The Magellanic Times

THE NEWSPAPER OF THE INTERNATIONAL ASTRONOMERS UNION GENERAL ASSEMBLY SYDNEY 2003

IAU XXV General Assembly Sydney 13-26 July 2003

Day 1 **Monday 14 July**

Connecting the Conference

by Shaun Amy

Over the last decade, access to a reliable data communications network has evolved from being of "novelty" value to that of a necessity. This is no more true than in the case of the Physical Sciences and in particular Astronomy, where numerous collaborations span the globe and transcend geographic and political boundaries. Fast access to remote data archives and the ability to access unique instrumentation, regardless of physical location, is becoming a reality as we move towards an "always connected" world.

The Sydney Convention and Exhibition Centre (SCEC) covers a large area and plays host to hundreds of meetings and exhibitions each year. The size and flexibility of the venue means that any temporary network has to be designed to be deployed and removed quickly. The network must be reliable and stable. The IAU General Assembly provides an opportunity to demonstrate advanced network technologies in practice and to enhance the conference experience for over two thousand conference delegates and exhibitors.

The wired network within the SCEC will provide switched Ethernet connections to the Internet Cafe (including an area to allow delegates to connect their own laptop computers), exhibition booths, a number of the main conference meeting rooms, media centre and other areas. The network backbone, interconnecting the individual switches, is gigabit Ethernet running over optical fibre. In addition, and for the first time at an IAU General Assembly, an 802.11b compliant wireless network will be provided in a number of areas (exhibition hall, lounge areas and main meeting rooms) offering those users with wireless-enabled laptop computers and hand-held devices to access network resources whilst "on the move".

To make the network a reality, many kilometres of fibre optic cable and unshielded twisted pair cabling has been deployed throughout the venue. Internet Protocol (IP) address allocation will be provided automatically via the Dynamic Host Configuration Protocol (DHCP) on both the wired and wireless networks. The network will be partitioned into a number of virtual networks to ensure the stability and performance of the networking services provided to the various areas. Both the wired and wireless network will not provide any security services to allow the greatest compatibility with network hardware and network protocols. Thus, delegates should ensure they install firewall software on their networked devices.

Whilst the internal network is impressive, there is little value providing a local-area network unless a high-bandwidth connection to the Internet is also provided. To meet the expected demand, a gigabit Ethernet link from the SCEC to the Australian Academic and Research Network (AARNet) hub at a nearby University has been installed. This should easily support the requirements of the most demanding demonstration.

At this hub site, gigabit Ethernet connections to both AARNet (http://www.AARNet.EDU.AU/, providing connectivity to both Australian and international Research and Education networks) and GrangeNet (http://www.GrangeNet.NET/, who provide a high-speed research network linking Brisbane, Sydney, Canberra and Melbourne) have been established. AARNet has fibre connectivity to a number of international advanced Research and Education networks such as Internet2.

Both the local and wide-area networks will not only enable exhibitors and delegates to access their e-mail, but will provide real-time access to remote computing clusters (where advanced data mining and visualisation techniques may be demonstrated), access to remote telescopes and even a real-time video and audio link to Antarctica.

It would not have been possible to provide such an advanced network without the generous support of AARNet and GrangeNet, who have provided connections to their networks at gigabit speeds and have agreed to cover the substantial Internet traffic charges. The assistance of Mr Alan Cowie (Manager, AARNet Sydney International GigaPOP) for help with various network installation and configuration tasks is gratefully acknowledged

aarnet Australian Academic and Research Network

grangenet

Why is this paper called the "Magellanic Times"? With a declination of about -70 degrees, the Magellanic Clouds are uniquely southern objects, best visible during (southern) spring and summer nights. The above image shows how extensive the Magellanic System is when viewed with the Parkes telescope. This image, made using data from the 21-cm hydrogen-line HIPASS survey, shows the Large Magellanic Cloud (LMC) at the left, with the Small Magellanic Cloud (SMC) slightly below and to the right of the LMC. The Magellanic Stream trails to the right of the LMC and SMC and, in this image, extends well into the northern sky. The Magellanic System is therefore a magnificent example of an interacting system, a subject matter of one of this week's Symposia: "Recycling intergalactic and interstellar matter" (IAU217).

Credit: Image made with the CSIRO Parkes telescope by M.E. Putman (University of Colorado), L. Staveley-Smith (ATNF-CSIRO), K.C. Freeman (Australian National University), B.K. Gibson (Swinburne University) and D.G. Barnes (Melbourne University).

WELCOME TO SYDNEY

It is a great pleasure to be here in Sydney for the XXV General Assembly of the International Astronomical Union and the associated scientific events. Many of us have travelled a long way to come to this country whose natural beauties are matched by a society which regards scientific research as a top priority. Australia has given, and is still making, fundamental and well known contributions to the development of astronomy in many areas, from stellar interferometry to optical and radio astronomy, from solar physics to the study of cosmic rays. We are thankful to the Australian authorities and to our colleagues for having invited us.

Some of the scientific and administrative activities of our Union have already begun, and we are all enjoying the pleasure of seeing old colleagues and friends. New scientific and human relationships will be established in the coming days and they will increase the level of collaboration in the international scientific community. The mission of the Union, since it was established in Rome more than 80 years ago, has indeed been to foster collaborations among the scientists of the world.

Wondering about the sky was certainly one of mankind's first activities, on all continents and cultural areas of the world. It is sad to think of many colleagues who have not been able to come to Sydney for economic or political reasons or, worst of all, because of horrible wars. I hope very much that the Union will not only foster scientific progress but also continue (and possibly increase) its efforts so that astronomy and science in general remain a common value for all mankind.

The Union, its General Assembly and the other scientific events planned every year would not be possible without the contributions of many people. Above all I wish to thank once more those who have invited us to this beautiful city, the General Secretary, Professor Hans Rickman, the Assistant General Secretary, Professor Oddbjorn Engvold, our secretarial staff in Paris and especially Ms. Monique Orine, the National and Local organizers in Australia, the members of the IAU Executive Committee, and the various sponsors. We would not be here without their intense efforts.

Franco Pacini
President

Today's issue

The Magellanic Times

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Deadline for daily issues
1pm on the day prior to publication

Printed by M P & D

This newspaper and you

by Seth Shostak

A daily newspaper at General Assemblies is akin to trees at Christmas: an old and venerated tradition.

The Magellanic Times, the current incarnation of this long-standing rite, will serve as a "bulletin board" to inform you of sessions and events, of course. But it will also report to you the exciting new results being presented at the Assembly. Unless you are afflicted with multiple personalities, it won't be possible for you to attend all the sessions that might interest you. This newspaper will endeavor to broaden your field of vision.

In addition, there will be articles describing the history and attractions of Sydney, and other pieces designed to either help maximize your enjoyment of the conference or fill awkward spaces in our page layout.

As it turns out, most of this depends on you. Contrary to wide-spread impression, *The Magellanic Times* does not boast a bulging staff of mild-mannered reporters, busily transcribing session proceedings or other newsworthy happenings. *You* are our reporters.

If you or your colleagues are presenting some new astronomical results guaranteed to set the world on its ear, or if your home institution is about to undergo major change or build a startling new instrument... Well, don't keep it a secret. Write this stuff up, and bring your manuscript to the *Times'* numerically small, but morally large staff in Promenade Room 4 (behind the registration area). All media are accepted as input, including computer files, handwritten notes, and back-of-the-envelope scribblings. We can endeavor to help you with photos, with the text, and with encouragement, if required. You will get our thanks, a by-line, and a modicum of notoriety for your efforts.

In addition, if you have comments, commentary or criticism, these too are welcome.

As the Editor of this Assembly's daily newspaper, I earnestly solicit your help and participation in making the publication worthy of scrutiny. Some of you may recall that I have held this job before: it's hard work, the hours are long, and the frustrations are often burdensome. But there's a great deal of pleasure in working with GA participants – a pleasure that more than compensates for the unrelenting anxieties that crop up when turning out a newspaper every day. You can help to preserve what's left of my mental equilibrium by bringing in your articles, your notices, and your commentary.

As earlier noted, *The Magellanic Times'* imposing editorial offices can be found in Promenade Room 4.

Symposium 216
Maps of the cosmos
Lister Staveley-Smith

Many great discoveries connected with the structure of our Galaxy and the Universe have come from the painstaking mapping of large chunks of sky. This symposium celebrates the science that is being achieved with contemporary surveys of the cosmos. Starting with the Cosmic Microwave Background, observations of which have come to underpin our knowledge of the geometry and energy content of the Universe and our absolute space motion, the symposium winds its way through various surveys of galaxies and clusters of galaxies in the nearby and distant Universe. We also look at the state of the intergalactic medium, which now appears to be the major repository of baryons in the Universe, via observations of ultraviolet and X-ray absorption lines. The symposium ends with a session describing some of the deepest maps ever made in the X-ray, optical, infrared and radio regime.

Descriptions of many current and future surveys are presented in the IAU 216 poster session which is open for the whole of the first week. Oral contributions will mainly emphasise the scientific results and impact from existing surveys on, for example, our knowledge of the formation of large-scale structure and the evolution of galaxies. Throughout the symposium, the synergy between observations and theoretical and numerical studies of the evolution of galaxies and large-scale structure is emphasized.

Symposium 216 will be in Harbourside Auditorium I from 14 – 17 July.

IAU Symposium 217
Recycling intergalactic and interstellar matter
Pierre-Alain Duc

In recent years, great progress has been made in the area of galaxy evolution. This has been facilitated by the wealth of new high spatial and spectral resolution observations from space (HST, XMM-Newton, Chandra); by large increases in sensitivity from ground-based 10 m-class telescopes (VLT, Keck, Subaru, Gemini, etc.); by the availability of deep or/and large radio surveys (VLA, HIPASS) and by similar increases in the computing power available for running numerical simulations. However, one critical aspect of galaxy evolution that is rarely explored per se is the transformation and recycling of the gaseous and stellar material outside of galaxies: gas consumed by star formation and subsequently ejected by supernovae or superwinds into the inter-galactic medium (IGM); injection in the IGM of metal-enriched material via AGN-driven jets; material ejected from galaxies through interactions and mergers; and gas stripped from galaxies by the ram-pressure of the intracluster medium (ICM). Numerical simulations can now follow in detail the evolution of the gaseous medium in galaxies through these violent events.

At the same time, our knowledge of the IGM has improved dramatically. In clusters of galaxies, the nature of the ICM can now be constrained more tightly through X-ray observations by Chandra and XMM. These observations have revolutionized our understanding of the cooling/heating processes in the intracluster medium, and allow us to measure its elemental abundances with unprecedented precision. The intergalactic medium at high redshift is investigated using absorption lines detected in high resolution spectra of background QSOs. In the local Universe, molecules in low-density gas clouds are observed well outside galactic disks through absorption against background UV sources. The first metallicity measurements of the high-velocity clouds in the Local Group were obtained by this method. Strangely enough, no pristine hydrogen clouds, devoid of any heavy elements, have yet been found, either locally or at high redshift. All these observations suggest a general "pollution" of the intergalactic medium by galaxy ejecta, even at high redshift. Even more surprisingly, surveys of planetary nebulae and RGB/AGB stars in 'empty' fields of nearby clusters confirmed that a large (10 to 50%) fraction of the total stellar population lie between galaxies. Various models of galaxy mass-loss via dynamical processes or superwinds have attempted to account for these observations, but they still disagree on the efficiency of the IGM enrichment mechanisms and on the nature of the progenitors.

What is the fate of the material liberated by galaxies during their evolution and currently observed in the IGM? It is very likely that the fraction of it that is not dispersed or evaporated, and hence lost for future recycling, may fall back onto galaxies. This is in agreement with numerical experiments which predict the re-accretion of tidal debris as well as gas stripped by ram-pressure. This reservoir of expelled material can be recycled in their progenitors, fueling star-formation episodes with a time delay depending on how far into the IGM the gas clouds had been injected. On the other hand, there is now observational evidence that galactic material may be recycled in the space between galaxies, forming a new generation of objects. Tidal Dwarf Galaxies (TDGs) are young galaxies assembled from the gas and stars ejected from interacting galaxies. Unfortunately, while numerical models support the formation of such objects, the conditions for their formation have not been fully investigated, and it is difficult to assess their cosmological importance. However, it has been claimed that TDGs could be good laboratories to study, in the local universe, the process of galaxy formation more commonly investigated through observations at high redshift. Also their dark matter content or absence of it may be used to constrain the dark matter distribution in the parent galaxies.

IAU symposium 217 will address in a concise manner all of these issues, following the fate of galaxy material from its liberation by galaxies, its journey into the intracluster medium, to its final recycling in and outside galaxies. We will first make a census of processed material in the intergalactic medium, such as the hydrogen clouds probed by radio surveys or by absorption lines in the spectra of background quasars, the metal-enriched hot gas studied via X-ray spectroscopy, and the intracluster stellar populations as traced by red giant stars or planetary nebulae. The focus will then turn to the physical ejection mechanisms from galaxies. In particular, the relative importance of starburst-driven superwinds, AGN-driven outflows, tidal interactions, harassment and ram-pressure stripping will be examined from the observational and theoretical sides. Finally, the subsequent "recycling" of the expelled material will be addressed, with an emphasis on re-accretion processes in galaxies and the formation of Tidal Dwarf Galaxies.

Symposium 218 Young neutron stars and their environment

Frank Verbunt

The pulsar in the Crab nebula has long dominated our thinking about young neutron stars. Its location at the site of the 1054 a.d.'new star' proves that neutron stars originate in supernovae. Its pulse period increases with time, as predicted by the model in which a dipolar magnetic field of the rotating neutron star emits Poynting flux. The magnetic field strength derived with this model, 10^{12} gauss, agrees well with estimates of the magnetic field of X-ray pulsars accreting matter from binary companions. The age derived from the dipole model corresponds well with the birth in 1054. The hypothesis that young neutron stars are born with rapid rotation and strong magnetic field thus appeared well founded. The Vela pulsar further strengthened this view.

In the last years it has become obvious, however, that young neutron stars may appear in many guises. Some have magnetic fields several hundred times stronger than that of the Crab pulsar, and emit not in the radio, but in optical, X and gamma rays only. Others were born rotating much slower than the Crab pulsar. And others yet show no pulse period at all, and emit far less flux than expected for a neutron-star atmosphere with the observed temperature: prima facie this appears to imply neutron star radii of a kilometer only. Central stars have been found in many supernova remnants, thanks to more sensitive radio observations and sharper X-ray images. The IAU Symposium on Young Neutron Stars & Their Environments will discuss the new observations at wavelengths ranging from the radio via the infrared and visual to X and gamma rays; and ponder their meanings for our overall understanding of the physics and demographics of young neutron stars.

Classical pulsars

A pulsar is characterized first by its period and period derivative (Figure 1). Most pulsars have periods of order 1 s, and characteristic ages $\tau_c \equiv P/(2\dot{P})$ of order 1-10 Myr. Thanks to surveys making use of improved detectors, faster computers, and refined software, the number of known pulsars has now passed 2000. This large number includes pulsars with rare properties. Thus, whereas most pulsars lie to the left of the 'death-line' in the $P-\dot{P}$ diagram, one has now been found well to the right of this line. A few pulsars have much lower radio luminosities than the bulk of previously found pulsars. Pulsars with much higher fields than that of the Crab are now known, including one in the range where previously only X-ray emitting, radio quiet neutron stars were found.

Population studies are helped by better statistics, and must answer questions about the birth rate of young neutron stars, and about the evolution of properties like period and magnetic field. Is the birth rate compatible with the death rate of high-mass stars? Are the rare pulsar properties in the tail of the distributions for the bulk of the pulsars, or do they indicate separate populations? An important puzzle here is the occasionally large difference between the characteristic age and the kinematic age derived from the distance of a young neutron star to the center of its supernova remnant: does this imply that the age estimates from the dipole model are incorrect?

Interaction with the remnant

For pulsars the energy loss through radio emission is insignificant compared to the loss of rotational energy through the Poynting flux of the rotating-neutron-star magnet. Emission in X and gamma rays is more important, but still small. To study the total energy loss we can take recourse in the study of its deposition in the medium surrounding the young neutron star. The superb sharpness of the Chandra images shows waves of energy travelling outward from the Crab and Vela pulsars (Figure 2). As a pulsar moves through space, it may catch up with the interstellar medium swept up by the supernova ejecta: numerical hydrodynamics is used to describe how the pulsar wind energy is absorbed. A pulsar moving through the interstellar medium leaves a trail of ionized material, bounded by H alpha emission. Such wakes have now been observed.

The sharp images and high spectral resolution of Chandra and Newton also provide much more detailed information on the chemical composition of supernova remnants as a function of location, testing our understanding of explosive nucleosynthesis. The spatial distribution of the hard X-rays can be compared in detail with the radio images, and constrain theories for the acceleration of particles to the relativistic energies of cosmic rays.

Neutron or quark? Atmosphere or solid surface?

The emission of pulsars spans the range of radio to high-energy gamma rays. Accurate timing and good spectral resolution allow separation of the radiation from the neutron star surface, and from the magnetosphere. The theory of the pulsar magnetosphere aims to explain the pulse form as a function of photon energy; and the relation between the highly variable individual pulses – including the enigmatic giant pulses – and the constant average pulse profile. The theory of neutron star atmospheres is somewhat in opposition to the observation that the spectra of some neutron stars look more like black bodies than like atmosphere spectra (!), but now it also has the first observed spectral lines to explain. A related question is the remarkable faintness of the neutron star surface: applying an atmosphere model to explain the X-ray flux of the central object in Cas A leads to a radius of 1 km only. Does this mean that it is a quark star? or are we looking at a solid-body surface instead of a gaseous atmosphere? How does this affect the rate at which the neutron-star cools?

Magnetars

A remarkable addition to the population of single young neutron stars is formed by the magnetars. They come in two varieties, soft gamma ray repeaters and anomalous X-ray pulsars; both types were already known in the 1970s, but have only recently been widely recognized as single young neutron stars. Soft gamma ray repeaters were found first, as the name implies, as gamma ray bursts that repeat. Some of their outbursts are so strong that they lead to significant ionization of Earth's upper atmosphere! A breakthrough came when pulse periods, and soon after period derivatives, were discovered. Interpreted in the dipolar magnetic field model, they imply magnetic fields of $10^{14\text{-}15}$ gauss, two orders of magnitude stronger than those of ordinary pulsars, and ages of a thousand years only. The suggestion that some X-ray pulsars are similar systems, with only slightly weaker fields and slightly higher ages, has gained by the discovery that they sometimes also show highly energetic flares. Improved X-ray positions allowed searches for optical counterparts, which turned out to be extremely faint and exclude the presence of a sizable accretion disk or of a binary companion. The proximity of all suggested magnetars to the galactic plane confirms that they are young. Presumably as a consequence of their high magnetic fields magnetars do not emit in the radio, but only at high energies. Indeed, their energy loss exceeds the loss of rotational energy, and is thought to be due to reconnection of their magnetic fields. Even though only a handfull of these magnetars are known in our Milky Way, their youth suggests that their birth rate is comparable to that of Crab-like pulsars. That the strength of the magnetic field is not the single determinant of radio or X-ray emission is shown by the discovery of a radio pulsar with a similarly high magnetic field. The study at all wavelengths of the magnetars, the theory of their emission, their demographics, and the relation to ordinary pulsars and to supernova remnants are the topics of several sessions in the Symposium.

Figure 1

What is 'red' below must be highlighted in the journal; eventually the text must be adapted accordingly

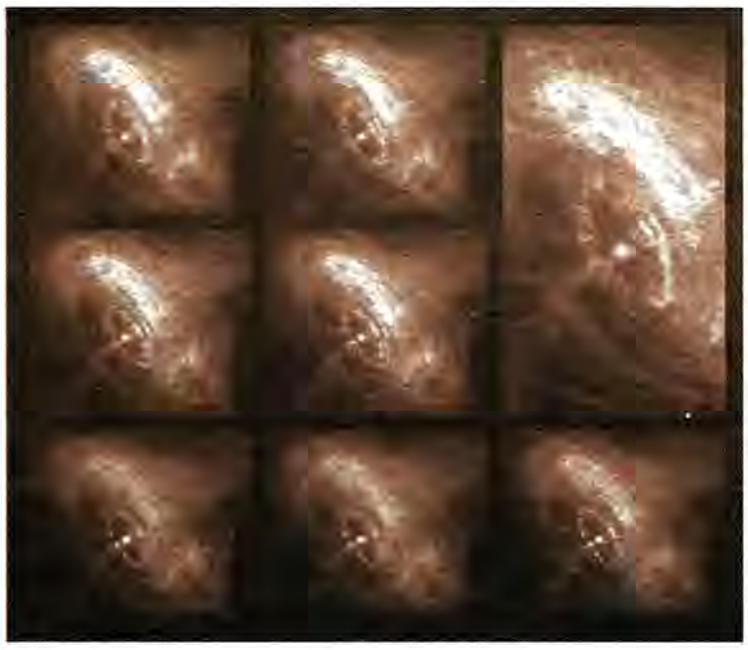
Diagram showing the period and period derivative of pulsars, those detected in radio in black, those detected in X and gamma rays but not in radio in red. Most pulsars have periods of order 1 s, and period derivatives of a few hundred nanoseconds per year. Lines of constant magnetic field, estimated from $B(G)2 = 10^{39}$ are indicated in red, labelled with $\log B$. Loci of constant age, estimated from $\tau_c = P/(2\dot{P})$, are indicated as dashed lines, labelled with $\log B(G)$. We further indicate the death-line, to the right of which no pulsars are found, and the photon-splitting line, above which no pulsars are found. (The slopes of these lines are from theory, their exact locations semi-empirical.) Exceptions were recently discovered: PSR J2144-3933 at 8.5 s, well to the right of the death line, and PSR J1847-0130 at $B \approx 10^{14}$ (G), above the photon splitting line.

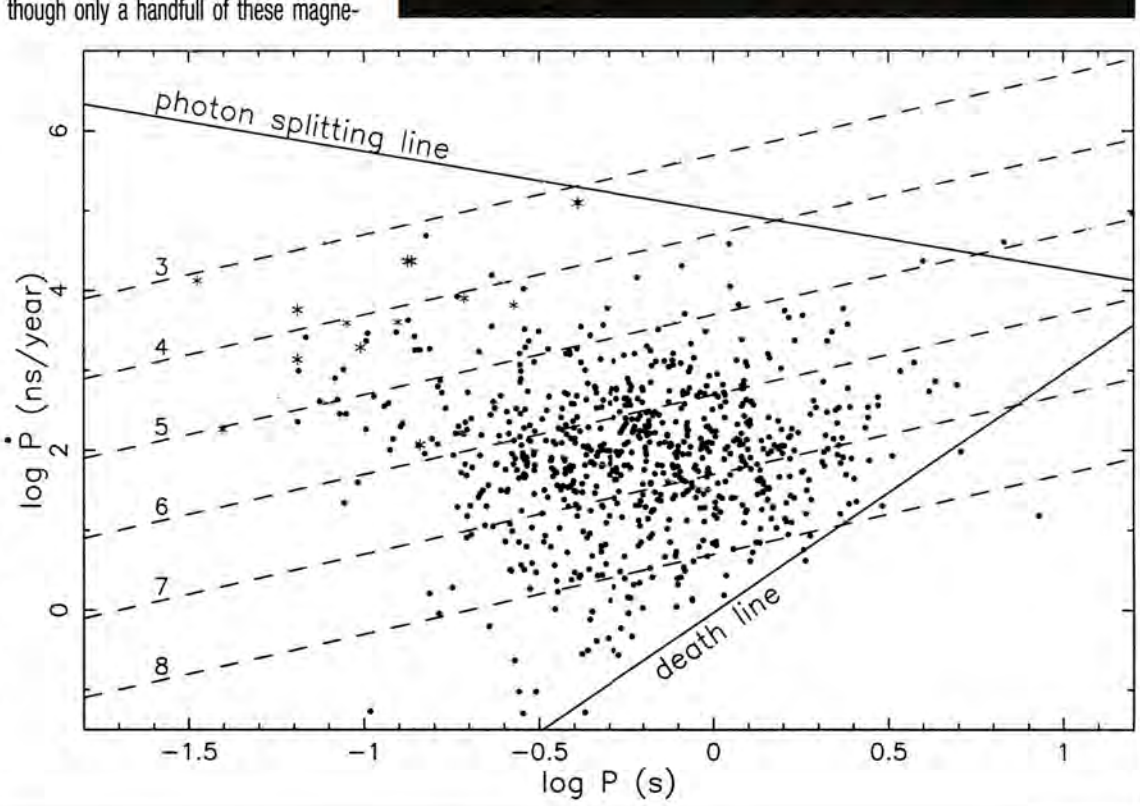
Asterisks indicate pulsars located within a supernova remnant; they include the youngest pulsar known, in Kes 75.The square indicates the bright gamma ray source Geminga. Open and filled stars indicate anomalous X-ray pulsars and soft gamma ray repeaters, respectively, all located above the photon-splitting line, and emitting no radio, but visual, X-ray and gamma rays only.

Figure 2

The Chandra images in this collage were made over a span of several months (ordered left to right, close-up). They provide a stunning view of the activity in the inner region around the Crab Nebula pulsar, a rapidly rotating neutron star seen as a bright white dot near the center of the images.

A wisp can be seen moving outward at half the speed of light from the upper right of the inner ring around the pulsar. The wisp appears to merge with a larger outer ring that is visible in both X-ray and optical images. (NASA/CXC/ASU/J. Hester et al.)





Discussion on the Future of Astronomical Plates

Does your observatory have a photographic plate archive? If so, are there plans to maintain it, catalogue it and digitize it? If not, is its future secure, or is the space it occupies coveted by other activities, and what will happen if push literally comes to shove?

We draw your attention to the Joint WG Meeting and public debate on Tuesday 15 July at 1400, and cordially invite you to attend. The three WGs concerned (Wide Field Surveys, Spectroscopic Data Archives and The Preservation and Digitization of Photographic Plates) represent a range of opinions about the way certain matters should be handled. For instance:

- An excellent site in the US has been offered for storing and digitizing direct plates from North America. But is the risk of having them all in one place greater than the risk of leaving them where they are, even at the mercy of changing observatory policies?
- Can a desk-top scanner reproduce sufficiently well the information in direct plates? What about photometric properties? Could a new, high-speed scanner (to be outlined) be the solution?
- What is the quickest way to generate an online inventory? Cannot each observatory undertake its own cataloguing?
- What are the most likely sources of funding for digitizing projects?

We hope that as many observatories as possible will be represented at this meeting. We value your input and your questions - and your answers.

Elizabeth Griffin, pp. Russell Cannon, Milcho Tsvetkov, and members of the three WGs

The Peter Gruber Foundation awards annual prizes in three areas: cosmology, genetics, and justice. A fourth prize category, women's rights, will begin this year. Each prize winner receives a gold medal and an unrestricted $150,000 cash award. The purpose of the awards is to recognize, honor, and encourage the best in each discipline.

Past winners in the field of cosmology have been Phillip Peebles and Allan Sandage in 2000, Martin Rees in 2001, and Vera Rubin in 2002.

The Peter Gruber Foundation's prize program began in 2000. The Foundation itself was established in 1993 and was funded entirely by its namesake, Peter Gruber. Incorporated in the U.S., the Foundation has established a record of charitable giving, primarily in the U.S. Virgin Islands, where it is located. It funds social service organizations there, and it has established scholarship programs, made contributions to community foundations, and has sponsored local and imported cultural programs.

Patricia Murphy Gruber serves as president of the Peter Gruber Foundation.

Complete information about the Peter Gruber Foundation, its awards and programs, and information on how to nominate someone for a prize can be found on its website at www.petergruberfoundation.org.

PETER GRUBER: A PROFILE

Born in Budapest in 1929, Peter Gruber left Hungary with his family during the ominous summer of 1939 – three months before Europe became engulfed in the Second World War, and settled in India. During these early experiences, he was moved to ask, even as a boy of ten, if life has a meaning and purpose. To examine that question, he began to study philosophy and religion on his own and has continued to do so, as well as to keep himself informed on developments in the sciences and other fields.

His formal education, begun in the city of his birth and briefly resumed in Calcutta, was interrupted for a second time by Japanese bombs. His parents sent him to a boarding school in the Himalayas, where he was educated by Jesuits. When the war ended, he briefly pursued university studies in Australia.

Coming to the United States in 1951, he was inducted into the U.S. Army and served in the Finance Corps. Upon discharge, he went to work on Wall Street.

The highly successful asset management business that Mr. Gruber has built over the span of his professional career enables him to support activities focused on the issues and matters that have always been of special interest to him. Among those is the concept of justice as the means to redress the arbitrary use of power. The perennial searching and contemplation of life that has marked and nurtured his intellect and spirit resulted in a decision to make the recognition of worthy and notable human achievement the principal focus of the Peter Gruber Foundation.

Rashid Sunyaev Wins International Cosmology Award

Peter Gruber Foundation Cites Astronomer for Pioneering Studies on Nature of Cosmic Microwave Background and Interaction with Intervening Matter

Leading Russian astrophysicist Rashid Alievich Sunyaev, a pioneer in the field of X-ray astronomy, has been selected by an international panel of experts to receive the 2003 Cosmology Prize of the Peter Gruber Foundation.

The Foundation annually presents its gold medal and a $150,000 unrestricted cash award to an outstanding scientist who has made groundbreaking contributions in the field of cosmology. This year's award will be presented to Professor Sunyaev on 15 July at the opening ceremony of the IAU General Assembly.

The official citation reads:

"The Cosmology Prize of the Peter Gruber Foundation is hereby proudly presented to Professor Rashid Sunyaev, Director, Max-Planck-Institut fuer Astrophysik, Garching, Germany, for his pioneering studies on the nature of the cosmic microwave background and its interaction with intervening matter.

Hailing from the former Asian Soviet Republic of Uzbekistan, Sunyaev became one of the most important and prolific members of the Moscow group that pioneered Relativistic Astrophysics. Together with its illustrious leader Zeldovich, he studied the relic radiation from the Big Bang leading to early tests of cosmological models that are still valid and have provided impetus to one of the most active areas of observational cosmology.

Through continuing collaborations around the globe, Sunyaev remains among the most effective scientific bridges between East and West."

Sunyaev's contributions have been wide-ranging. He co-authored a series of landmark papers that laid the foundations for understanding fluctuations in microwave background radiation and thus advanced ongoing studies about the conditions in the early universe. Together with Yakov B. Zeldovich, he was the first to describe the apparent cooling of radiation as it passes through hot gas, a process now known as the Sunyaev-Zeldovich Effect.

In another collaboration in the early 1970s, with Nikolai Ivanovich Shakura, he helped establish the principles governing current studies of key phenomena of basic nuclei in the Milky Way. More recently, Sunyaev led the team that built and operated the Kvant X-ray observatory for the MIR space station and the GRANAT orbiting X-ray observatory. He continues to be a leader in the area of X-ray astronomy.

Born in 1943 in Tashkent, Uzbekistan, Sunyaev was educated at the Moscow Institute of Physics and Technology and Moscow University. He worked at the Institute of Applied Mathematics in the Soviet Union and was head of the High Energy Astrophysics Department at the Space Research Institute at the Russian Academy of Sciences. Since 1996, he has been a director of the Max-Planck Institute for Astrophysics in Germany.

"We are extremely pleased to honor the work of Professor Sunyaev and to pay tribute to the Russian school of astrophysical cosmology," said Peter Gruber, chairman of the Peter Gruber Foundation. "It is through international efforts that the whole of humanity is benefited."

The Cosmology Prize of the Peter Gruber Foundation is one of the premier international prizes in the field. Last year's prizewinner was Dr. Vera Rubin, an observational astronomer known for her study of how galaxies revolve within dark matter. The recipient in 2001 was Sir Martin Rees, the Astronomer Royal of the United Kingdom and Royal Society Research Professor at Cambridge University. Recipients of the Cosmology Prize in 2000 were Allan R. Sandage, Staff Astronomer Emeritus, The Observatories (Pasadena, California) Carnegie Institution of Washington, and Phillip J.E. Peebles, the Albert Einstein Professor of Physics at Princeton University.

A distinguished Advisory Board selected the Cosmology Prize recipient for 2003 after a worldwide solicitation of candidates. Current members of the Advisory Board are: Professor V. Radhakrishnan of the University of Bangalore; Professor Lodewijk Woltjer of France's St. Michel l'Observatoire; Professor Ekmeleddin Ihsanoglu of Istanbul's Research Center for Islamic History, Art and Culture (IRCICA); Professor Virginia Trimble of the University of Maryland and the University of California at Irvine; Dr. Katsuhiko Sato, Dean of the School of Science at the University of Tokyo; Professor John Ball of the Mathematical Institute, Oxford; and Professor Robert Williams, Distinguished Research Scholar at the Space Telescope Science Institute in the U.S. Dr. George V. Coyne of The Vatican Observatory serves as a special cosmology advisor to the Foundation.

In 2000, the Peter Gruber Foundation and the International Astronomical Union (IAU) announced an agreement by which the IAU provides its expertise and contacts with professional astronomers worldwide for the nomination and selection of Cosmology Prize winners. Under the agreement, the Peter Gruber Foundation also funds a fellowship program for young astronomers, with the aim of promoting the continued recruitment of new talent into the field.

The International Astronomical Union, founded in 1919, is a worldwide organization of professional astronomers. Its membership includes more than 8,000 astronomers from more than 70 countries.

The Peter Gruber Foundation

The Peter Gruber Foundation was founded in 1993 and established a record of charitable giving principally in the U.S. Virgin Islands, where it is located. In recent years the Foundation has expanded its focus to a series of international awards recognizing discoveries and achievements that produce fundamental shifts in human knowledge and culture. Further information about the Peter Gruber Foundation and its awards is available from www.petergruberfoundation.org.

Day Tour and Post-GA tours

Raymond Haynes
NOC Tours Coordinator

As of the 25th of June, 1946 people had registered to attend IAU 2003. It is therefore not surprising that a significant number of these have also opted to undertake a range of longer tours before or after the 2-week congress, or have enrolled to see the environs of Sydney and Canberra in shorter day tours. There are also social events like the reception and the conference dinner and public and invited discourses.

Here I focus on the tours program.

Immediately after IAU 2003 there are a number of longer tours which promise to be both exciting and to introduce visitors to Australia 'up close and personal.'

They include:

A Central Australian Tour

This tour will acquaint you with the vastness and uniqueness of Central Australia and the Great Outback, and is suitable for the less adventurous who still want to experience the "red heart of Australia" and to see and feel the "magic" of the desert area. The tour includes the monolithic Uluru (Ayers Rock) and the outback town of Alice Springs. Central Australia is beautiful at this time of the year, with mild days and chilly nights and a sky full of jewels.

A NSW Observatories Tour

This tour is for those who wish to visit some of the main astronomy observatories in Australia – Siding Spring Observatory of the Australian National University (ANU), which is also the home of the 3.9 metre diameter Anglo-Australian Telescope and the UK Schmidt Telescope, and the Parkes and Paul Wild Observatories of the Commonwealth Scientific and Industrial Research Organisation (CSIRO). The tour is being run by Dr. Graeme White, an astronomer and well-known public educator. As a bonus, the trip passes through some of the most interesting inland scenery of eastern Australia. It proceeds over the majestic Blue Mountains with their sheer cliff faces, across the fertile Bathurst plains to the old gold mining town of Parkes, then north to the WarrumbunglesNational Park and its unusual volcanic formations, across to the wheat/cotton growing region of Narrabri, then back to Sydney through the lush wine-producing Hunter Valley.

Barrier Reef Exploration

This tour introduces visitors to sub-tropical Cairns and the ultimate cruise on Australia's Great Barrier Reef, the world's largest marine park. There are exotic islands, coral cays, white sandy beaches, balmy bays and the remote outer reefs. You will spend 3 nights aboard the first class mini-cruise ship the Reef Endeavour. Participants departing Australia after this tour may do so via Cairns.

Kakadu & Arnhemland Exploration

This post tour offers a wonderful opportunity to explore the uniqueness of much of this vast continent with its amazing contrasts. The tour takes in Kakadu and the beauty of Arnhemland (both in the remote areas of the Northern Territory of Australia). The highlights of this tour are the Twin Falls and the Jim Falls, the Yellow Waters cruise, Ubirr and Nourlangie Rock and Arnhemland. Participants are advised that they can depart from Australia via Darwin after this tour if they wish.

There is also a large range of Day Events to suit every taste. You can book these day tours up to the day before the tour is due to depart. Just see the Travel Desk to make a booking of any of the following.

