderately large aperture telescope in the coming decade. Site-survey for searching a suitable location for this telescope is being carried out at four places in the Shivalik hills after a rigorous first phase survey of about three dozen possible sites.

The observatory has a solar division also which is equipped with:

i) Solar horizontal spectrography operating on 16 cm solar image. The dispersion in first order is 1.2A/mm with grating blazed for 2.5 microns. This is used for the study of molecular and atomic lines in the sun.

ii) A Halle H- alpha filter with a pass band of 0.5A is used with a 22 mm image for obtaining time sequences of flares, prominences and surges.

Theoretical studies of molecules in the sun have been carried out and a number of new molecular species have been shown to be presented in solar features. It has also been shown that molecular species play an important role in contributing to continuous opacity in sun-spots right from the ultraviolet to near infrared.

Occasionally, studies of Sudden Phase Anomalies occurring in very low frequency signals occurring due to solar flares have also been studied.

A low dispersion solar flare spectrograph is nearing completion. Augmentation of the H-alpha time sequence photography with CN and K line filters has been planned.

—C.D. Kandpal

RESOLUTIONS OF THE XIX IAU GENERAL ASSEMBLY

NOTE : The text of the Resolutions given here is for information only and the definitive version as passed by the XIX General Assembly will appear in the IAU Transactions Volume XIX B (1986).

RESOLUTION B1 : Responsibility for Time

THE INTERNATIONAL ASTRONOMICAL UNION

RECALLING

1) that the establishment of International Atomic Time (TAI) and of Coordinated Universal Time (UTC) is one of the present tasks of the Bureau International de l'Heure (BIH), and
2) that the IAU is the main parent scientific union of the BIH, the other parent unions being the International Union of Geodesy and Geophysics (IUGG) and the International Union of Radio Sciences (URSI), and

CONSIDERING

1) that the atomic time scales, originally used mainly in astronomy, have now a much wider use, including numerous and important technical and public applications,
2) that TAI is based solely on physical measurements independent of astronomy,
3) that there exists an inter-governmental organization of which the Bureau International des Poids et Mesures (BIPM) is the Executive Body in charge of the unification of measurement of the major physical quantities,
4) that UTC is based both on TAI and on the astronomical time scale designated as Universal Time, (UT1), and
5) that the URSI recommendation A-1, 1984, relative to the transfer of TAI to the BIPM

APPROVES of TAI having been taken over entirely by the Bureau International des Poids et Measures, under the responsibility of the International Committee on Weights and Measures (CIPM) and of the General Conference of Weights and Measures,

RECOMMENDS

1) that the function of determining and announcing the leap seconds of the UTC system, as well as the function of determining and announcing the DUT1 corrections, be given to the New International Earth Rotation Service entrusted by IAU and IUGG with the evaluation of the Earth rotation parameters, and
2) that a permanent committee, where the IAU will be represented, be created under the sponsorship of CIPM in order to take care of the interests of TAI users, and

EXTENDS to the Paris Observatory its thanks for the service provided to the international community by supporting the BIH.

RESOLUTION B2 : Reference Frames

THE INTERNATIONAL ASTRONOMICAL UNION

RECOGNIZING the highly significant improvements in the determination of the orientation of the Earth in space as a consequence of the MERIT/COTES* programmes of observation and analysis, and

RECOGNIZING the importance for scientific research and operational purposes of regular Earth-orientation monitoring and of the establishment and maintenance of a new Conventional Terrestrial Reference Frame,

THANKS all the organizations and individuals who have contributed to the developments and implementation of the MERIT and COTES programmes and to the operations of the International Polar Motion Service and the Bureau International de l'Heure, and

ENDORSES the final report and recommendations of the MERIT and COTES Joint Working Groups, and

DECIDES

1. to establish in consultation with IUGG a new International Earth Rotation Service within the Federation of Astronomical and Geophysical Services (FAGS) for monitoring Earth-rotation and for the maintenance of the Conventional Terrestrial Reference System; the new service is to replace both the IPMS and the BIH as from 1988 January 1;
2. to extend the MERIT/COTES programmes of observation, analysis, intercomparison and distribution of results until the new service is in operation;
3. to recommend that an optical astrometric network be maintained for the rapid determination of UT1 for so long as this is recognized to be useful;
4. to set up a Provisional Directing Board to submit recommendations on the terms of reference, structure and composition of the new service, and to serve as the steering committee for the extended MERIT/COTES programmes; and

INVITES National Committee for Astronomy and for Geodesy and Geophysics to submit proposals for the hosting of individual components of the new service by national organizations and observatories; and

URGES the participants in Project MERIT to continue to determine high-precision data on Earth rotation and reference systems and to make the results available to the BIH until the new service is in operation.

**MERIT* = *A programme of international collaboration to monitor Earth-rotation and intercompare the techniques of observation and analysis.*

**COTES* = *A programme of international collaboration to establish and maintain a new conventional terrestrial reference system.*

RESOLUTION B3 : CCIR Actions

THE INTERNATIONAL ASTRONOMICAL UNION

RECALLING the considerations (a) to (d) of IAU Resolution No. 3 passed at the XVIIth General Assembly in 1979 concerning harmful interference to radio astronomy observations, and

NOTING

a) that the IAU, URSI, and COSPAR have collaborated over many years in the Inter-Union Commission on the Allocation of Frequencies for Radio Astronomy and Space Science (IUCAF) in obtaining such bands by international agreement, that certain experiments have begun in which transmissions take place from space in one of these bands, and that these transmissions may interfere with observations of OH emission from Halley's Comet,
b) that proposal for revision of Recommendation 314 of the CCIR*, for consideration by its XVIth Plenary Assembly, reflects the interests of astronomers, and
c) that additions to CCIR Reports 224 and 697, and a draft new Recommendation (Doc. 2/176) emphasize the concern of astronomers regarding the possible effects of spurious emissions from space stations, especially those which are geostationary,

RESOLVES

a) that the documentation of Study Group 2 of the CCIR, regarding revisions to Recommendation 314, Reports 224 and 697 and draft Recommendation (Doc. 2/196) is welcomed by astronomers as contributions to the XVIth Plenary Assembly of CCIR and
b) that in respect to draft Recommendation (Doc. 2/196), astronomers should take note of the likely limitations on observations within 5^{o} of the geostationary satellite orbit from any single observatory, and of the need to reduce the side-lobe gains of their antennae to the greatest practicable extent, and

RECOMMENDS in view of the particular danger of interference to radio astronomy from space-based radio transmissions, that all those concerned in the design of systems requiring radio transmissions from space should consult with IUCAF at the planning stage to ensure that sensitive passive radio observations are not jeopardized in the future.

**International Radio Consultative Committee*

RESOLUTION B4 : Radio Frequency Transmission from Space

THE INTERNATIONAL ASTRONOMICAL UNION

CONSIDERING

a) that certain frequency bands in the range 1300-1800 MHz are very important to the science of radio astronomy, in particular the allocated bands 1330-1427 MHz 1610.6-1613.8 MHz, 1660-1670 MHz and 1718.8-1722.2 MHz.
b) that radio astronomy observatories are particularly vulnerable to interference from transmitters located on aircraft and spacecraft;
c) that the frequency range 1300-1800 MHz is also the object of considerable attention for satellite systems in a number of countries for navigation, position location, and communications;
d) that certain modulation methods are coming into more common usage in Space Radio Services, such as spread spectrum techniques which may cause interference to radio astronomy, not only in frequency bands adjacent to transmission bands, but also at frequencies far removed from bands allocated to space radio services;
e) that the International Telecommunications Union (ITU) World Administrative Radio Conference (WARC) for Mobile Services, which is scheduled for 1987, may allocate frequencies in the band 1300-1800 MHz in order to accommodate satellite services, and
f) that the Mobile Service WARC in 1987 and the WARC on the Use of the Geostationary-Satellite Orbit and the Planning of the Space Services Utilizing it, which is scheduled for 1988, may establish technical standards governing unwanted emissions from the transmitters in the space services;

URGES

a) that administrations avoid, whenever practicable, planning space systems with transmitters on spacecraft or aircraft which operate in the frequency bands listed above in Consideration (a) above;
b) that administrations take into account the current allocations to the radio astronomy service and its vulnerability to air and space transmissions when preparing proposals for the 1987 WARC for the Mobile Services and the 1988 Space WARC;
c) that administrations devise and adopt technical standards governing unwanted transmissions from transmitters in the space services both nationally and through the Radio Regulations of the ITU; and
d) that administrations coordinate those satellite systems which may impact radio astronomy through the Interunion Commission on the Allocation of Frequencies for Radio Astronomy and Space Science (IUCAF) with sufficient lead time in the planning phase for an effective exchange of concerns to take place.

RESOLUTION B5 : VLBI Coordination

THE INTERNATIONAL ASTRONOMICAL UNION

RECOGNIZING

1) that the well established international collaboration in ground-based VLBI, has resulted in high angular resolution radio imaging;
2) that ground-based VLBI images have demonstrated the need for even higher resolution which can be achieved by the combination of ground arrays and future space-based antennae;
3) that the feasibility of launching space-based VLBI elements into Earth orbit is under investigation by space agencies around the world;
4) that the full scientific benefits of VLBI will result only from observations obtained through the combined and simultaneous use of all space-based antennae with existing ground facilities; and
5) that COSPAR has established its Ad-Hoc Committee to examine the requirements for coordinated space and ground-based VLBI activities;

RECOMMENDS that the appropriate national and international authorities concerned with space and ground-based VLBI make every effort to coordinate in a timely way the contributions to this important international programme.

RESOLUTION B6 : Protection of Observatory Sites

THE INTERNATIONAL ASTRONOMICAL UNION

REAFFIRMS the importance of resolutions, adopted by previous General Assemblies, which relate to the protection of observatory sites and observing techniques. These include the following:

(1961) Resolutions No. 1 and No. 2: Transactions IAU XI;
(1964) Resolutions No. 3 and No. 5: Transactions IAU XIIB;
(1967) Resolution No. 2: Transactions IAU XIIIB;
(1970) Resolution No. 10: Transactions IAU XIVB;
(1976) Resolution No. 8 and No. 9: Transactions IAU XVIB;
(1979) Resolution No. 3: Transactions IAU XVIIB; and

REQUESTS that astronomers urge civil authorities make all possible efforts to preserve the quality of observing conditions at the remaining excellent sites on this planet.

RESOLUTION B7 : Danger of the Contamination of Space

THE INTERNATIONAL ASTRONOMICAL UNION

NOTING WITH GRAVE CONCERN the dramatically increasing uses of space for scientific and other purposes and the accompanying contamination of space that adversely affects astronomical observations from the ground and from space,

RE-AFFIRMS its previous resolutions bearing on uses of space,

MAINTAINS that no group has the right to change the Earth's environment in any significant way without full international study and agreement, and

URGES that all national representatives bring this concern to the notice of adhering organizations and space agencies in their countries.

RESOLUTION B8 : Tycho's Observatories

THE INTERNATIONAL ASTRONOMICAL UNION

NOTING WITH GREAT SATISFACTION that action has been initiated in both Sweden and Denmark which aims at an improvement of the state of the remains of Tycho Brahe's observatories on the Island of Ven, a site of unique significance in the history of astronomy,

URGES the relevant authorities to make every possible effort to preserve the ruins and to keep the site as a whole in a condition worthy of its past.

RESOLUTION B9 : Endorsement of Commission Resolutions

THE XIXth GENERAL ASSEMBLY OF THE INTERNATIONAL ASTRONOMICAL UNION

HAVING full confidence in its Commmissions,

ENDORSES the other Resolutions submitted by them to the Resolutions Committee. These will be published in the official languages of the Union, French and English in Transactions IAU XIXB.

RESOLUTION C1 : Astronomical Constants

COMMISSIONS 4, 7, 8, 19 & 31

RECOGNIZING the importance of ensuring that the IAU system of astronomical constants is rigorously defined and is well suited to current applications,

INVITES the Presidents of IAU Commissions 4, 7, 8, 19 and 31 to form a working group to serve in collaboration with the appropriate special study group of the International Association of Geodesy which will

1. review current determinations of astronomical and geodetic constants,
2. provide for informational purposes the current best estimates of the values, accuracies and sources of these constants,
3. propose appropriate changes in the relevant definitions and values of the constants of the IAU system,
4. urge all authors to specify completely the values and accuracies, as well as the sources, of the constants used in their work, and
5. submit a preliminary report in 1987.

RESOLUTION C2 : Reference Systems

COMMISSIONS 4, 7, 8, 19, 20, 24, 31, 33 & 40

RECOGNIZING

1. the existence of inconsistent reference systems based upon different theories and modes of observations,
2. the significant improvement in the accuracy of observations using new techniques, and
3. the importance of a space-fixed reference system, independent of the mode of observation, for use in astronomy and geodesy and satisfying the requirements of relativistic theories,

INVITES the Presidents of interested IAU Commissions (for example, 4, 7, 8, 19, 20, 24, 31, 33 and 40) to form an IAU Working Group, with appropriate sub-groups devoted to specialized topics, under the overall chairmanship of the Chairman of the Joint Discussion on Reference Frames, which will report to the XXth General Assembly in 1988 with recommendations for

1. the definition of the Conventional Terrestrial and Conventional Celestial Reference Systems,
2. ways of specifying practical realizations of these systems,
3. methods of determining the relationships between these realizations, and
4. a revision of the definitions of dynamical and atomic time to ensure their consistency with appropriate relativistic theories, and

INVITES the President of the International Association of Geodesy to appoint a representative to the Working Group for appropriate coordination on matters relevant to Geodesy.

RESOLUTION C3 : Astronomical Designations

COMMISSION 5

With a view to avoiding confusion, RECOMMENDS strongly that IAU resolutions which concern the designation of astronomical objects outside the solar system be forwarded to the Working Group of Commission 5 on Designations for its advice before being passed on to the General Assembly.

FURTHERMORE COMMISSION 5

RECOGNIZING the many benefits that would follow from the clear and unambiguous identification of all astronomical objects to which reference is made in astronomical journals and other sources of data,

STRONGLY URGES

1) that all astronomers follow the IAU recommendations on the designation of objects outside the solar system that were adopted by Commission 5 in 1979 (IAU Transactions XVII B, 87-88) and the supplementary precepts that are given in the Memorandum on Designations adopted in 1985, and
2) that the Editors of astronomical journals draw the attention of authors to these recommendations, preferably by providing a summary, and request referees to refer back any papers or tabulations that do not provide satisfactory designations, and
3) that the Space Telescope Science Institute adopt these principles for objects discovered with the space telescope.