Summary of available day tours

(if you wish to go on a tour please see the travel desk)

day tour	date	departure time
City of Sydney	13 July	0900
Coffee Cruise	13 July	1000
Koalas & Kangaroos	13 July	1330
Opera Afloat	14 July	1900
Bridge Climb	14 July	0855
City of Sydney	15 July	1300
Bridge Climb	16 July	1325
Ku Ring Gai Bush walking	16 July	0900
Observatory Evening	16 July	2000
Blue Mountains	17 July	0800
Bridge Climb	17 July	0855
Koalas & Kangaroos	17 July	1330
Creation of an Opera	17 July	0900
Coffee Cruise	18 July	1415
Observatory Evening	18 July	2000
Aboriginal Walkabout	18 July	0900
Northern Beaches	19 July	0900
Blue Mountains Hiking	19 July	0820
Canberra	19 July	0800
Dinner Cruise	19 July	1900
Hunter Valley Overnight	19 July	0800
Sheep Station	19 July	0900
Blue Mountains 4WD	20 July	0820
City of Sydney	20 July	1300
Hunter Valley	20 July	0800
Koalas & Kangaroos	20 July	1330
Learn to Surf	20 July	0900
Coffee Cruise	21 July	1000
Observatory Evening	21 July	1800
Sheep Station	21 July	0900
Aboriginal Walkabout	21 July	1300
Ku Ring Gai Bushwalking	22 July	0900
Observatory Evening	22 July	1800
Creation of an Opera	22 July	1300
Opera Afloat	23 July	1900
Northern Beaches	23 July	1300
Blue Mountains	23 July	0800
Koalas & Kangaroos	23 July	0900
Creation of an Opera	24 July	0900
Aboriginal Walkabout	25 July	0900

Astronomy on the Go

by Michael Burton
School of Physics, University of New South Wales

How often do two thousand of the world's leading astronomers come to one's country? Not often! So was born the idea for 'Astronomy on the Go', to take advantage of the publicity that would be generated by your presence at the IAU GA in order to run a science outreach program, and do our best to stimulate interest in the sciences through our natural wonder about the stars. Over most of Australia, outside the major cities, people are generally aware of the spectacle of the night sky, there being relatively low levels of light pollution over Australia due to the low population density. No time is better to watch the Milky Way than in winter (for visitors from the North – that's now!), when the centre of the Galaxy passes directly overhead at midnight from the latitude of Sydney. Astronomy on the Go aims to take advantage of both our natural curiosity about the Universe and the stellar display of the winter sky to motivate a public outreach program in science.

Astronomy on the Go is actually being run by science students from the University of New South Wales. Equally as important as bringing science to the public is the training of scientists with the skills to talk about their work in a comprehensible matter, and giving them the confidence to do so. We must hope that they can do better than the current generation of scientists in communicating the importance of science to the functioning of modern society, especially given the low levels of science literacy apparent across much of it. A large part of the program involved training some of the current crop of university students so that they could go out and talk about science in an entertaining and informative way. Astronomy on the Go thus started during the final session of the 2002 university year with the recruiting of students for the program. Around twenty-five put their hands up, with in the end some twenty participating. Some were postgraduates doing PhDs in astronomy, others were undergraduate physics students, while yet others were studying science communication, majoring in the biological sciences and not studying the physical sciences at all. Indeed one of the successes of Astronomy on the Go has been the bringing together of students from different disciplines, and their learning from each another through the different skills they each brought to the program.

Astronomy on the Go consists of four distinct elements. The last two of these are actually taking place during the GA, and you will be able to take part in them yourself. These are two Science in the Pub events, on 16th and 23rdJuly , taking place in the Harlequin Inn, just five minutes work from the Convention Centre, and a special Schools' Day in the Convention Centre on the 24th (during the time of the GA itself). However the major part of Astronomy on the Go has been three tours conducted of regional New South Wales, visiting high schools during the daytime and conducting a 'Starry Starry Night' presentation in the evenings.

Before we could head out on the tours, though, we needed to learn what to do. So the first part of the program was to visit, in May this year, six schools around the Sydney metropolitan area. And before that we had to practice our presentations so that we wouldn't appear too raw to the school children! There were two types of presentations we gave, talks about the solar system or about the stars, and project SEARFE. Our talks were fairly conventional in nature, pretty picture slide shows of everybody's favourite astronomical objects. Project SEARFE was rather different, however, with the focus being on radio astronomy. It was an initiative from the University of Sydney, and then conducted with extensive support from the CSIRO (Australia's national science organisation), and aimed at the final year physics classes at school (the HSC year in Australia). A broadband, omnidirectional radio antenna + receiver + PC was used to conduct an experiment measuring the radio emission background at the school, and incorporated into a presentation which discussed radio waves and radio astronomy, while featuring some of the key physical ideas associated with their detection and measurement. As part of the exercise the students conducted two 'standard' measurements of their radio frequency environment and then were given a disk with their data for them to upload on to the Astronomy on the Go website, for comparison with similar scans made at schools right around Australia. As you may have guessed by now, there was also a deeper message being given here, that Australia's RFI environment is among the lowest on our planet, with large areas of virtually uninhabited land over much of the continent, which also provides the most suitable location for the next generation of radio telescopes, LOFAR and the SKA.

To come back to the outreach program, our first task then was to prepare the presentations and practice them amongst ourselves, before then heading off to schools around the Sydney metropolitan district where we tested ourselves against our audience, the high school students. It was a learning experience all round! Most classes were very receptive to us, and the questions would flood in. But not with year 10 classes! At that age it is just not cool to communicate with your teachers or to ask questions. Didn't we all pass through such a bellicose stage when we were about sixteen?!

The tours started in early June and lasted until just before the GA started. We conducted three tours, and imaginatively named them the Southern, the Western and the Northern tours for the directions they set off from Sydney. A different group of students ran each tour, travelling around in a van which affectionately acquired the name "Daisy", through a story which can only be told by the students, and involves some of the bovine life encountered along the way. Each tour visited around five country towns along their cardinal directions, spending the days at high schools and the evenings with public presentations. At each school we would end up giving typically five or six presentations through the day. They would range from small groups of a dozen HSC-year students for SEARFE, to individual classes for some talks, to an entire year of 100 or more students for others. The latter could be quite challenging at times, especially if there was no microphone to drown out the sounds of excited chatter!

The evening entertainment was a presentation we called "Starry Starry Night", and featured an interactive discussion about the heavens, while viewing the changing colours of the sky from sunset until it became fully dark. We would talk about some of the features apparent in the sky, and use them to include a discussion of how modern science came into being through the process of quantitative measurement and analysis pioneered by the Renaissance astronomers. We would also bring in some of the cultural aspects of the night sky, legends from past civilisations, including some aboriginal mythology. In places where the sky was truly dark we were able to point out that most spectacular, and unexpected, "constellation", the Emu of aboriginal legend. If you get the chance to get outside Sydney look for it yourself, for it is quite striking, made up of the dark clouds spread along 30° of the Milky Way, from the Coalsack in Crux, to Sagittarius. Every Starry Starry night presentation had to be different, tailored for the local conditions. Sometimes we were lucky enough to be at an Observatory on a dark sky site, and the true wonder of the southern sky could be seen. Other sites were in town parks with streetlights around, and at other times we would be foiled by clouds. So we had a number of indoor presentations in readiness to complement the sky viewing, using planetarium software to show the motions in the sky, and a portable planetarium, as well as slide shows and the SEARFE equipment.

One of the activities we conducted is one you can join in yourself – a star counts exercise! Using a number of star maps drawn to different magnitudes of the South Cross to Pointers region, familiar to just about every Australian, the object was to find just how dark the sky was at your home by matching the charts to the sky above and seeing which one most closely resembles it. Try it yourself while in Oz! Download the activity sheet from the Astronomy on the Go website (see below for the URL), then enter the results through a web form, and compare with what others have found.

The website has been one of the features of Astronomy on the Go, providing not only the detailed itinerary for the tours and the program of presentations, but as a means of communication amongst the participants. Read the daily Blog that the students wrote on each tour, and then view the extensive picture gallery they compiled. Databases were also set up so that participants in SEARFE and the Dark Skies projects could also download their results and compare with participants elsewhere, and find the darkest sites in the State, both for radio astronomy and for optical astronomy.

Putting Astronomy on the Go together has been an exhaustive process, involving much more than what was naively anticipated when we started last year. By the time we finish there will have been around 130 public presentations, of one sort or another, given to a total audience of about 10,000. Has it been worth it? Yes! Just to look at the students, exhausted but enthused, after a days talking astronomy to a diverse range of people is to know that it has worked! Producing quantitative statistics to satisfy an accountant may be another matter, but we all have no doubt that we've managed to inspire more than a few people along the way on our perambulating route around New South Wales!

Astronomy on the Go website: www.phys.unsw.edu.au/outreach

Participants: UNSW staff – Michael Burton, Will Rifkin, Anita Pavic, Amy Winter. UNSW students–Marton Hidas, Tracey Hill, Steven Longmore, Cormac Purcell, Yael Augarten, Beau Bellamy, Michael Day, Mathias Kanzelsperger, Dorota Kubuj, Carmen Li, Juanita Mintono Phang, Jason Moore, Sherlin Ng, Dean Nicolson, Kylie Rivero-Glover, Liz Tay, Uwe Zell.

Metropolitan Schools: Catherine McCauley, Wenona, Mt Carmel High, Heritage College, Newington College, South Sydney High

Southern Tour: Batemans Bay, Nowra, Goulburn

Western Tour: Bathurst, Kelso, Mudgee, Dubbo, Cowra, Lithgow

Northern Tour: Taree, Port Macquarie, Westport, Coffs Harbour, Armidale, Tamworth

Science in the Pub: July 16th and 23rd at the Harlequin Inn.

Schools Day: July 24th in the Sydney Convention Centre.

Astronomy on the Go website: www.phys.unsw.edu.au/outreach

Sponsors: The U Committee and the Faculty of Science of the University of New South Wales.

Pictures: see Astronomy on the Go website for an extensive collection.

Science in the Pub

Life, the Universe and Everything

Harlequin Inn, Pyrmont, Wednesday July 16th, 7 – 9pm.

Special Session 2, Astronomy in Antarctica

Friday July 18th

Visions for Antarctic Astronomy

Taronga Zoo, Saturday July 19th

IAU Symposium 221, 'Star Formation at High Angular Resolution'

Tuesday July 22nd – Friday July 25th

Science in the Pub

What is a Planet?!

Harlequin Inn, Pyrmont, Wednesday July 23rd, 7 – 9pm.

Schools' Day at the GA

Thursday July 24th

Project SEARFE
"Starry Starry Night"
Astronomy Talks
UNSW Outreach Centre for Sciences, 02-9385-7311,
www.phys.unsw.edu.au/outreach

Astronomy on the Go In a Nutshell

www.phys.unsw.edu.au/outreach

A science outreach program for the International Astronomical Union General Assembly, Sydney July 2003

Metropolitan Area Visits

- May 1: Catherine McCauley School, Five presentations
- May 5: Wenona School, Five presentations
- May 7: Mt Carmel High School, Four presentations
- May 8: Heritage College, Three presentations
- May 21: Newington College, Eight presentations
- May 30: South Sydney High School, Seven presentations
-

The Launch

- June 4: School of Physics, University of New South Wales

REGIONAL TOURS

Southern Tour

- June 9: Public Talk, Batemans Bay High School, Michael Burton "Our place in the Cosmos"

(Steve Wallace, 4472-7233)

- June 10: Batemans Bay High School, Six presentations
- June 10: Nowra High School, Three presentations
- June 11: Nowra High School, Seven presentations
- June 11: Starry Starry Night, Nowra High School (Vicki Templeton, 4421-4977)
- June 12: Starry Starry Night, Goulburn High School (Vero Joseph, 4821-4022)
- June 13: Goulburn High School, Six presentations

Western Tour

- June 16: Bathurst High School, Six Presentations
- June 16: Starry Starry Night, Bathurst Observatory (Ray Pickard, 6337-3988)
- June 17: Kelso High School, Three presentations
- June 18: Mudgee High School, Six presentations
- June 18: Starry Starry Night, Mudgee Observatory (John Vetter, 9718-6314)
- June 20: Dubbo Senior College, Two presentations
- June 20: Dubbo Primary School, Two presentations
- June 21: Starry Starry Night, Dubbo Observatory (Peter Nielson, 6885-3022)
- June 23: Cowra High School, Four presentations
- June 24: Starry Starry Night, Derby Falls Observatory, Cowra (Markham Monk, 6435-1900)
- June 25: Starry Starry Night, Lithgow Hill School Oval (Lee Middleton, 6352-1422)
- June 26: Lithgow High School, Six presentations

Northern Tour

- June 23: Taree High School, Five presentations
- June 23: Starry Starry Night, Taree Park (Peter Baker, 6552-1166)
- June 24: Public Talk, Port Macquarie Observatory, Michael Burton "Stardust, the stuff of life"(Jim Daniel, 6583-1933)
- June 25: Westport High School, Seven presentations
- June 25: Port Macquarie School of the Air
- June 27: Coffs Harbour High School, Six presentations
- June 28: Starry Starry Night, Coffs Harbour High School (Giorgio Dal Pozzo, 6652-3466)
- June 30: Armidale High School, Three sessions
- June 30: Starry Starry Night, Armidale High School (Kevin Birkett, 6772-7466)
- July 2: Tamworth High School, Four presentations
- July 2: Starry Starry Night, McCarthy Catholic College, Tamworth (Ian Evans 6761-0800)

Science in the Pub

- July 16, Harlequin Inn, Pyrmont, "Life the Universe & Everything" with Fred Watson and David Malin, compered by Alf Conlon
- July 23, Harlequin Inn, Pyrmont, "What is a Planet?" With Penny Sackett, Pat Roche, Gibor Basri and Chris Tinney, compered by Fred Watson

Schools Day

- July 24, Sydney Convention Centre. Talks + IMAX + Expo (Anita Pavic, 9385-7311)

Charley Lineweaver
"Where is the Universe heading?"

Michael Burton
"Stardust–the stuff of life"

Maria Hunt
"The search for life in the Universe"

John Storey
"Astronomy in Antarctica–the quest to build the Earth's ultimate telescope"

The Team

- Academics: Michael Burton and Will Rifkin
- Science Student Centre: Anita Pavic and Amy Winter
- Postgraduate students: Marton Hidas, Tracey Hill, Steven Longmore & Cormac Purcell
- Undergraduate students: Beau Bellamy, Carmen Li, Dean Nicolson, Dorota Kubuj, Helen Zhow, Jason Moore, Juanita Mintono Phang, Kylie Rivero-Glover, Liz Tay, Mathias Kanzelsperger, Michael Day, Sherlin Ng, Uwe Zell, Yael Augarten

Sponsors

- The U Committee, University of New South Wales
- Faculty of Science, UNSW
- School of Physics, UNSW
- SEARFE: U. Sydney, CSIRO, UNSW, UTS, IBM, BAE Systems, Institute of Engineers, Perth Observatory, Australian Geographic

Speaking Australian

by Seth Shostak

One of the many disconcerting things that General Assembly participants will have to deal with in Sydney is the local language.

This is occasionally, and insincerely, referred to as "English," but that's like referring to the boiled missionaries served up by 19th century cannibals as "cuisine." The modern-day Australians have had a long time to modify and improve on their Mother Tongue, and have introduced many terms that - while perfectly transparent to other countrymen - can befuddle and intimidate the visitor. To avoid such painful social interaction, this article will enlighten you with regard to some of the myriad linquistic quirks of the Australian language.

Keep in mind that, for more than a hundred years, males outnumbered females in Australia by five to one or more. In many ways, it's still a "man's" society. "Helping the mates" here has nothing to do with conjugal cooperation. Women are still regarded as novelties, and in order to simplify conversation, are all called "Sheila." For their part, most men are called "Bruce."

At first listen, Australian sounds incomprehensible. However, once you get past the dipthongs-on-steroids, you will find that many of the words are familiar. Americans may wish to note that a large number of apparently strange words merely reflect British usage ("boot" for "trunk," "torch" for "flashlight," etc.) However, there is still a subset of peculiarly Australian terms guaranteed to puzzle those who read the Oxford English Dictionary at bedtime. Listed below are a few of these, together with official translations:

AUSSIE	ENGLISH
"G'day, mate"	"How are you, friend?"
"She'll be right"	"OK"
"She's apples"	"OK"
"No worries'	"OK"
"Cactus"	"Not OK"
"Fair dinkum"	"I agree"
"Bingle"	"Crash"

(as in "Looks like Bruce's had a bit of a bingle in his car.")

The list is deliberately short so as not to burden the reader with too much vocabulary in the first lesson. It is also worth noting that "G'day, mate" has only been uttered three times in Australia by natives (all were during the filming of "Crocodile Dundee.") The local usage is a simple "G'day." If you add the "mate," you'll be put down for a bounder.

If you are still having difficulties comprehending the locals, interpreters capable of translating between Australian and English can be hired in Sydney.

The Magellanic Times

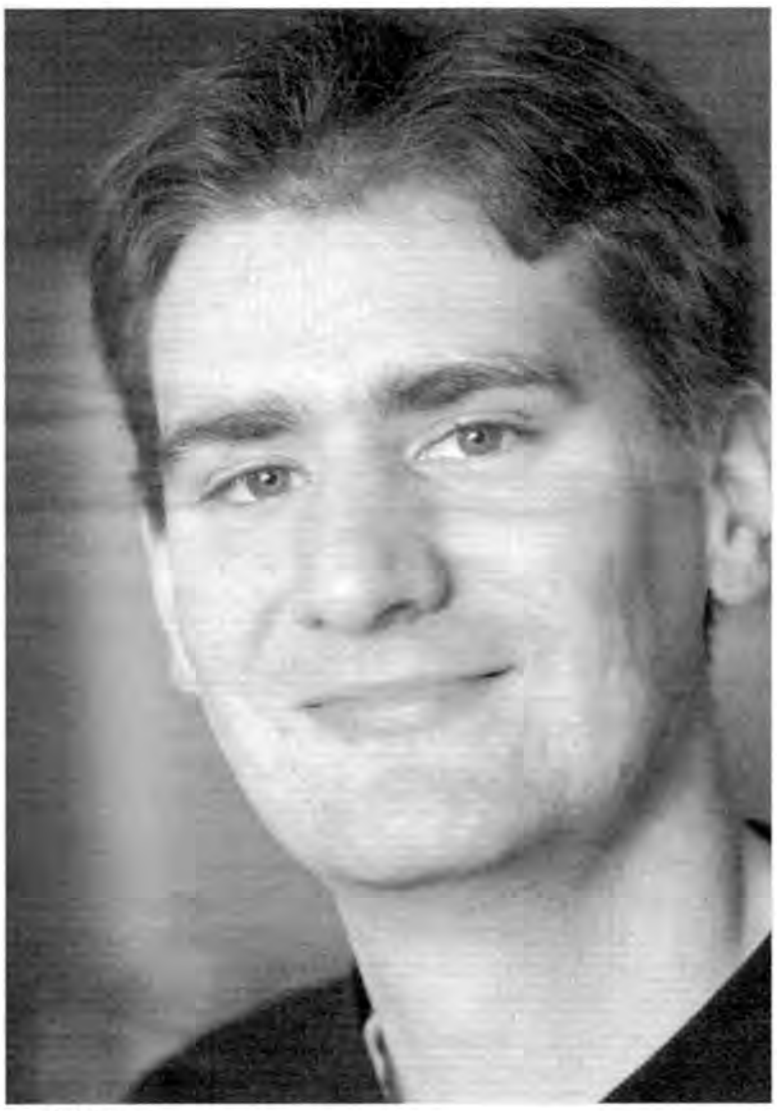
THE NEWSPAPER OF THE INTERNATIONAL ASTRONOMICAL UNION GENERAL ASSEMBLY SYDNEY 2003

IAU IAUXXV General Assembly Sydney 13-26 July 2003

Day 2 Tuesday 15 July

Gaseous Galaxies: An Australian Discovery

by David Frew and Brett Little



Brad Warren

In research unveiled at the General Assembly today, doctoral student Brad Warren, from the Research School of Astronomy and Astrophysics at the Australian National University, describes his important discovery of twenty primarily gaseous galaxies which have a very low numbers of stars. Mr Warren collaborated with fellow ANU researcher Dr Helmut Jerjen, and Dr Baerbel Koribalski from CSIRO's Australia Telescope National Facility.

The new galaxies are vast disks of hydrogen gas, typically 10 kiloparsecs across and containing a billion solar masses of hydrogen. Candidates were identified from the HIPASS survey at Parkes, NSW, with follow-up observations taken with the Australia Telescope Compact Array (ATCA) at Narrabri. As Warren says, 'when you look at the gas the [radio] signal just booms in, but when you look for stars, all you see is a barely recognizable smudge.'

Many of the galaxies had been detected optically in previous surveys such as the ESO Southern Sky Survey, but their importance was not recognized at the time — often only basic positional data and a magnitude was known. Optical images, taken with the University's 2.3-metre telescope at Siding Spring Observatory, Coonabarabran, confirmed the very low surface-brightness nature of the objects.

The recessional velocities of the galaxies were low, all less than 2.000 kms^{-1}, and inferred distances ranged from only 4 to 20 Mpc. The dynamical masses derived from rotation curves revealed that most are dwarf galaxies.

Warren hasn't a definitive answer as to why most of these galaxies have not formed stars from their rich source of hydrogen, but it may be related to the fact that many are rather isolated field galaxies. 'Most Galaxies, like our own Milky Way, have transformed most of their gas into stars, but the galaxies we have discovered have held back and we are not sure why. Discovering this missing link will give us important insights into how, when and why galaxies such as our own formed', he says.

He aims to derive more accurate values for the masses and dynamics of the candidate galaxies. Planned follow-up spectroscopy should allow a better estimate of the star formation rates at different positions in the galaxies, and allow a better determination of the relationship between the HI distribution and any associated stellar population. A paper co-authored with Jerjen and Koribalski is in preparation on one of the most interesting galaxies in the sample, ESO 215-G009.

'This research throws up a further challenge in the ongoing quest to discover the secrets of the Universe', says Warren. Com-bined with the recent discovery of ultra-compact high-surface bright-ness dwarf galaxies in the Fornax galaxy cluster by Michael Drink-water's team, the range of galaxy properties is now thought to be far greater than that envisaged by astronomers as recently as a year ago.

Today's issue

The Magellanic Times

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Deadline for daily issues
1pm on the day prior to publication

Text files for publication may be emailed to john@strangeplanet.com.au

Printed by
Marrickville Print & Design
Ph: 1300 888 490

Erratum

The National Organizing Committee (NOC) was incompletely listed in your program booklet. Amends are made below:

A.R. (Harry) Hyland and John B. Whiteoak, Co-Chairs

Members:
Michael Burton
Lee Christopher
Jon Everett
Raymond Haynes
Sue Little
Nick Lomb
Dick Manchester
John O'Byrne
Bruce Peterson
Helen Sim
Alan Vaughan
Tony Turtle
Rachel Webster
Graeme White
Bill Zealey

Opening Ceremony Video Highlights History and the Distance Scale

by David Malin

On Tuesday night, the speeches at the Opera House will be punctuated by a series of three entertainments. These will include aboriginal music and a dance piece, as well as a short organ recital by Australia's Chief Scientist, Robert Batterham. The middle 'entertainment' is by Sandy Evans and David Malin, who have combined their talents to produce a video set to modern jazz which explores some aspects of the colourful history of Australian astronomy.

A key theme is distance – both the astronomical distance scale, and the tyranny of distance that has beset Australia since European settlment began in 1788. The story really began when Captain James Cook voyaged to Tahiti in 1769. The purpose of the voyage was to observe a transit of Venus to refine the solar constant – the distance to the Sun. Cook had another agenda, to claim the 'Great Southern Continent' for the British crown. In doing so, he mapped New Zealand and Australia's east coast, claiming it for George III. Thus a journey of astronomical discovery led to the charting of Australia, and eventually its European settlement in 1788.

Australia remained isolated for almost a century until an astronomer connected the island continent to the rest of the world. This man was Charles Todd, who supervised the construction of a telegraph line from Adelaide to the northern tip of Australia, and thence to Java, where there was an existing international cable connection. This was in 1872.

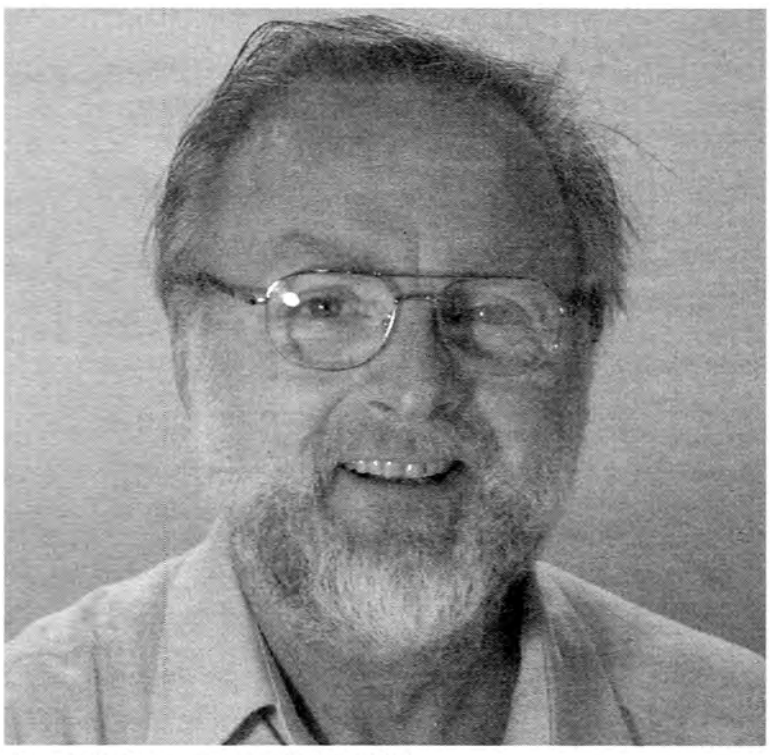
Suddenly, anyone in a capital city of Australia could send a message to a capital city anywhere in the world within a few minutes, something that had heretofore taken months.

The program also celebrates the glory of the southern sky, with a sweeping tour of the Milky Way, dwelling on some of its brightest stars. The distance theme is emphasized by the inclusion of animated pulsars, Cepheid variables, and Proxima Centauri, the nearest star. Nearby galaxies swirl across the sky, and the program ends dramatically with a mammoth climax that is set to explode all modern cosmological models.

The video was made principally by David Malin, using still images animated by special software. The music was expressly composed by Sandy Evans, a well-known jazz saxophonist. The performance will be augmented by conch shell and trumpet calls and will fill the Opera House with modern music and astronomical imagery.

In a generation besotted by videos, this is one you won't to miss.

NGC 2997, as seen by David Malin.



David Malin, as seen by NGC 2997.

Access to Journals Made Easy

by Roslyn Boundy and Judy Lai

Do you have the space and financial resources to subscribe to all the astronomical journals? If not, help is on the way. The NASA-funded Astrophysics Data Systems (ADS) is the first and only database that provides free access to all journals in astronomy in a unified online system.

Established twelve years ago, ADS consists of four databases, covering Astronomy and Planetary Sciences, Space Instrumentation, Physics and Geophysics, and ArXiv Preprints. France, Germany, Japan, Brazil, Chile, Britain, India, Russia, China, Korea, and Argentina each host a mirror site to enhance global access to these data.

'ADS has completely changed the way astronomers obtain astronomical literature,' says Project Scientist, Guenther Eichhron.

'A new software interface has been developed to digitize historical publications stored on microfilm into electronic articles, some of which date back as far as the early 1800s,' says Eichhron.

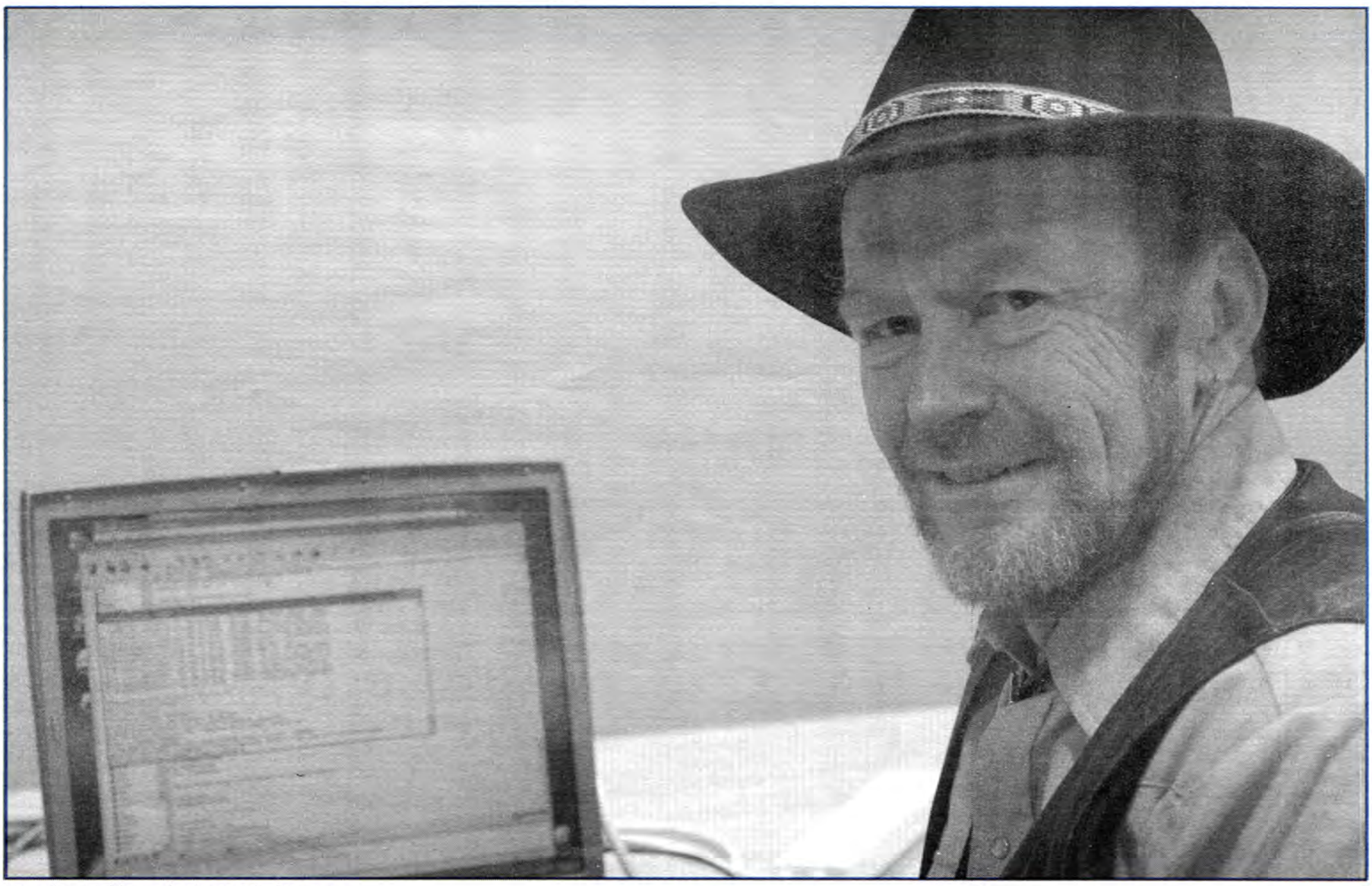
ADS has developed this new software interface with the John G. Wolbach Library at the Harvard-Smithsonian Center. So far, they have generated the data for approximately 682 volumes of 42 journal titles, including Annals of the Harvard College Observatory and Beobachtungs-Ergbnisse der Koniglichen Sternwarte zu Berlin.

Historical literature is particularly significant for astronomical research as new phenomena require astronomers to look back at previous findings, to develop on earlier studies or observations.

Currently, ADS provides search options for abstracts of full-text articles only. In a few months, the system will be enhanced with the use of optical character recognition (OCR) and full-text articles will become searchable. OCR is also used to extract references from the full-text articles to build up the Citations Online Databases and allow more advanced reference search options. There are currently 9 million citation pairs from publishers and editors.

In total, there are approximately one million pages of electronic images available from the scanned microfilm publications. There are 300,000 scientific papers and 3.3 million scanned pages used by approximately 60,000 worldwide users, 10,000 of which are regular users. Conference meetings, such as the XXV International Astronom-ical Union General Assembly, will also be published on ADS

For more information, go to the ADS Home Page at "http://adswww.harvard.edu/"



Guenther Eichhron checks out the literature.

A snapshot of the young universe

by Gareth Kennedy

The recently launched WMAP (Wilkinson Microwave Anisotropy Probe) satellite has given us our best view of the universe only 380,000 years after the Big Bang.

At this time in our universe's history, its temperature had cooled to approximately 2,800K, allowing photons to decouple from the baryons and the universe to become transparent. The afterglow from the previous opaque period is observed by us as the Cosmic Background Radiation (CBR) and contains many of the universe's secrets.

The WMAP satellite, which is currently orbiting the L2 point 1.5 million km from Earth, has obtained additional information on the polarization of the CBR. According to Lyman Page, of Princeton University, this has revealed large-scale correlation between temperature and polarization (see figure 1), giving us knowledge of the physical processes operating in the early universe.

The CBR data returned from WMAP, combined with data from previous surveys, has given us our best breakdown of the composition and parameters of our universe. As noted by Chuck Bennett of NASA's Goddard Space Flight Center, We now know that the cosmos is 13.7 ± 0.2 Gyr old, has a Hubble constant of approximately 71 km/s/Mpc, and is roughly flat. A plot of the types of universe and newly constrained possible models is shown in figure 2.

These new constraints on our cosmological models also allow us to put an upper limit to the combined masses of all neutrinos of 0.7 eV, a much sought-after constraint in particle physics.

While the results have allowed us to constrain many models of the universe, one result still leaves many questions unanswered; namely, that the composition of the universe is 4% Baryonic material, 23% Cold Dark Matter, and an incredible 73% Dark Energy. This composition can now be used as the initial conditions of the universe to be used in theoretical models of its further evolution.

However, despite not knowing for sure the nature of Dark Energy, we can still use our constraints on its influence, combined with WMAP polarization data to begin to distinguish between specific inflation models.

We now know that the parameter W has a value of approximately -1, which is the same as what is expected by adding a Cosmological Constant to our existing models, so it looks like Einstein was right all along

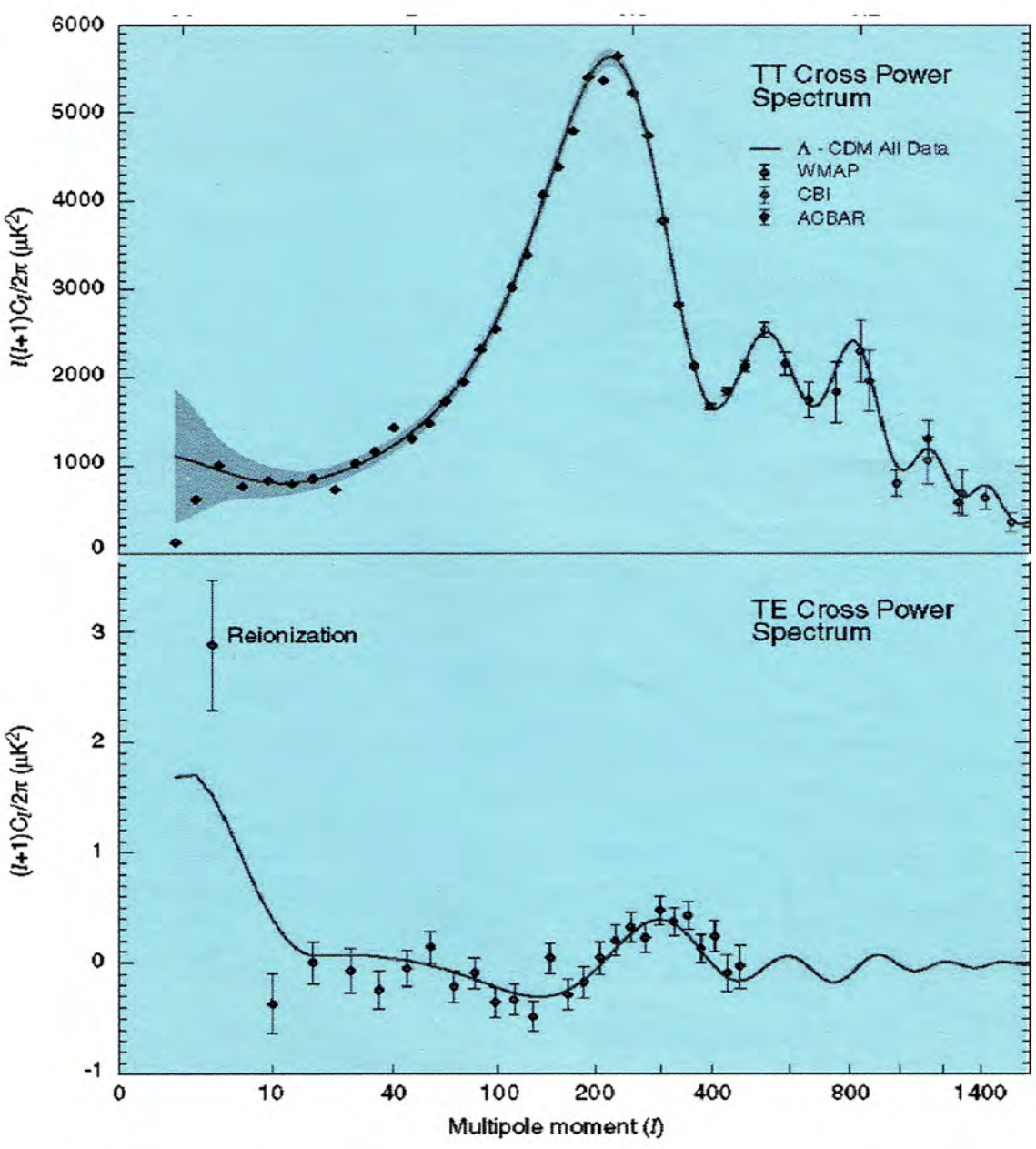


Figure 1. Temperature cross power spectrum (top), and temperature polarization cross power spectrum (bottom).

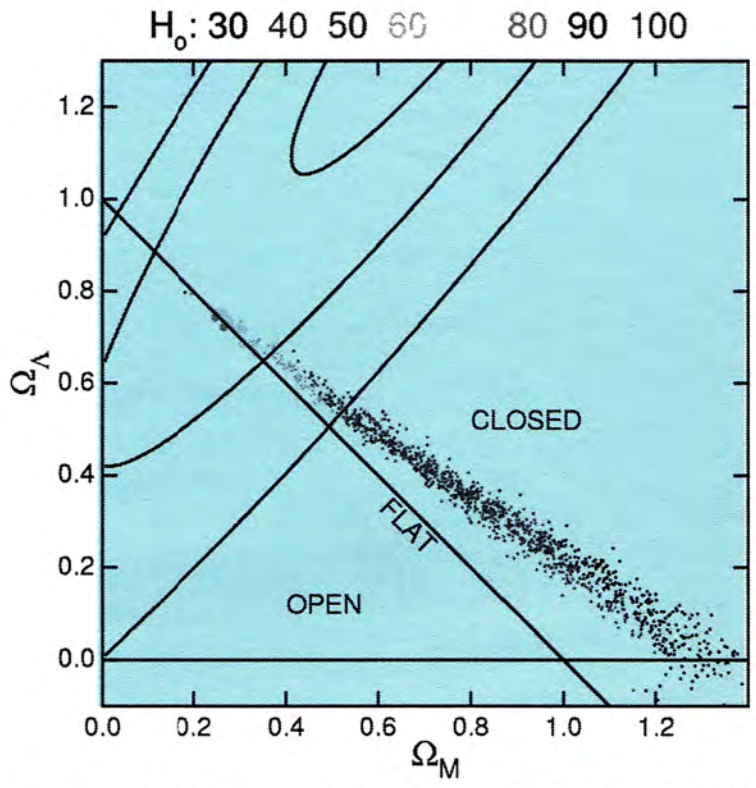


Figure 2. Plot of two cosmological parameters on each axis, including the types of universe each set of values represent, and the newly constrained models of cosmological universes are shown as data points (with highest H_0 towards the right).

Real Astronomy for Generation X?

by Morris Jones

A friend of mine, slightly younger than myself, has escaped urban Sydney for Australia's vast, clear dark skies. He was doing some engineering work at one of our optical observatories, tinkering with the sort of computer applications that affect every aspect of modern life except for applying sauce to meat pies (visit a Sydney café for a demonstration!)

No, he wasn't an astronomer, and wasn't really interested in the subject.

At least, that's how it started. Upon returning to Sydney, his exclamation to me was not one of triumph over cantankerous operating systems, but a simple observation of nature: 'There were stars!'

Sounds obvious. But it needs to be explicitly stated that for urban Sydneyan Generation X and anyone younger, the heavens are an artificial experience. We can go to the IMAX cinema, or look at CCD images on the Internet. But whole cohorts of young people never see the Milky Way unassisted. I know it's a phenomenon that appears elsewhere. My friend is originally from an urban centre in a nearby Asian tiger economy, and light pollution there is often even worse.

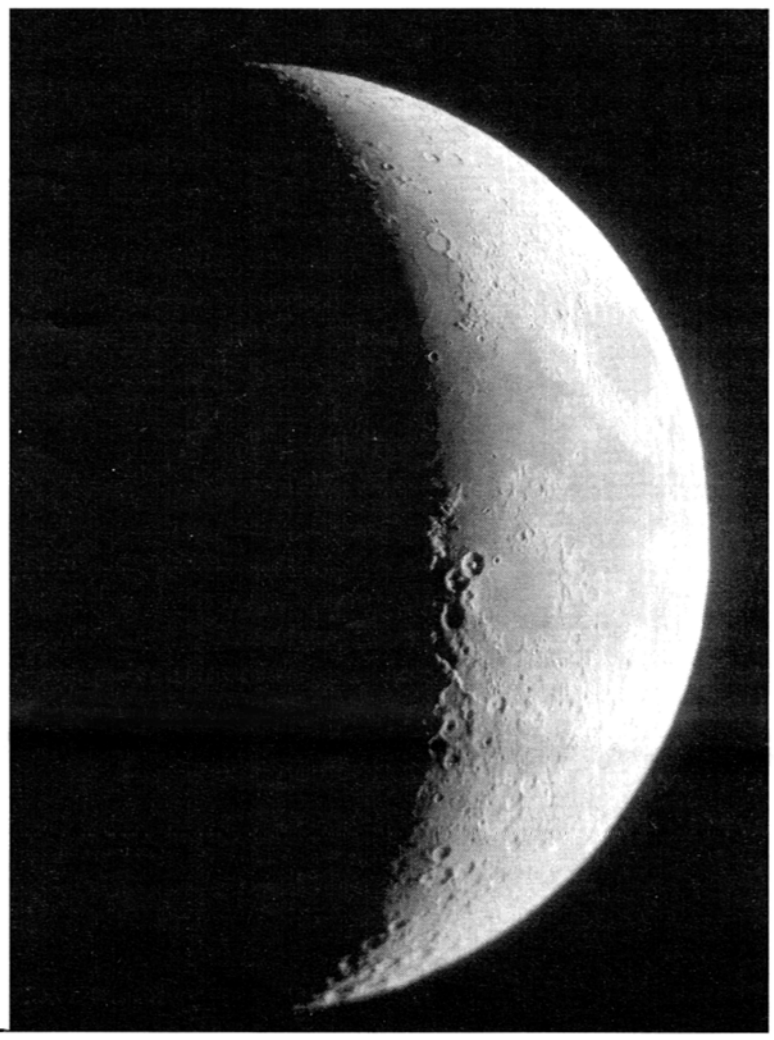
The heavens are closer to us now than ever. We've scoured the icy fractures of Europa and the dusty plains of Mars via technology, and every month, somebody seems to find another extrasolar planet and tell you its preferences in music and literature. But the concept of space as a nearby, natural, even accessible environment seems to have disappeared.

It was not until a couple of years ago that I, a Generation X thirty-something, had the experience of a field, illuminated by moonlight. Until then, such an experience had been a poetic fantasy that seemed to be exaggerated by dramatic license. I was in the countryside, without street lights. Sydney offers many attractions, but not this.

It's easy enough to get out into the countryside and look up, but the fact remains that in this vastly urbanised nation, most young people don't. They're missing out on a lot of things in the process, but a clear view of the night sky must be one of the greatest deprivations. It's cheap, but priceless. It's also simple, but so many people can't bring themselves to do it, until circumstances force them.

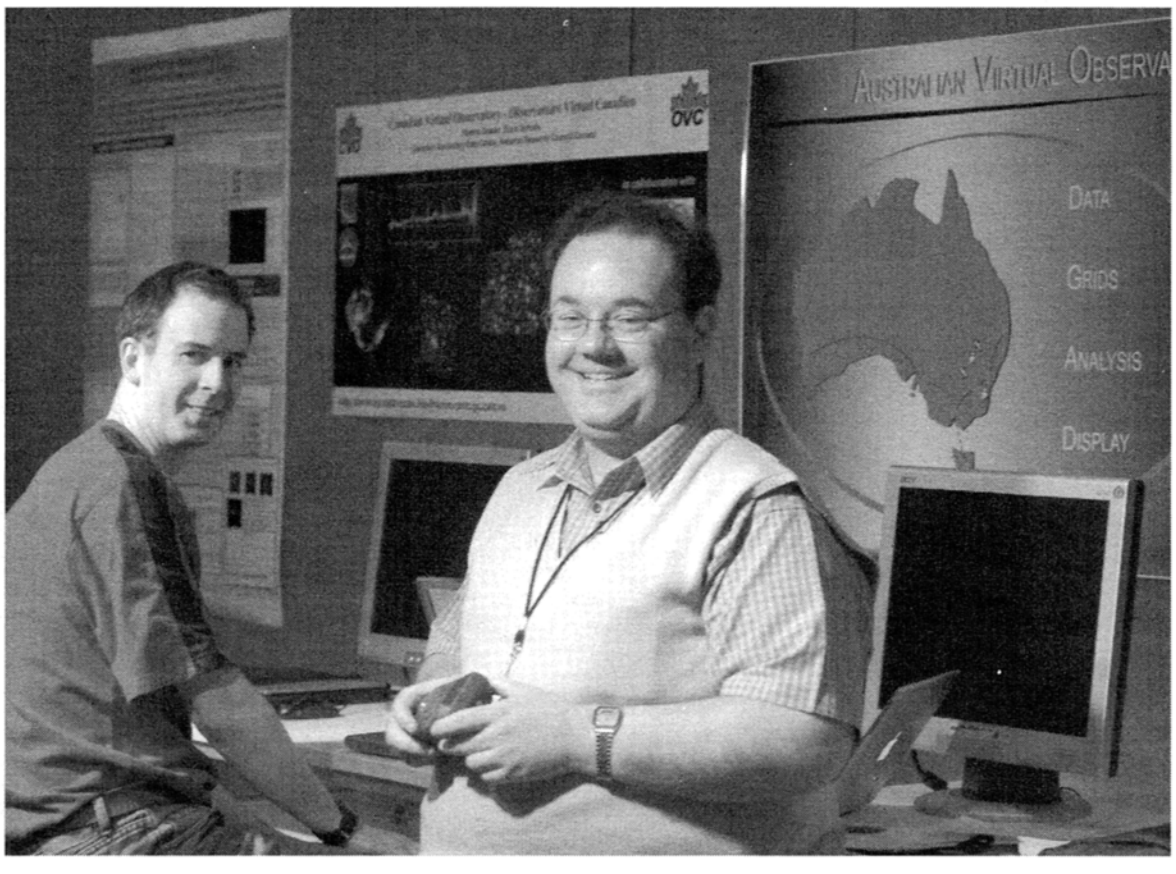
We can teach the public the importance of astronomy through seminars, media reports and documentaries, but reality is still the most potent demonstration of the wonders of space.

Jones is a Sydney-based writer and university lecturer. He can be read at http://www.spacedaily.com



Real Input for the Virtual Observatory

by Francoise Genova and Seth Shostak



How can you gain access to existing astronomical observations? There was a time when the latest, most interesting results were stashed away as photographic plates in the desk drawers of individual researchers.

Technology of the 21st century is about to change all that. Within a few years, you should be able to gain access to observations from around the world using the International Virtual Observatory.

The IVO is a community-based initiative to facilitate global, electronic access to astronomical data archives, both ground- and space-based observations. Of course, just being able to dial-up the data isn't enough. You will need the means to read and understand it, too. So the IVO hopes to enable useful data analysis through a coordination of format standards and by distributing state-of-the-art tools.

You can help. If you have questions or comments concerning the Virtual Observatory, then be sure to attend the second day of Joint Discussion 8, and participate in the JD8 round table to be held on Friday, July 18 at 14:00. You are also encouraged to come for a preliminary discussion of this topic, particularly if you would like to make a short presentation during the round table. If this interests you, you should contact Francoise Genova who can generally be found at the IVOA or Centre de Donnees de Strasbourg (CDS) exhibit booths.

You can see a demonstration of Virtual Observatory projects at booth G23-24-25, in the exhibit hall.

Sunyaev Gets Prize

by James Hitchcock

The official opening of the 25th General Assembly of the IAU will take place tonight at the Sydney Opera House. During the ceremony, one of the world leading astrophysicists, Professor Rashid Alievich Sunyaev, will be presented with the Cosmology prize of the Peter Gruber Foundation.

Professor Sunyaev, currently dividing his time between his position as the director of the Max-Planck-Institut fur Astrophysik in Garching, and Moscow, has been recognized by the Gruber Foundation for his work in the field of the Cosmic Microwave Background and interaction with intervening matter.

In particular his pioneering studies concerning relic radiation from the Big Bang led to early tests of cosmological models that are still valid. These have provided impetus to one of the most active areas of observational cosmology. As a side benefit, his continuing world-wide collaborations have made Sunyaev one of the most effective scientific bridges between East and West.

Sunyaev is most widely known for a series of landmark papers that built the foundations for understanding the fluctuation in the microwave background radiation, and which have advanced our understanding of the conditions in the early universe. He was the first to describe, together with Zeldovich, the apparent cooling of radiation as it passes through hot gas, a process that is now known as the Sunyaev-Zeldovich effect.

The prize includes a gold medal and a cash award of $150,000. This is Sunyaev's second prize this year, after previously being awarded the Dannie Heineman prize for astrophysics by the American Institute of Physics and the American Astronomical Society, as well as the Bruce medal in 2000.

On the opening day of the Assembly, Sunyaev said that it was an honor to receive the award. He commented on Iakov Borisovich Zeldovich, a colleague in the Moscow group, who was his mentor. 'Zeldovich was able to influence young people... he had a talent to explain things simply.'

When asked what he would do with such a large and unrestricted cash prize, Sunyaev replied he said that he would 'help students in Russia with their studies,' mentioning his special concern for poorer young people from former soviet states who come to Russia for their education. Sunyaev himself was born in Uzbekistan and educated at the Moscow Institute of Physics and Technology and Moscow University.

He notes that we are currently in 'a crucial moment in cosmology. The next 10 years will be an important time for understanding the parameters of the universe. This understanding will grow and become more precise.'

Professor Sunyaev will be talking on Wednesday morning at Symposium 216, Session 5 on 'Clusters of Galaxies', specifically about hot gas in clusters of galaxies, and will also touch on some history in the second half of his talk. To attend the session, make your way to Harbourside Auditorium 1 by 11am, Wednesday.

Are You A Registered Guest?

Registered guests are encouraged to avail themselves of an informal meeting place in Exhibition Hall 5. Informal discussion will be held here all day throughout the General Assembly, and will offer you the splendid opportunity to talk with, and get to know, other registered guests. Astronomers may pass by as well, and can occasionally be counted on to spark spirited discussions. Registered guests of the world: unite – in Exhibition Hall 5.

Hike to Ayers Rock Cancelled

The planned overnight hike to Ayers Rock has been cancelled due to maintenance on this imposing icon of Central Australia.

The planned itinerary, leaving Sydney's Circular Quay at 8:00 pm and hiking straight through to the hulky hunk just west of Alice Springs, will likely be replaced by an informal pub tour in The Rocks.

'Ayers Rock has accumulated an offending coating of oxidation and dust in the past few hundred thousand years,' noted tour leader Bruce Bloke, 'and we thought it about time to buff it up a bit.'

The rock has been shipped to a small facility outside of Brussels, where it is being sand blasted and burnished with wire brushes to a bright sheen.

Special Session 3

A new classification system for double stars

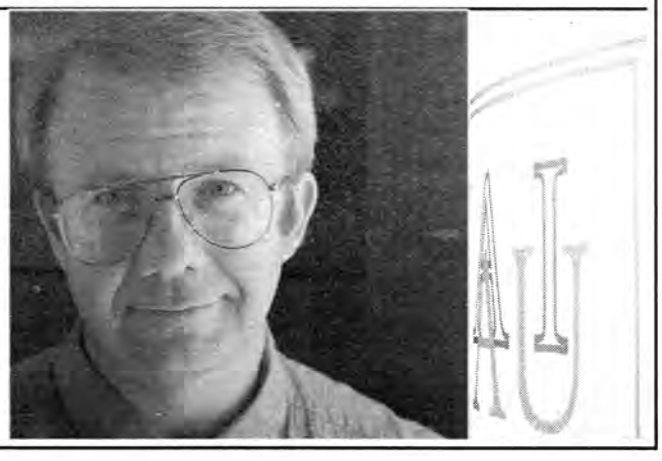
Friday, 18 July Sessions 1-2, HM4

Brian Mason

Traditionally, the designations given to companions were tied to the techniques which discovered them. With advances in observational techniques, these previously isolated period/separation regimes now overlap, leading to confusion in designations.

These difficulties led to a multi-commission meeting at Manchester. At that meeting a Type C Resolution was passed by Commissions 5, 8, 26 and 42 to unify the designation schemes of stellar and substellar companions discovered by multiple techniques.

Special Session 3 on Friday will report on the preliminary efforts with a discussion of potential problems and needed modifications. The goal would be to draft a Type C Resolution to present the whole sky catalogue at Prague.



Science in the Pub comes back to its spiritual home, the Harlequin Inn, with two of its favorite scientists – and attempts to answer some of the big questions of life, the universe and everything! We look at how our culture and the Universe are enmeshed, and ask whether astronomy plays a role in defining who we are and what we believe in. Our two favourite astronomers from the Anglo Australian Observatory lead the fray: Dr Fred Watson and Dr David Malin, in a discussion moderated by Alf Conlon.

Science in the Pub

Fred Watson comes from a long line of Freds, but is the first one in the family to have become an astronomer. Educated in Scotland, he has worked at both of Britain's Royal Observatories and at their overseas telescopes in Hawaii and the Canary Islands. In Australia during the 1980s, he helped to pioneer the use of fiber optics in astronomy, a technique that has today assumed world-wide importance.

Fred is now Astronomer-in-Charge of the Anglo-Australian Observatory at Coonabarabran in northwestern NSW, and an adjunct professor in the University of Southern Queensland and the Queensland University of Technology. He is a well-known broadcaster and writer on astronomical topics. His new book on the history of the telescope will be published next year by Allen and Unwin.

David Malin was with the Anglo-Australian Observatory for 26 years, and sometimes he even worked there. Occasionally, his chemistry and scientific imaging background were useful in the main aspects of astronomical photography, data gathering, data extraction, data analysis, etc. He invented new ways of revealing both information and faint fingerprints on astronomical plates, a speciality that has given him an international reputation and a police profile. These novel image enhancement techniques quickly led to the discovery of two new types of galaxy that bear his name. Malin-Carter 'shell' galaxies have extremely faint but large-scale features and fingermarks that are associated with otherwise normal galaxies, while in 1987 he discovered an extremely faint, uniquely massive 'proto-galaxy' that has since been named 'Malin-1,' or just 'Malin' for those who have trouble with numbers.

Malin has published over 120 scientific papers and a similar number of equally obscure popular articles on astronomy and photography. He has also authored or co-authored seven books, now widely remaindered. David Malin is also a well-known and entertaining lecturer on these and on other, totally unrelated topics and has worked with Australian composers Martin Wesley-Smith and Ross Edwards on combining photographs with modern music. His latest book ('Heaven and Earth' Phaidon Press, 2002) is a large format celebration of the beauty of the scientific image. It includes at least one fingerprint.

Our moderator tonight, Alf Conlon, enjoyed being an undergraduate at UNSW so much, he stayed as one for most of a decade, interspersing studies in information systems, philosophy and cognitive science with work for a variety of publishing and technology.

Next Science in the Pub Session

Wednesday, July 23rd, 7pm at the Harlequin Inn, 'What is a Planet?' This question will interest all those curious about the wanderers in the night sky.

Intergalactic HI Clouds?

by Brett Little

Intergalactic HI clouds don't exist. At redshift 0, anyway.

That's the message being promulgated by Frank Briggs, of the Australian National University.

Historically, intergalactic HI clouds in the local universe have not been considered as the most important, or even mildly relevant objects. For instance, in 1980, Rick Fisher and Brent Tully typified intergalactic HI clouds as 'not cosmologically significant.' But Frank Briggs has taken this downsizing to a whole new level.

Intergalactic HI clouds are no longer merely cosmologically insignificant in the local universe. They don't exist. Period.

One such example is the Leo ring, first examined by Schneider et al. (1983): a ring of HI gas surrounding the M96 group. At present there has been no star formation detected in the ring, and analyses of the dynamics suggest that the ring is primordial. However, the ring is in direct interaction with the M96 group, and thus is not considered intergalactic.

Instead of judiciously disqualifying every possible candidate, Briggs simply goes to the source, and examines the possible formation histories for intergalactic HI clouds.

Intergalactic HI clouds would have to originate from gas clouds formed after the epoch of re-ionization. These can be differentiated into low and high mass clouds. High mass clouds will eventually begin star formation, and for this reason we can disqualify them as they are more likely to form clusters or dwarf galaxies.

The low mass clouds can be divided into early and late forming groups, and once again put up for inspection. Early forming, low mass objects will eventually give in to gravitational pressure and star formation will begin. Gas will then be lost and ionized, due to expulsion by supernovae explosions. Late-forming low mass objects will not have captured sufficient gas to begin star formation; however, they also will not have collected enough gas to obtain a sufficient mass to be classified as an intergalactic HI cloud.

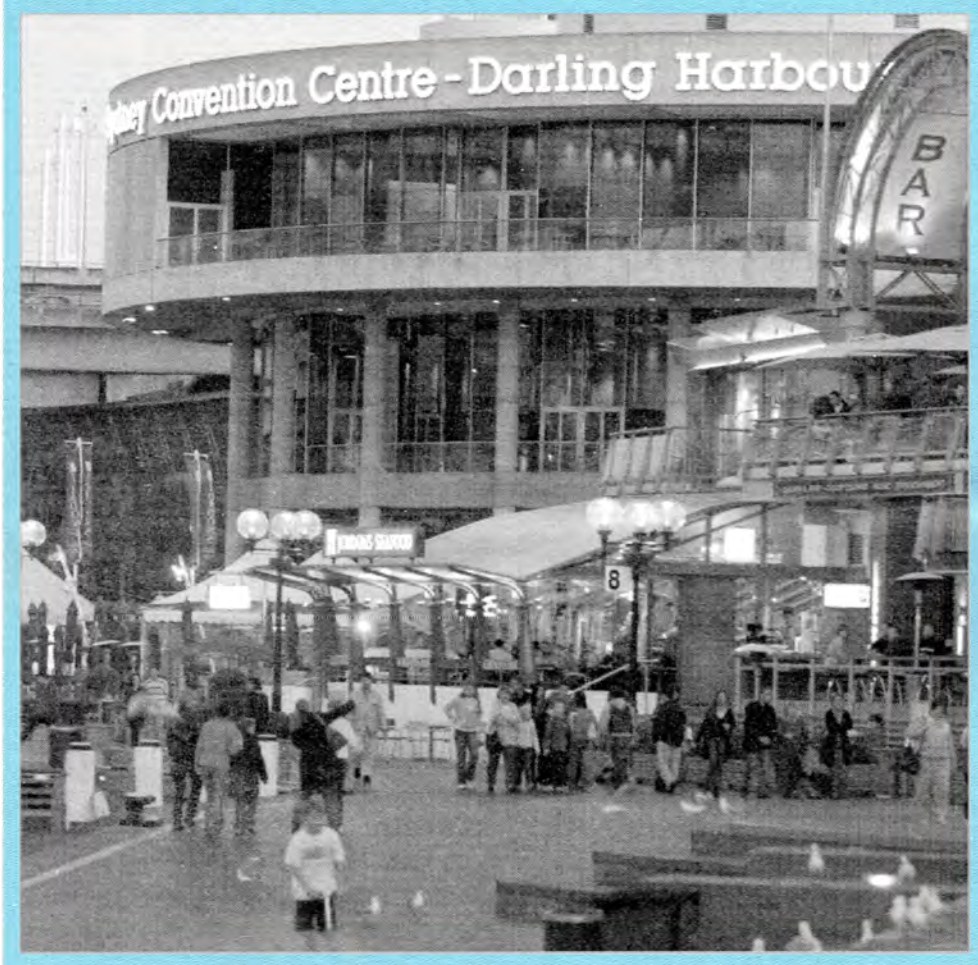
After ruling out the three possible origins of intergalactic HI clouds, it would appear that Briggs may be correct, and there are no intergalactic HI clouds at a redshift of 0.

What's Going On?

by Judy Lai

Welcome all! The time has come to participate in the XXV International Astronomical Union General Assembly. And once again, a range of exciting upcoming events have been planned for your entertainment.

A must-go event for all registered guests is the Welcome Reception and the Opening Ceremony which will be held at the Sydney Opera House. The presentation of the prestigious Gruber Prize for cosmology will take place here. Additionally, this iconic location is a fantastic opportunity for everyone, especially our international guests, to experience a piece of Australian culture.



For those of you who enjoy witty banter (OK, it's actually a debate), then consider heading off to the Harlequin Inn to watch Fred Watson and David Malin battle it out over 'Life, the Universe and Everything.'

Otherwise, you can just head off to the Astro Expo for a relaxing afternoon to browse through the displays, computer programs and websites, talks, demonstrations, 'Ask an Astronomer' and much, much more.

Listed below is a suggested list of highlighted events to keep an open eye for.

TUESDAY JULY 15

5:00pm	Welcome Reception commences
6:00pm	Opening Ceremony commences
7:50pm	First Session of the IAU General Assembly commences
Venue:	Sydney Opera House

WEDNESDAY JULY 16

7:00pm- 9:00pm	Science in the Pub
Venue:	Harlequin Inn, Harris Street, Pyrmont

JULY 21-27

All Day	Digistar 3 SP Planetarium
Venue:	Powerhouse Museum

FRIDAY JULY 18

10:00pm-4:00pm	Astro Expo
Venue:	Exhibition Hall 5

Introducing Common Causes of Confusion — from Working Group Designations

by Helene Dickel and Marion Schmitz

Much of the confusion in source designations found in current literature may be traced to failures in correctly formating the designation. There are two basic rules:

1) do not alter an existing designation, and

2) the general format for a new designation based on J2000 coordinates is acronym^JHHMMSS.s+-DDMMSS, where the coordinate part is based on truncated coordinates. The ^ stands for a required space.

For details, see the "IAU Recommendations for Nomenclature" at URL http://cdsweb.u-strasbg.fr/iau-spec.html

DROPPING DIGITS for an existing designation is a widespread problem.

At least in the title of your paper and when you first introduce a source designation, please write it out in full; do not drop digits to save space because others will not be able to find your source in the astronomical data bases such as NED and SIMBAD.

Be aware that "designations" that include coordinates are to be treated like proper names; therefore, they must not be changed even if the positions change or become more accurately known.

The Magellanic Times

THE NEWSPAPER OF THE INTERNATIONAL ASTRONOMICAL UNION GENERAL ASSEMBLY SYDNEY 2003

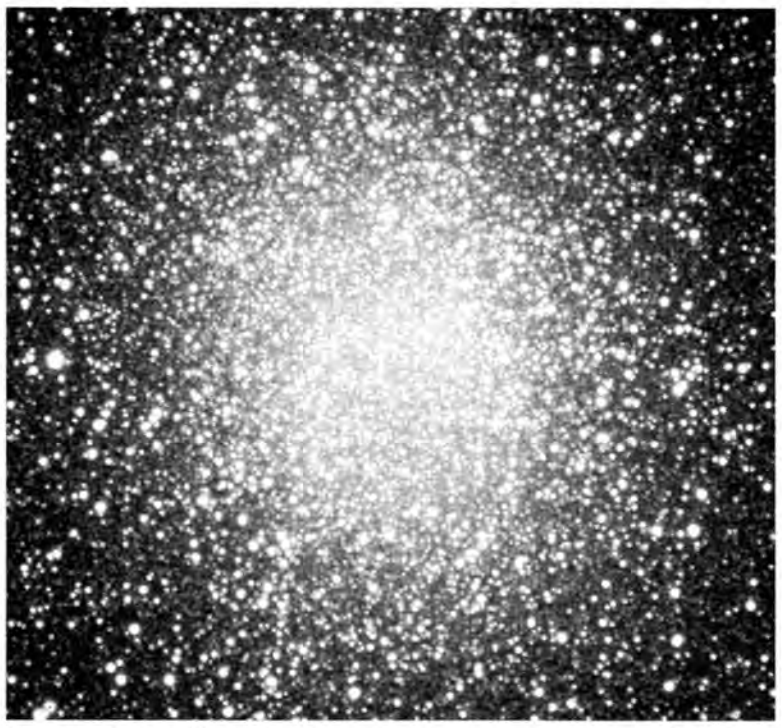
IAU IAUXXV General Assembly Sydney 13-26 July 2003

Day 3 **Wednesday 16 July**

A Very Special Globular

by Laura Stanford

Laura Stanford



Omega Centauri's good side

Omega Centauri is the largest globular cluster associated with our Galaxy. A globular cluster typically contains about a million stars, and orbits the Galaxy in the halo. There are about 150 globular clusters associated with the Milky Way. In most globular clusters, all the stars form from the same gas, and so have basically the same abundance of iron and other elements from star to star within a given cluster, although there are variations from cluster to cluster.

As a consequence of their repeated passage through the plane of the Milky Way, and the effect of gas blown out by asymptotic giant branch (AGB) stars and supernovae, star formation within a globular does not happen over an extended amount of time: all the stars are about the same age. Globular clusters are very old stellar systems, thought to have formed at very early times – about 13 gigayears ago. The constant iron abundance and age of each cluster can be seen in its colour-magnitude diagram – a plot of luminosity versus colour.

Omega Centauri is different from other clusters, as was first recognized from its color-magnitude diagram. It has a range in abundances for all elements studied (not only iron), although the studies so far have concentrated on the red giant branch (RGB) stars.

We have a sample of about 450 members of the cluster for which we've obtained photometry and spectra of Main Sequence Turnoff (MSTO) stars. The photometry was taken with the ANU's 40 inch telescope at Siding Spring Observatory (SSO), and the spectra were made with the Two Degree Field spectrograph on the Anglo-Australian Telescope, also at SSO.

We have shown that MSTO stars also exhibit a range of iron abundance, similar to that found in the RGB stars. We have also determined ages for our sample of MSTO stars, where the age sensitivity is the greatest on the colour-magnitude diagram. We have found in our analysis so far that there is an age range in the cluster of at least several gigayears, and that there is an age-metallicity relation in the cluster where the metal-rich stars are younger than the metal-poor ones.

This age range and age-metallicity relation has been suspected for this cluster for some time, but until now the evidence was less than compelling. Our stars are known members of the cluster, and having stellar spectra makes the abundance determinations more reliable than other means used heretofore.

This indicates that Omega Centauri formed differently to other globular clusters, although there is still speculation as to how this happened. A popular hypothesis is that Omega Centauri is a stripped nucleus of a dwarf spheroidal galaxy, where the small galaxy was ripped apart by the Milky Way – similar to what is happening to the Sagittarius Dwarf Galaxy now.

Did the Universe Have a Beginning?

by Anthony Aguirre

Anthony Aguirre in a steady state

Shortly after the expansion of the universe was discovered, cosmology divided into two camps. Supporters of the 'steady state' model held that the universe had no beginning, but instead always existed in the same state, with the creation of new matter counteracting the dilution caused by the universe's expansion. The opposing theory, the 'big bang,' held that the universe began at some finite time, expanding ever since. Both models made specific observational predictions, and the big bang model emerged victorious. The question of whether the universe had a beginning appeared to be definitively answered, and positively.

Soon, however, certain shortcomings of the big bang became evident. How, for example, did the universe start out so very uniform? And what was the origin of the remaining nonuniformity in the initial state that grew into stars, galaxies and other structure of the universe? Soon, a theory called 'inflation' (invented primarily by Alan Guth) emerged which appeared to offer answers. It holds that the initial phase of the universe consisted of an extremely rapid expansion that smoothed it out (while generating the required tiny density fluctuations necessary for the formation of galaxies.) This inflationary stage provided the required initial conditions for the 'big bang' that followed. This theory made a number of predictions that have been verified over the intervening years, and has become a necessary ingredient in the currently accepted standard model

continued on page two

Today's issue

The Magellanic Times

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Deadline for daily issues
1pm on the day prior to publication

Text files for publication may be emailed to john@strangeplanet.com.au

Printed by
Marrickville Print & Design
Ph: 1300 888 490

Red-Vested Volunteers

by Hoi Tak Leung

As you move around the Convention Centre for the IAU XXV, you may find yourself asking, who are those mysterious people in red vests that are wandering the conference, always willing to help and frequently assisting with various conference chores?

They are volunteers – the people behind the scenes that power the General Assembly along. Whether it be in the media room, setting up the audio visual displays in the auditoriums, distributing satchels, putting up posters, or guiding lost scientists to their rightful place in respective symposiums – you'll probably find that a red-vested person is in charge.

Why do they do it? For one thing, there's the matter of finances. Virtually all of these volunteers are students – in return for their laborious toils, they receive a significant financial discount on the registration fee. For Noel William-Jackson, a PhD student from University of Southern Queensland, the discount 'may mean the difference between attending and not attending – full time students frequently cannot afford the registration cost.' So what's a poor student to do? Volunteer.

More importantly however, the good ol' Australian tradition of volunteering – so famously exhibited in the 2000 Sydney Olympics – lives on. William-Jackson enjoys the personal interaction in volunteering immensely – 'I love helping people.' Randall Wayth – a PhD student from the University of Melbourne – has taken great pride in being the leader for the troubleshooting team that takes care of all conference problems – 'it's been highly enjoyable learning about organizing.'

The volunteers are also granted a level of behind-the-scene access that might otherwise not be available. Mr. Wayth was looking forward to mingling with 'some of the big knobs' of the conference; so was Isabel Perez – a post-doctoral student from the Australian National University – who was excited about mingling with like-minded people from the conference and being able to meet the organizing committee. This level of access alone makes the volunteering experience an extremely valuable one for the students – how often do you get to mingle with distinguished professors and scientists from esteemed institutions around the world?

Whether they be from near, somewhat near, or far (Perez has traveled to the conference as a volunteer from Holland), these volunteers are all immensely dedicated to the common cause of ensuring the IAU XXV is a successful one – for that alone, they should be applauded.

So, next time you see a red-vested volunteer running around, don't just wonder who they are – go up to them and congratulate them for their efforts. For our purposes at least, they make the world turn smoothly.

Randall Wayth points the way for Lanie Dickel

NSW Not for Sale

Recent efforts by the New Zealand government to purchase the state of New South Wales have been rebuffed, according to a recent report from Canberra. 'While the offer was attractive, plans to turn the lands abutting Jackson Harbour into the worldís second-largest sheep station were, in the end, unacceptable,' said the Land and Environment Minister. A secondary offer by New Jersey to purchase NSW is still under consideration.

Did the Universe Have a Beginning? continued from page one

of cosmology.

But inflation has a certain, and rather significant, side effect, which may have served to resurrect the 'steady state' model of the universe. Soon after inflation's invention, it was noticed by several theorists that in nearly all ways that inflation could occur, inflation would not, in fact, end for the entire universe at once. Instead, inflation only ends in certain regions, creating 'bubbles' of non-inflating universe that can evolve into regions like the one we observe. Elsewhere, inflation continues forever, continually spawning new bubbles indefinitely into the future. Thus the global picture of the universe resembles a steady state, where the continual creation of 'bubble universes' counteracts the expansion, just as in the classic steady state model.

This led to an obvious question: if inflation can be a steady state, why bother with a beginning at all? Although each 'bubble' may have a beginning, why not have the universe as a whole exist infinitely back in time, thus solving the vexing question of 'what came before the beginning of the universe.' However, no satisfactory model embodying this idea was developed, and in fact over the years several theorists proved theorems that purport to show that such a model was impossible. Recently, however, this seems to have changed. The most recent 'impossibility theorem' by A. Borde, A. Guth and A. Vilenkin prompted Anthony Aguirre and Steven Gratton to devise a model in which an inflationary universe does continue indefinitely back in time.