MEMORANDUM ON DESIGNATIONS - NEW DELHI 1985

1. The IAU Style Book, 1986 Revision, will provide rules on designations to be used for constellations, stars and other astronomical objects.
2. Astronomers should consult "The First Dictionary of the Nomenclature of Celestial Objects" by Fernandez, Lortet and Spite and its supplement (1983 Astron. & Astrophys. *Suppl. 52*, No. 4, 1986 *ibid.* in press) for the designations of various types of astronomical objects already in the literature and to avoid duplication when proposing designations of new objects.
3. The following precepts are now added.
   (i) The IAU approved three-letter abbreviations for the constellations, together with LMC and SMC for the Magellanic Clouds should be used. These abbreviations should not occur with any other meanings.
   (ii) Abbreviation of abbreviations (e.g. 'N' for 'NGC') should never be used.
   (iii) Personal names such as 'Gum Nebula' should be preserved as in the First Dictionary.
   (iv) New acronyms for abbreviating catalogues, types of objects, authors' names, observatories, etc. should have at least two letters.
   (v) The list of types of objects (e.g. GCL, SNR, etc.) given in The First Dictionary should be followed closely.
   (vi) Specific references are needed for acronyms that appear in the First Dicnary which are classified with E (explain) or Z (avoid) for which reference may be ambiguous, e.g. OH.
   (vii) For designations based on coordinates,
   - use *truncated* coordinates, *not* rounded up;
   - use explicit leading zeroes and the declination sign;
   - use decimal points if appropriate;
   - adopt the EINSTEIN extended format if possible (e.g. acronym HHMMSS+DDMMSS or acronym HHMMSS.SS etc+DDMMSS.S etc);

     HHMMSS.SS etc+DDMMSS.S etc);
   - when necessary to distinguish old names based on Besselian 1950.0 coordinates from new names based on Julian 2000, precede the right ascension with a J in the latter case;
   - adopt for designations based on galactic coordinates the prefix G (e.g. acronym GLLL.LL+BB.BB); and
   - if a coordinate designation includes the catalogue name, rather than the type of object, do not change the designation when the coordinates are improved.

   (viii) The recommended form for designation of individual objects inside a larger object is:

   (e.g. LARGE: Acronym Number)

   (ix) When objects are designated on finding charts the coordinate equinox, the scale, and the N-S and E-W orientations should be indicated clearly.

4. Astronomers may obtain further advice, if necessary, from representatives of the Working Group of Commission 5 on Designations. The current (November 1985) representatives are:

Name	*Address*	*Tel./Telex*
C. Jaschek	11 rue de l'Universite 67000 Strasbourg, France	
J.M. Mead or W.H. Warren, Jr.	Astronomical Data Centre Code 633 NASA Goddard Space Flight Center Greenbelt, MD 20771, USA	(301) 344-8310 89675 NASCOM GBLT
M.-C. Lortet	Observatoire 92195 Meudon Cedex, France	
H.R. Dickel	349 U. of Il. Astron. Bldg. 1011 W. Springfield Ave. Urbana, IL 61501-3000, USA	(217) 333-5602

RESOLUTION C4 : Space Astrometry

COMMISSION 8

NOTING the resolution of IAU Symposium 114 (Leningrad, May 1985), and

CONSIDERING

1. that new technologies become most useful for astrometry when the observations are made from space, and
2. that accuracies of 10^{-4} to 10^{-6} second of arc appear to be possible,

REQUESTS appropriate agencies

1. to consider the importance of the scientific results obtainable by space astrometry,
2. to develop advanced astrometric instruments, particularly interferometers operating in the optical, UV, IR and radio domains, and
3. to promote programs utilizing such instruments.

RESOLUTION C5 : Data Handling for Solar Research

COMMISSION 10

CONSIDERING the large amount of solar information published in the Quarterly Bulletin of Solar Activity (QBSA), and the bulkiness and cost of disseminating hard copies of the data versus the increasing use of magnetic tape storage,

RECOMMENDS that judicious choices be made in order to reduce the use of hard copying and promote the use of magnetic tapes in data distribution for the QBSA.

RESOLUTION C6 : Carrington Reference System

COMMISSION 10

CONSIDERING the importance of the Carrington reference system for statistical studies of solar phenomena from long time-series observations, and the importance of continuity between more than 100 years of past solar data and future data of similar type; and

CONSIDERING the difficulty at the present time to improve significantly the determination of the position of the solar axis,

RECOMMENDS that the Carrington reference system continue to be used generally.

RESOLUTION C7 : Adequate Network of Solar Observatories

COMMISSIONS 10 & 12

CONSIDERING the importance of ground-based optical and radio solar observatories for obtaining data which are critical to our understanding of the Sun, which are complementary to solar space projects, and which have scientific importance beyond solar physics, and

CONSIDERING that many ground-based solar observatories around the world are threatened by closure,

RECOMMEND that the appropriate organizations within the countries involved cooperate to ensure that an adequate network of observatories be maintained to study the Sun, taking account of the need for proper longitude coverage as well as the special contributions of some unique instruments.

RESOLUTION C8 : Working Group on Planetary Surveys

COMMISSION 16

PROPOSES the formation of a special Working Group on Planetary Surveys to coordinate ground-based and space-based observations of variable phenomena on the surfaces and in the atmospheres of the planets and satellites. These observations must be regular and are meant to serve in planning future space missions and to complement spacecraft-encounter data. They also will contribute to the understanding of possible correlations of solar activity and planetary phenomena.

RESOLUTION C9 : Earth Rotation Studies from Space

COMMISSION 19

NOTING that the new International Earth Rotation Service, to become operational in 1988, already depends considerably on radio and laser-ranging techniques and eventually may be based on these methods; and

RECOGNIZING that classical astrometric determinations of latitude and universal time might be valuable for studies of long-period variations in earth rotation, for improvement of star catalogues, and for studying geophysical phenomena such as changes of the local vertical, variations in refraction and the possible prediction of earthquake activity;

RECOMMENDS that a working group be established to study the future role of classical astrometric observations and to report on this study to the IAU at its next General Assembly.

RESOLUTION C10 : Polarimetry and Large Telescopes

COMMISSIONS 25 & 9

CONSIDERING that certain properties of astronomical objects are revealed best through measures of their polarized radiation, which is generally quite small, and

NOTING that relatively large telescopes are often needed to provide the necessary high signal-to-noise ratio,

RECOMMEND that, in achieving the compromises involved in the design of the very largest telescope, due weight be given to the need to avoid instrumental polarization as far as possible.

RESOLUTION C11 : Designation of Supernovae

COMMISSION 28

RECOGNIZING the need both for an immediate assignment of designations to supernovae as they are discovered, so that researchers can refer to them unambiguously, and for a permanent list of confirmed events for archival purposes,

RECOMMENDS

a) that the IAU Central Telegram Bureau, which has provided temporary designations since January 1985, continue to do so,

b) that the events in order of discovery be designated SN1985A, SN1985B,..., SN1985Z, and as required SN1985aa,..., SN1985ab,..., SN1985az,...,SN1985ba, SN1985bb,..., SN1985bz,...,..., SN1985za,..., and SN1985zz.

This system provides essential continuity with that established many years ago by F. Zwicky, while permitting easy computer sorting, because the lower case letters will automatically follow the upper case ones, and

c) that the archival list continue to be maintained at the California Institute of Technology for the present.

RESOLUTION C12 : Stellar and Solar Research at Mount Wilson

COMMISSIONS 29, 36 & 12

RECOGNIZING the continuing excellence of the facilities of the Mount Wilson Observatory for solar, stellar and inter-stellar research,

ENCOURAGE efforts to ensure continuity of research at this Observatory.

RESOLUTION C13 : Recommendations of Radio Source Nomenclature

COMMISSION 40 WITH THE SUPPORT OF COMMISSIONS 5 & 48

CONSIDERING

1) that the IAU adopted a new standard epoch designated J2000 that uses definitions of time and earth motion that are superior to former conventions,
2) that the new standard epoch and astronomical constants adopted by the IAU have been used for astronomical ephemerides since January 1984, and
3) that the increased use of computers for data handling, data archiving, and telescope control require unambiguous easily readable formats for radio source names,

RECOMMENDS

1) that observers should use the approved catalogue designations with source names (A&A Suppl. *52* No. 4 and supplements),

   Abbreviations should not be used. Since catalogue parameters such as epoch, wavelength, and naming convention are implied by the catalogue name, they will not have to be displayed explicitly. In naming new catalogues, the approved, updated list of designations should be consulted to avoid duplication, and the new catalogue name should be registered promptly. If reference is made to a catalogue that has been listed, the appropriate literature citation should be given.

2) that the use of J2000 for source names based on equatorial coordinates start as soon as possible with the format

   Catalogue name HHMMSS.SS etc.±DDMMSS.S etc.,

   The leading zeroes should be included. When fewer digits are needed, the coordinates should be truncated, not rounded. If more digits are required, they can be added to the decimal fraction of a second. Note that old catalogue names need not be changed, since the prefixed catalogue name implies the epoch. The source name is a convention, and is not necessarily a statement of an accurate position. However, when there is any possibility of confusion between designations based on B1950.0 and J2000, the prefix B or J should be used in front of the right ascension.

3) that if galactic coordinates are used, the name should be prefixed by G (without a space), and the digits should be truncated as in (2) with the format

   Acronym LLL.LL etc.±BB.BB etc.,

4) that pulsar designations should retain the format

   PSR HHMMSS.SS etc.±DDMMSS.S etc.

   and J2000 should be used as soon as possible, in view of the astrometric precision needed for some pulsar related problems,
5) that observers should include the epoch of observation in all catalogues and, when proper motion is important, the relevant supplementary publications concerning J2000 should be consulted, and
6) that observers should note that the relevant IAU resolutions concerning J2000 and the new astronomical constants are summarized in *USNO* Circular No. 183 with illustrative examples.

RESOLUTION C 14 : Faint Standard Star Studies

COMMISSION 45

REALIZING the importance for all astronomy of obtaining a network of standard stars for spectral, photometric, radial velocity, and astrometric research, and

RECOGNIZING that the progress of our science continues to bring new knowledge by exploring to ever-fainter magnitude limits, and

NOTING the increase in the number of large telescopes with efficient detectors both on the ground and in space,

RECOMMENDS that the necessary time on large telescopes be devoted to fundamental work of establishing a network of faint standard stars around the sky for situations in which it is not appropriate to use neutral-density filters.

RESOLUTION C15 : Future High Energy Space Missions

COMMISSION 48

NOTES WITH APPROVAL the existing and planned studies of a number of space missions of great relevance to its work, specifically the Advanced X-ray Astronomy Facility, the X-ray Multimirror Facility and the Superconducting Magnet Facility on the Space Station. The Commission looks forward to the early construction of these facilities which can contribute significantly to international cooperation in high-energy physics.

Version francaise des Résolutions

La version anglaise finale de plusieurs résolutions n'étant parvenue qu'hier après-midi, les lecteurs comprendront qu'il n'a pas été possible d'en obtenir une traduction française définitive. Cette dernière paraitra au printemps 1986 dans le volume B des Transactions de la XIXeme Assemblée Générale.

PROPOSALS FOR PRESIDENTS AND VICE-PRESIDENTS OF COMMISSIONS OF IAU 1985-1988

Com. No.	*President*	*Vice-President(s)*
4	B. Morando France	P.K. Seidelmann USA
5	G. Wilkins UK	B. Hauck Switzerland
6	A. Mrkos Czechoslovakia	E. Roemer USA
7	V.A. Brumberg USSR	J.Henrard Belgium
8.	Y. Requieme France	M. Miyamoto Japan
9	C.M. Humphries UK	J. Davis Australia
10	M. Pick France	E. Priest UK
12	M. Kuperus Netherlands	J.W. Harvey USA
14	R.W. Nicholls Canada	S. Sahal France
15	L. Kresak Czechoslovakia	J. Rahe FRG
16	G.E. Hunt UK	D. Morrison USA A. Brahic France
19	W.J. Klepczinski USA	B. Kolaczek Poland M. Feissel France
20	Y. Kozai Japan	Y.V. Batrakov USSR
21	K. Mattila Finland	A.C. Levasseur-Regourd France
22	P.B. Babadzhanov USSR	C.S. Keay Australia
24	A.R.Upgren USA	W.F. van Altena USA
25	F.G. Rufener Switzerland	I.S. McLean UK
26	K.D. Rakos Austria	H. McAlister USA
27	B. Szeidl Hungary	M. Breger Austria
28	P. van der Kruit Netherlands	G. Tammann Switzerland
29	G. Cayrel-de-Strobel France	P. Conti USA
30	J. Andersen Denmark	D.W. Latham USA
31	D.D. McCarthy USA	P. Paquet Belgium
33	W.B. Burton Netherlands	M. Mayor Switzerland
34	J. Lequeux France	J.S. Mathis USA
35	D. Sugimoto Japan	A. Maeder Switzerland
36	K. Kodaira Japan	D. Gray Canada
37	D.C. Heggie UK	G.L.H. Harris Canada
38	E.A. Muller Switzerland	F.G. Smith UK
40	J. Baldwin UK	P.G. Mezger FRG
41	J. Eddy USA	J.D. North Netherlands
42	J. Smak Poland	R.H. Koch USA
44	Y. Kondo USA	K. Pounds UK
45	R. Garrison Canada	M. Gollay Switzerland
46	C. Iwaniszewska Poland	A. Sandqvist Sweden
47	G. Setti Italy	K. Sato Japan
48	C. Cesarsky France	R. Sunyaev USSR
49	S. Grzedzielski Poland	L.F. Burlaga USA
50	S. van den Bergh Canada	D.L. Crawford USA
51	F.D. Drake USA	G. Marx Hungary

Delhi, 25 November 1985

REPORT OF THE FINANCE COMMITTEE

Prof. Ye Shu-hua
Chairman

The Finance Subcommittee has inspected the accounts of the IAU for the period 1982-84 and finds everything to be in order. We commend the General Secretary for making a fundamental advance in the modernization of the operations of the IAU secretariat. We particularly applaud the installation of the IBM XT for keeping the membership files, the installation of a TELEX machine for rapid communication and for revising the format and presentation of the fiscal accounts. The new format with explanatory notes is much clearer than the previous, which not only makes our job easier, but will also result in better fiscal management.