The approach of Aguirre and Gratton was to study mathematically what a steady-state distribution of inflating background and 'bubble universes' would look like. They discovered that while the universe did not have any beginning, it did have a sort of 'edge': a region of space-time that was not part of the 'known' universe, and could not be reached by anyone in it, yet nevertheless existed. So what was there? The answer turned out to be astonishing: another steady-state universe! Thus it turned out that the secret to making the universe not have a beginning was to require that the universe has an identical twin. Each region (both the original 'universe' and its twin) would constitute an infinite cosmology with neither beginning nor end, and neither region could communicate with the other, but only together would they form a mathematically self-consistent model for the universe.

Whether the cosmology of Aguirre and Gratton turns out to be satisfactory or not, one thing appears clear: the question of whether the universe has a beginning is still very much open.

New fast lane toward discoveries of clusters of galaxies inaugurated

by Marguerite Pierre

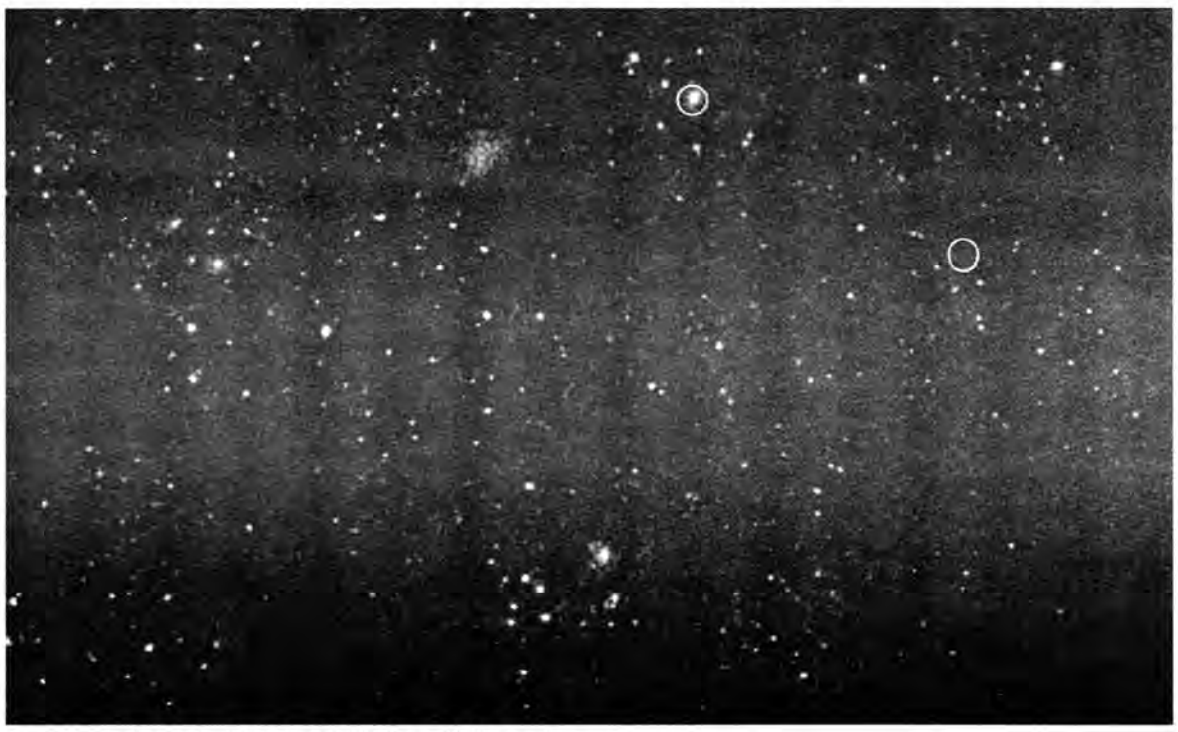
On the 14th of July 2003, a European and Chilean Consortium led by a French group issued a joint ESA/ESO press release presenting the first X-ray image of the deep universe on large scales. The goal of the project, known as 'The XMM Large Scale Structure Survey' (XMM-LSS) is to map the distribution of matter in the universe out to a redshift of unity, using clusters of galaxies and QSO's. The current sky coverage obtained by means of the XMM-Newton X-ray observatory is the order of 6 square degrees at a depth of ~5 10^{-15} erg/s/cm^2. The picture reveals more than a thousand new X-ray sources, showing a wealth of spectral properties. Most of these are (point-like) active galactic nuclei. But within this sample, we find a density of ~ 15 clusters per square degree showing extended emission.

The ultimate goal of the survey is to measure, for the first time, the cluster-cluster correlation out to a redshift of 1, in two redshift bins $0<z<0.5$, $0.5<z<1$. This requires some 900 clusters in total, thus an area of the order of 60-70 square degrees. Clusters of galaxies are the most massive objects in the universe and located at the nodes of the cosmic network, and are thus privileged cosmological tools. The XMM-LSS will enable constraining cosmological parameters in a unique way, as cosmological constraints provided by clusters are independent and complementary to those provided by CMD and SN observations.

Tracking down the clusters is a painstaking, multi-step process. In tandem with XMM-Newton, the team uses the four-meter Canada-France-Hawaii Telescope (CFHT), on Mauna Kea, Hawaii, to take an optical snapshot of the same region of space. Clusters are detected as extended sources in the XMM image using a sophisticated multi-resolution wavelet-based algorithm. When the program finds a cluster, it zooms in on that region and converts the XMM-Newton data into a contour map of X-ray intensity, which it then superimposes on the CFHT optical image. This is used to check if anything is visible within the X-ray emission. If it is, the work then shifts to one of the world's largest telescopes, the European Southern Observatory (ESO) Very Large Telescope where the astronomers identify the individual galaxies in the cluster and take redshift measurements.

Such a technique using moderated telescope time (10,000 second XMM pointings, 3 hours for VRI imaging at CFHT and 2 hours with FORS2/VLT) has proven very successful for detecting clusters, measuring their redshift and obtaining an estimate of their velocity dispersion out to a redshift of 1. The XMM-LSS truly opens a new era for probing large volumes of the distant universe.

The presented results were obtained by the XMM-LSS consortium, led by Service d'Astrophysique du CEA, PI Marguerite Pierre, (France) and consisting of Co-I institutes from the United Kingdom, Ireland, Denmark, The Netherlands, Belgium, France, Italy, Germany, Spain and Chile. The home page of the XMM-LSS project can be found at: http://vela.astro.ulg.ac.be/themes/spatial/xmm/LSS/index_e.html



First image from the XMM-LSS Wide Field X-Ray Survey

Division Structure Complete!

by Virginia Trimble

Six years ago, the IAU began reorganizing itself with about 10 divisions, representing large swaths of astronomy in addition to, and perhaps someday instead of, about three dozen Commissions responsible for smaller territories. Some cases were easy – high-energy astrophysics and astronomy from space merged as Division XI. Planetary Systems coalesced into Division III. And so forth.

But Commission 6 remained reporting directly to the Executive Committee because their work was relevant to the entire Union, not just one subfield. These have now been assembled into Division XII, with Union-wide Activities as its working name, and a small prize offered for a better one. The member commissions and their presidents are:

5 F. Genova (France)
6 K. Aksnes (Norway)
14 S. Johansson (Sweden)
41 A. Gurshtein (Russia)
46 J. Pasachoff (USA)
50 M. Smith (Chile)

and they, together with the former members of the Executive Committee, Johannes Anderson (Denmark) as Vice President, and Virginia Trimble (USA) as President, will be proposed as the initial Division Committee. It is hoped that the ill luck that might be associated with being Division 13 will now bring this process to a natural halt.

Women in Astronomy Meeting (WAM) Monday 21 July

by Anne Green and Sarah Maddison

The IAU XXVth GA Women in Astronomy Meeting luncheon will be held on Monday, 21 July. The WAM will run from 12.30 pm to 2.00 pm, and all IAU delegates are invited. The meeting will be held in the Skyline Terrace on Level 3 of the Convention Centre North.

The keynote speaker is Dr Andrea Dupree (CfA), who will give a summary of the Women in Astronomy II meeting held in Pasadena late June, 2003. The focus will be on the current status of women in astronomy since the 1992 Baltimore Charter and to recommend future action that will improve the environment for all astronomers. Breakout groups of 10-12 will discuss various issues over lunch and then report back at the Plenary Session at the end of the meeting. One of the goals of the WAM is to establish an IAU Working Group on the status of women in astronomy.

There is no registration fee for WAM, but registration is required for catering purposes. There is a limit of 200 attendees, so please be sure to register to avoid disappointment! You can do this at the Registration Desk by midday Friday, 18 July.

Supernovae Blow Themselves a Place in the Union

by Virginia Trimble

Do you think that supernovae were discovered (a) in one million BC by a Zinjanthropan named Og (who saw one, but neglected to write a paper about it), (b) in 1572 by Tycho Brahe (who also saw one, and did publish the result), (c) in 1920 by Heber Doust Curtis (who said 'a division of the novae into classes may not be impossible,') (d) in 1932 by Kurt Lundmark (who coined the name), or (e) in 1933-34 by Walter Baade and Fritz Zwicky (who suggested neutron star formation as the energy source)?

Your choice. But you are not allowed to doubt that, ever since, supernovae have come to seem more and more important in the astronomical scheme of things. That importance is reflected here in Sydney by special sessions on the connection between supernovae and gamma ray bursters on the morning of Friday, 18 July; by the re-establishment of a Working Group on Supernovae during Sessions 3 and 4 on Monday, 21 July; and by an assortment of relevant talks in Symposia 217 and 218 and several Joint Discussions.

Supernovae do many things for us. The core collapse sort (Types II, Ib, and Ic) are a major source of neutron-rich, heavy elements. The nuclear explosion sort (Type Ia) are an important source of iron. Both types distribute oxygen, silicon, sulfur and other materials through the Galaxy, and help to regulate star formation by heating, stirring, and sometimes compressing interstellar gas. Some produce pulsars and other neutron stars and probably, black holes. They are the energy source for acceleration of cosmic rays (though only Enrico Fermi knows exactly how this is done.) Some are good distance indicators. And of course, they help to keep astronomers and astrophysicists employed and off the streets.

Supernovae are common (a few per galaxy per century) and gamma ray bursts are rare (perhaps one per galaxy in 10 million years.) Yet there seems to be an intimate connection. This was hinted by SN1998bw, though

Virginia Trimble explodes across the page.

the supernovae was anomalously bright and the gamma ray burster in the same galaxy at the same time was anomalously faint. And just a few months ago, GRB 030329 came to look, in spectrum and light curve, more and more like a fairly normal supernova just before it faded from sight. The talks Friday morning will highlight both observations and physical mechanisms, as will Invited Discourse 1 by Shrinivas Kulkarni.

Why is there going to be another supernova working group? The first one was organized in the 1950's by Fritz Zwicky to coordinate photographic searches for them, and died with him in 1972. The second (1982-9) had as its primary goal to promote follow-up studies of mostly serendipitous discoveries, and to try to keep the community prepared to take advantage of a nearby bright one, just in case. The Working Group voted itself out of existence because SN1987a had made us all so supernova-conscious that it didn't seem to be needed.

The third incarnation of the Working Group on Supernovae, being coordinated by Wolfgang Hillebrandt (Germany) and Brian Schmidt (Australia), has all the old goals and more. Planned searches now find several hundred events per year, some of them very faint. To extract statistical information from these on rates, types, and parent populations, we need to know accurately the coverage in time and space of each search. The desire for follow-up is beginning to lead to harsh competition for ground and space telescope time by groups whose goals are really the same, and who could well use each other's data if it were archived and available in one place. The creation of such an archive is a new goal. Another is the provision of rapid alerts of new events, for which the GRB circular might be a model.

Finally, calculation of pre-supernova evolution of stars, of collapse and nuclear explosion mechanism, and of expected light curves and spectra have become both complex and numerous. These are needed, for instance, to extract nucleosynthetic information from the temporal development of SNII spectra, and to use Type Ia supernovae as 'standardizable candles' for cosmological applications. It is intended to provide a central accessible archive of such models, as well as data, for general community use.

Mad, Rad, and Dangerous to Eat

by Seth Shostak

Its name sounds like something that infests backyard gardens, but in fact Vegemite is well-known as Australia's favorite condiment. You can find this black, tarry substance at any convenience store or military depot, and the facts are that no self-respecting Aussie battler would fail to have several gallons stored at home or in the tray of his ute.

Originally developed as a synthetic lubricant during the Boer War, Vegemite acquired a following when it was accidentally mistaken as a sandwich spread due to the local mispronounciation of 'mayonnaise.' Nearly every Australian school child has been raised on bread and Vegemite, a fact often cited to explain exam results.

You may wish to essay this local delicacy, to better appreciate the Aussie culture. To make sure that you don't commit a major social offense by misusing this down-under wonder, we have listed the principal applications of Vegemite below:

Internal

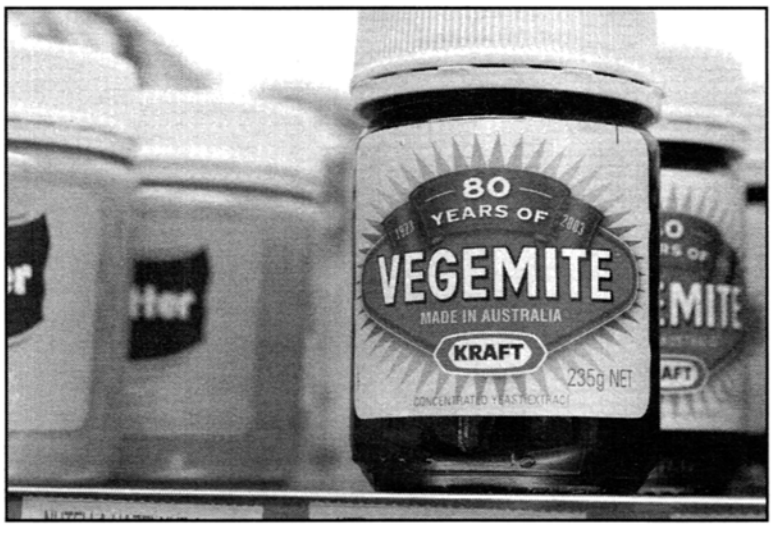
- On bread, spread to a thickness of 2 – 3 cm.
- Straight out of the jar, using either a large spoon or tongs.

External

- Spread over the body to discourage annoying insects.
- Bicycle chain lubricant.
- Antiperspirant.

Industrial

- Bearing grease for large telescopes.
- Pickling steel.
- Slowing neutrons in reactors.



Ghosts of Galaxies

by Gareth Kennedy

The formation of galaxies has provided us with many beautiful images of the universe in action, but not everyone wins in this scenario.

When a cluster of galaxies merges, the large galaxies accrete to form a larger galaxy. However, any small galaxies in the neighborhood become tidally disrupted, torn apart into filaments, or just left as puddles of light. It is these shredded remains that form a population of ghost galaxies, thought to exist around galaxy mergers in clusters and groups.

Unfortunately for astronomical 'ghost-busters' such as Michael Gregg (University of California) these elusive ghosts become completely dispersed relatively quickly. This, combined with the low luminosity of these objects, makes these ghosts very difficult to detect.

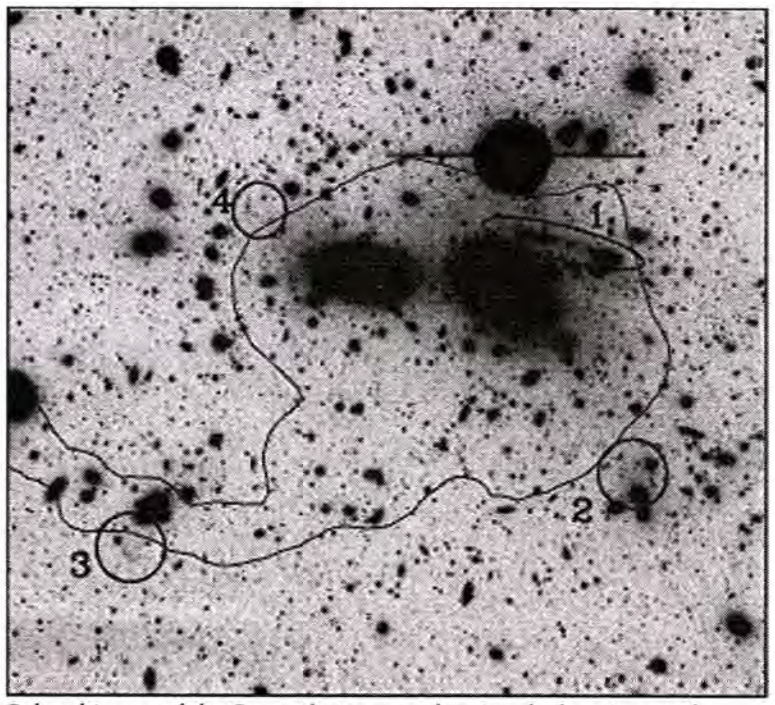
One of the first signs of these ghosts was detected as a dim plume observed in Centaurus just below the galaxy NGC 4709. When it was observed, there were only two ghost galaxies known, but as Michael Gregg commented, in astronomy if you 'find one it's an anomaly, if you find two it's a population.' Luckily, the rest of the population has begun to show itself, particularly between z = 0.1 and 0.2.

What has been observed so far is that these ghosts can be seen as plumes, or diffuse clouds. The plumes are typically seen as a straight or slightly curved line across the sky, near their parental galactic maker. The diffuse clouds observed typically surround their parent galaxy and appear as a dim halo.

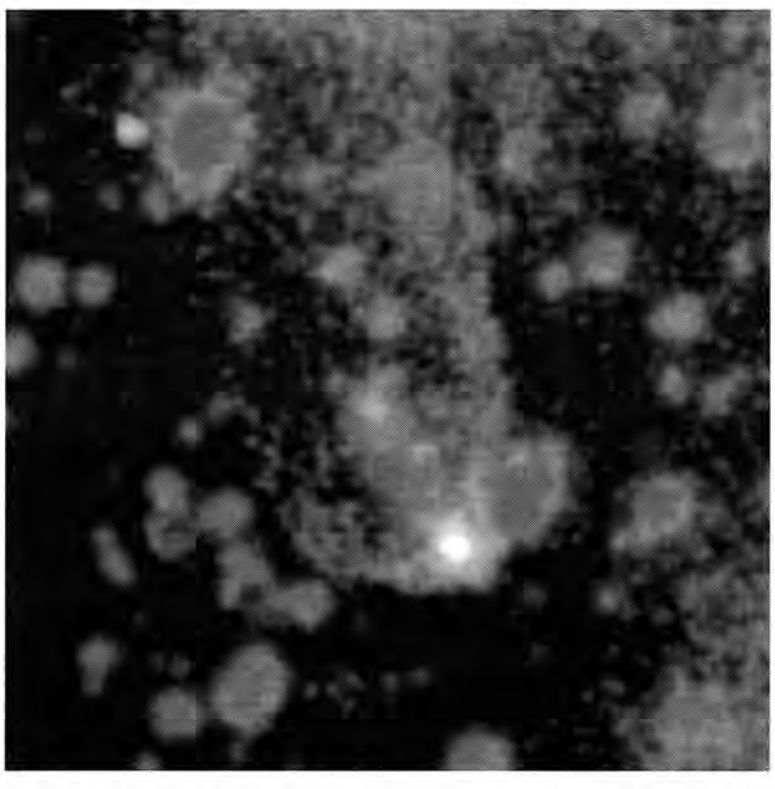
The diffuse plumes are of particular interest. Objects observed in these regions seem to have similar luminosities and metalicities to those observed in globular clusters (GCs), while others are closer to ultra-compact dwarfs. This leads to the possibilities that these plumes may form unbounded GCs in the intracluster medium.

These remnants of galactic collisions are thought to contribute to the formation of dwarf galaxies, as well as to the continued building of the large parent galaxy that caused their original death.

These ghosts give us a tantalizing glimpse of a more chaotic period of our universe, when galaxy clusters began to form.



R-band image of the Coma cluster core showing the locations and approximate sizes of the low surface brightness features (heavy solid circles labeled 1-4) discussed here. The image is 37' x 33'; north is up, east to the left. The thin solid line is one X-ray contour from ROSAT observations showing the extended ridge which includes LSB-3.



Credit: X-ray: NASA/CXC/ASTRON/B.Stappers et al., Optical: AAO/J.Bland-Hawthorn & H.Jones

A New Era in Studying Pulsars and their Winds

by Alan Peyaud

With the high quality X-ray data from Chandra that has become available these last few years, astronomers have had the possibility to better understand the busy life of pulsars and see some features that optical telescopes were unable to resolve.

As pulsars slow down while traveling, they dump their energy into a relativistic wind, forming what is called a Pulsar Wind Nebulae (PWNe). These PWNe have a distinct bow-shock-like structure shaped by the pulsar traveling at high speed with respect to the ambient medium.

Pulsars Wind Nebula are one of the best objects for the study of ultra-relativistic outflows and the interaction of relativistic flow with thermal matter. 'The detection of a pulsar in the Crab Nebula demonstrated that young neutron stars can interact with their environments in spectacular fashion, their relativistic winds generating nebulae observable across the electromagnetic spectrum,' notes Bryan Gaensler from the Harvard-Smithsonian Center for Astrophysics.

The study of Pulsar Wind Nebulae is a valuable opportunity for the investigation of similar physical phenomena in other classes of sources. These interstellar probes share similarities with such astronomical phenomena as gamma-ray bursts, micro-quasars and AGN jets.

Frenk Warns Astronomical Survey May Be Australia's Last Big Splash

by Anthony Flynn

Mexican born, Professor Carlos S. Frenk BSc Physics, MA, PhD (Cantab), FRAS holds the prestigious position of Ogden Professor of Fundamental Physics at the University of Durham. He is also involved in the 2dF Galaxy Survey.

Funded by CSIRO and PPRAC, this is a major new UK-Australian redshift survey which takes full advantage of the unique capabilities of the 2-degree field, Anglo-Australian Telescope (one of the largest telescopes in the world) located in Coonabarabran, NSW Australia.

The Two Degree Field (2dF) system is arguably the world's most complex astronomical instrument. It is designed to allow the acquisition of up to 400 simultaneous spectra of objects anywhere within a two degree field on the sky. It consists of a wide field corrector, an atmospheric dispersion compensator, a robot gantry which positions optical fibres to 0.3" and two spectrographs each of which accepts 200 of the fibres to produce low to medium resolution spectra. A tumbling mechanism with two field plates allows the next field to be configured while the current field is being observed.

Yesterday, Frenk presented an exemplary seminar: *Groups and Clusters of Galaxies*. This presentation focused on the construction and early analysis of groups and clusters constructed from the 2dF Galaxy Redshift Survey. He outlined the goal of this survey, which is to secure high quality spectra and redshifts for 250,000 galaxies brighter than bJ=19.45 (extinction-corrected), with a deeper extension to R=21 making best use of good conditions. Frenk presented survey findings for the statistical properties as a group population and for the galaxy content of groups as a function of their mass and luminosity.

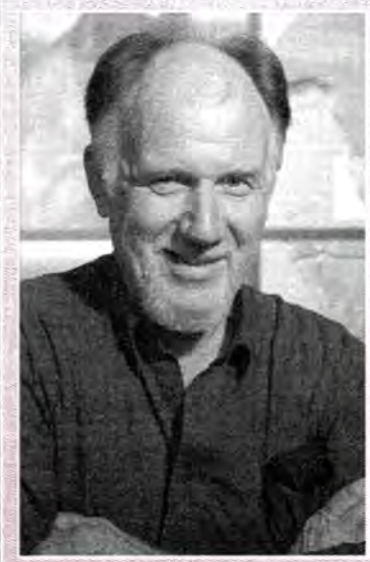
There have now been nearly six years of scheduled 2dF observations. After many years of hard development work, 2dF is probably AAO's greatest achievement. Frenk noted that 'we have now finished the 2dF Galaxy and QSO redshift surveys, both extremely successful projects – this is undoubtedly Australia's largest contribution to astronomical research ever.'

Asking about future research, Frenk expressed concern and disappointment that due to the lack of Government funding, this survey is likely to be 'Australia's last big splash in the field of astronomy unless policy changes.'

Carlos Frenk considers the future.

Preserving Space

by Anthony Flynn



John Campbell

It's not often that two, apparently unrelated scientific disciplines come together, but John Campbell of James Cook University has managed to intermingle two of his passions, archaeology and astronomy. Originally schooled in archaeology, Campbell is one of the leading scientists in the field of archaeo-astronomy.

With the success of the Apollo 11 mission, one of humankind's most historic sites was created. It wasn't founded on the plains of the American Midwest, on the shores of Great Britain, nor within the crumbling walls of ancient Rome. It was created on the moon. Humans were actually on another planet. Because this base is so historic and because some private companies have recently announced plans to return to the Apollo lunar landing sites, archaeologists and historians have begun to research the possibility of applying historic preservation laws to those sites. The United Nations' Outer Space Treaty clearly states that a country that sends objects into space, onto the moon, or onto other celestial bodies does not lose jurisdiction or ownership over those objects. This means that the United States still owns and has jurisdiction over the objects left at each of the Apollo lunar landing sites.

So are we going to start preserving space junk? Not quite. Rather, the idea behind this new area of study focuses on preserving artifacts and sites that are of historical significance.

So are we going to start preserving space junk? Not quite. Rather, the idea behind this new area of study focuses on preserving artifacts and sites that are of historical significance.

'We are creating heritage – present day archaeology – heritage in space.'

The Local Structure of the Universe

by David Frew

University of Hawaii astronomer Brent Tully presented the results of his ongoing survey of the local structure of the Universe at the GA yesterday. All in the audience were impressed by the detailed interactive maps revealing the large-scale structures present in the local universe.

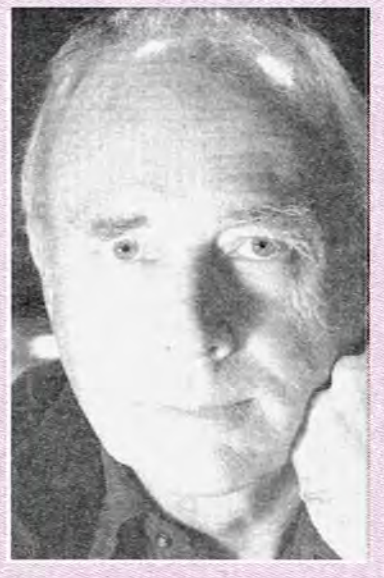
Tully has been working on the problem since the 1980s and has recently turned to new software to visualize the distribution of galaxies over scales of several hundred megaparsecs. Tully used the 3-D interactive data tool, Partiview, developed by Stuart Levy at the National Center for Supercomputing Applications (NCSA) at the University of Illinois. The audience was first treated to an overview of structure within a volume out to 0.14c, based on data from the Sloan and 2dF redshift surveys, before looking in detail at the 30,000-or-so galaxies in a cube 16,000 km/s across centered on the Milky Way. Large scale features such as the Great Wall, Perseus-Pisces supercluster and the Pavo-Indus sheet were clearly seen in the sample. 'This sample doesn't have well defined selection criteria, but gives us detail that is unavailable in the deeper surveys,' says Tully.

Tully used several direct techniques to obtain distances to some of the nearest galaxies in this sample, including Cepheid variables and the tip of the red giant branch (TRGB) method, and for more distant galaxies, a variety of secondary distance methods including the SBF method and the Tully-Fisher relationship, which he pioneered three decades ago. This allows Tully to study peculiar velocities and large-scale flows, and to better understand the influence of the Great Attractor.

'The bulk density in the local survey is higher than the density shown in the Sloan survey or 2dF,' says Tully, but this is a selection effect as the most numerous dwarf galaxies are not detected in the mid-range surveys, and are instead restricted to the brightest portion of the galaxy luminosity function.

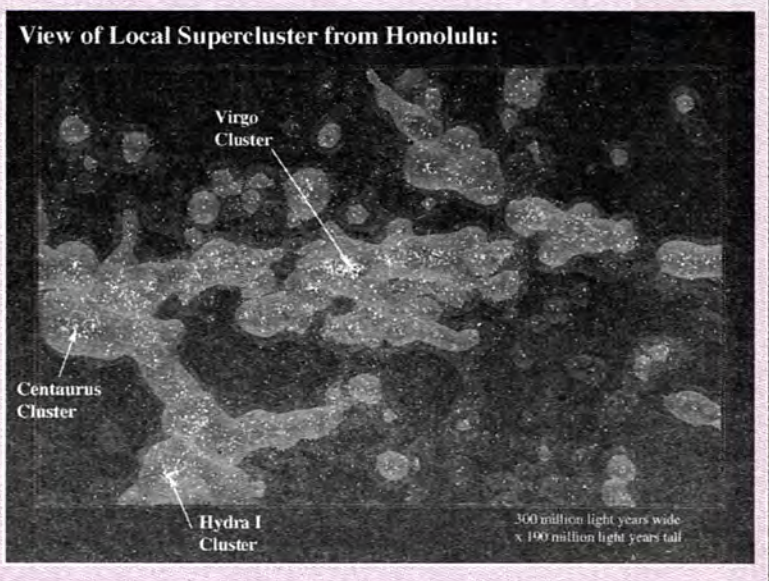
One of the most intriguing features is the Great Attractor, a mass concentration in the southern sky, which is perturbing the Hubble flow over an enormous volume of space. It seems to be a more extended structure than previously thought, and comprises several galaxy clusters including the Centaurus and Hydra clusters at 4,000 to 5,000 km/s and the rich Norma cluster (Abell 3627) at about the same distance. The 'Local Supercluster', centered on the Virgo group is an extension of this larger filamentary structure.

On the same line of sight as the Centaurus cluster is the more distant Shapley Concentration at cz = 15,000 km/s, and which influences the motion of galaxies over a large volume. It



is the most massive concentration in the nearby universe, and is comprised of at least 30 rich galaxy clusters, each as rich or richer then the Virgo cluster. The CMBR dipole is largely explained by this overall concentration of mass, centered in the southern sky and partly hidden in the optical by the galactic plane.

Tully states that most of the collapsed mass in the universe is concentrated in the rich galaxy clusters, while the visually obvious filaments and sheets are 'just frosting that look great' in the simulations. The rich clusters are the main cause of large-scale flows, with galaxies streaming toward these concentrations on scales of 10 to 30 Mpc, while the more extended sheets and local flows in the filaments connecting them are much quieter, with velocities typically less than 50 km/s.



Clockwise from top left:
Brent Tully concentrates on concentrations;
The universe according to Tully;
The rich galaxy cluster Abell 3627, at the heart of the Great Attractor, is revealed in this deep image taken at ESO.

Endless Voids Not So Empty After All

by Gareth Kennedy

Recent observational results of the local galactic group and of the Virgo cluster have shown the presence of diffuse light in the 'middle of nowhere.'

These new results represent a breakthough both in our understanding of galactic formation and in the power of our telescope technology. Until recent observations by HST and the new generation of large optical telescopes, the question of what existed in the region between galaxies remained both literally and figuratively unresolved.

It now seems that the contribution to the light received from these diffuse sources is much higher than previously thought, ranging from 1% to 50% of the total light of the galactic cluster according to Magda Arnabold of INAF and the Observatory of Turin.

We now know that these regions consist of moderately old stars, with moderate metallicities. We also know that these regions can give rise to supernovae, and hence planetary nebulae (PNe), although it is still a matter of debate as to whether these objects formed locally or not.

The PNe observations presented by John Feldmeier (Case Western Reserve University) detail the importance of these objects in relation to the dynamics of these diffuse light producing regions. By using a precise emission line present in all PNe spectra we can accurately measure the radial component of the velocity. In addition PNe have a well studied luminosity function allowing us to use them as 'standard candles' to give us distances. By combining these we can obtain reasonable dynamics of the regions they occupy, including these intracluster diffuse light sources.

The general theory of the formation of these diffuse sources is as follows: Begin with multiple large galaxies, and a scattering of smaller galaxies. The large galaxies will interact to form a yet larger galaxy. The smaller infalling galaxies typically become tidally disrupted, leaving trails and puddles of debris in the local region. It is this debris that is thought to contribute the material for these diffuse light sources.

This theory can be checked by the use of N-Body simulations based on the initial conditions provided by standard ΛCDM by comparing the fraction of diffuse light to ordinary light predicted by the model with the observed fraction. Preliminary results from this method have so far shown excellent agreement.

Sydney Observatory: Another Local Focus

by Morris Jones

An astronomer in Sydney should take some time out to visit the local observatory. Admittedly, Sydney Observatory has not been used for professional astronomical observations for many years, but the place demonstrates how important astronomy has been to the development of this city.

An historical building with lovely sandstone architecture, a tour through the gardens is worthwhile on any day. The view of Sydney is also spectacular from this hill-top location.

Inside, the observatory functions as a museum for the history of Astronomy in Australia, and a reminder of astronomy's importance as a navigational science before GPS was introduced. Sydney is a harbour city, and the observatory features a time ball that was used by sea captains to calibrate their chronometers.

The Observatory can be explored as part of a tour through The Rocks, the historic old part of Sydney that surrounds it.

And the winner is Sydney... again

by Judy Lai and Debbie Ng

Does the phrase 'Sydney wins' sound familiar? No, we're not speaking of competition for an Olympic site. Instead, this time our 'little' city of Sydney has been chosen to host the XXV International Astronomical Union General Assembly. An odd choice you might think, considering that larger cities (for example, Moscow) are internationally renowned for their outstanding astronomical research centers. But this is not to say that Sydney was a hopeless match against these 'major competitors.' So, let's consider the question of, why Sydney?

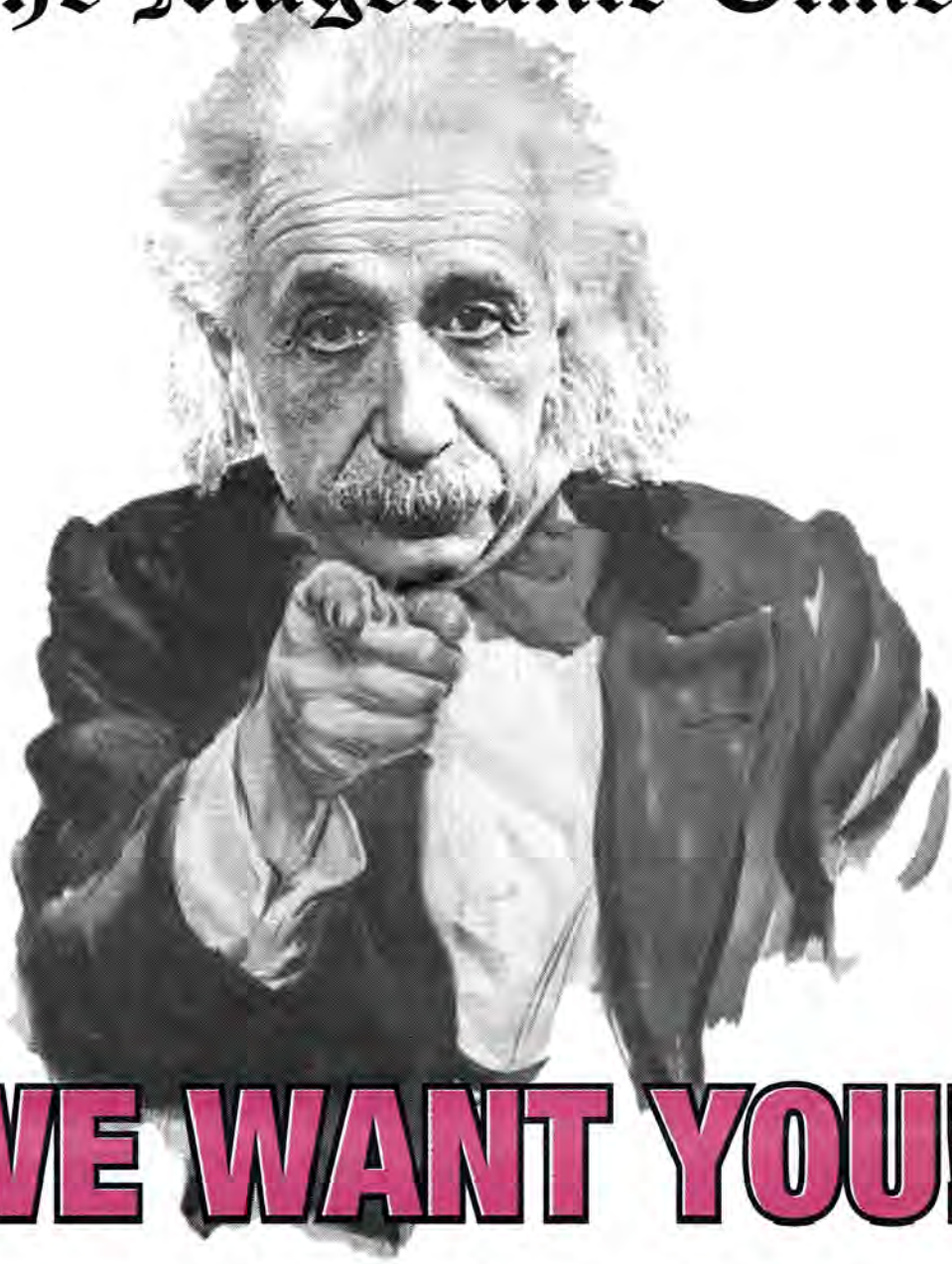
First, Sydney offers the tantalizing possibility of hosting the Opening Ceremony at the Sydney Opera House – a true-blue national icon. And there's Sydney's wonderful personal hospitality, with friendly faces and many a 'g'day, mate' to make visitors feel their presence is appreciated.