Along this line, we commend the General Secretary for continuing the effort started by his predecessor of maintaining as large a fraction of the IAU funds in interest bearing accounts as possible as well as taking advantage of favourable exchange rates whenever possible.

The Finance Subcommittee notes with satisfaction the low administrative costs of the IAU. We acknowledge the debt owed by the IAU and its members to the officers, particularly the General Secretary and Assistant Secretary, and to their institutions for the generous support which makes this possible.

We have examined both the proposed 1985 budget and the income and expenses for the first three quarters of the year. We have assured ourselves that the proposed budget will be met very closely, provided that all countries make their payments before the end of the year.

The Finance Subcommittee discussed the proposed 1986-1988 budget at some length. First, the proposed annual increase in the unit of contribution received particular attention. We are all aware that the costs of operating all organizations are rising nearly everywhere. In the IAU, the problem is compounded because the inflation rates differ in different countries and the exchange rates between countries also vary substantially. We endorse the approach taken by the General Secretary to form an average range of inflation around the world and then to set the increase of the unit at, or slightly below, the low end of this range. The Subcommittee realizes that such an approach will, from time to time, cause hardships for individual countries, but, over the course of time, such problems will average out. Therefore, realizing that we must continue to pay for the operations of the Union in the face of rising costs, we strongly endorse the proposed value of the unit of contribution.

As a corollary, we note that the payment of the 1985 contributions are running somewhat late. We urge that the adhering bodies take note of the importance to the IAU of receiving the contributions early in the year, and we urge all countries to pay their contributions as rapidly as possible. We gratefully thank those countries which actually pay in advance.

With regard to the actual budgets proposed for 1986-88 we make the following comments. We note with enthusiasm the increasing emphasis upon the scientific programs of the IAU, but, this increase can only be obtained by squeezing the rest of the budget. We feel that we must carefully examine all the IAU programs and put our resources into areas which are best, or uniquely, done by the IAU. The Finance Subcommittee unanimously agrees that the IAU is unique in fostering international exchange of and contact between, astronomers. This is particularly important for developing countries, and those with foreign currency exchange problems where the IAU funding often acts as important seed money for maintaining international contacts.

Therefore the Finance Subcommittee recommends increasing the funding for the exchange of astronomers by 3333SFr. per year, making up this amount by reducing support for the Regional Astronomy meetings.

There are three resolutions pending before the General Assembly which call for increasing funding for support of services. The Finance Subcommittee feels that such resolutions should be brought to the attention of the Executive Committee in time to receive careful attention when the draft budget is prepared. It seems unwise to increase the projected deficit.

As a final comment, we note that the IAU membership is growing rapidly and the operations are becoming more complex. We feel that the Union should anticipate that the time will arise in the future when the General Secretary's job cannot be carried out effectively by one or two scientists who volunteer their time and services to the Union, and that the IAU Secretariat staff may have to be enlarged. In this case, the expenses will rise and additional sources of funding may have to be developed. We realize the important role that the IAU plays for astronomy, and it may be time to investigate the balance between the services rendered and the charges assessed. It is clear that many IAU functions cannot be self-supporting. Therefore, unless the adhering countries can afford to pay increased assessments, the IAU will have to look to those activities which produce income to carry the burden for the rest of the programs.

We recommend that the Executive Committee look into this matter in the near future in consultation with people experienced in the problems of funding non-profit, scientific societies. The IAU operations are now approaching in size and complexity those of a small corporation and deserve expert attention by experienced people.

It is a pity that Mandakini*'s staff was so much concerned with reporting on astronomy and related matters that the Paper could not cover any of the cultural events from the land whose cultural traditions in music, as in astronomy and mathematics, go back to a hoary past. For a change we now make amends.*

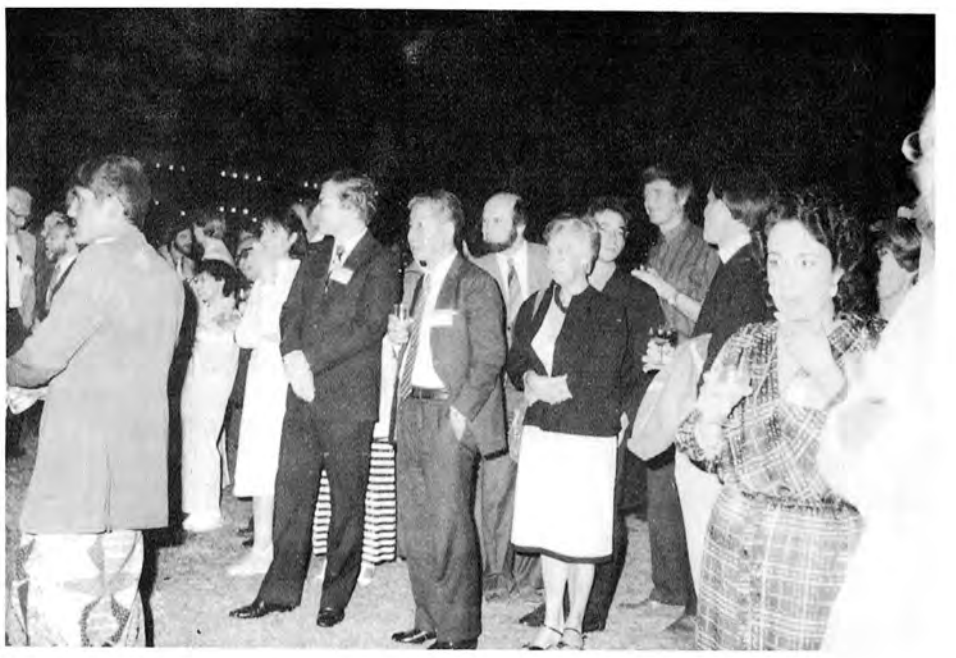
Tuesday's cultural programme at Vigyan Bhavan was a rare feast for the gods. The performer was a child artist, master U. Srinivas, master in two senses: a minor in age and a master of his craft or art. His speciality is the mandolin; his message, the Carnatic music. The child prodigy rendered on his chosen medium some of the finest classical pieces from two of the 'Trinity of Carnatic Music'– Dikshitar and Thyagaraja – most of them devotional. Carnatic and Hindustani are the two major classical genres of music in this land.

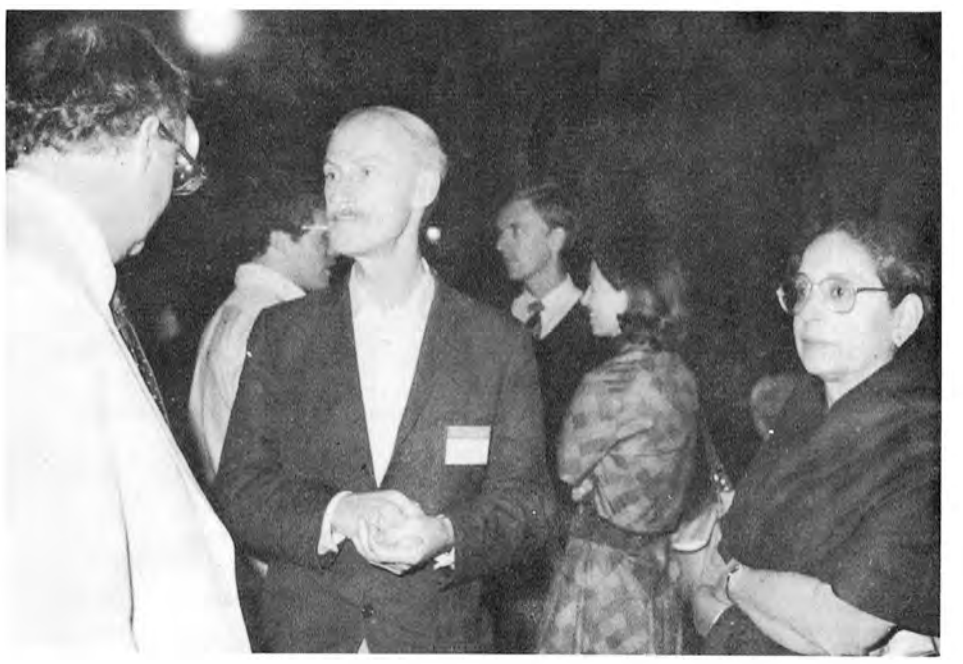
Srinivas's name today is well known on the concert platform, reaching even Paris earlier this year.

The capacious auditorium was packed to capacity, listeners even standing along the aisles to hear the star performance.

You may not have seen many of them –they were too busy making the XIX IAU General Assembly a success.

FAMILY' BANQUET





NEHRU PLANETARIUM

IAU delegates are welcome to this planetarium at Teen Murti Bhavan, New Delhi, currently showing 'Comet Halley Returns' and 'The Giant Planets'.

The programme starts at 3 p.m. and lasts about an hour.

FURTHER LIST OF IAU COLLOQUIA FOR 1986 & 1987

(see also Mandakini *No.9)*

132. The Impact of Very High S/N Spectroscopy on Stellar Physics", Paris, June 1987.
133. "Mapping the Sky — Past Heritage and Future Directions", Paris, May or June, 1987.

GAMMARICK*

A gamma-ray* source called Geminga
Had a nature no theorist could finger.
Was it dark and degenerate,
Quite long-lived, or ephemerate?
Re-arranged, it remains: G! Enigma.

John Faulkner

**"gamma-ray" is both more accurate and scans better.*

Mandakini reader:

Who is an Editor?

Mandakini:

He/she who has the discrimination to separate chaff from grain, and print *the former.*

M. Reader:

But you printed mine!

HIPPARCOS INPUT CATALOGUE CONSORTIUM

NOEL ARGUE

In July 1988, a French Ariadne rocket will bear into the skies a satellite that is destined to have a profound effect on the whole foundation of astrophysics. This satellite, a project of the European Space Agency, will measure positions, trigonometric parallaxes, proper motions and do photometry for about 120,000 stars. The precision will depend to some extent on ecliptic latitude and brightness; at 8 mag (V) it will average 0".002 for position and parallax, and 0".002 yr^{-1} for proper motion, deteriorating a little to an effective limit of 11 mag (but a small number of stars as faint as 13 mag will be included in special cases).

As a matter of fact 0".002 is no big deal for the parallaxes. This accuracy can be achieved routinely by large reflectors, both by photography and, especially with CCDs, with the added advantage at a limiting magnitude of 20, but the number of new parallaxes coming in each year is probably less than 100. Hubble Space Telescope will yield parallaxes to accuracy 0".0005, but again, due to pressure of other work, the number per year will be measured in tens. The most extensive data available today are those in the general catalogue of Trigonometric Stellar Parallaxes (Jenkins) containing 7400 stars with accuracy 0".015. Relative to these, HIPPARCOS will extend the parallax horizon by a factor 7.5 in distance and 400 in volume combined with a large improvement in statistics.

Double and multiple stars will be an important part of the project, both in the measurement of known systems and in the discovery of new ones. This will be important in the physics and evolution of such systems and in mass-luminosity calibrations. Recalibration of period-luminosity relations will also be possible. The proper motions will be reduced to an inertial system linked to extragalactic objects, allowing precise descriptions of the dynamics of stars and other bodies in the galaxy. This link will be carried out in two ways; by direct observation of bright radio stars whose motion relative to the extragalactic system has been measured by radio interferometry, and by measurement relative to extragalactic sources using Space Telescope and ground based astrometry. The radio stars chosen will be predominantly RS CVn binaries and their use as astrometric objects presents for each case challenging problems in VLBI, VCA and the optical.

At this accuracy, relativity effects become important, for instance, the gravitational light deflection at large angular distances from the Sun. There may be the possibility to detect missing mass in the Galaxy.

The hardware, observing strategy and reduction procedures were described in authoritative papers presented at the Joint Commission Meeting 7,8,24,25,33 & 37 on 23 November to be published in *Highlights in Astronomy*. There was much interest in JDI on Reference Frames on 20 November.

The satellite cannot be slewed to individual stars like a telescope. Its lines of sight will trace well-defined paths on the sky. To ensure a sufficiently rigid system, an adequate distribution of targets along each path must be provided, and is being selected and tested by computer simulation before the flight. (The zonal errors have not yet been properly assessed, but are not expected to exceed one-tenth of the random error 0".002). These matters are being taken care of by the Input Catalogue Consortium based at Meudon. Its first task was to sift through more than 200 proposed projects in order to identify stars in common. This was a very formidable task, some fashionable stars being common to several projects usually under a variety of star names and coordinates(!). The whole list has now been reduced to 200,000 different stars, and the task remains to reduce it further to about 120,000 in such a way that each star gets its share of the available photon events, Inevitably certain interesting stars will be crowded out in high density regions and by certain instrumental effects. These tasks could not have been carried out without the use of the datasets held at the Stellar Data Centre, Strasbourg, in particular the SIMBAD database. The Consortium has encountered many problems arising from inconsistencies between various datasets. It has also had to organise observing campaigns to provide positions good to 1".5 and photometry for input to the satellite where these data were not provided in the datasets. Along with the cross-identifications, the correction of many catalogue errors, and the sorting out of many omissions and inconsistencies among multiple star catalogues, the resulting Input Catalogue is becoming a most valuable dataset, to be released for genral circulation after launch. If, by some most unfortunate mischance, HIPPARCOS were to be blown up at launch, the astronomical community would still benefit greatly from this Input Catalogue.

Lastly, mention ought to be made of TYCHO, an arrangement whereby signals from the star mapper photomultipliers uses to monitor the satellite's attitude are recovered and analysed to yield photometric data. The outcome will be 200,000 stars brighter than 10 mag conforming nearly to the Johnson B and V scales with standard errors of about 0.03 mag and positions good to 0".1. This also will make an extremely valuable catalogue.

POSITIONS AVAILABLE

Beginning fall 1986, the Department of Physics and Biruni Observatory, Shiraz University, Shiraz, Iran, have two openings at the assistant/associate-professor levels. One of the positons is for an observational astronomer in stellar photometry. The other will consider applications from theoretical physicists. The appointments are for an initial period of two years with the possibility of a renewal. The main observing facility at the Biruni Observatory is a 51-cm Cassegrain telescope equipped with a photometer and adequate sets of filters.

Applicants should be Ph.D's in physics, astronomy and astrophysics or equivalent degrees. The duties will consist of a normal teaching load of physics and astronomy courses, with emphasis on astronomical and observational techniques in the case of the astronomer.