'I think hosting the event here was a fantastic idea because Sydney has an exceptional reputation for organizing large-scale events. Just look at the Olympics and how successful they were,' notes Assembly participant Carlos Frenk. 'I feel privileged to be here in Sydney because I know that the IAU GA will be organized with the highest level of professionalism.'

However, the Australian culture is more than meets the eye. Sydney proudly holds the title of being the world's most multicultural city. As this event unites astronomers worldwide, our multicultural environment is important in that it enables our international guests to feel home away from home. For example, an oriental meal can be had just around the corner from the Convention Centre in Chinatown. Or guests can head to The Rocks for an Old English experience.

And speaking of history, the Southern Cross is predominantly displayed upon the blue, red and white Australian flag. The significance of placing the Southern Cross on the Australian Flag is that it represents the unique spiritual connection Australians have with astronomy (ok, so that's an exaggeration). But seriously, Andreas Corsali, an Italian navigator, once described the constellation as being 'so beautiful that no other heavenly sign may be compared to it.' The same could be said of Sydney.

The Magellanic Times



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THE NEWSPAPER OF THE INTERNATIONAL ASTRONOMICAL UNION GENERAL ASSEMBLY SYDNEY 2003

IAU XXV General Assembly Sydney 13-26 July 2003

Day 4 **Thursday 17 July**

Constant Conundrums

by Tamara Davis

A famous Albert once said: 'What really interests me is whether God had any choice in the nature of his creation.' One of God's choices may have been the values of the fundamental constants of nature, such as c, the speed of light, e, the fundamental charge on the electron, G, Newton's gravitational constant and Planck's constant.

These are features of nature that are traditionally assumed to be fixed and universal, their values determined not by fundamental theory but empirically. Recent developments in string theory and other attempts to unify the forces of nature hint that some of these 'constants' may not be god-given and fixed after all, but determined by physical processes. If so, it makes sense to ask whether or not some of these quantities may vary with time or physical environment.

However, for this hypothesis to be meaningful, care needs to be taken with the definition of which parameters are fixed for the purpose of specifying a system of units. The above parameters all have units defined somewhat arbitrarily on historical grounds. These quantities may be combined in various ways to form dimensionless ratios – pure numbers. One of these is the so-called fine-structure constant. You'll read elsewhere in this newspaper about recent astrophysical evidence that suggests a possible increase of the fine-structure constant over cosmological time scales. (Or alternatively, a larger fine-structure constant in the environment of the quasar absorption systems observed.) Loosely speaking, this result could be expressed either as a varying speed of light, a varying electric charge or a varying Planck's constant. On the basis of the quasar observations alone it is not possible to discriminate among these three interpretations.

A key point to remember is that all scientific measurements involve some sort of dimensionless ratio or comparison. For example, a person's height is a ratio of the size of their physical body to a standard unit of length such as the meter. When it comes to the speed of light, we have to decide what standard system to adopt for comparison. Fundamentally, it is impossible to distinguish between a varying speed of light and a variation in the length and time standards one is adopting. In fact, today our standards of length and time are both defined in terms of the speed of light, which by definition is assumed to be constant.

Several candidate theories have been published in which either the electric charge, e, or the speed of light are considered to vary. These theories make different predictions, and can therefore be distinguished by observations. It is indeed meaningful to ask whether a varying c theory is valid, because it contains within it the assumption that all else is constant, and therefore a variation in c has a clear background against which it can be measured.

On closer inspection, it turns out to be possible to re-cast say, a varying-c theory as a varying-e theory, but only at the expense of considerable complication in the description. The choice of which theory to use is merely an issue of simplicity. A simple varying speed of light theory, in which the only parameter that varies is c, can be converted to a very complicated varying electron charge theory, in which many other parameters vary as well.

This 'duality' does not affect our ability to discriminate between different varying-c theories. Ultimately, such contending theories must be distinguished on the basis of how well they agree with experiment and observation. For example, a theory in which the speed of light starts out infinite at the big bang and falls steadily toward zero will differ in its observational predictions from a theory in which the speed of light merely declines by a small amount at some cosmological epoch. To the extent that the recent observations of a varying fine-structure constant are reliable, the results would favor the latter theory over the former.

While we might like the idea of constants in Nature, it remains to be seen whether Nature agrees.

The fine structure of Tamara Davis

Do constants change

by Michael Pracy and Mathew Coleman

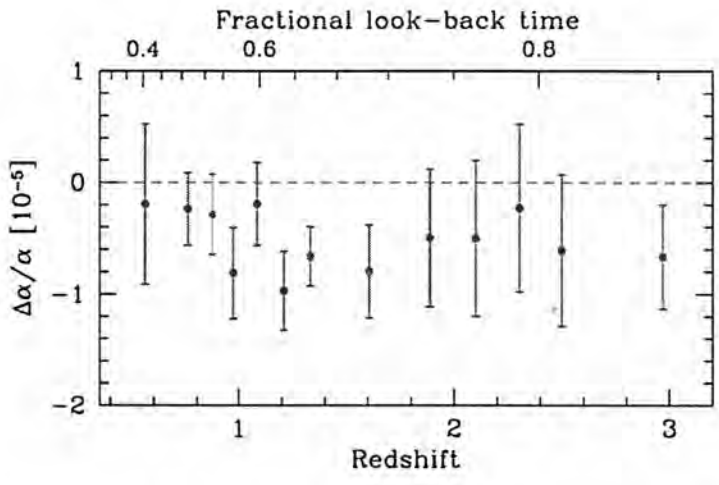
Michael Murphy & John Webb

In an IAU presentation next week, John Webb will present the latest results from efforts by his UNSW research teams to measure possible variations in the fine-structure constant. These results may change scientists' understanding of fundamental physics.

The fine-structure constant is the central parameter in electromagnetism, and equal to $\alpha = e2/hc$. It is a measure of the strength of the electromagnetic interaction, and it quantifies the strength with which electrons bind within atoms and molecules.

Since 1999, John Webb and his UNSW team, together with international collaborators, have obtained high-resolution spectra for over 100 absorption systems at various redshifts using the HIRES instrument on the 10 m Keck telescope. Distant quasars illuminate these intervening systems, thereby producing absorption lines and allowing scientists to measure the transition energies of a certain ionic species. The value of α determines the precise energies at which these transitions occur.

Previous researchers only utilized the two transitions of alkali doublet absorption lines. But Webb's team took a different approach: they developed a new method utilizing absorption lines from many different ions (eg. Fe, Mg, Cr, Zn, Ni, Si, Al). This allows them to measure α in the absorbing clouds to an order of magnitude better precision. Team member Michael Murphy states 'if α is different in the clouds, this will produce a distinct pattern of shifts in the absorption lines and it's this pattern we search for.' This allows the team of scientists to make a measurement of α at various epochs of the universe.



Their results are very surprising: α seems to be one part in 200,000 smaller in the absorption clouds than is measured on Earth. The clouds cover a huge redshift range, corresponding to look-back times of 20-85% of the

continued on page two

The Magellanic Times

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Deadline for daily issues
1pm on the day prior to publication

Text files for publication may be emailed to john@strangeplanet.com.au

Printed by
Marrickville Print & Design
Ph: 1300 888 490

Eta Carinae Enters Its Minimum!

by Ted Gull

On June 29th, just before the 25th International Astronomical Union General Assembly began, Mike Corcoran announced in IAU telegram 8960 that, based upon Rossi X-Ray Telescope Explorer monitoring, Eta Carinae with a 2,022 day period had entered the current minimum.

Astronomers around the world are monitoring this Luminous Blue Variable star as it, and the expanding ejecta known as the Homunculus, go through dramatic changes throughout the electromagnetic spectrum. RXTE is monitoring the X-Ray flux daily; Chandra is obtaining X-Ray spectroscopy. The Hubble Space Telescope (HST) is providing images and spectroscopy in the ultraviolet and visible portions of the spectrum. The Far Ultraviolet Spectrographic Explorer (FUSE) is obtaining spectra down to 900A. The Very Large Telescope Ultraviolet/Visible Echelle Spectrograph (UVES) is monitoring Eta Carinae and the nebular scattered light.

Just why is Eta Carinae so interesting to astronomers? Well, it's a very massive star (and likely a binary based upon the 5.52-year period), thought to be about 110 solar masses with a mass loss rate equivalent to the mass of our Sun every few thousand years. It is going to be a supernova. Some suggest that it could be a progenitor for a gamma ray burster. (Yes, Australia, it could be quite a show when it goes, but don't hold your breath as it's likely to be a few thousand years in the future!) Moreover, the 5.52 year period appears to be driven by the ultraviolet source being obscured for several months. The surrounding ejecta relaxes in excitation during that time. Indeed Eta Carinae is an atomic spectroscopist's laboratory.

In the 1840's, Eta Carinae (or Eta Argus as it was known then) brightened to be second only to Sirius in apparent magnitude. Over the following years it faded. By the 1940s, astronomers knew that a nebulosity had formed around the star. Gaviola did a decade-long systematic spectroscopic and imaging study, which he published in the early 1950's. Because the nebular shape, with a few arcsecond seeing, vaguely appeared to be humanoid in character, he named it the Homunculus (or little man). Thackeray, and colleagues, published many papers identifying and discussing the abundant emission lines in the visible spectrum. Many lines, such as the hydrogen Balmer lines, had P-Cygni profiles, but in addition, included relatively narrow nebular lines. In the 1980's, Australia's own John Hillier did a thesis on the spectrum of the Homunculus, determining that it was primarily a bipolar reflection nebula.

Often people could not even agree on the spectral type of the star, as the spectra seemed to change unpredictably. As an example, many spectra were recorded by the International Ultraviolet Explorer from 1978-1986. Kris Davidson and Ted Gull observed Eta Carinae in 1981 and spent an entire eight-hour shift confirming that indeed the star they had set upon was Eta Carinae. Peculiarly, all emission lines in the ultraviolet simply were not present. Most other spectra recorded throughout the 18.5 year lifetime of IUE did show these lines. It was not until last summer, that Ted realized they had accidently observed Eta Carinae in a spectroscopic minimum!

In the mid-1990's, Augusto Damineli did a very methodical study of ground-based spectra and discovered a spectroscopic period of about 5.5 years. Mike Corcoran had noticed X-Ray changes of Eta Carinae and began a weekly monitoring program with RXTE. Kris Davidson, who has followed Eta Carinae for more than a few decades, won several proposals to use HST to study Eta Carinae, which then appeared to be multiple components resolved by Weigelt in the 1970's. Spectroscopic observations with HST and the Faint Object Spectrograph helped determine that there was one steller component. The rest were very bright emission blobs.

In 1997, the Space Telescope Imaging Spectrograph (STIS) was installed into the HST. As Davidson expressed it, good spatial resolution and good spectral resolution at last could be used to separate the spectrum of the Weigelt emission blobs from the Central Source. We obtained first spectra on New Years Eve 1998, and a complete spectrum from 1,650 to 10,300A with 0.1 arcsec resolution and R~6,000 during the last minimum.

Since 1998, an informal workshop has been held every two years to discuss observations and models of Eta Carinae and its ejecta. That first summer we held a workshop in Big Sky, Montana. It was a thrill to see this continuous spectrum of Eta Carinae and a slice of the ejecta, including portions of Weigelt B and D. Sveneric Johansson and Torgil Zethson from University of Lund spent many months identifying the emission lines of Weigelt B and D. By spring of 2000, we had repeated the same observations twice with the identical position angle. While low excitation lines of Fe II and many other species remained, high excitation lines of Fe III, Fe IV, Si III, Ne III appeared. Ultimately Torgil Zethson completed a doctoral thesis identifying nearly 2,500 emission lines. Some Fe II lines in the near red and two particularly at 2507 and 2509A appear to be pumped by hydrogen Lyman alpha.

Deeper exposures were done at various position angles and offsets from Eta Carinae. Kris Davidson and colleagues were able to use the velocity shifted spatial variation of [Fe II], [Ni II] and other emission lines to trace the expanding profile of the Homunculus, which is primarily a reflection nebula. It appears to be a double-lobed structure with an extended disk between. More recently Kazunori Ishibashi and colleagues published the mapping of the Homunculus. We found a Little Homunculus, about one quarter the linear size of the Homunculus, buried within the Homunculus, much like the Russian Matroyska dolls. Close to the Central Source is a small ionized gas region, about a half arcsecond in radius surrounding the continuum source.

Progressively into the ultraviolet, the spectrum of Eta Carinae, the central source, becomes increasingly complex. Viotti published stellar line identifications using the IUE spectra, but observations with IUE were limited by the 3 arcsecond diameter aperture and by the 10x20 arcsecond oval aperture. As the entire Homunculus fitted within the oval aperture, nebular scattered light obviously contributed to the total flux. It was not until we did the observations with STIS that we realized that in the mid-ultraviolet (~1800A) ninety percent of the light is scattered starlight within the nebular. Spectra with the STIS in the ultraviolet took advantage of the 0.05 arcsecond stellar-like image so finally we were able to separate out the nebular scattered light from the stellar flux. The spectra were still very complex, but we gradually began to isolate narrow absorption lines.

In 2002, a large group of Eta Car afficionados joined forces and proposed a Hubble Treasury proposal to follow the star through its current minimum, watching the change in the stellar spectrum and the nebular line emission. Not only would we see many emission lines change, but we might also get velocity changes due to the potential binary companion (while Eta Car is estimated to be about 110 solar masses, its companion may be a lightweight 40 solar masses!). Kris Davidson as the principal investigator prepared a proposal that was accepted. So now we are following the changes of the system as the X-Rays are crashing and in the optical and ultraviolet spectral regions, not only are the highly excited spectral lines disappearing, but an iron curtain, due to many absorption lines in the ultraviolet, is descending.

If you are interested in seeing the initial stages, come by a longish poster on the wall outside Tumbalong Meeting Room 2, and a talk by Ted Gull during the Division VI science session on Friday, session 3.

Eta Carinae in an expansive mood

Do constants change?

from page one

age of the Universe. This could mean that the fundamental constants change slowly with time or are perhaps different in different parts of the Universe.

According to Professor Paul Davies, 'if these results hold up, we could be faced with changing the conceptual foundations of modern physics and cosmology.' The team is quick to point out that their measurements were all based on spectra from a single telescope and instrument ñ independent measurements are required for confirmation. A variable fine-structure constant may mean the central paradigm with which we interpret the universe will change ñ quantities such as the strength of gravity or speed of light are called into question.

John Webb will give updated results during Joint Discussion 21 session next Wednesday in his presentation titled, 'Do Constants Change?'

Ice Found on Mercury

by James Hitchcock

One of the most controversial issues in recent years in the mainstream science media is whether or not there is ice present on Mars. Now scientists have found evidence which points towards the presence of polar ice on Mercury.

Mercury, being the closest planet to the sun and with temperatures reaching as high as 425 C, may sound like one of the least likely places in the solar system to find ice. The first radar images to be made that indicated the presence of ice on Mercury were taken during 1970/1971 by Richard Goldstein. In 1974, the Mariner 10 mission passed Mercury and again in 1975, recording images of the surface which found it to be similar to that of heavily cratered moons.

Yesterday in Harborside Meeting Room 3, Martin Slade of JPL and Bryan Butler of the National Radio Astronomy Observatory spoke about their findings made during 12 years of study of Mercury. In 1991, Slade and Butler conducted studies of the hot planet using a radar system consisting of the 70 m (230 ft) dish antenna at Goldstone, equipped with a half-million-watt transmitter, and the VLA (Very Large Array) as the receiving system. The beam of 8.5-GHz microwaves sent from Goldstone bounced off Mercury and was collected at the VLA to produce a radar image of the planet. The researchers used the Goldstone-VLA radar system to look at the side of Mercury that was not photographed by Mariner 10.

The results of this experiment included the discovery of bright features in the north polar regions of the planet, as well as three large basin features. Data taken in successive years has confirmed these bright patches, and in 1994 bright patches were also found in the south polar regions. In 1998, the Arecibo radio telescope's radar transmitter was upgraded to megawatt power levels, which further increased the clarity of their measures.

Speaking with the scientists, they commented that there were

Radar measurements showing bright patches at the Mercurian poles

Bryan Butler and Martin Slade

two strong pieces of evidence that support the presence of ice. 'There is the same type of transparent material... as seen on the South Pole of Mars, Greenland and in the high Himalayas. The Arecibo observations also showed polarization inversion which is a signature [of water ice material].'

In what Butler likened to a Goldilocks situation, he said it was unlikely that this material was carbon dioxide ice, as it would not be stable enough under the present conditions on Mercury.

For the ice to be persistent on Mercury, it needs to be hidden from sun. Slade said that these ice deposits were 'found in permanently shaded regions within large craters'. In these regions temperatures would reach as low as -161 C which would be more than cold enough to support these ice structures. The largest areas at the South Pole can be found within the large crater Chao Meng-Fu.

These ice deposits would have to be pure water ice; if they were contaminated there would not have been the degree of reflectivity that is observed. This also indicates that deposits were laid down in one or a small number of rapid events, such as a large comet impact. Butler and Slade both agree that the presence of ice on Mercury is most likely due to impacts from comet or meteorites.

Further research into these ice deposits will continue with the Arecibo facility furthering studies on Mercury's South Pole in 2004, 2005 and 2011. NASA will launch Messenger Mercury explorer in March 2004, which will increase the world's knowledge of this small, hot planet dramatically.

Magellanic Clouds

by Seth Shostak

As everyone this side of Astronomy 101 appreciates, the broadsheet in your hands is named for the pair of small galaxies currently being shredded by the Milky Way. These constitute a celestial spectacle visible only from southern latitudes (at least, until the next major pole shift), and serve as an obvious and appealing icon for this meeting.

The Magellanic Clouds, the lesser and the greater, are themselves named for the 16th century Portuguese explorer, Ferdinand Magellan, whose ship became the first to circumnavigate the globe. (Magellan himself did not manage this round-the-world whirl. He was killed by Phillipine natives while attempting to enlighten the local populace on the benefits of Christianity.) The fact that Magellan's name became attached to the nearest extragalactic objects is obviously not due to priority of discovery. For half a century before his 1520 voyage, the Portuguese had been sending ships to double the southern tip of Africa, and presumably the crews had noted the two faint, white clouds that moved with the stars.

Beyond that, the southern hemisphere, including Australia, was populated by millions of inhabitants, any of whom might have had as much claim on naming rights as Magellan. Indeed, the clouds figure in one of the Australian Aboriginal dreamtime stories as the campfires of an old couple.

It may be that Magellan's essential contribution to getting the clouds noted by his European cohorts, and ultimately the world, was that he apparently used them for navigation, and wrote about having done so. There was no southern hemisphere equivalent of the Pole Star, but Nubecular Major and Nebecular Minor (as Magellan called them) were observed to rotate about the position where such a useful star might be.

His use of the clouds to determine bearing, and his description of same, have had consequences of nomenclature a half-millennium later, including the moniker of this newspaper. To find something first is good; but to publish it first is occasionally better.

Visit the Powerhouse

by Morris Jones

Sydney is filled with attractions for visitors, but delegates to the IAU shouldn't miss one that's just a short walk away. The Powerhouse Museum is one of the world's most interesting showcases of science and technology. This building used to generate electricity for Sydney's trams, which disappeared for several decades before the current Light Rail system was introduced.

The Powerhouse focuses on design and culture as much as technical subjects, and has attracted a number of curious and controversial exhibitions. At the moment, there's a strange collection of photographs of Japanese street fashion entitled 'FRUiTS.' Somebody from the SETI community should examine these for possible evidence of alien infiltration of our home planet.

For stargazers, the principal attraction will probably be the excellent collection of space hardware. This was one of the first exhibits anywhere in the world to give a balanced, international focus to space exploration. The exhibit houses rarely seen models of Russian space hardware, alongside full-scale mockups of a space shuttle cabin and a space station module. Don't miss the Lunokhod moon rover, which trundled across the surface of the moon more than 30 years ago. No amount of staged photography will ever make this as glamourous as a Formula 1 racing car, but it's certainly one of the most interesting objects ever sent into space. The dummy cosmonauts inside the Soyuz descent capsule are wearing actual Russian spacesuits!

Just beside the entrance courtyard to the museum is a pie shop that sells classical Australian cuisine. Get yourself a meat pie with mushy peas, mashed potatoes and gravy!

Consult a map of Darling Harbour for directions. Admission fees are charged.

Gruber Fellowship

by Hans Rickman

The IAU has a cooperative agreement with the Gruber Foundation wherein it gets $75,000 (US) every three years to be used to help young astrophysicists at a critical stage in their research careers. The fellowships will allow these excellent young folks to pursue research at a top-level research institution. Special consideration is given to researchers from economically disadvantaged countries.

Sergey Sazonov

Dr. Mayra Osorio

Dr. Yiannis Tsamis

The first winners of the Gruber Fellowships, two years ago, were Sergey Sazonov and Anshu Gupta. Sazonov studied the interaction of radiation with hot plasma together with cosmology prize winner Rashid Sunyaev, and Gupta studies 'strange stars,' theoretical models of ultracompact objects. Both of these winners have finished their fellowships.

The newest recipients of Gruber Fellowships are Mayra Osorio (Mexico) and Yiannis Tsamis (Greece). Osorio has been studying infrared emission from young stellar objects (protostars) at the National University of Mexico, and is now at the Instituto de Astrofisica de Andalucia in Granada, Spain.

Tsamis' work has involved the elemental abundances in planetary nebulae. His home base has been University College, London, and he'll be furthering his research at the Observatoire de Paris in Meudon.

One of the most important things the IAU should focus on is how we can support young astronomers. Such new members of the research community often have a difficult time pursuing their work, and everything we can do to help them is clearly a good thing. The Gruber Fellowships are an important step in this direction: one for which I am very grateful.

The (not so) Secret Food of Sydney

by Hoi Tak Leung

Are discussions about 'The association of PSR B1757-24 and the SNR G5.4-1.2' or 'Double degenerate progenitors of supernovae type 1A' making you hungry? Perhaps you have no idea yet about where to eat this weekend.

No worries. Fine food is available everywhere in Sydney. Let me make a few (admittedly unsolicited and somewhat biased) recommendations that might not appear in your standard Lonely Planet Sydney guide.

Best Chinese Food

- Cho Dumpling King – Shop TG6 Prince Centre, 8 Quay St, Haymarket – (02) 92812760.
- Chinese Noodle Restaurant – Shop TG7 Prince Centre, 8 Quay St, Haymarket – (02) 92819051.

Located right next to each other (with the large Burlington Chinese supermarket right beside it), the former specialises in small Taiwanese dishes, most being an excellent bargain – in particular, look for its $5 meals in the afternoon. The latter is a mainland Chinese restaurant – famous for its hand-pulled noodles. Be patient – both places are usually packed (and the former closes before 9 pm – very early for an Asian restaurant) but the queues are really a confirmation of quality and value. $25 will pack even the two sturdiest stomachs with delicious fried dumplings and hand-made noodles.

Best Hamburger

- Paul's Famous Hamburgers – 12 Princes Highway, Sylvania, (02) 95225632

Say the name 'Paul's Hamburgers' outside southern Sydney and they might think that the milk company has gotten into the hamburger industry. Say it inside southern Sydney, however, and 'Paul's Hamburgers' simply means the best hamburger (and probably the best-kept secret) in all of Sydney. Around a 30 minute drive from the city, and worth every single minute - get a Special Burger and a cup of their renowned Pineapple crush, then sit back at the nearby Georges River (under Tom Ugly's Bridge) and enjoy the pristine water view. I dare anyone to show me a better burger place in Sydney.

Best place to eat at 4am after an all-night astronomy session

- 10 Hickson St, The Rocks, Sydney – (02) 92476371.

It is difficult to find anywhere that serves food at 4 am. But Pancakes at the Rocks does. Delicious pancakes of all imaginable varieties (who cares about the fat content of the chocolate pancake when it tastes that good?) are served here; if you don't desire pancakes, crepes and pizzas are available too. I'd bet your stomach is satisfied after eating here; just don't plan on sleeping for a few hours afterwards.

Best ethnic food region

- Norton St, Leichardt.

Take a trip into the heart of Leichardt, and you'll find Italian food and culture that rivals anything found in Naples or Rome. On the weekend, Norton St in particular is a hub of activity, usually filled with frantically spoken Italian. The quality of spaghetti and espressos here far exceeds that anywhere else in Sydney.

Best undiscovered European food in the CBD

- The Spanish Club – 88 Elizabeth St, Sydney – (02) 92678360.

Located in the heart of Sydney, this establishment remains oblivious to many visitors who might not expect excellent authentic Spanish food in the heart of the Central Business District – yet it shouldn't be, considering its high quality. A sampling of the paella here (with fantastic seafood) will excite your tastebuds; the flamenco dancers that perform here will excite your... imagination.

Radio Astronomy at 70: from Karl Jansky to Microjansky

JENAM-2003 Symposium
Budapest, Hungary, 27-30 August 2003

It was 70 years ago, in 1933, when the synergy between scientific discovery and technological progress enabled Karl Jansky to open a new window on the Universe, thus marking the birth of radio astronomy.

Since then, radio astronomy has made huge progress, resulting in the improvement of sensitivity over the last decades by many orders of magnitude and approaching micro-arcsecond angular resolution. It has become one of the major tools for studying the Universe. Radio galaxies with their enormously energetic clouds of relativistic electrons and cosmic jets that extend up to millions of light years into space, a broad variety of atoms and molecules – from neutral hydrogen to complex organic conglomerates – cosmic microwave masers, the microwave background radiation, quasars, pulsars, gravitational lenses and extrasolar planetary systems were all discovered in the radio domain.

Radio telescopes have also been used to measure the relativistic bending of electromagnetic waves that pass near the limb of the Sun, to establish the existence of gravitational radiation, to measure continental drift, and most recently to measure the finite speed of gravity waves. The progress of radio astronomy is driven by the needs of fundamental science and is based on the state-of-the-art developments in technology.

Advances of modern radio astronomy will be in the focus of the symposium 'Radio Astronomy at 70: from Karl Jansky to Microjansky,' which will be held under the auspices of the annual Joint European National Astronomy Meeting (JENAM) in Budapest, Hungary, 27–30 August, 2003. More information on the symposium can be found at JENAM-2003 web site www.konkoly.hu/jenam03/

The (early) registration for the symposium and the JENAM-2003 as a whole closed some time ago. However, those who are interested in the symposium topics but have missed the registration deadline are welcome to contact Leonid Gurvits (lgurvits@jive.nl) or Sandor Frey, Symposium LOC Chairs, (frey@sgo.fomi.hu). We will be as accommodating as possible.

Special Session 2:

Astronomy in Antarctica

Friday July 18th Harbourside Meeting Room 3

by Michael Burton

Antarctica is the last frontier for life on Earth. However, not only does life exist there, it flourishes in Antarctica once it has adapted itself to the local conditions there. So, too, runs the story for astronomy.

Antarctica is the last continent where astronomy has been pursued, but once astronomers have adapted their techniques to the environment, it presents them with new opportunities for exploring the cosmos, routes that might only otherwise be ventured by heading into space. The extremely high, dry and cold conditions of the Antarctic plateau provide superlative conditions for astronomy across the infrared and millimeter bands. Less appreciated, but equally important, the stability of the atmosphere, including the near-absence of wind on the summits of the plateau, increases greatly the isoplanatic angle compared with temperate latitude sites, with subsequent improvement in the performance for adaptive optic wavefront correction systems as well as for interferometric measurements.

The length of the Antarctic night similarly offers new prospects for long-time period monitoring. The vast quantities of pure ice make the plateau an attractive platform for the measurement of neutrinos. The proximity to the magnetic poles also increase the cosmic ray fluxes, particularly at low energies.

Antarctic astronomy has actually been underway since the discovery of the first meteorite on the continent, in 1912 during Douglas Mawson's Australasian Antarctic Expedition, but didn't start in earnest until the 1970's with helio-seismological measurements being made at the South Pole. The subsequent three decades have seen a gradual ramping up of facilities and, importantly, the infrastructure and logistic capability needed to conduct sophisticated experiments. The upgrade of the Amundsen-Scott South Pole station has now almost been completed by the USA. At the French-Italian Concordia Station on Dome C, one of the summits of the plateau, the first automated winter-time astronomical measurements have now been made, and the station will be open for winter-time operation within a couple of years. Ambitious astronomical facilities are now being planned by scientists from several nations.

Special Session 2, "Astronomy in Antarctica," examines the progress and prospects for astronomy on the continent. It is a one day meeting which aims to overview the field, examine the results obtained across several wavebands, and look at the plans for new facilities. There are four sessions to the program:

Session 1, 09:00-10:30, is an overview of astronomy in Antarctica. It is designed for the professional astronomer, not the Antarctic specialist, to give them a quick rundown on the potential of Antarctica for a wide range of astronomical observations, and to illustrate some of the science that has been obtained, both from photon-based and particle astronomy.

Session 2, 11:00-12:30, examines some of the results obtained from infrared and sub-millimeter experiments, including site testing of the high plateau to quantify the conditions for astronomical observations.

Session 3, 14:00-15:30, examines the results obtained in the fields of CMBR and high energy astrophysics. Perhaps the most spectacular results to emerge so far from Antarctic astrophysics are of the power spectrum in the microwave background, and these will be shown in this session. There will also be presentations on the future plans for astronomy at both the South Pole and at Dome C.

Session 4, 16:00-17:30, looks at the future of Astronomy in Antarctica. To focus our attention on a wide range of proposed projects the session concentrates on experiments that have been funded. It includes both photon-based experiments, as well as the most ambitious project so far for Antarctica, the ICECUBE neutrino telescope. Finally. the session finishes with some speculation about what might happen beyond Dome C, in particular at Dome A, the 4,200 m summit of the Antarctic plateau.

In addition to the oral presentations, there are also a number of posters where the results from other experiments are presented. The full program for Special Session 2 can be found on the meeting web-page, at www.phys_.unsw.edu.au/sps2.

Video link-up with the South Pole

13:00-13:45, Theatrette, Exhibition Hall

There will be a special event taking place during the lunch break of Special Session 2, a live video link-up with the South Pole! Taking advantage of direct satellite communications using an internet video connection, we will conduct interviews with several of the scientists now wintering at the South Pole. Stranded there since the departure of the last flight at the end of February, with their next direct contact with the outside world at station opening in November, a band of approximately 50 dedicated people are working through the 6-month night, where the temperature averages -60 C, for the cause of science. Five of the astronomers will talk briefly to us about the experiments they are running. Then there will be an opportunity to ask them questions. So put your thinking hats on – what do you want to know about astronomical life at the very end of the Earth? But please, no questions about how cold it is, or about penguins or polar bears – for an Antarctican that's a bit like asking an astronomer what their star sign is!

Visions for Antarctic Astronomy

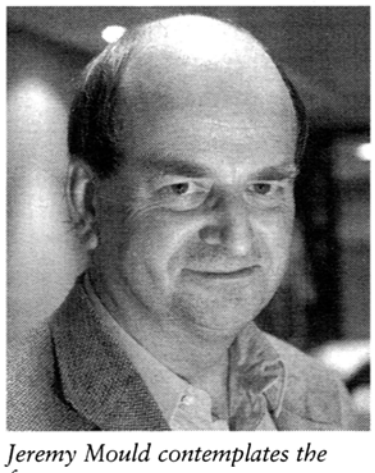
Taronga Zoo, Saturday July 19th

There is one final event associated with Antarctic astronomy taking place in Sydney this week. It is not a part of the General Assembly, but is a meeting open to all. It will take place the day after Special Session 2, in Taronga Zoo, on a spectacular headland in a bush setting the other side of the Sydney Harbour from the Convention Centre. Entitled "Future Visions for Antarctic Astronomy," it is an opportunity for a free-wheeling discussion on the future directions for Antarctic astronomy. Not being constrained by the formal atmosphere of the GA, nine speakers will be presenting their visions on where the field should go, and how it might get there. The full program is available via the SPS2 website. Registration for this meeting can be made on the day, or during Special Session 2. Full details will also be available at Special Session 2 on the 18th. Just be sure to be on the 9:15am ferry from Circular Quay to Taronga Zoo on the 19th!

NOAO: Revolutionary New Projects

by James Hitchcock

Dr. Jeremy Mould, formerly of the ANU Mt. Stromlo Observatory and now Director of the National Optical Astronomy Observatory, spoke recently about the NOAO's current research.



Jeremy Mould contemplates the future

At the moment there are two main projects the NOAO is involved with, the first being the Giant Segmented Mirror Telescope (GSMT). 'The GSMT is about to enter the four year design and development phase, and the main science goal is to understand the process by which galaxies formed in the early Universe and how the components assembled. In addition the GSMT will have a big impact on elucidating how solar systems, like our own, form.'

Managing the design and development of this joint operation will be the NOAO, Caltech, the University of California, and ACURA, a Canadian research group. The facility will operate as a public/private partnership. 'Site testing is occuring at six locations,' according to Mould.

The other major project the NOAO is involved with is the LSST or Large Synoptic Survey Telescope. 'This will be quite a revolutionary facility because it will be able to produce a digital movie of the sky.'

The LSST has four main objectives or uses:

- To find tens of thousands of supernovae, which will help us understand how the structure of the universe has changed
- To detect weak lensing
- To find and track asteroids, down to the size of 300 m (those responsible for causing the largest degree of damage in case of earthly impact)
- To explore the outer fringe of the Kuiper Belt

LSST is a partnership of the NOAO, the University of Arizona, the University of Washington, and Research Corporation. 'The LSST is planned to be operational by 2011.' It has the capability to churn out 3-5 Terrabytes of data a day.

One the most important aspects of this project will be that all the information gathered will be made immediately available to the public. Dr. Mould said it will 'provide a whole new method for searching the sky, whether in a classroom or a university.' All the information will be accessible via the interenet, which creates opportunities for the general public to be involved in learning about our universe with cutting edge technology.

Dr. Mould notes that 'it is an extremely fertile time for astronomy... discoveries are being made at a huge rate.' When asked why people are interested in these projects, he replied 'people want to know the answers [to the mysteries of the universe].' Dr. Mould will be speaking about his work this morning at Joint Discussion 8, Large Telescopes and Virtual Observatory: Visions for the Future.

Profiling Galaxy Outflows in Virgo

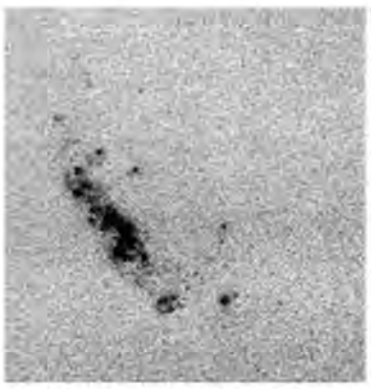
by O. Ivy Wong

Most spiral galaxies undergo stripping by the intracluster medium (ICM). Professor Jeff Kenney's (Yale University) talk on 'Galaxy-Intracluster interactions in the Virgo Cluster' involved the high-resolution study of individual galaxies in the Virgo Cluster that have outflows that could be explained by the ram pressure stripping process.

Broadband colour (BVR) image of NGC 4522

Ram pressure stripping occurs when the gas in a galaxy falling into a cluster is being stripped away due to the interaction of the galaxy's gas with the surrounding cluster gas. Signs of active ICM pressure are the asymmetric HI distribution and kinematics which result from the combination of ICM wind and the galaxy rotation.

Half of all Virgo spiral galaxies have been discovered to be in the process of being stripped or having been stripped in the past. These galaxies have been found to have truncated H-alpha disks as well as being HI-deficient.



H-alpha image of NGC 4522 of the same scale as the broadband image

Half of all Virgo spiral galaxies have been discovered to be in the process of being stripped

Two galaxies, NGC 4522 and NGC 4569 in the Virgo cluster were presented by Kenney in detail during his talk in S217.

In NGC 4522 seen in images taken with the WIYN 3.5m telescope, large amounts of extraplanar HI have been found close to the disk truncation radius. This implies an early stage of stripping. Due to the fact that more HI has been found in the galactic halo than the disk, the gas is deduced to be more easily stripped on the side of the galaxy rotating into the ICM wind. The star-forming regions of the ISM (interstellar medium) have been found to be effectively stripped. However, the giant molecular clouds are too dense for stripping to occur directly from ram pressure.