THE CHRETIEN AWARD

PETER B. BOYCE

What does the name "Chretien" mean to you? To four more scientists this year it means the chance to engage in research projects with their foreign colleagues. Each year the American Astronomical Society awards $20,000 to astronomers around the world for cooperative international projects in observational astronomy. This year the winners of the awards in honour of Prof. Henri Chretien are:

Teresa Lago, University of Oporto, Portugal, for spectroscopic studies of early type stars. This award will allow Dr Lago to invite colleagues to visit her institution for collaborative research.

Richard Schwartz, University of Missouri, USA, for studies of W-R stars. Dr Schwartz will visit the USSR for several months.

Mark Birkinshaw, Center for Astrophysics, USA, for work on the Sunyaev-Zeldovich effect. Dr Birkinshaw will make several observing trips and collaborate with a number of foreign colleagues to continue his work on this difficult observational problem.

David F. Malin, Anglo-Australian Telescope, Australia, for continuation of his photographic studies of clusters of galaxies. Mr Malin will travel to Tucson, Arizona, to use the facilities at Kitt Peak National Observatory for extending his innovative work to the northern hemisphere.

Prof. Henri Chretien was a French mathematician and optical designer who had a great love of astronomy. He gave us the design of the Ritchey-Chretien telescope for our science and the Cinemascope lens for our movie entertainment. He travelled extensively, often for astronomical purposes, and made friends around the world. He was particularly fond of visiting the United States, where Richie carried through the construction of the first telescope employing Chretien's design. It is in honour of the memory of this great man that the Chretien Awards have been established.

The selection committee, which chooses the recipients of the awards, encourages astronomers from around the world to apply for these awards. The winners are selected on the basis of the quality of the science to be done during the period of the award. Of course, many good projects are proposed every year, and the committee also considers the importance of the applicant's career, the degree to which the award will help to develop strong international ties with other astronomers, and the degree to which innovative instrumentation or techniques are involved. In any case, the awards are made to individuals, and are not made to supplement other, larger projects.

Although the programme is administered by the American Astronomical Society, both the programme and the selection committee are international in character. Past awards have gone to astronomers from Spain, Canada, Mexico and the UK.

Information about the programme may be obtained at this meeting from Dr Peter Boyce, or from the AAS Executive Officer, 1816 Jefferson Place, Washington, DC 20036, USA. Telex 257 588 AASW UR. The next deadline is 1 April 1986. (I'm not kidding!)

NIGERIA BECOMES IAU MEMBER

With the setting up of a National Committee on Astronomy headed by Professor Sam Okoye by the Nigerian Academy of Science, Nigeria joins IAU as an adhering member.

The main Astronomy group in Nigeria is at the University of Nigeria, Nsukka, where there is now a Department of Physics and Astronomy. There is Astronomy teaching at undergraduate level, and graduate programmes in Astronomy and Astrophysics. A ten-meter radio telescope is now completed and it is hoped that this will be used for meter-wavelength observations as well as VLBI studies. There are also a number of ongoing and planned cooperative programmes involving the IAU and other observations at Ootacamund, Jodrell Bank, Bonn, and other centres. The Nigerian group will be pleased to widen these international collaborative efforts.

—Chidi Akujor
Representative of Nigeria
XIX General Assembly

ARE THERE LIMITS TO SCIENCE?

"Might another, astronomically remote, alien civilization surpass our human science and become 'scientifically more advanced' than ourselves?, asks a philosopher of science Nicholas Rescher of the University of Pittsburg, USA. 'No', is Rescher's answer. And he adds, 'Aliens might well surpass us in many ways — in power, in longevity, in intelligence, in ferocity, and so on. But to worry (or hope) that they might surpass us in SCIENCE *as we understand it* is to orient one's concern in an unprofitable direction. (*The Limits of Science* by Nicholas Rescher, 1984).

Contrast this view with what Sir Peter Medawar, the Nobel Prize-winning immunologist and a brilliant writer, says in his latest book, also titled *The Limits of Science*. "Science", says Medawar, "is a great and glorious enterprise — the most successful... that human beings have ever engaged in". "In terms of the fulfilment of declared intentions, science is incomparably the most successful enterprise human beings have ever engaged upon."

Quoting from Karl Popper, Medawar says: "It is important to realise that science does not make assertions about ultimate questions — about the riddles of existence, or about man's task in the world."

—P.S. Shankar

WISH THEM A HAPPY BIRTHDAY

28-11-85

Dr William E Harris	Canada
Dr Kenneth F Hartley	UK
Dr Ake G Hjalmarson	Sweden
Prof Bertil Hoeglund	Sweden
Prof Roger J Hosking	New Zealand
Dr Claude A J Jamar	Belgium
Dr N B Kalandadze	USSR
John Charles Raymond	USA
Dr J Rosenberg	Netherlands
Mr Harry Seddon	UK
Dr N V Steshenko	USSR
Dr Katsuo Takarada	Japan
Prof Kazuo Takayanagi	Japan
Prof Franco Verniani	Italy
Dr Amos Yahil	USA
Dr William J Zealey	Australia

ERNST ÖPIK
1893–1985

P.A. WAYMAN

By the death on 10 September 1985 of Ernst Julius Öpik, the IAU has lost one of its senior distinguished members whose work has influenced many branches of astronomy.

Öpik began his contributions to astronomy in an amateur capacity before taking his science degree. He observed meteors assiduously and in due course his Ph.D degree concerned the science of meteors. He became an authority on the atomic processes involved in their light-emission. His initial work developed during the turbulent years that followed World War I. Born in Estonia he worked in Moscow, in the University of Turkestan in Tashkent, in Tartu, Estonia, at Harvard College Observatory in the 1930's as a Visiting Professor, in Hamburg for a few years after World War II, and eventually, with near-annual visits to the University of Maryland, for thirty two years, 1948-1980, at Armagh Observatory, Northern Ireland.

Eric Limdsay, director of Armagh observatory (1938-1974), who had taken his Ph.D. degree at Harvard, recognised the opportunity offered by the personal circumstances affecting Öpik in 1947; Öpik had spent two years as Professor of Astronomy in the University of the Baltic and as Rector of Estonian Students. This temporary association of 'displaced' scholars and students had been supported by relief funds for a while but it could not be permanent. Thus Ernst Öpik was invited by Eric Lindsay to work at Armagh Observatory where be became a highly valued staff member. He worked there incessantly and with true devotion to science for over half of his long working career even though he was already nearly 55 years of age when he arrived with his wife and a large family.

Early in his career, in 1915-16, Öpik recognised the high density of O_Z Eriadni estimating a figure around 2.5×10^4. This was independent of Adam's determination of the spectrual type of Sirins B and hence the discovery of white dwarfs. Öpik rejected such a high density as "impossible" but of course he was very near to a major discovery. At the age of 23, it seems likely that he thereafter determined always to follow his tentative findings, through to their furthest end. This may have led to a few erroneous positions but in general his scientific insight was individualistic, sound and perspicuous to a high degree. He contributed valuable ideas to the theory of stellar structure, particularly in regard to convection effects. He dispensed with the notion of mixing length as an unwarranted escape from real difficulties. His interest in this topic led him to a study of solar stability on a time scale of 10^4 to 10^5y and hence to geologic evidence of the ages.