In NGC 4569 (M90), great amounts of dust and star formation have been observed in the disk. A truncated H-alpha disk and an extraplanar H-alpha arm have also been observed.

Four other galaxies were also observed to compare with both NGC 4522 and NGC 4569. These four galaxies are highly-inclined, HI-deficient spiral galaxies and similar to NGC 4522 and NGC 4569. For three of the galaxies, more HI and disturbed kinematics have been observed on the side of the galaxy which is rotating into the ICM wind. This is the exact opposite of what was observed for NGC 4522 and NGC 4569. The same three galaxies also show active, later stages of stripping than NGC 4522. One theory is that the difference is related to the amount of extraplanar HI as well as the stripping phase. The fourth galaxy used in the comparison shows a symmetric truncated disk and no evidence for extraplanar gas or ongoing truncation. This particular galaxy was probably stripped more than 100 million years ago.

South-Eastern Branch of the European Astronomical Society

by Magda Stavinschi

Magda Stavisnchi

The South-Eastern Branch of the European Astronomical Society was established in 2000 in Bulgaria. The idea was born several years ago, as a natural consequence of the situation the countries of this part of Europe, except perhaps Greece, are facing. The branch functions like an AU Working Group.

These countries lived for many decades isolated from the occidental world. Under these conditions, astronomy advanced only thanks to the creative abilities of the researchers. The lack of specialized journals and books, the interruption of the contacts with the researchers from the 'capitalist world,' as well as the lack of state-of-art endowments, almost stopped the progress of astronomy in the southeast of Europe.

The political developments at the end of the eighties promised improvement. Unfortunately, it was not so. After a period of general euphoria, we saw that getting freedom is not sufficient; we must know what to do with it. The consequences were immediate: the dissolution of the Council for Reciprocal Economical Aid, false privatization – all this led to a quick economic decline. A serious consequence of this decline was the migration of young people to the West. The great institutes and universities of Europe and North America discovered young scientists for which the lack of – western-type entertainment led to a considerable gain of time for study. Moreover, they made a huge effort to integrate into a world they had never dreamed of.

At first, we were glad because the scientific capacity of this zone of Europe is recognized again; we were being heard of again. But the lack of hope for a better tomorrow and the temptations of the occidental world entailed a dramatic decrease in staff in the East European research institutions.

Unfortunately, the situation is almost the same in all former communist countries of south-eastern Europe. The problems are the same for all of us, so we are the ones who have to solve them. We know and understand them deeply, and it is better to search for a solution and to find it together.

This is the background that motivated the initiators of the South-Eastern Branch of the EAS. We thought that it easier to meet each other from time to time, to speak about our common research topics, all in order to exchange ideas and to find solutions for the future.

This is only a short description of a regional group which tries to push astronomy – research and education – further during an epoch of a very rapid progress and competition.

Astro Expo in the Exhibit Hall

Bob Hanisch (Space Telescope) stands by his stand in the Exhibit Hall, eager to show Assembly delegates the wonders of the Virtual Observatory. 'I'd encourage everyone to come by and see all the neat stuff here. There are more than thirty exhibitors, after all.'

It's a suggestion worth taking. The Astro Expo is chock-a-block with everything you wanted to know about new projects, big telescopes, and where to stock up on free giveaways.

The Exhibit Hall is open from 10:00 to 16:00 most days, and 11:00 to 18:00 on Saturday and 11:00 to 17:00 on Sunday. Astro Expo will close on Thursday, July 24. Be sure to check it out.

Square Kilometre Array on TV tonight

At 8pm on Thursday evening on ABC's "Catalyst" program, there will be a feature on the next-generation radio telescope – the Square Kilometre Array, and its low-frequency predecessor COFAR.

Echidna Solves a Prickly Problem in Astronomy

by Stuart Ryder

The Anglo-Australian Observatory (AAO) has an admirable track record in delivering cutting-edge instrumentation for use on the 3.9 m Anglo-Australian Telescope, and at other observatories worldwide. In particular, the AAO has been a pioneer in the field of optical fiber positioners for multi-object spectroscopy. One of the first was the FOCAP 'plug plate' system, in which fibers would be inserted by hand into pre-drilled brass plates.

Although this technology has long been superseded for optical spectroscopy, it has recently been used quite successfully with the University of Cambridge's CIRPASS instrument to enable near-infrared (J and H band) spectroscopy of up to 150 objects simultaneously over a 40 arcminute field of view.

In the 1990s, the AAO built 2dF, the Two-Degree Field Facility, which uses a 'gripper' on an x-y stage to pick and place up to 400 fibers on a flat plate covering 2 degrees of sky. With this instrument, astronomers from the UK and Australia have recently completed a redshift survey of some 22,000 quasars, and ten times as many galaxies. The complete data sets from both these surveys are being released publicly in conjunction with IAU XXV in Sydney.

The AAO has recently commissioned OzPoz, a 'big brother' of 2dF, for use at ESO's Very Large Telescope in Chile. A smaller version of OzPoz, named 6dF (for Six-Degree Field) has also been put to work on the AAO's 1.2m Schmidt Telescope.

Anna Moore checks out Echidna fibers

These instruments differ from 2dF, in that they have to work with a curved focal plane, necessitating the use of a gripper on a curved radial arm.

When the AAO was asked to build a 400 fiber positioner for the Fibre Multi-Object Spectrograph (FMOS) at the prime focus of the Subaru 8.2m telescope on Mauna Kea, they were presented with a different challenge. Although Subaru's prime focus delivers an impressive half-degree field of view, it is physically ten times smaller (150mm) than the field plates of 2dF. The 'pick and place' approach of fibers on magnetic buttons does not allow for the close packing of fibers that would be required. Could the AAO come up with a workable solution?

As it turned out, the the AAO engineers were already beginning to re-think the whole problem, and proposed the idea of fibers attached to an array of individually deployable spines. Each spine can be pivoted within a 'patrol radius' of 7mm. Because of its resemblance to the defensive habits of a certain native Australian animal, the fiber positioner has been christened 'Echidna'. The spines are positioned using a combination of piezoelectric and magnetic forces. It's not easy to describe in words how it all works, but if you come down to the AAO's booth (G08A) in Exhibition Hall 5, you can see a working demonstration model of Echidna. You can also meet our 'kickbot', which is an Echidna-like gadget that actually walks! And if you do come and have a chat with the AAO staff about your instrumentation needs, you might even get your own baby echidna to take home with you.

What is an ALMA?

by James Hitchcock

ALMA, or the Atacama Large Millimeter Array, is a group of 64 radio-telescope antennas that are 12 m in diameter to be situated in the Atacama Desert of Chile.

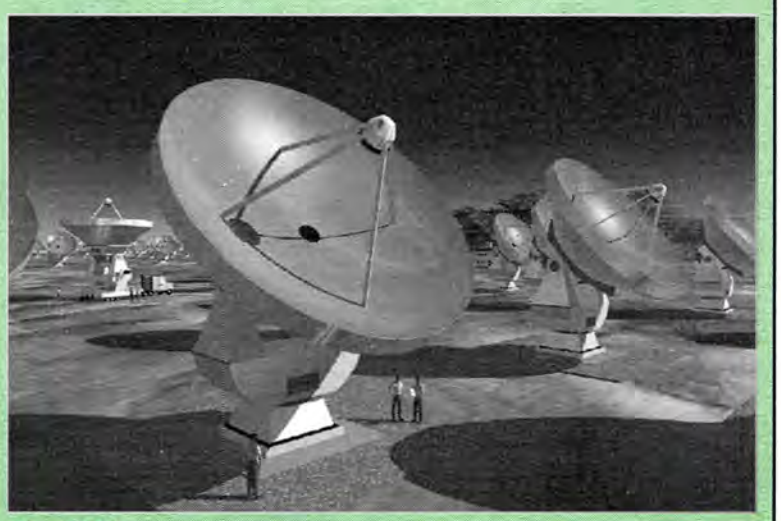
ALMA is a joint project carried out between North America and Europe. The partners funding the project are U.S. National Science Foundation and also the National Research Council of Canada from North America and the European Southern Observatory [ESO], with 10 member states and Spain who will be working with the ESO.

The facility will be used to research what is known as the cold, or early universe It will focus on the formation of galaxies at the earliest times in cosmic history; new planets forming around young stars, the birth of new stars and of course our solar system. It will bring to millimeter and sub-millimeter astronomy aperture synthesis techniques similar to those used in radio astronomy, a step that will allow precision imaging to be done on sub-arcsecond resolution scales. The clarity of the research at millimeter wavelengths is provided by thermal emission from cool gas, dust and solid bodies.

The site is ideal because of the weather conditions. There is very little precipitation and the high altitude only helps. At its broadest, it will 14 kilometers wide, while its narrowest dimension is 150 meters. The superconducting receivers on the antennas will operate at –269 C which makes ALMA the biggest superconducting electronics system in the world.

The project is now in its initial stages, with work to start within the next month. Total construction is aimed to be completed by 2011 or 2012, and it is to be fully operational by 2007. The facility will be open to scientists from all over the world who will compete for observing time by submitting proposals to be judged on scientific merit.

For more information on ALMA, visit the exhibit in the Exhibition Hall found in the southern end of the building, open to the public from Friday July 18 to 21.



The ALMA telescope.

Harbour Bridge to Close

Participants are advised that the City of Sydney's Department of Viaducts and Public Conveniences will be dismantling steel work at the center of Harbour Bridge beginning tomorrow. This is to make room for a large ship expected during the weekend.

Hemp ropes will be fastened to the structure on either side of the gap created by these works to keep bridge sections from sagging during the period of deconstruction. Traffic that normally uses the bridge will be diverted either to the Harbour Tunnel, or to a large collection of pontoons that will be lashed together to form a floating causeway.

If you have signed up to do the Bridge Climb during this period, be advised that a replacement activity, involving a rope-and-piton ascent of Centre Point Tower, is being offered.

The ship requiring passage, inbound from Belgium, is bringing the refurbished Ayers Rock back to Sydney for overland transport to the Northern Territory.

Stromlo Fires Back

by Blake Rutledge, Erica Belling and Sarah Gough

Dr. Brendan Nelson, Commonwealth Minister for Education, Science and Training, has reconfirmed his interest in providing support for supplementary resources in addition to the $7.3 million already designated to the rebuilding of the Mt. Stromlo Observatory on the southwest outskirts of Canberra.

Addressing the IAU General Assembly at the opening ceremony held at Sydney's Opera House, Dr. Nelson stated that he will be 'very receptive to receiving arguments' for additional resources to those already granted by the government.

In January, 2003 Mt. Stromlo Observatory was destroyed by bushfires that swept through Canberra. Five telescopes were burned in the blaze, along with a high-tech equipment workshop, seven houses occupied by staff and an Australian National University (ANU) administration building.

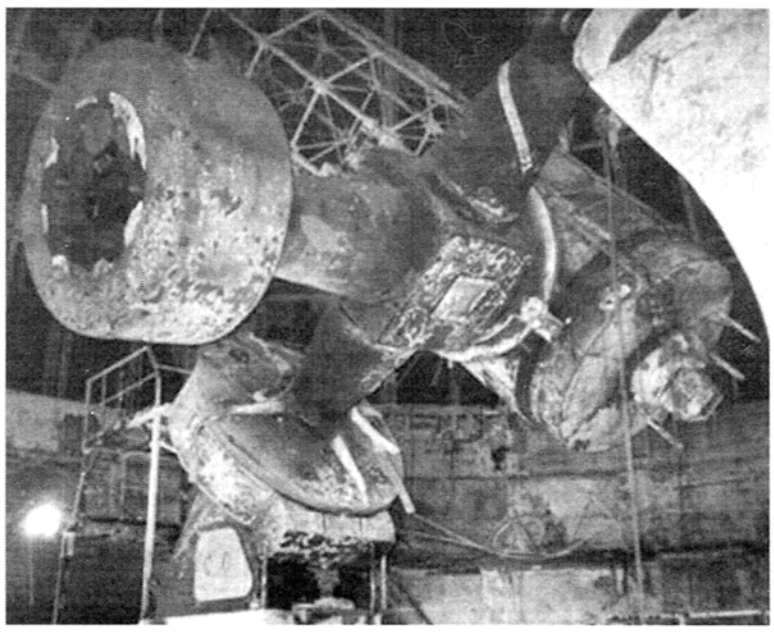
While it is estimated that more than $40 million worth of damage was caused by the fires, the $7.3 million provided from the government is much needed. Presently, rebuilding of the facility is yet to commence, as funding has not yet been finalized. However, detailed plans for the reconstruction of the site have been developed.

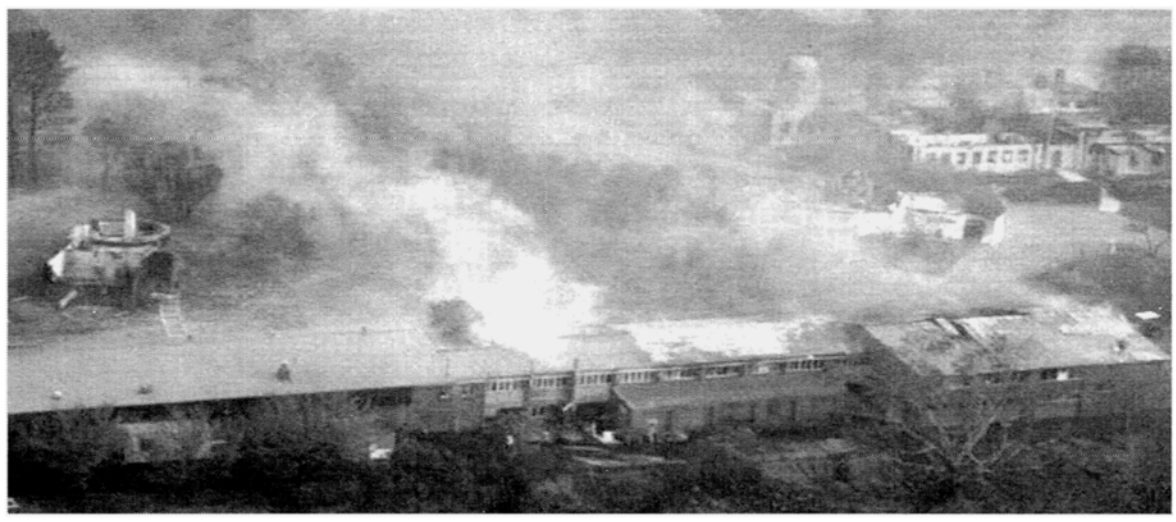
Professor Penny Sackett, Director of the Research School of Astronomy and Astrophysics, believes the 'new design is overwhelmingly orientated around meeting the needs of staff, students and visitors, while also ensuring Mt. Stromlo retains its status as an internationally important observatory.'

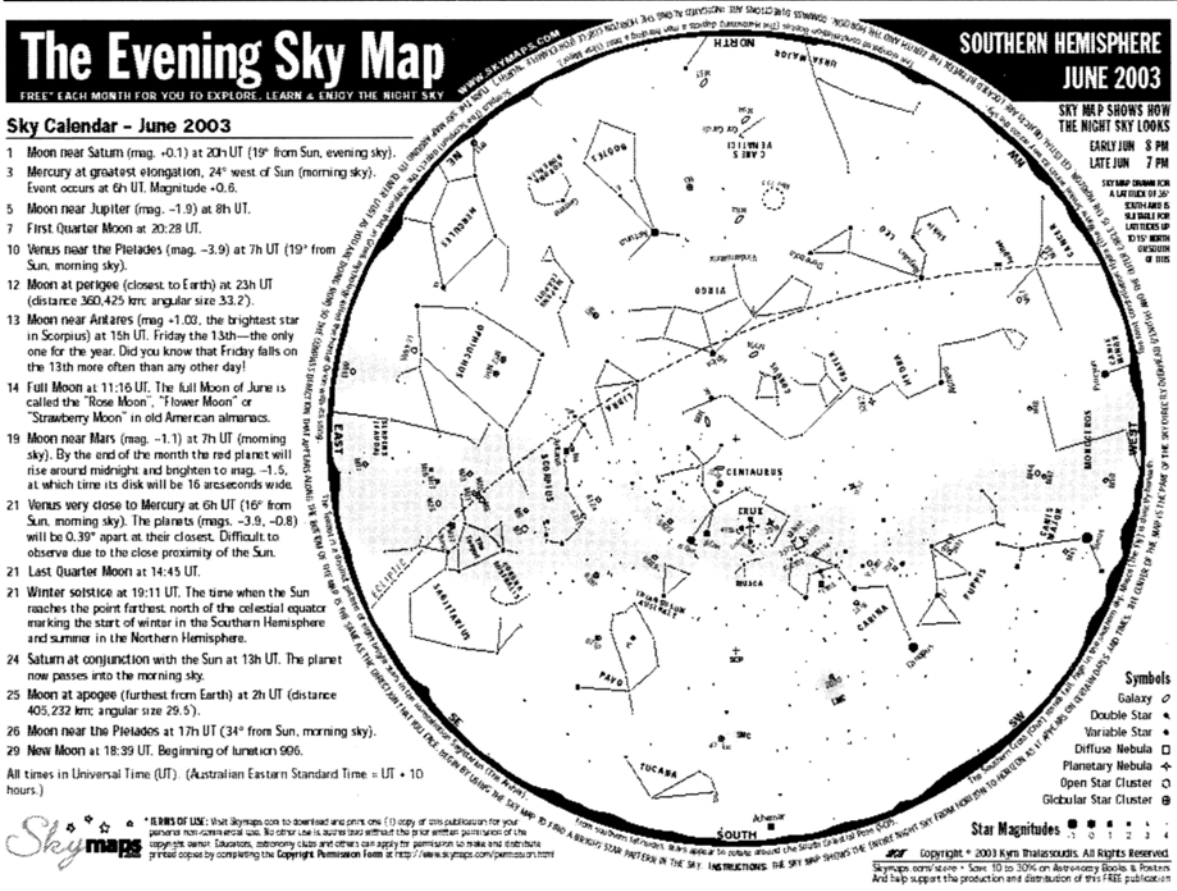
The government's financial backing will ensure that Mt. Stromlo remains a world-class astronomy research and education facility. It is expected that the funds provided by the government will aid in the rebuilding of instrument workshops and to purchase two new telescopes. Restoration of the facility is of particular importance to the government, as the Mt. Stromlo area is heritage listed.

The restoration of the observatory is vital for Australian astronomy, as it accounts for one third of Australia's astronomical research. Dr. Nelson hopes that through the use of Mt. Stromlo Observatory, the ANU will 'continue its mission to advance the frontiers of astronomy, train outstanding scientists and stimulate interest through educating the public.'

Mt. Stromlo observatory is dedicated to the future of astronomy and is presently running a new advanced instrumentation center involved in both research and development and construction of instrumentation for Extremely Large Telescopes (ELTs).







The Sky at Night?

James Taylor inquired of 'The Magellanic Times' whether it would 'be possible to include a map of the southern sky for those of us visiting from the northern hemisphere?' Apparently Mr. Taylor has so far failed to recognize anything in Sydney's southern celestial setting.

We have tried to oblige Mr. Taylor with the accompanying star chart, courtesy of Kym Thalassoudis. Mind you, no one has ever seen more than six stars with the unaided eye from Darling Harbour, and two of these are suspected of being slow-moving aircraft. However, those of you making treks to the outback should rip out the accompanying graphic and have it laminated for future use.

The Magellanic Times

THE NEWSPAPER OF THE INTERNATIONAL ASTRONOMICAL UNION GENERAL ASSEMBLY SYDNEY 2003

IAU XXV General Assembly Sydney 13-26 July 2003

Day 4 **Thursday 17 July**

Astronomers Save The World

by Erica Belling and Blake Rutledge

The threat is real. We are now looking beyond the probabilities toward the consequences.

'It is only fairly recently that we have come to appreciate that these impacts by asteroids and comets (often called Near Earth Objects, or NEO's) pose a significant hazard to life and property,' says Chief Scientist of NASAs Astrobiology Institute, David Morrison. Morrison is also chair of the IAU Working Group on NEO's.

We may never experience the devastating effects of a large asteroid collision with Earth. On the other hand, we might be hit tomorrow. But even accepting the fact that the chances of such an event are slim, the consequences are so catastrophic that we must evaluate the nature of the threat and be prepared to deal with it.

Asteroid destroys New Zealand [photo credit: NASA]

This idea prompted Morrison to conduct further research on identifying asteroids that could pose a threat to Earth, rather than simply quantifying the likelihood of it occurring. He believes this approach is a practical use of astronomy, and is excited by the prospect that one day his research could save the world.

NASA's Spaceguard Program has led to observation of 650 of the 1,100 suspected NEOs greater than one kilometer in diameter that are in close proximity to Earth. The program aims to identify ninety percent of these asteroids by 2008.

Spaceguard is currently concentrating its efforts on NEOs between one and two kilometers, as smaller asteroids would only cause local damage and not pose a global threat. Morrison suggests that 'the minimum mass impacting body to produce such global consequences is several tens of billions of tons, resulting in a groundburst explosion with the energy of a million megatons of TNT.'

He believes that if such an asteroid were to hit Earth's surface, it could 'depress global temperatures, leading to a massive loss of food crops and the possible breakdown of society... potentially affecting the entire planet and its population.'

Possible solutions for avoiding a collision include attaching rocket engines to the asteroid or using nuclear explosives to change the asteroid's course.

David Morrison is pleased with the progress of the Spaceguard research, whose funding is currently applied to conducting extensive observations in northern hemisphere skies. However, he would also like to see such research occurring in the southern hemisphere, possibly in Australia.

David Morrison on the alert for asteroids.

The Green Bank Telescope Makes its Debut

by Phil Jewell and Jay Lockman

A new radio telescope is making its IAU debut at this General Assembly. The Robert C. Byrd Green Bank Telescope (GBT), a facility of the U.S. National Science Foundation, began regular operations in 2002 and results from its scientific programs are now appearing. The telescope is 100 m in diameter with offset optics, a precise active surface, and full sky coverage above declination –46 degrees.

Its initial operations were primarily at the longer radio wavelengths in studies of pulsars and the 21 cm line, but last year the active surface was used for the first time, extending the telescopes operating range to cover water maser emission lines at 22 GHz. The facility can address many scientific areas, including atomic and molecular spectroscopy and imaging, continuum imaging, pulsar observations, VLBI, and planetary radar reception.

Commissioning of the various telescope systems will continue through the next two years to permit operation at 43 GHz (7 mm) this coming winter and, finally, operations in the 3 mm band in early 2005. At the frequency of the CO transitions near 115 GHz the GBT will have an angular resolution of 7 arcsec allowing study of the molecular clouds in nearby galaxies with extraordinary sensitivity.

The GBT's reflecting surface is made up 2,004 panels, each of which is controlled by precision actuators. The active surface positions are presently set by a lookup table generated from a finite element structural model, but will eventually be set by a novel laser metrology system.

The offset optics yields key advantages to observers, although the system requires a rather massive and complex structural system for backing support. Because there is no blockage in the optical path, diffraction sidelobes and spectral standing waves are significantly reduced. This gives the images obtained with the GBT much higher fidelity than would be possible otherwise.

The telescope commissioning has not been without its challenges. Not only is the GBT the largest moving object on land, but with a total rolling weight of 7,600 metric tons distributed over its 16 wheels, it likely sets a new record for the most force a wheel has ever put on a track. Alas, the original track was not up to the challenge and developed cracks that limited operation over the past winter. A plan to modify or replace the track is being developed and should eventually provide a permanent solution to this problem. Short-term mitigations have been found and the telescope remains in full operation while these studies are underway.

The GBT is located in a unique region known as the National Radio Quiet Zone. It is a large area of 34,000 sq km in the states of West Virginia and Virginia (USA) in which fixed radio transmitters are restricted to signal levels below a prescribed limit at the position of the GBT. The Quiet Zone helps protect the GBT from the harmful effects of radio frequency interference (RFI) that would otherwise seriously impede sensitive radio astronomy observations. RFI is analogous to light pollution at visible wavelengths and is an increasingly difficult problem for radio astronomers worldwide.

Scientific results from the GBT have been presented at this meeting in S217 (Recycling Intergalactic and Galactic Material), S218 (Young Neutron Stars), JD2 (Mercury), and at the Division X science meeting.

More information about the GBT can be found at www.gb.nrao.edu. The GBT is open for proposals and is scheduled three times per year. The next proposal deadline is 1 October, 2003.

The GBT, reposing in the West Virginia sun

Jay Lockman and Phil Jewell, reposing in the media room

The Magellanic Times

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Deadline for daily issues
1pm on the day prior to publication

Text files for publication may be emailed to john@strangeplanet.com.au

Printed by
Marrickville Print & Design
Ph: 1300 888 490

Accreting Supermassive Black Holes Common in Local Universe

by Michael Ireland

After seeing the results from the 2dF survey a few years ago, I thought that the accreting Supermassive Black Holes (SMBHs) that powered Active Galactic Nulcei (AGN) were a phenomenon associated with another age: an age where massive galaxies underwent violent mergers and the universe was still young.

The results presented by Amy Barger in Symposia 216 convinced me that this idea was wrong. These SMBHs have not disappeared in the local universe, but have just undergone a `cosmic downsizing.'

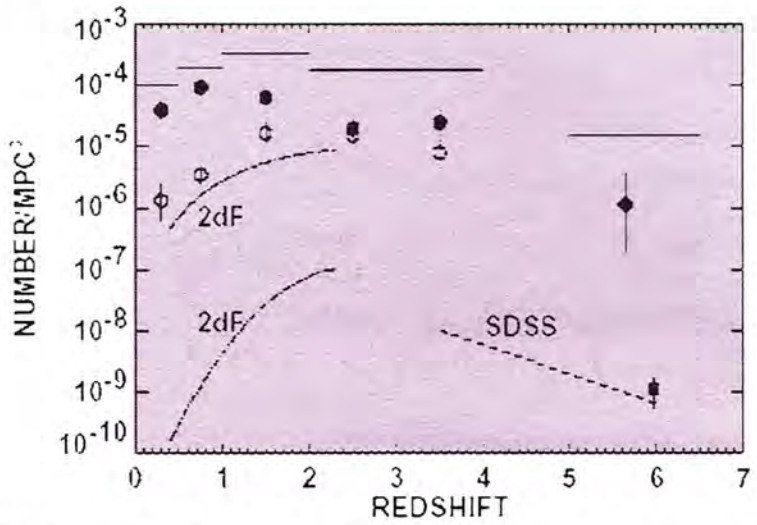
Barger and her colleagues have searched for high redshift galaxies using deep images from the CHANDRA X-ray satellite with follow-up optical images. Their result for high-luminosity sources matches that from the optically selected 2dF survey: bright AGN were more common at a redshift of 2 than now. However, they had an advantage over the optical survey because X-rays can penetrate sources surrounded by high column densities of gas and dust, whereas optical wavelengths cannot. When they included X-ray sources of lower luminosity the results were surprising. Low-luminosity AGN are at least as common, and maybe more common at redshifts less than 1.5 than at higher redshifts.

In fact, not only were there more AGN at low redshift and low luminosity than expected, there were also fewer than hoped at higher redshifts between 5 and 6. At these redshifts, there were not enough moderate-luminosity AGN to re-ionize the intergalactic medium, implying that a stellar population must be the dominant cause of the re-ionization epoch.

These kinds of results will hopefully answer many questions about the driving process behind accretion in AGN. Are AGN generally driven by galaxy mergers? Can AGN 'conserve fuel' by having a relatively low accretion rate, thereby extending their lifetimes to cosmic timescales? Supporting results will come from mid-IR missions such as NASA's Space Infra-Red Telescope Facility (SIRTF), which will be able to detect the reprocessed light from obscured AGN that are not found in optical surveys.

Because these intermediate- and low-luminosity AGN are so common in the local universe, Barger found that the total amount of X-ray flux from AGN is the same now as in the past. Although the era of giant galaxy mergers resulting in extremely high-luminosity AGN has passed, the local universe is filled with a new and exciting population of fainter AGN.

The highly luminous Amy Barger



Number-density of sources with 2-8 keV luminosities between 10^{4} and 10^{44} ergs s^{-1} in filled symbols, and sources between 10^{44} and 10^{45} ergs s^{-1} in open circles. The upper 2dF curve represents the 2dF result for sources with similar luminosities to the open circles

Teachers Day at the IAU GA

by Robert Hollow

Thirty years ago, at the first GA in Sydney, the IAU established an important tradition: at every GA, there is a one or two-day workshop on astronomy for local school teachers.

These workshops provide encouragement and support for astronomy teaching through information, activities, resources, and networking. The workshops are designed by a local committee (chaired at this GA by Rob Hollow) to meet local needs. They take advantage of international astronomy education experts who are attending the IAU GA, but also use local experts who are familiar with the local curriculum. Through these workshops, the IAU leaves its 'imprint' on local astronomy education.

The workshops are a project of IAU Commission 46 (Education and Development.) Interested members of Commission 46 attend the workshops to get a first-hand view of astronomy education in the host country, and to network with local astronomy educators and teachers. This year's workshop is hosted by Nick Lomb and the Powerhouse Museum. Commission 46 expresses its thanks to them, and to all the organizers and presenters.

Below are listed the details of Teachers' Day 2003.

On Saturday 26th July Australian teachers will have the chance to participate in a series of workshops presented by some of the best astronomy educators from around the world, at a special Astronomy Day for Teachers.

This will be held at the Powerhouse Museum, close to the conference venue here at Darling Harbour. Sessions cater to teachers of Primary (Elementary) students, Junior Science and Senior Physics. Participants will have a chance to find asteroids using Spaceguard software, learn how to run astronomical role-playing activities, examine the SEARFE project probing our radio environment, find out how to get involved with the latest remote telescope schemes such as the Charles Sturt University Remote Telescope and the Faulkes Telescope, have an adventure along the electromagnetic spectrum and try out a range simple hands-on activities that underpin key concepts such as distance determination and the 3-D nature of the Earth.

The focus is on providing teachers with the confidence and resources to improve their teaching of astronomy in the classroom. The presenters include many of the speakers and participants in Special Session 4 on the Effective Teaching and Learning of Astronomy that takes place on the last Thursday and Friday of the GA. These include Julietta Fierro from Mexico, Syuzo Isobe from Japan, John Percy from Canada, Leonarda Fucili from Italy, Peter Michaud from USA, Case Rijsdijk from South Africa and Bill Mcintyre from New Zealand. Australian presenters include George Warr, David Mckinnon, Paul Francis and Cameron Bell. Teachers will have the opportunity to discuss common issues and problems and hopefully help suggest new ideas and perspectives in the open forum that will conclude the day. They will go away stimulated, challenged and armed with a wide range of printed, visual and computer resources that will support them back at school.

IAUXXV General Assembly Sydney 13-26 July 2003

NOTICE FROM THE NATIONAL ORGANISING COMMITTEE TO ALL PARTICIPANTS

Please do not forget to return your questionnaire to the registration desk before you leave the conference.

Research Reveals Dingos Actually Love Children

A recent study involving two thousand laboratory dingos and several hundred blow-up infants has shown that, contrary to widespread impression, dingos actually love children.

'When the inflatable infants were left abandoned in the bush, we found that most dingos would nuzzle them back towards urban areas in an obvious attempt to reunite them with their own kind,' notes Prof. Bazza Grogan, the principal researcher. 'Even those dingos who didn't do this would spend hours fawning over the kids and bringing them choice bits of half-masticated marsupial for nourishment.'

Authorities in Western Australian, cognizant of these findings, have begun employing dingos in day care centres. 'They're conscientious and loving,' a government spokesman said, 'and a lot cheaper than the human nannies we had been using.'

'No doubt about it,' said Grogan, 'dingos love kids. For breakfast, lunch, or dinner.'

The Young and the Hairless

by Le Tran

What do you get when you take an IAU member, lose the glasses, ditch the brown cardigan, add a stylish shirt, and top that with a full head of hair?

Spotting Scott Shepard amongst the sea of distinguished IAU members is a rare find. He is young, 27 in fact, and has just been admitted into the Satellite Working Group. Barely graduated from his study of Natural Satellite and Distant Objects from the University of Hawaii, Scott is one of the youngest consultants in a team which consists mainly of slightly more, shall we say, 'experienced' members.

Being a diplomat, Scott believes in the importance of maintaining the pool of knowledge and experience that older members bring into the field of astronomy and science as a whole. But his appointment is no doubt good news for Mike O'Hearn, a professor at the University of Maryland, and a strong advocate for the greater involvement of young people in working groups.

O'Hearn emphasizes that 'The need to add new blood is a widely recognized issue, but it is one that is often ignored. In many organizations within the IAU, young people are forgotten.'

O'Hearn asserts that it is critically important to get young people involved in the working groups at an early stage. He refers to the method of rotation that has been recently harnessed by the Satellite Working Group, which allows fresh faces to be appointed. This has resulted in many new discoveries by young people, and the creation of a new field.

'Having young people involved helps to create an active IAU, and to further the evolutionary nature of science', O'Hearn says.

O'Hearn and his fellow colleagues aim to push this issue throughout the conference. The effort is part of a greater vision, one that aims to give the structure of the working groups a serious facelift through creation of mission statements. The purpose of a mission statement is to supply the working groups with a definition that many currently lack, and to help change the pattern of membership to include more young people.

So what will this mean? The vision, if successful, will ensure that faces like Scott Sheppard's will not be such a rare discovery.

A Jovian Trojan-Satellite Population Exchange

by Travis Stenborg

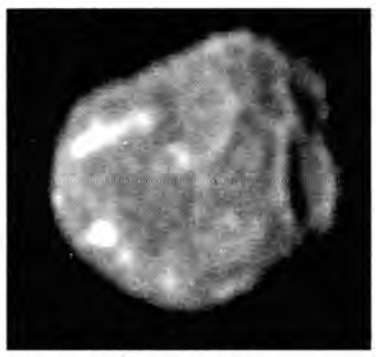
Our solar system currently plays host to at least three naturally populated Sun-planet Lagrange point systems; Jupiter (1,016 L4 bodies, 602 L5 bodies), Mars (1 L4 body, 5 L5 bodies) and Neptune (1 L4 body). Many of these Trojans share spectral similarities with Centaurs, short-period comets and transneptunian objects, prompting speculation that some members of the current Trojan populations originally belonged to some of these more mobile families of minor body.

As a variation on this theme, planetary Trojan-satellite exchange through L4 or L5 orbital perturbation/ejection, temporary interaction with an L1 or L2 collinear Lagrange point and finally orbital re-capture as a satellite, has also been proposed.

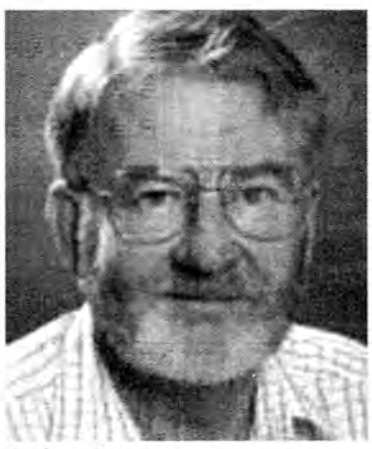
Monash University's Andrew Prentice will discuss Amalthea as an example of a Jovian satellite-Trojan exchange in a segment of tomorrow's Special Session 1: Recent Progress in Planetary Exploration (Friday, 18th July).

Last year, NASA's Galileo spacecraft revealed Amalthea to be a porous assemblage of rock and ice with a correspondingly low bulk density, ~1 g/cc) - somewhat different from the rock-metal mixture (bulk density ~3.8 g/cc) predicted for a satellite condensing into Amalthea's current orbit (every other inner Jovian satellite, that is the Galileans and Metis, Adrastea and Thebe, has a bulk density several times that of Amalthea.) In addition, Amalthea's radius (83 km) places it within the size distribution of the Jovian Trojans (up to ~300 km x 150 km diameter for 624 Hektor, with lower limits determined by Poynting-Robinson drag, etc.)

It seems that Amalthea's physical properties point to it being a captured asteroid rather than a native satellite.



Jovian satellite Amalthea: A captured Trojan asteroid?



Andrew Prentice

Galileo Phones Home

by Le Tran

Fourteen years after its launch from Earth, the spacecraft Galileo is due to hit Jupiter on the 21 September, 2003. The contact will put an end to the Galileo mission (to put it gently), which began with the liftoff from Kennedy Space Center, on 18 October, 1989. Galileo reached Jupiter in 1995 and has since made discoveries that have both puzzled and excited scientists.

Among the findings are revelations of the changes in Jupiter's composition, its atmosphere, and reasons for the existence of the red spot.

The most exciting discoveries, however, have been those related to Jupiter's four moons, Ganymede, Europa, Io and Callisto.

Torrence Johnson, of the Jet Propulsion Laboratory, has been involved with the mission since its inception in 1976. For Johnson, findings concerning the two moons Ganymede and Europa have been the highlight of the mission.

The Ganymede discoveries reveal that this Mercury-sized moon has a heavy center of rock and iron, surrounded by an icy surface. It has a magnetic field similar to Earth, strong enough to locally dominate the magnetic field of Jupiter.

Galileo also discovered strong evidence that Europa, which is the size of the Earth's moon, has a relatively young geological surface. The moon has a melted saltwater ocean about 100 km deep, and this global ocean is encapsulated in a thin ice shell. There may also be internal heat sources.

Johnson believes that these discoveries suggest that Ganymede and Europa are possible habitable zones, saying that 'the mission has contributed to the evolving understanding of the zones that can maintain life.'

The fascination with Jupiter and its moons has prompted a second mission. Planned as Galileo's successor, the Jupiter Icy Moon Orbiter is expected to launch in 2010, although this has not yet been confirmed. The mission is still under study and will be included in NASA's budget next year.

Interstellar Matters

by Bo Reipurth

Division VI holds its Science Meeting this afternoon. In addition to a presentation by **Ted Gull** on *Eta Carinae* discussed in yesterday's *Magellanic Times*, we have 5 more talks.

Bruce Elmegreen will give us an overview of the latest results on large-scale star formation processes. **Mike Dopita** summarizes recent results on extragalactic H II regions in connection with efforts to understand starburst and high-redshift galaxies. **Frank Winkler** presents selected highlights among new studies of supernova remnants. **Blair Savage** discusses FUSE results on O VI observed along sight lines through the galactic halo. And **Yoshiaki Sofue** reviews the latest large-scale CO surveys of nearby galaxies.

Come join us this afternoon in **Tumbalong Meeting Room 2** starting at 14:00.

Letter to the Editor

G'day, mate,
There's something a bit cactus about The Magellanic Times. Australian (and Queen's) English seems to have hit a bit of a bingle. But no worries. This small criticism comes with a dictionary for the benefit of the editor and in the interests of a dinki di Aussie Magellanic Times.

AMERICAN	ENGLISH
Realize	Realise
Organize	Organise
Criticize	Criticise
Tantalize	Tantalise
Standardizable (yuk)	Standardisable
Center	Centre
Fiber	Fibre
Chicken	Chook

She's apples, and hopefully she'll be right in the next tantalizing edition.

Faithfully,

Carol Oliver

The editor, who hails from a large western-hemisphere country that will not be named for security reasons, apologizes for the apparent chauvinism in usage Ms. Oliver describes. However, in the interests of consistency, he has chosen to adopt the spelling of his native country for this rag, simply because in so doing, there is more likelihood of trapping errors. Surely this is equitable dinkum.

Editor

Data Avalanche No More

by Judy Lai and Debbie Ng

Don't you just hate it when you have to browse through tens of astronomical data systems (for half an hour or so) just to retrieve one piece of information?

Don't worry – you're not alone. The folks at the International Virtual Observatory Alliance (IVOA) are here to solve your problem, as noted in the second issue of this newspaper. Earlier this year, they started developing a new software program which is aimed at linking all telescope archives into one unified virtual observatory.

Funded by the Australian Research Centre, the IVOA is currently intended to operate in eight countries including Australia. This initiative can now make it possible for telescope data described in various formats to be compiled into one easily accessible and common format. As a result, long gone are the days and nights (and about a hundred cups of coffee) of having to go through a mountain full of radio, X-ray, optical, and other data. Instead, all the information you need will be at your fingertips.

'Observational data and the result of large-scale theoretical simulations are key ingredients in the virtual observatories,' noted participant Cathy Trott. 'Really, it's science without having to go to a telescope,' she adds.

The topics covered in this program include systematic exploration of the large-scale structure of the universe, the structure of galaxies, AGN populations, and variability on a range of time-scales, wavelengths, and flux levels. These data have been distributed and analyzed by astronomers who specialize in the fields of optical, radio, high energy, and ground-based astronomy.

This year, researchers from the IVOA aim to publish four premier data archives techniques. For example, 2dF instrument on the Anglo-Australian Telescope have located 22,000 quasars identified spectroscopically.

The software package has been designed to provide high-performance computational resources with a mass storage system. This function enables a diverse range of users to access resources with the 'the convenience of single sign-on authentication'.

The IVOA also plans to develop a small Australian Astronomy Grid by mid-2004. However, sponsors from the media and other interested parties are required if the software program is to be successfully implemented. For more information, go to the IVOA Australian home page on http://www.aus-vo-org.

Where the Stars Are

by Sean Urban and Norbert Zacharias

One of the primary missions of the U.S. Naval Observatory (USNO) is to determine the positions and motion of celestial objects. To that end, the USNO staff has embarked on a multi-year observing program to map all stars between 8th and 16th magnitude at a precision 10 times more accurate than ever before. The project, called the USNO CCD Astrograph Catalog (UCAC) uses a 20-cm astrograph designed specifically for astrometry. Observations began in 1998 from Cerro Tololo Inter-American Observatory; after 3 years of observing, the telescope was relocated to Flagstaff, Arizona where it continues observing the Northern sky.

The second data release of the project, termed UCAC2, has just been made available; it supersedes the UCAC1 that was released in 2000. The UCAC2 contains positions, proper motions, and photometry for 48 million stars of magnitude 8<R<16 and covers 86% of the sky with complete coverage from the South Celestial Pole to +40 degrees declination. The Two-Micron All Sky Survey (2MASS) H, J, and K_s photometric data are included for 99.5% of the stars.

Sean Urban and Norbert Zacharias as a stellar binary

The data can be used for a wide variety of research, especially in the fields of minor planet ephemerides, galactic dynamics, and stellar clusters. Telescope pointing, CCD calibrations, occultation observation planning, and object identification are some of the immediate, practical uses of the UCAC2 data set. The data have already been utilized for astrometric calibrations and verification of several projects, including the Sloan Digital Sky Survey and 2MASS.

Some characteristics of the UCAC2 will be described during JD16, 'The International Celestial Reference System: Maintenance and Future Realization' on Tuesday, July 22. The catalog is a 3 CD set; to obtain a copy at this meeting contact Norbert Zacharias or Sean Urban. For those not wanting to carry 48 million stars home in their luggage, send an e-mail to nz@usno.navy.mil with your request and a postal address.

Panspermia?

by Seth Shostak

About 25 years ago, two U.K astronomers, Fred Hoyle and Chandra Wickramsinghe, proposed that comets might be the Johnny Appleseeds of life, carrying vital spores from world to world, an idea that is known today as panspermia. If the tail of such a life-loaded comet were to brush the Earth's atmosphere, it might pass some of the frozen microorganisms into the atmosphere, where they could descend to our planet's surface. The two astronomers suggested that this might account for the start of life on Earth. They also made the suggestion that interstellar transmission of disease could take advantage of this mechanism. This idea was comitted to paper in a book, 'Diseases from Space.'

Now Jayant Narlikar, of the Inner-University Centre for Astronomy and Astrophysics, Pune, India, has performed an experiment that seems to support these ideas. The experiment, funded by the Indian Space Research Organization, involved flying a cryo-sampler in a balloon that reached an altitude of 41 km. That cryo-sampler had 16 cylinders that were evacuated and decontaminated before launch. A liquid neon-cooled cryo pump sucked in air from various heights. The heights ranged from 25 to 41 km, and each cylinder had air samples from a specific altitude.

This payload was brought down and examined in biology labs in Cardiff and Sheffield, England, and the researchers found evidence for live cells in the samples from 41 km. Some cells were also found at lower altitudes, but these samples haven't yet been examined for bacteria.

Curiously, the bacteria found at 41 km were non-culturable. This is important in ruling out laboratory contamination of the samples – the bacteria found were clearly not a common lab bacterium. The material has been analyzed by biologists, and the results published in the FEMS (Federation of European Microbiology Societies) Journal. A detailed account of the results also appeared in Current Science, an Indian journal. Narlikar's team is proposing to analyze the remaining samples, including an isotopic analysis – i.e., does the composition of the sample accord with a terrestrial composition?

Narlikar emphasizes that this is the first attempt to demonstrate that biological systems exist at such heights. But he admists that he still doesn't know if admits the biology he's found comes from above or below! Narlikar is confident that its come from above because atmospheric scientists have noted that even in the strongest volcanic eruptions, the ash goes up to no more than 32 km, so having found something at 41 km, and at a time during which there had been no recent volcanic eruptions, speaks to the real possibility of an extraterrestrial origin.

What about the possibility that a disease like SARS may have come from space? 'We sent a letter to Lancet, the medical journal,' Narlikar says, 'suggesting that these things are percolating down from atmospheric heights down to Earth. Clearly, they would reach the tallest peaks first (Himalayas – and thanks to the wind – into China.) So we suggested that this might be the origin of the SARS virus.'

Narlikar remarks that the idea of panspermia is greeted in one of two ways: Either there is a violent opposition, a sort of geocentric mind set, he calls it. The other reaction is to say that this is an interesting investigation, and should be explored further. Narlikar notes that the reaction is less hostile today than 25 years ago because in the interim bacteria have been found living in extreme conditions in the Earth, and have been experimentally subjected to harsh conditions and survived. So the idea of panspermia is no longer regarded as quite as radical as it once was.

How would panspermia affect our view of the origin of life? Narlikar laughs: 'Well, we could all be ETs!'

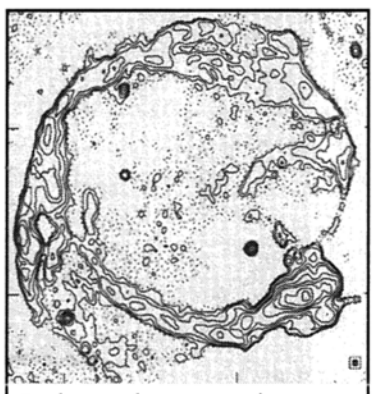
Jayant Narlikar, possible child of the stars

Focus on History

by Wayne Orchiston

The Sydney GA offers a rich program for those with a passion for astronomical history. Commission 41 (History of Astronomy) has organised nine different Science Meetings and Working Group Meetings for the first half of Week Two, running in two parallel 'streams.'

On Monday morning in Skyline 1, Science Meeting 1 (Applied Historical Astronomy), we'll discuss ways in which historical data



Radio isophote map of G315.4–2.3, the supernova remnant most likely associated with the historic supernova of AD 185. This supernova may have been recorded by Polynesian astronomers

can be used to address contemporary astrophysical issues. Of particular interest are historic supernovae and their remnants, eclipses that throw light on the Earth's rotation, and long data sets on solar activity and variable star magnitude estimates. This Science Meeting has been organised by Professor F. Richard Stephenson, President of Commission 41.

There will be a Working Group meeting on "Astronomical Archives" (WG1) in Skyline 1 on Monday afternoon, with oral and poster papers covering important archival collections in Japan, Romania, and at the U.S. Naval Observatory, Cambridge University (the RGO Archives), the Royal Observatory Edinburgh and Padova Observatory.

John Tebbutt (1834-1916) featured on an Australian $100 bank note. Doyen of nineteenth century Australian astronomy, for more than half a century Tebbutt observed prolifically, publishing nearly 400 research papers and notes (many in Astronomische Nachrichten and Monthly Notices).

Australia is represented by a Keynote paper on the ATNF Historic Photographic Archive – a unique radio astronomy resource – and a paper about the Tebbutt Collection in Sydney.

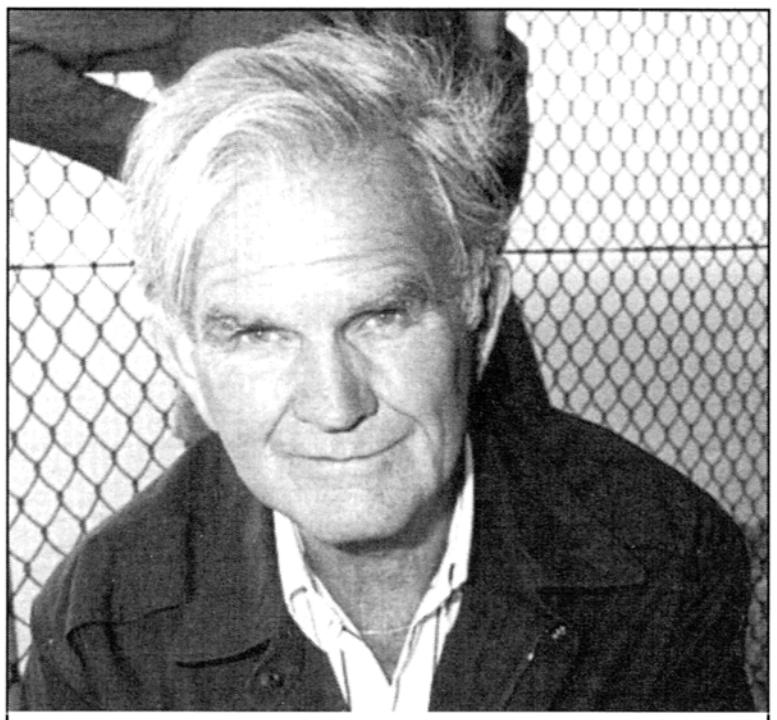
Running opposite the above programs on Monday, in the Merino Room, is a joint Commission 40–41 Science Meeting on "The Early Development of Australian Radio Astronomy." This all-day meeting features an introductory overview by Woody Sullivan, and papers by a number of retired radio astronomers who played a role in the development of Australian radio astronomy between 1946 and 1988: Bob Batchelor, Bob Duncan, Bruce McAdam, Don McLean, Doug Milne, Harry Minnett, Masaki Morimoto, John Murray, Brian Robinson, Mal Sinclair, Bruce Slee, Shigemasa Suzuki and John Whiteoak.

Throughout lunchtime on Monday, from 1:00 pm, a ten-minute video about Grote Reber will run in the Merino Room.

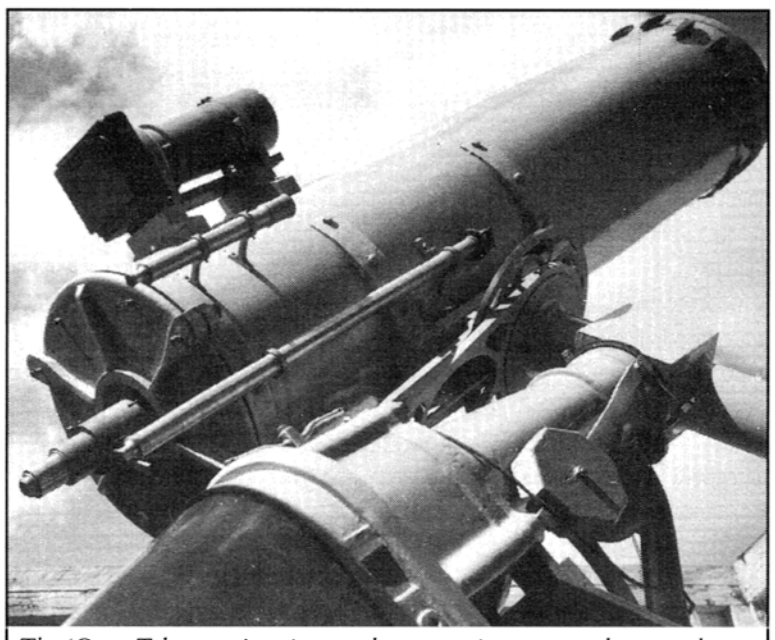
On Tuesday morning in Skyline 1, WG3 will focus on "Historical Instruments," with Keynote papers about significant instruments at Sydney Observatory and in the Science Museum, London, and other oral and poster papers about Japanese, Italian and US telescopes, Gregory's invention of the Cassegrain telescope, instruments developed by Sir George Airy, the Struve arc of the meridian, the Anglo-Australian Telescope, and the 'Catts Telescope', an early Grubb reflector that was used with distinction at Mount Stromlo Observatory and Mount Bingar.

WG4 ("Transits of Venus") runs all Tuesday afternoon in Skyline 1, with papers about the nineteenth century American, Belgian, Brazilian, Dutch and German international transit expeditions, and observations of these transits carried out in Australia, India, Italy, Mauritius and New Zealand. There is also a paper about the 1769 transit. This meeting will include the 'world premier' of a short time-lapse movie of the 1882 transit, developed from photographs found in the Lick Observatory plate archive.

There are also two different half-day history meetings in the Merino Room on Tuesday. In the morning, Commissions 40 and 41 will offer Science Meeting 5 ("Pioneering Observations in Radio Astronomy"), with papers about such luminaries as Grote Reber and Olof Rydbeck; the world's first female radio astronomers (Elizabeth Alexander and Ruby Payne-Scott); the post-war role of Wurzburg dishes; interstellar scintillations; the discovery of Sgr-A*; early radio astronomy developments in France, Japan and Russia; and the commemoration of the historic Dover Heights research station.



Bruce Slee, the pioneering Australian radio astronomer who, with the late John Bolton and Gordon Stanley, was involved in early work on discrete sources at Dover Heights. In his active retirement, Slee continues to observe active stars and microquasars with the Australia Telescope Compact Array

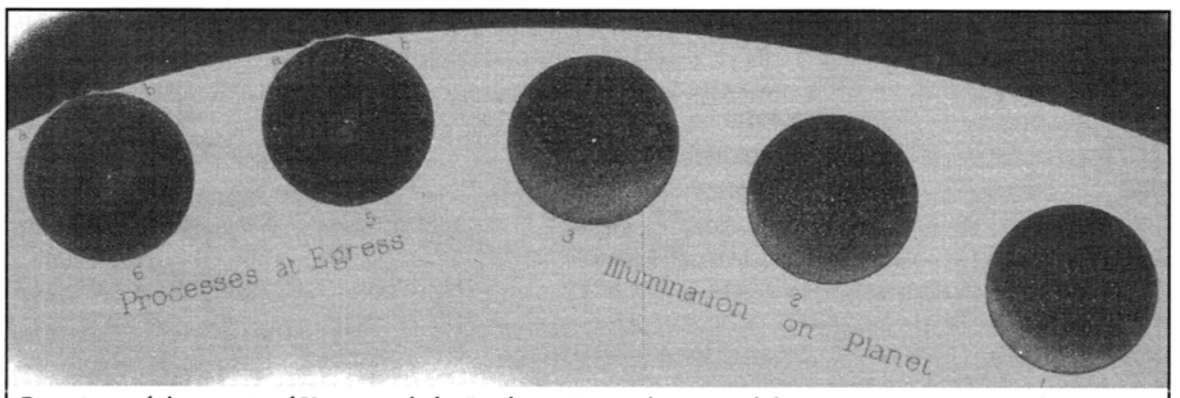


The 'Catts Telescope,' a nineteenth century instrument that somehow escaped Ian Glass's book on Grubb telescopes. During the 1950s and 1960s, this instrument was used at Mount Stromlo and Mount Bingar for a wide range of photometric and spectrophotometric studies by staff, visiting astronomers, and PhD students

The afternoon meeting in the Merino Room (SM3: "Recent Research") is an astronomical smorgasbord program that covers a range of topics. In addition to a Keynote paper about the Struve dynasty of astronomers, and contributions on aspects of Australian, British, Chinese, Egyptian, French, Japanese, Taiwanese and US astronomy, there are personal recollections of Mount Stromlo Observatory in the 1960s by John Graham (Carnegie Institution), one of their earliest PhD graduates. Given the recent disastrous bush-fire, this will be a particularly poignant presentation.

The history of astronomy program finishes on Wednesday at lunchtime. Between morning and lunch WG2 ("Astronomical Chronology") in Skyline 1 will offer papers on the CHRONICA project, and astronomical milestones in Mesopotamian and more recent western astronomy, while SM4 ("Ethnoastronomy and Archaeoastronomy"), in the Merino Room, will feature a Keynote introductory paper by Clive Ruggles and Keith Snedegar – the organizers of this meeting – and a range of oral and poster papers about African, Indonesian and Vietnamese indigenous astronomical systems and European sites, structures and artifacts of astronomical significance. There is even a paper about the orientation of churches!

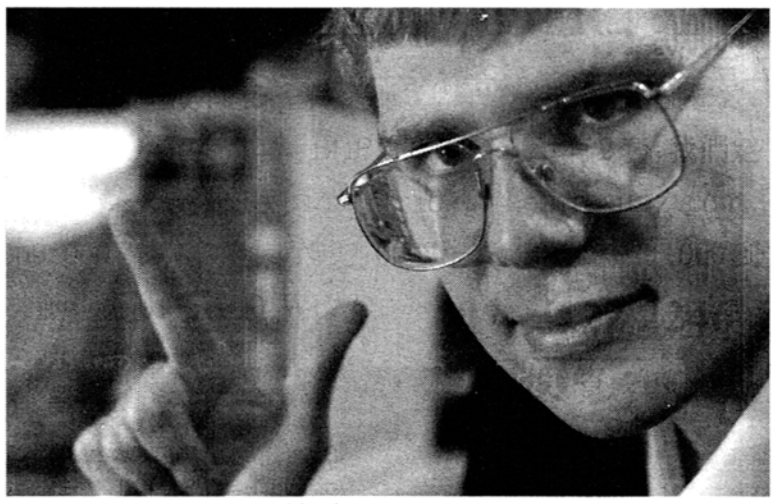
With 96 different oral or poster papers spread over nine different fields of astronomical history and one and a half days of joint meetings with C40 (Radio Astronomy), this is far and away the richest program offered by C41 at any General Assembly, and all IAU members are very welcome to attend our sessions. The final program and abstracts of all papers are included in the Commission's own History of Astronomy Program and Abstracts booklet, copies of which will be available in the Skyline 1 and Merino Rooms throughout the history sessions.



Drawings of the transit of Venus made by Professor Liversidge, one of the astronomers associated with Sydney Observatory's 1874 transit of Venus program. Liversidge was based at Goulburn, ~210 km south of Sydney, and used a 3.25-in equatorial refractor furnished with a red filter

Mapping Micro-arcsecond Quasars with the Interstellar Radio Telescope

by Jean-Pierre Macquart



Jean-Pierre Macquart twinkles his eyes

Look up at the night sky, and one of the first things you notice is that the stars are twinkling but the planets are not. Most of us have realised this from childhood. But we might not have realized that exactly the same physics is being used to image the regions around the black holes of the brightest, most powerful radio quasars with micro-arcsecond resolution.

Objects twinkle at radio wavelengths not due to Earth's atmosphere, but due to scattering off turbulent fluctuations in the electron density of the ionised component of our Galaxy's interstellar medium. Only sources with a small angular size relative to the scale of the scintillation pattern exhibit scintillation, which is why only stars twinkle at optical wavelengths. At radio wavelengths the typical angular scale of the scintillation pattern is of order tens of micro-arcseconds. So a radio source must be exceptionally small to exhibit interstellar scintillation. Pulsars, located near the Galactic plane, whose radiation propagates through copious amounts of interstellar gunk to reach Earth, are known to scintillate.

But the discovery that quasars also exhibit fast scintillations came as a shock. The intra-hour variations that were reported in PKS 0405-385 by Lucyna Kedziora-Chudczer and Dave Jauncey, and later J1819+3845, by Jane Dennett-Thorpe and Ger de Bruyn, astounded many. Most of the radio energy emitted by these quasars was coming from a tiny region, and implied brightness temperatures well in excess of the inverse Compton limit! For instance, the scintillation properties of PKS 0405-385 showed that most of this quasar's radiation emanates from a region no larger than 20x30 micro-arcseconds, giving it a brightness temperature over $5\ 10^{13}$ K.

Living on Earth may be expensive, but it includes an annual free trip around the Sun. Scintillating quasars reflect this fact. As the Earth moves around the Sun, its velocity changes with respect to the scattering material. The time scale of the intensity fluctuations is observed to vary with an annual cycle, as both the magnitude and direction through which Earth cuts through the scintillation pattern change. This is demonstrated beautifully for J1819+3845 (Dennett-Thorpe & de Bruyn 2003, in press) and for PKS 1257-326 (Bignall et al. 2003). It also proves that the variability is scintillation-induced, not intrinsic to the sources.

Not only does interstellar scintillation point to such incredibly compact quasars, it also provides the means of imaging them. The annual cycle in scintillation velocity has opened the possibility of using the interstellar medium as a giant radio interferometer capable of making micro-arcsecond two-dimensional images of these extraordinary sources.

This technique of Earth Orbital Synthesis, outlined in 2002 (Macquart & Jauncey), exploits the fact that the direction of the scintillation velocity changes. As it does so, we probe source structure along different directions. One can think of the interstellar medium as a 100,000 km interferometer primarily sensitive to structure parallel to the direction of the scintillation velocity. As in Earth rotation synthesis with a conventional east-west interferometer, one observes long enough for the interferometer to rotate through a range of angles with respect to a source in order to build up enough u-v coverage to construct a source image. Here we rely on Earth's orbit and observe at intervals over a year to build up many one-dimensional slices and eventually construct a complete two-dimensional image.

We are applying this technique to J1819+3845, the fastest (20 min), most extreme (40% modulated) variable quasar known, using the Westerbork telescope. Although our full orbital synthesis is not yet complete, we already know the source consists of at least two distinct polarized features separated by 40 microarcseconds and offset approximately 50 microarcesecoseconds from the bulk of the unpolarised emission. The source also appears to be extended in a direction coincident with a possible extension observed in a 22 GHz VLBI image.

This scintillation imaging will elucidate some of the key questions related to these quasars: why are they so bright and how can they possible stay so bright for many years? If the high brightness temperature is due to Doppler boosting caused by highly relativistic flows, why don't the sources expand and stop scintillating after a few months? If not, other processes should limit the brightness temperature to similarly short times.

Intra-day variability is not just confined to a few oddballs. Nowadays, several hundred intra-day variable radio sources are known to exist, most of which have been discovered in the last year from The Micro-Arcsecond Scintillation-Induced Variability (MASIV) Survey using 13 days of VLA time, spearheaded by Jim Lovell.

The population of intra-day variable sources has implications for future telescopes and surveys. If, as suggested by MASIV, fainter quasar cores are also more compact, the SKA may well find a microJansky radio sky replete with intra-day variable sources.

Another tantalising hint provided by the MASIV survey is that the distribution of intra-day variable sources across the sky is clumped, pointing to specific nearby (<100 pc) regions of our Galaxy which produce enhanced scattering and pick out compact quasars. So the question is, are intra-day variable sources peculiar because the sources themselves are special, or the interstellar medium along their lines of sight?

We have much more to learn from the twinkling radio sky.

Next Generation of Astronomers from the University of Melbourne

by O. Ivy Wong

The astrophysics group at the University of Melbourne is headed by Professor Rachel Webster, and there is, and has been, some very interesting work undertaken by the graduate students there. Some of the PhD projects range from the studies of HI, gravitational lensing, and the theory of neutron stars to studies of such exciting objects as active galactic nuclei (AGNs) and ultra compact dwarfs (UCDs).

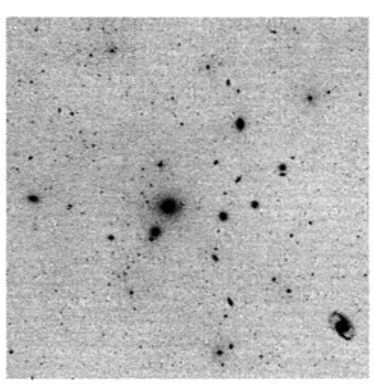
Four doctoral students from this group; Arna Karick, Martin Meyer, Donald Payne and Randall Wayth, gave this reporter some insight into their projects.

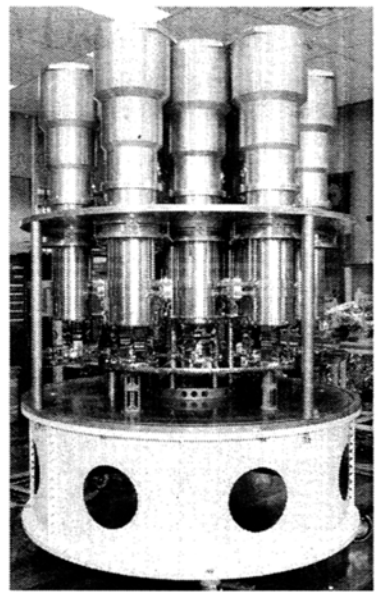
Martin Meyer is working with Dr. Martin Zwaan, Prof. Rachel Webster and a large team of people around Australia and abroad. He is involved with the HI Parkes All-Sky Survey Catalogue (HICAT), which is the largest uniform catalog of HI sources, with 4,300 objects identified from their HI content. An accurate measure of the HI cosmic mass density at the present epoch will be obtainable from this survey. This catalogue will also enable further investigation of, for instance, the Tully-Fisher relation, the role of HI in the evolution of galaxies, and the clustering of HI-rich galaxies (which has been found to be weaker than for optically selected galaxies.)

Randall Wayth works on gravitational lensing with Professor Rachel Webster, as well as an international team of collaborators. As part of his research, he has developed LENSVIEW which is software for modeling resolved gravitational lensed images. This software also reconstructs the surface brightness profile of the source and is able to project a given source through a lens model in order to generate a 'true'image by conserving the surface brightness.

Donald Payne works with Dr. Andrew Melatos on the magnetic field evolution in accreting neutron star binaries. They have found that it only takes 10^{-5} solar masses of accreted mass before the magnetic dipole moment gets significantly decreased.

Arna Karick is working with Webster and Dr. Michael Drinkwater (University of Queensland) together with an international team of collaborators on the Fornax cluster of galaxies. This cluster has recently revealed to us a new class of objects called ultra compact dwarfs (UCDs).





***Above:** The multibeam receiver for HICAT, used on the Parkes 64 m telescope.*

***Left:** The Fornax cluster of galaxies*

Star Gazing Reaches New Heights

by Debbie Ng and Nicole Scardino

Just as Galileo revolutionized the world of astronomy, the European Southern Observatory is looking to take astronomical research to a new level. Ground-based Extremely Large Telescopes are set to reach new heights with the development of the OWL project (Overwhelming Large Telescope).

Roberto Gilmozzi thinks big

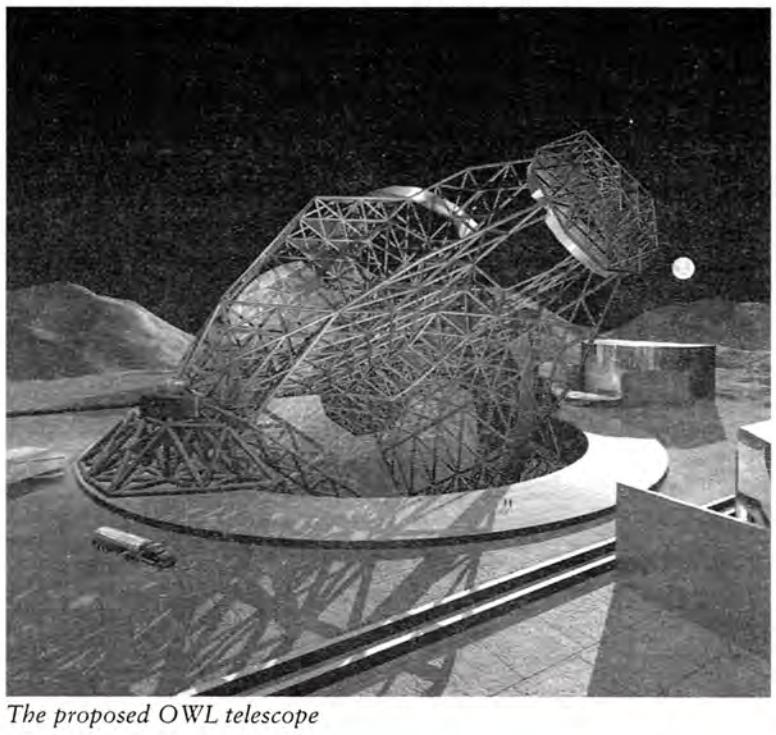
The project was motivated by a desire to build the largest telescope possible within the allocated budget of $1 billion. The project looks to minimize costs through the mass production of the many mirrors needed to make the telescope. The limits of a finite budget have been at least partially circumvented by the smart use of mass production.

OWL is set to live up to its name, becoming the world's largest optical telescope with a proposed mirror size of approximately 100 m, a structure of approximately 90 m and a surprisingly low total weight of 8,500 tons. While preliminary designs have been made, the parameters of the telescope will inevitably vary once actual construction begins and a site is selected.

The goal of every telescope when it is first envisioned is to answer the many questions posed by the scientists who build them, and OWL is no exception. In addition, OWL will, it is hoped, truly push the limits of astronomy. The Principal Investigator of the OWL project, Roberto Gilmozzi, describes the plans as 'a quantum jump in terms of what we can do.' It is hoped that the telescope will fill in some of the gaps in our current knowledge of the creation of stars by making it possible to look at the first population of stars and the distribution of matter in the early universe.

During yesterday's Joint Discussion on Large Telescopes, the important issue of international cooperation was raised. Members of the discussion agree that 'they are all in the same boat,' and therefore have benefited from the creation of international working groups. Such cooperation is described as crucial by Gilmozzi, who is keen to see the project prosper. The sharing of ideas has the potential to accelerate improvement in the design of OWL.

Current estimates are that OWL will have first light by 2015, and will be fully operational in 2018. If all goes to plan its findings could be as astronomically important as Galileo himself!



The proposed OWL telescope

A Major Extinction Event?

by Malcolm Walter

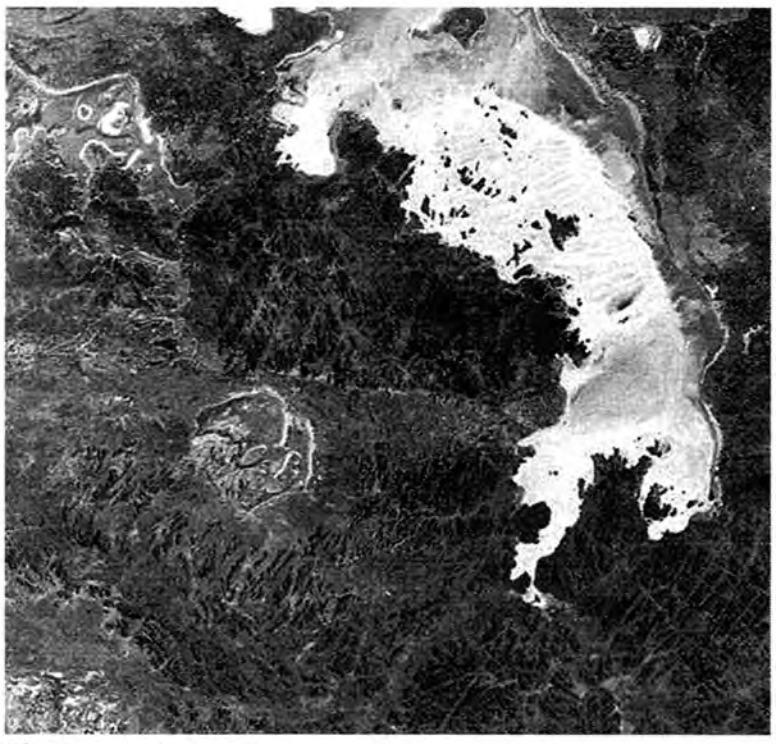
Malcolm Walter, impact beneficiary

About 20 years ago, two separate groups of researchers discovered, firstly, an impact crater in South Australia (the so-called Acraman impact site), and the ejecta layer associated with the impact. It's estimated that the impactor was about 4.5 km wide, and that the transient crater that resulted was about 40 km in diameter. The final collapse crater is perhaps 80 – 100 km in diameter. It's now deeply eroded, but all the classic indicators of impact are present; it's well established as an impact site.

Because the ejecta layer is present in proterozoic rock, the age of the impact has been estimated at 580 Mya, an intriguing time in Earth's history. This is just when animal fossils first appear in the rock record, and shortly after what is called a 'snowball Earth' event, during which there was global glaciation.

About ten years ago, one of my graduate students was studying the distribution of fossil plankton in proterozoic rocks in Australia, and quite fortuitously found a radical change in the types of plankton right at the level of the Acraman ejecta layer. She was working with another graduate student who was studying the carbon isotope record in the same rocks and, lo and behold, he found a carbon isotope anomaly at the same level. The isotope anomaly is consistent with substantial reduction in bio-mass (or, not to put too fine a point on it, an extinction.)

For decades, people have been coming up with creative hypotheses to explain the origin of the animals of the Cambrian Explosion, and most recently the snowball Earth glaciation has been implicated. But now we have a new possibility: there was an extinction event that wiped out much of the plankton of the oceans, and so made new niches available for rapid evolution of these metazoa. At the same time, the impact would have dumped vast amounts of nutrient-rich dust into the ocean, stimulating a flourishing of life. This could well be the early Earth's version of the demise of the dinosaurs, an event that presaged all that followed.