His ideas were in many ways ahead of his time. He was able to 'juggle' with conflicting physical factors, but it had to be done in the days before enormous computation was possible. That represented a mode of operation into which he never entered, but astronomers in many different fields who have made extensive calculations have often found that their conclusions were presaged by Öpik's physical insight.

In Ireland, Öpik contributed enormously by his function over several decades as Editor of the *Irish Astronomical Journal*, which became, at one time, virtually 'Öpik's Journal!' In those pages he found himself able to write hundreds of short and long articles and express his own views unrestricted by the confinements of other editors and publication committees. In his case this process was largely healthy; in other hands it could have been disastrous. On occasion Öpik gave the impression of a formidable and even unreasonable critic but basically he was a simple and kindly person who always wished to assist any scientist, young or old, who showed proper respect for the basic tenets of the scientific method. Brought up in an authoritarian mould, he never abandoned his respect for authority, and he expected himself to be recognised as an authority when appropriate. On the cultural side he was equally highly-placed, being a musician of considerable ability and fluency. His compositions were as avant-garde as his astronomical ideas. As a social colleague he could be divertingly entertaining, with reminiscence and with a happy blend of wit and erudition. He was not a constant attender of scientific meeting but he operated in an international framework by his contributions to astronomy.

A NEW VERY HIGH ANGULAR RESOLUTION STELLAR INTERFROMETER

JOHN DAVIS
Chatterton Astronomy Department
University of Sydney, Australia

The University of Sydney has designed a new stellar interferometer of unprecedented angular resolving power to carry on where the Narrabri Stellar Intensity Interferometer left off. The new instrument, which is a modern version of Michelson's original stellar interferometer, overcomes the problems of mechanical instability and atmospheric turbulence by using the latest technology in the form of laser interferometers, active optics, computer control, etc. The design of the new instrument is based on a fully developed 11.4 m baseline prototype, which is currently under extensive trials so that its performance could be optimised. The basic features of both the prototype and the new instrument are (i) rigid support of all components (provided by massive concrete piers); (ii) small apertures (10 cm in the prootype and 14 cm in the new instrument); (iii) active optical path equalization; (iv) wavefront tilt removal in real time by using active optics; and (v) rapid sampling of the combined light beams (~ 1-10 ms).

The new instrument features baselines covering the range 5-640 m — the shortest baseline will provide some overlap with measurements by speckle interferometry using the existing large telescopes and the longest baseline will allow a sample of the hottest O-type stars to be measured. The instrument will have a limiting magnitude V~ + 8.5 and it will have a higher angular resolving power than any other instrument, existing or proposed, anywhere in the world. It will be capable of measuring angular sizes and separations down to 5×10^{-5} arc-sec — the angle subtended by the thickness of a human hair at a distance of 100 km!

The new instrument is expected to make important contributions to stellar astrophysics, many of which cannot be made in any other way. For example, in conjunction with observations made with conventional telescopes, it will provide fundamental data such as effective temperatures, radii and masses for stars; it will provide an independent calibration of the zero point of the Cepheid lumiosity scale and it will enable studies to be made of rotational distortion, limb darkening, extended atmospheres, mass loss, etc.

The new stellar interferometer will be sited at the Paul Wild observatory along with the Australia Telescope (*Mandakini* No. 6). It will be constructed over a period of 3 years and will cost about A$ 2.4 million (US $ 1.6 million). A proposal for funding is being considered by the Australian Federal Government.

Dear Editor

Re : The Wilson-Bappu Effect

Several moving and sincere tributes have been paid at this meeting to the late Dr M.K. Vainu Bappu. However, his best-known astrophysical contribution, with Olin C. Wilson, has unfortunately been misquoted. Perhaps the best tribute we can make is to give as accurate a recall as possible (without access to references) of this work. It may also serve the useful purpose of reviving the memories of older astronomers, while also informing a younger generation.

The Wilson-Bappu effect is not just a "relation between the absolute magnitude of bright G, K, and M stars and the width of their H and K absorption lines". Rather, it is an amazingly tight, and virtually linear, relationship between their absolute *visual* magnitudes and the logarithm of the width the *emission cores* lying deep within the H and K lines. Thus the effect is both strange and subtle, for it links an essentially non-physical quantity (the *visual*, rather than *bolometric* magnitude) with one requiring the utmost care and diligence to measure. Theorists initially reacted to this strange effect with either abhorrence or distrust, a notable exception being Fred Hoyle, who attempted an early, characteristically ingenious explanation for it.

To me, however, whatever the true cause of the Wilson-Bappu effect, its main importance is as a supreme example of something in astronomy which is often the bane of physicists who enter the field late in their careers. Namely, while its physical cause might be unknown, it is nevertheless an empirical relationship of great power and predictive ability. I recall (not too inaccurately, I hope!) but one case in point, namely the celebrated problem of the distance to the Hyades. I believe that, when applied to the 4 K giants in the Hyades, the Wilson-Bappu effect suggested that the Hyades cluster should be more distant than the then canonical distance modulus of ~ $3^m.03$ — in fact, by another ~ $0^m.2$-$0^m.3$! This result, which accords with present understanding, took another 20 years of toil, strife, bickering, careful re-observation and re-analysis to establish by more conventional, classical techniques.

Surely, the Wilson-Bappu effect lies in that class of which Martin Schwarzschild wrote so eloquently, in his great book, "Thus pillars rather than crutches are the observations upon which we base our theories."

With apologies for unintentional errors, and in the sure knowledge that a future (or indeed, even present) Owen Gingerich will ferret them out, I am, Sir,

Yours sincerely,

John Faulkner
Lick Observatory/
Tata Institute of Fundamental Research, Bombay

MEDICAL SERVICES FOR IAU DELEGATES

The Green Cross Society has provided medical aid for the participants at the IAU XIX General Assembly. The service, which started on 17 November, is located in Room No.110. The duty officers of the Society comprise medical and paramedical personnel, who have attended to more than 500 participants so far.

Some of the patients needing hospitalisation were promptly and under proper care transported to ambulances to hospitals. The members of the Society who have provided facilities unique for a conference of this magnitude, consider it a privilege to have been of service to international astronomers.

ASTRONOMY AT LUCKNOW UNIVERSITY UTTAR PRADESH, INDIA

The Department of Mathematics and Astronomy, Lucknow University, Lucknow, is imparting teaching in astronomy as a full elective subject at the undergraduate level besides imparting teaching in astrophysics as an optional paper at the post-graduate level.

Regular observing of the 'light of the night sky' shall start by the middle of 1986 at the department as a part of research programme. Arrangements have been completed for taking daily the photographs of the Halley Comet.

P.P. Saxena
Dept. of Mathematics & Astronomy
Lucknow University, Lucknow

CHRISTENING THE MINOR PLANETS

A Correction

We certainly had lively discussion regarding the naming of asteroids, but it occurred in a friendly, enthusiastic manner and no resignation was threatened (as reported in *Mandakini* of 27 November).

We will remember the atmosphere of this IAU assembly like the rippling of a brook. There was a flow of lifelong impressions, but it came to us gently.

Tom Gehrels

The history of science is one long litany of abandoned "truths".

'Halos around galaxies are like halos around saints. You cannot see them, but they must be there.'

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