The Acraman impact site

IAU Commission 36 Theory of Stellar Atmospheres

Monday, July 21, 11:00 – 12:30, Room PM 1

Work of Commission 36 and its new Organizing Committee for 2003-2006

Possible topics for future scientific meetings during 2005-2007 (e.g., the fine structure across stellar surfaces, quantum-optical effects in astrophysical radiation, and atmoepheres of non-spherical stars.

Possible needs for establighsing specific working groups

Exchange of information relevant to the training of young researchers

Suggestions for additional topics are welcome. Contact Commission President Dainis Dravins not later than Friday, July 18.

Commission 5 Business Meeting Schedule

Monday, July 21, Pyrmont Room 1

9:00 – 10:00
Working Group Virtual Observatory

10:00 – 10:30/11:00 – 11:30
Working Group Atronomical Data

11:30 – 12:30
Working Group FITS

14:00 – 15:00
Working Groups discussions continued

16:00 – 17:30
Commission 5 Business Meeting

Shedding Light on Dark Matter

by James Hitchcock

In 1937 Fritz Zwicky found that the visible component of a cluster makes up only a small fraction of the total mass. In fact 80-85% came from an unknown and invisible matter, so-called dark matter. Einstein predicted that when you look near a dense object, light gets distorted. He was correct. However he also predicted that lensing would not play a major role in the study of dark matter. This is one thing he got wrong.

Finding an effective technique to view dark matter has taken some time, but recently Dr Richard Ellis of Caltech along with his team (Tommaso Treu and Jean-Paul Kneib) have had a major breakthrough in the study of this elusive dark matter.

Using the NASA/ESA Hubble Space Telescope they have constructed what they term a 'mass map' of the galaxy cluster CL0024+1654. To make this map, they were allocated in excess of 120 hours observing time. The cluster is equal in angular size to the moon, and required 39 observations.

Ellis notes that 'the new dark matter map is more detailed and extensive than previous ones.' The study was been successful because of the use of the Hubble Space Telescope; previous researchers have tried to perform similar investigations using ground based telescopes, but the technique relies heavily on finding the exact shapes of distant galaxies behind the cluster.

'On the largest scale, the dark matter falls of from the center at the same rate as the galaxies. Although theorists have predicted the form of dark matter in galaxy clusters from numerical simulations based on the effects of gravity alone, this is the first time we have convincing observations to back them up. Some astronomers have speculated clusters might contain large reservoirs of dark matter in their outermost regions. Assuming our cluster is representative, this is not the case.'

Of course performing many replications of such an experiment is extremely time consuming, especially when considering it took three years to map just one cluster.

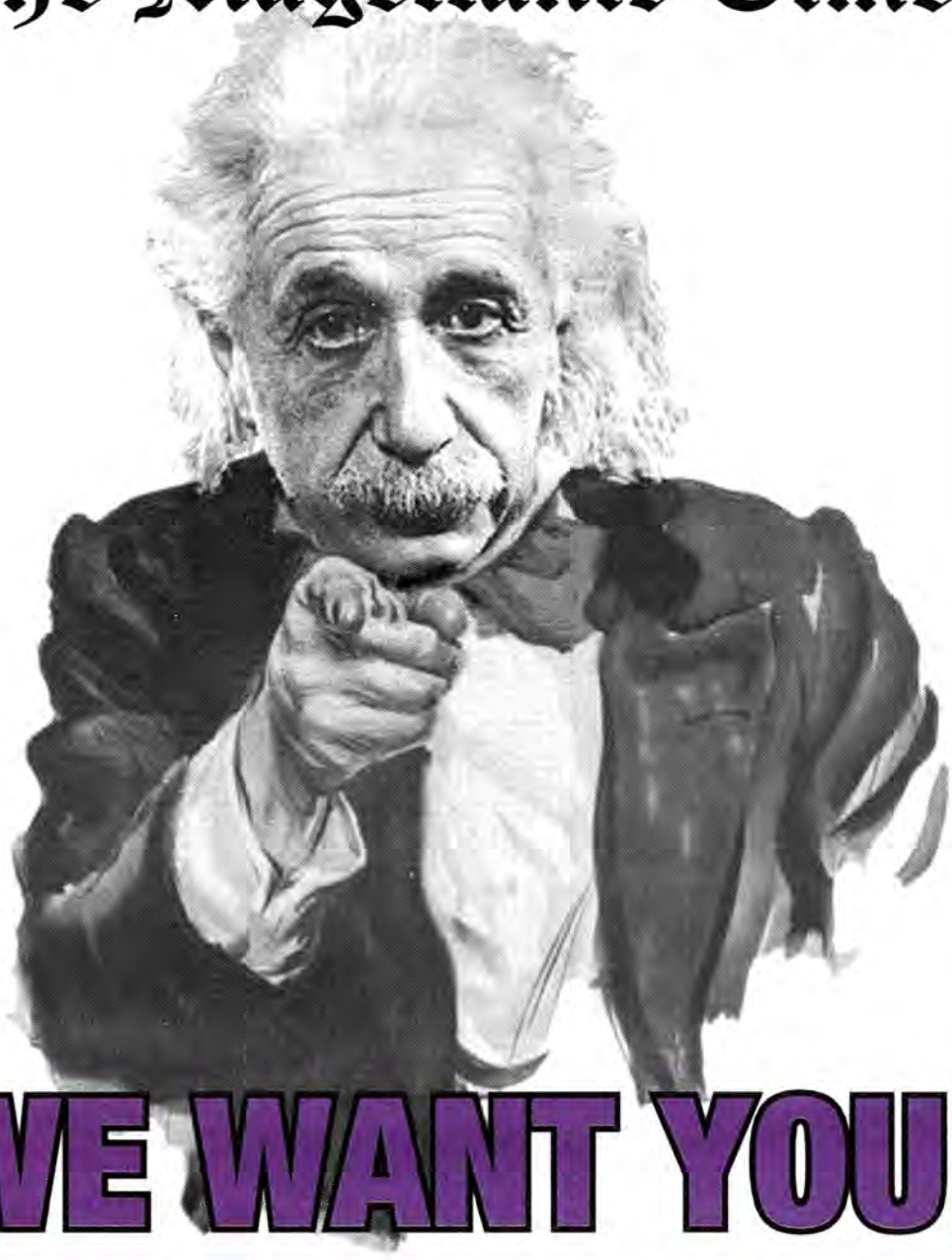
'On a small scale we found clumps in dark matter that correlate with clumps in the galaxy,' says Ellis. He used the analogy of a cake and icing to describe this effect, the cake being the dark matter and the galaxy being the icing. Wherever there is a lump on the cake, icing is smeared on that lump.

When describing what this means in terms of the creation of galaxy clusters, Ellis says that 'dark matter acts as early seeds for the growth of galaxies and structure. The theorists are probably right that dark matter is the reason we are here... and was crucial to the formation of galaxies such as the Milky Way. Like most things in science, it's a partnership between theory and observation.'

Ellis is planning to study a second galaxy cluster using Hubble's new camera, the Advanced Camera for Surveys, later this year. The new camera is 10 times more efficient than the Planetary Camera 2 and the Wide Field Camera used in this experiment. This will make future investigations even clearer, and help us to better understand how galaxy clusters are assembled.

Richard Ellis seen in the light.

The Magellanic Times



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The Magellanic Times

THE NEWSPAPER OF THE INTERNATIONAL ASTRONOMICAL UNION GENERAL ASSEMBLY SYDNEY 2003

IAU XXV General Assembly Sydney 13-26 July 2003

Day 6 **Monday 21 July**

The ATNF and the SKA

by James Hitchcock

Professor Brian J. Boyle, the former director of the Anglo-Australian Observatory, was named the new director of the CSIRO Australia Telescope National Facility (ATNF) in May. Boyle took up his appointment this month.

I spoke to Professor Boyle about some of activities that have been going on, and what he will be overseeing in the future.

Brian Boyle

The ATNF project, The Australian Telescope Upgrade, was put forward to receive a funding boost from the Australian Federal Government. The project was selected with the aim of maintaining Australia's leading position in Southern Hemisphere radio astronomy. It will enable observations to be made at shorter wavelengths and higher angular resolutions than before.

The other project Boyle and the ATNF are currently involved with is the SKA (the Square Kilometer Array.) The SKA is being planned by an international consortium and will be the biggest radio telescope the world has ever seen. It will have a collecting area of one million square meters giving it 100 times the sensitivity of today's best radio interferometer. The SKA will be the first aperture synthesis telescopes with multiple independent fields of view, with up to as many as 100 at a time.

At current there are a number of possible designs which have been put forward for the SKA, including:

- A set of large spherical reflectors, which will be shaped to form local parabolic patches
- A large low profile parabolic reflector of long focal length with a receiver supported by a balloon
- An array of steerable parabolic dishes
- A fixed planar array
- An array of spherical Luneburg lenses
- A parabolic cylindrical reflector

The SKA will help researchers in many fields, and will assist in answering questions about the evolution of the universe, galaxy and star formation, the production of heavy elements, the presence of dark matter, the behavior of gamma-ray bursters, gravitational waves, jovian planets and of course the search for extraterrestrial intelligence. Boyle comments that 'the SKA will be used to probe the very first structures formed in the early universe.'

There are many proposed sites for the SKA, however Boyle believes Australia to be the best. 'Australia is naturally radio quiet, and it offers a unique environment.' With the majority of its population in coastal regions, that means there are huge stretches of space in the interior with no one in sight for miles. Construction of the SKA would also create a cutting edge communication network for inland Australia.

'Australia has a rich astronomy heritage, both with the original owners and the European land settlers' Boyle notes. The SKA array will be complementary with the views of the original owners of the land, helping to keep inland Australia quiet and undisturbed. The SKA would be anything but a scar.'

Headed for an upgrade: the Parkes 64 m radio telescope, six hours west of this conference.

The Future of Australian Astronomy is Looking Big

by Nicole Scardino and Debbie Ng

Is bigger really better? Australia is looking to increase its role in the international astronomical community with its participation in the Extremely Large Telescope (ELT) project. This interest is being developed through the Extremely Large Telescope Working Group (ELTWG) which was established earlier this year to liaise with the astronomical community. The group will also explore and develop the funding opportunities and possible industry partnerships for an ELT.

The Australian astronomical community has previously worked on many projects. More recently they have been increasing their participation in the Gemini telescope as well as looking at the next generation of larger telescopes, instruments that will allow them to explore the universe in finer detail. Just like the Overwhelming Large Telescope (OWL) project, ELT is a major leap forward in astronomical technology. The resolution of ELT will be comparable to that of space telescopes.

Modern technology has lead to exponential improvements in telescopes. In the past, telescopes tended to double in size with each generation, but as technology advances, scientists have been able to quadruple the size of the mirrors for the next telescope. For example, whereas 4 m mirrors were previously expanded to 8 m, the scientists involved with ELT are looking to expand the diameter of mirrors from 8 m to 30 m. This allows finer detail to be seen of course, and may permit the direct detection of planets around other stars. ELT will also enable astronomers to analyze the atmospheres of extrasolar planets.

The ELT poses many technical challenges, including the exacting manufacture of precision mirrors and a structure that is strong enough to withstand the elements. The design phase of ELT is expected to begin in 2004, followed by a construction period that is set to last until 2012 - 2014.

Australia is not intending to make its own ELT, but hopes to contribute to an international project. The country already has shares in two telescopes, in a field of approximately 18 international telescopes. Astronomers are looking to expand this share to 20%. The aim is to increase scientists' technical knowledge, as well as the use of their expertise in the production of the large components required for these telescopes. Australian teams are constructing two instruments for the Gemini telescope and another for the European Southern Observatory in Chile.

So why are the Australians interested in building a 20 – 30 m telescope when the Europeans are going for the 100 m option? As Matthew Colless of the Australian National University explains, the astronomical community needs a range of telescopes to support a variety of needs. The smaller telescopes are always needed to feed the larger ones.

The ELT, ready to confront the universe.

The Magellanic Times

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Deadline for daily issues
1pm on the day prior to publication

Text files for publication may be emailed to john@strangeplanet.com.au

Printed by
Marrickville Print & Design
Ph: 1300 888 490

Astronomy and Astronomers

by Janice McAdam

Janice McAdam

Although astronomy is the earliest of the observational sciences, it is unkind to refer to astronomers as members of the oldest profession. In a society where a word association test usually invokes the response 'mad' to the word 'scientist,' an astronomer is often regarded as a harmless eccentric. But a discipline in which one can seriously discuss the association of Lyman-alpha forests with supergiants as well as red, white and degenerate brown dwarfs, has a Grimm-like quality unmatched by any other scientific field; ancestral memories are stirred by a terminology that embraces both black holes and galactic halos, while spectral lines send a shiver up the most pragmatic spine.

In science fiction the protagonists are not usually astronomers but engineers or explorers, whose encounters with multi-limbed fauna from Planet X or meteor showers are considerably more pictorial than wrestling with a recalcitrant computer – and it is hard to get excited about something called SS433, which sounds more like a steamship than a binary system. But occasionally there is authenticity: Fred Hoyle's scientists were so realistic that astute reader of The Black Cloud can identify some of the protagonists with British astronomers of the 1950s. And women astronomers can appreciate Tricia McMillan in The Hitchhiker's Guide to the Galaxy who, despite her degrees in astrophysics and mathematics saw only the prospect of 'the dole queue again on Monday.'

Because stories about the stars are sometimes associated with magic, there can be a blurring of the distinction between astronomers and astrologers in the minds of children (and as many astronomers will testify, in adults as well; my husband has been asked several times whether he reads palms.) Our friends may imagine that we lead a romantic star-studded life. But literal stargazing is rare for radio astronomers, who find it hard to identify even common constellations; a radio astronomer asked to test a scout for his Stargazer Badge is a worried astronomer indeed!

I doubt whether appreciation of astronomy was stimulated by the cameo appearance of the Arecibo Telescope in the James Bond movie Goldeneye when it emerged majestically from a lake – a valuable application but one that was probably not in its original design specifications.

Astronomy is not just a science, it can be an art form; the photographs of David Malin or the technical equipment at an observatory have a beauty of their own that even non-astronomers can appreciate. One Australian author saw the tower of the Parkes Telescope 'with a great white daisy-shaped dish on top, turning its face in a listening attitude on the stalk of steel truss work... so delicate and fragile against the pure blue sky.'

And while on the subject of Parkes – have you seen The Dish? It has introduced many to the radio telescope and gives some indication of Australia's participation in the first moon landing. And it is easy to identify an astronomer in the audience – if somebody is laughing at a point in the movie when nobody else is, there's your astronomer!

From a talk by Janice McAdam on ABC Radio National 'Ockham's Razor' 13 July

What happened to the Statutes?

by Johannes Andersen, Hans Rickman, and Oddbjorn Engvold

On Tuesday evening, the General Assembly approved the revision of the Statutes and By-Laws proposed by the Executive Committee (EC). The detailed revisions are too extensive for an in-depth discussion at the GA itself, so we summarize here the main changes and the underlying intention, which is to enable the IAU to react more rapidly, flexibly, and effectively to changes in today's astronomy, and thus play an even more significant role tomorrow.

The existing Statutes and By-Laws were, in structure and spirit, a finely preserved example of the post-WWI atmosphere in which the IAU was created. States regarded international scientific organizations as an important but potentially dangerous resource, to be strictly controlled by government agencies in a top-down system. Hence the rigid rules for national and individual membership, the cumbersome procedures for creating Commissions and controlling their membership, etc.

This straightjacket has been an increasing burden on any new initiatives. And indeed, every recent General Assembly has made small changes of our basic documents to adapt them to some aspect of the current situation – often after some rational, but formally illegal decision had been taken. The result was a tangle of rules that made it wellnigh impossible for anyone to locate the rules applying to any actual situation.

Discussions with the National Representatives at the Manchester GA resulted in a decision to perform an in-depth revision of the Statutes and By-Laws, and a consensus on the main principles for this revision. The actual text has been developed in several iterations before and after the 2002 meeting of the EC, involving the Division Presidents at every step, and finally submitted to the Adhering Organizations half a year ago.

But what does all this mean for daily life in the IAU, as seen by you, the membership? Amateur lawyers among you may want to go into the details of the text (which will soon be posted on the IAU web page). Its new structure, with the main permanent definitions contained in the Statutes, matters of interpretation and application in the By-Laws, and all rules on a given subject kept together, will make the task much easier than before. The final level, the Working Rules for day-to-day administration, will be correspondingly revised by the EC now that the new foundations are in place.

The new relations between Divisions and Commissions are probably of greatest interest. The Division structure was created to enable more efficient communication between the EC and the main scientific fields, and to allow those fields to develop more suitable internal structures, when needed. The new rules will allow and encourage this to happen more flexibly and rapidly, as new Commissions may be created by the Divisions themselves, with the approval of the EC (which can be given by e-mail, hence in a matter of weeks). Commission Presidents and Vice-Presidents will similarly only need EC approval, and their Organising Committees are approved at the Division level. The former limit on the number of Commissions of which one can be a member will disappear, and the creation of Working Groups has also been correspondingly de-centralized.

It is hoped that this new freedom will allow the Divisions to update and develop their Commission and Working Group structure as needed, more rapidly and with less control from above than previously. To keep the process alive, a 'sunset clause' gives Commissions a default lifetime of six years, after which their continuation needs review every three years. But the obvious aim of the EC is to promote, not hinder, a well-functioning Commission structure, and it is up to the Divisions to recommend such changes as it finds productive.

The creation of a new Division XII will be proposed to group the few, seemingly diverse Commissions that have not yet been within the Division structure. What characterises them, however, is that they deal with matters of Union-wide concern and those involving other Unions and other external organizations (ICSU, UN, OECD, ITU...). The new Division will help the IAU to better support these activities while recognizing the obviously very different natures of their individual fields.

The IAU is often criticised by young astronomers for being conservative, slow, and bureaucratic. The new Statutes and By-Laws have lifted the formal barriers for the IAU to play an even more active role in astronomy in the 21st century. Whether it will actually do so depends on the imagination and energy of the membership. The EC encourages, and will support all constructive initiatives towards that goal.

Didgeridoos Dangerous, Doctor Declares

Musicians and tourists keen to master a a well-known local instrument – the didgeridoo – should give these picturesque pipes a pass.

This is the considered opinion of medical researcher Dr. Warren Gamba, who recently completed a study involving four dozen primates and a large sampling of the gnarly horns. 'The low frequency tones of the didgeridoo resonate with the monkey's livers,' notes Dr. Gamba, 'eventually breaking the connective tissue that keeps them situated in the abdomen.' After as little as twenty-five hours of punishing exposure to didgeridoo sounds, many of the monkeys were in a state that the researcher would only describe as 'regrettable.'

'Flutes are good,' Dr. Gamba notes, 'and most saxophones are harmless. But these didgeridoos – well, they really should be didgeridon'ts. Frankly, I'd advise anyone who's purchased one of these lethal horns to use them as vacuum cleaner attachments. They're really great for getting into ceiling corners.'

Measuring Stellar Mass Loss Rates at the Femto Level

by Jeffrey Linsky and Brian Wood

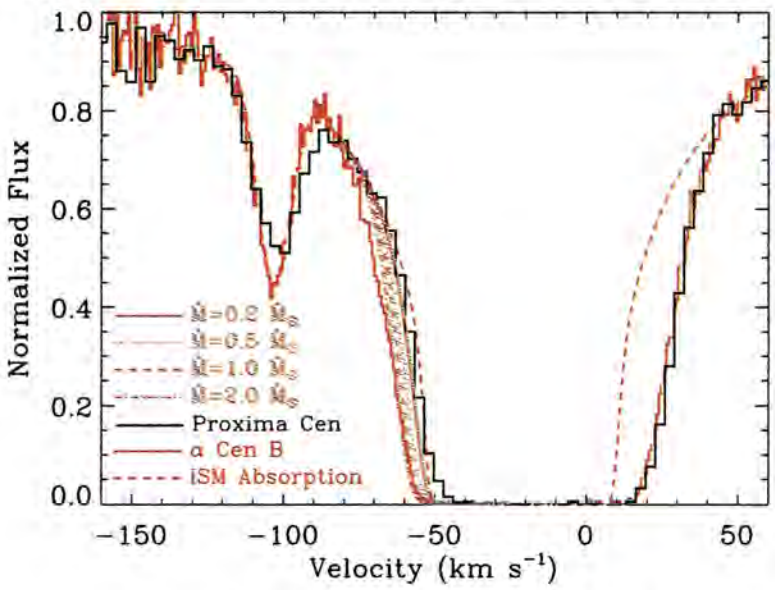
Jeffrey Linsky loses mass only slowly

Stellar mass loss is critically important for understanding stellar evolution and the chemical enrichment of the interstellar medium from which new generations of stars are formed. Until now, these techniques could allow us to measure mass loss rates in the range 10^{-5} to 10^{-10} solar masses per year.

By comparison, the solar mass loss rate is 2×10^{-14} solar masses per year. Is is possible to extend mass loss measurements by a factor of 10,000 or more? Even small mass loss rates are critically important for controlling the angular momentum evolution of a star and for understanding the evolution of planetary atmospheres, and thus whether or not life can form on planets around other stars. The high spectral resolution, well-characterized instrumental profiles, and excellent wavelength scales of the GHRS and STIS instruments make the seemingly impossible task of measuring mass loss at the femto level, 10^{-15} solar masses per year, feasible.

High resolution GHRS and STIS spectra of nearby main sequence stars show a Lyman-alpha emission line formed in the stellar chromosphere, a broad interstellar hydrogen absorption component located near line center, and a narrow unsaturated interstellar deuterium absorption line displaced by -82 km/s from the interstellar hydrogen absorption line. A careful analysis of this complex line from some nearby stars reveals subtle features indicating stellar mass loss.

Figure 1 shows the Lyman-alpha line profile of Alpha Cen B (K1 V) and its distant companion Proxima Cen (M5.5 Ve) observed by STIS. One can predict the shape of the interstellar hydrogen absorption feature from the interstellar deuterium and metal lines formed at the same temperature as hydrogen. The predicted interstellar hydrogen absorption (the dashed line in Figure 1) is narrower than the observed absorption, indicating that additional hydrogen absorption is present on both the red and blue sides of the interstellar absorption. What is the cause of this additional absorption?



Comparison between the Ly-alpha spectra of Alpha Cen B and Proxima Cen. The inferred ISM absorption is shown as a dashed line. The Alpha Cen/Proxima Cen data agree well on the red side of the H I absorption, but on the blue side the Proxima Cen data do not show the excess Ly-alpha absorption seen toward Alpha Cen B (i.e., the astrospheric absorption). The blue-side excess Ly-alpha absorption models are for mass loss rates from 20% to 200% of the mean solar rate

The key to understanding the extra absorption is the interaction of inflowing partially ionized interstellar gas with the outflowing ionized solar (or stellar) wind. This interaction defines the large-scale structure of our heliosphere, and for other stars their "astrosphere." The heliospheric interaction has been modelled by Baranov, Zank, Izmodenov, and others.

They find that charge exchange reactions between protons and hydrogen atoms lead to a concentration of hot hydrogen, the so-called "hydrogen wall," located at roughly 200 AU in the upwind direction where the two gas flows interact. The effect is to produce extra absorption in the Ly-alpha line that is redshifted relative to the centroid of the interstellar absorption for the line of sight to a star. Redshifts are predicted for nearly all angles relative to the upwind direction of the interstellar gas flow.

Additional absorption on the red side of the interstellar Ly-alpha line by the heliospheric hydrogen wall is now detected in STIS and GHRS spectra of nearby stars for eight lines of sight. Stars with coronal winds like the Sun will have astrospheres analogous to the heliosphere if they are embedded in partially ionized interstellar gas. Since we observe a stellar hydrogen wall from the outside, the additional Ly-alpha absorption will be blueshifted relative to the interstellar absorption rather than redshifted. This is the observable quantity for measuring mass loss from solar-like stars.

Comparison of the STIS Ly-alpha profiles for Proxima Cen and Alpha Cen B (Figure 1) provides an excellent example of heliospheric and astrospheric absorption. The blue side of the Ly-alpha absorption in the spectra of the two stars is different. Since this part of the absorption is due only to the astrospheric hydrogen wall absorption, the stellar winds of the two stars must be different. Comparison of such observations with theoretical models lead to estimates of the stellar mass loss rates.

Since the winds of cool dwarf stars originate in coronae, we expect and indeed find that the measured mass loss rates (per unit stellar surface area) are correlated with the X-ray surface fluxes derived from ROSAT PSPC data. This is shown in Figure 2 for the stars we have studied to date. For low to moderate activity stars as measured by the X-ray surface flux, there is a good power law relationship between the mass losss rate and X-ray flux. However, near an X-ray surface flux rate of 10^6 ergs/cm^2/s the stellar wind appears to be suppressed. This important new result could be explained by the onset of very strong magnetic fields in young active stars, but observations of more stars are needed to confirm this.

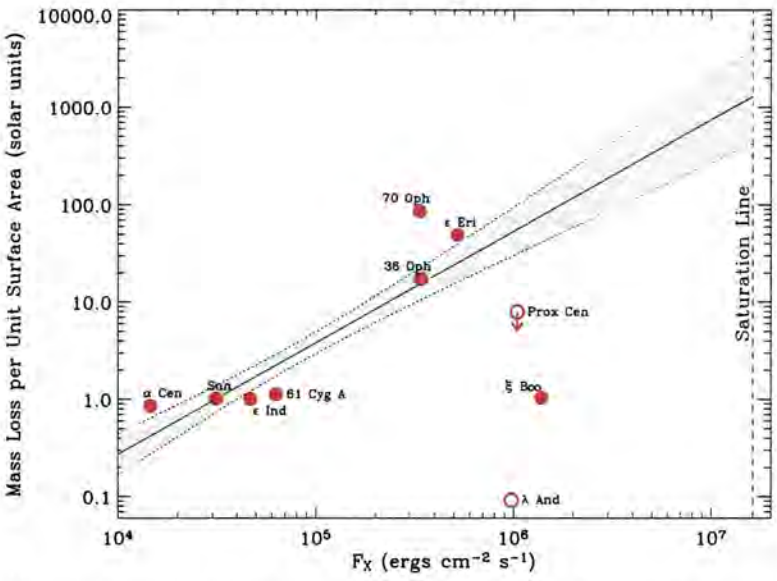
As stars age, their rotation rates decrease due to magnetic braking and the X-ray fluxes decrease. We adopt the empirical relations of Ayres, combine them with our empirical mass loss/activity relation, and find a simple relation between mass loss rate and stellar age.

This relation, plotted in Figure 3, predicts that the mass loss rate of the young Sun was 200 – 10,000 times larger than at present. The cumulative mass loss from age 10^8 years to the present is less than 0.03 solar masses.

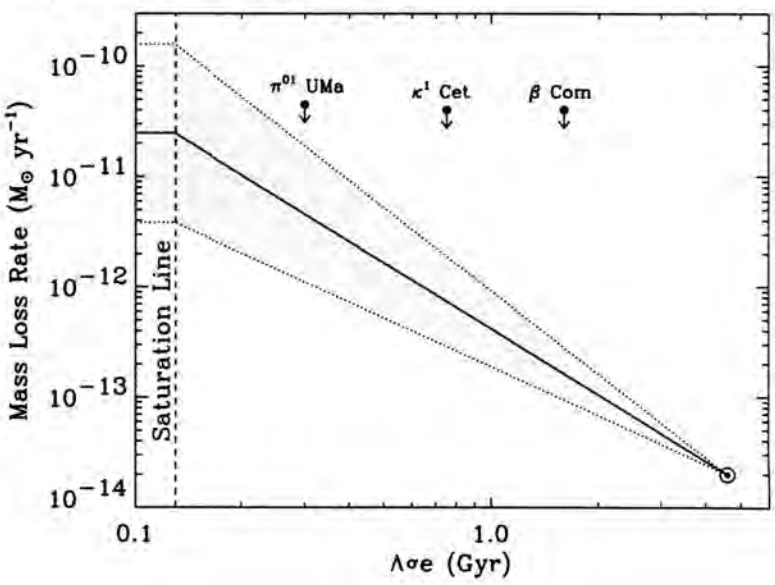
This new result provides the first quantitative estimate of the solar wind flux that planets received during the early solar system. This is important for addressing such questions as (i) why the young Earth had running water when the Sun was 25% fainter than today, and (ii) whether solar wind erosion removed water and other molecules from the young Martian atmosphere.

Stellar winds can erode planetary atmospheres, and the higher mass-loss rates suggested for the young Sun and young stars with high X-ray fluxes would exacerbate these effects. Solar wind sputtering processes have been proposed to have important effects on the atmospheres of Venus, Titan, and Mars.

Unlike Earth, the Martian atmosphere is not currently protected from the solar wind by a strong magnetosphere. There is evidence that Mars once had a magnetic field, which disappeared at least 3.9 Gyr ago. At that time, the Martian atmosphere would have been exposed to a solar wind about 40 times stronger than the current wind, which would have had a dramatic effect on its atmosphere. Mars appears to have had running water on its surface in the distant past and a thicker atmosphere that could have supported a climate consistent with surface water. Solar wind erosion is a leading candidate for the cause of Mars' present thin atmosphere and lack of surface water. Planets around other stars could have similar histories.



Measured mass loss rates (per unit surface area) plotted versus X-ray surface flux. A power law has been fitted to the solar-like GK dwarfs (filled circles), and the shaded region is the estimated uncertainty in the fit



The mass loss history of the Sun. The upper limits are based on radio nondetections of three solar-like stars

SMART Side of the Moon

by James Hitchcock

The Earth and the moon have shared a common history for 4,500 million years. However the moon still holds many secrets. The SMART mission will aim to answer questions such as the origins of the Earth-moon system, the early evolution of life, and the existence of in situ resources needed to support human life.

On the eve of the launch of ESA's SMART-1 (Small Missions For Advanced Research in Technology), ESA's Project Scientist Bernard H. Foing presented information about the SMART program's advanced technologies, operations, and future goals.

Bernard Foing leans lunar-ward

The SMART-1 mission will be the first-ever European mission to the moon. Foing noted that this particular mission is special because in addition to its scientific objectives, it will also perform technology tests. Instruments on board will test the new technologies relevant to the investigations and also test the spacecraft itself, so that engineers and scientist on Earth can understand how well these new technologies work.

The mission objectives include:

- Test a navigation system that, in the future, will allow spacecraft to autonomously navigate through the solar system
- Try to communicate with the Earth using a laser beam instead of radio
- Constantly monitor the performance of the ion engine

Once at the moon, the SMART-1 will aim to:

- Investigate the theory that the moon formed out of the debris of a massive collision between a Mars-sized object and the Earth approximately 4,500 million years ago
- Study the processes of rocky planet formation, volcanism, tectonics and geochemistry
- Chronicle the asteroid and comet bombardment of the Earth-Moon systems by studying the craters of the Moon
- Search for signs of water-ice in the craters near the moon's poles

The SMART-1 mission

SMART-1 will be launched on an Ariane-5 rocket and will be propelled using an ion engine. Foing comments that 'the ion engine is ten times more efficient than chemical engines for the exploration of deep space.' As normal-sized solar panels supply only a few kilowatts of power, a solar-powered ion engine cannot compete with the thrust or acceleration of a chemical rocket engine which burns for, at most, only a few minutes. But these ion engines can go on pushing gently for months and up to years on end, making deep space missions possible.

SMART-1 will first go into elliptical orbit around the Earth and will gradually expand this ellipse into a circle and then into a spiral by firing its ion engine. Eventually the moon's gravitational field will kick in, and the SMART-1 craft will be pulled into orbit. Scientific measurements will begin January 2005, nearly a year and a half after its launch later next month.

The SMART-1 will cost approximately 110 million euros, weigh in at 367 kg and measure approximately one cubic meter.

Foing comments that 'the infrared spectrometer allows the detection of minerals on the moon. The craft will cover the polar regions and permanently shadowed areas for water and ice deposits to obtain spectrographic proof of the extent of water ice.'

The mission will be the first in a series, with the Lunar A project due in 2004 and the SELENE project in 2005. Foing notes the mission will be 'preparing for the next step of human exploration of the universe.' It is thought that in the future through dedicated projects such as this the moon may be usable as a robotic outpost by 2010, ecosystem experiments may start as early as 2015, and human lunar bases by 2020.

'The message is, international exploration of the moon has started again,' says Foing. SMART-1 will be launched from Kourou, French Guiana, on August 28 at 23:00 hours UTC.

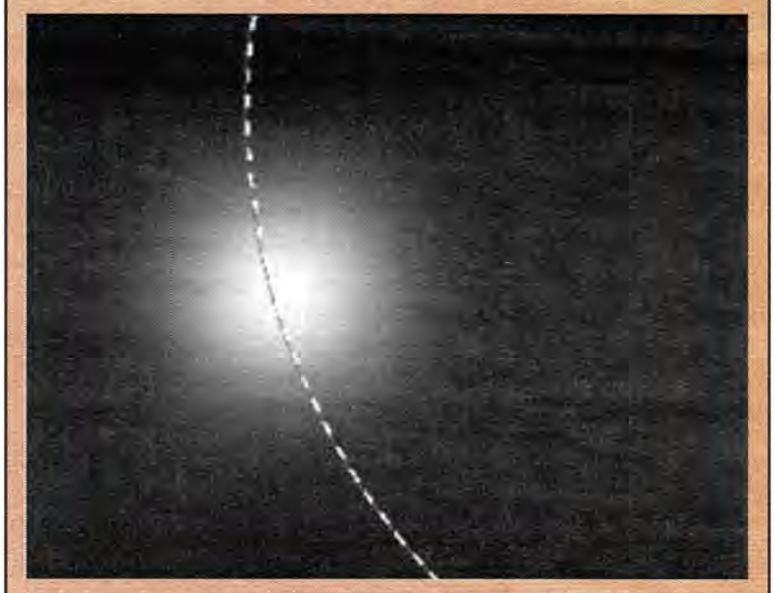
S219: Stars are Suns: Activity, Evolution, and Planets

by Arnold Benz

Much progress in solar and stellar astronomy in recent years is due to space missions like SoHO, TRACE, and RHESSI on the solar side, and Chandra, and XMM on the stellar side. High-energy observations of coronae are therefore one of the two focal points of Symposium 219.

Stellar astronomers and guests will be surprised with the progress on magnetic reconnection and particle acceleration in solar flares and how this raises more questions than it supplies answers. The second focus is on extrasolar planetary systems and their relation to the central star. The recent discoveries in the field are a mind-broadening experience to all of us. Add to this evolution in time, and it becomes difficult to draw the line between where solar physics ends and stellar astronomy begins.

The meeting starts today at 14:00 with overview talks and first results of the newest instruments: RHESSI, INTEGRAL, SMA, and VLTI. A few surprises, such as the first astronomical sub-arcmin images in gamma-rays, will be offered.



The gamma-ray photons above 1 MeV are imaged for the first time at a spatial resolution of 23 arcsec by RHESSI. The figure shows two minutes of a flare that occurred near the limb (dashed) on July 23, 2002. Most of the emission originated from high-energy protons impinging on the solar chromosphere during an X-Class flare. The position is a surprise: it is different from the X-rays produced by electron bremsstrahlung at lower energy!

Biggest Blowout this Side of the Black Stump

by Seth Shostak

Have you experienced the real Australia yet? Or are you spending your copious free time wandering the wharves of Darling Harbour in a vain search for palatable food at less-than-astronomical prices?

Look, let's face it: there's not a lot of opportunity for you to savor the manifold attractions of this enormous continent. But no worries. You can have it all – heck, you can *experience* it all – simply by coming to the East Meets West party on Thursday night.

OK, you're thinking 'how exciting could the company of a thousand astronomers be?' Good point. But the organizers of East Meets West have already planned for attractions thrilling enough to galvanize a room full of solar seismologists.

Of course, like any decent beanfeast, there will be food and music, the best of both. But when did you last attend a social event at which you could take a whack at playing the didgeridoo or catch a virtual wave on a mechanical surfboard while clockwork sharks nip at your heels? A sheep shearing demonstration will instruct you in the fine points of removing commercial fiber from ungulants (always a useful skill), and two Chinese masseurs will wreak havoc with your musculature. A pair of highly talented caricature artists will be on hand to bemuse and delineate the guests, and a karaoke machine will permit you to put the limited musical talents of your partner on public display.

Ten years from now, you won't recall all those fourth-rate eateries you mistakenly frequented here in Sydney. But remembrances of this party will stick in your brain like peanut butter on a koala. Register now, before this bountiful blast is sold out.

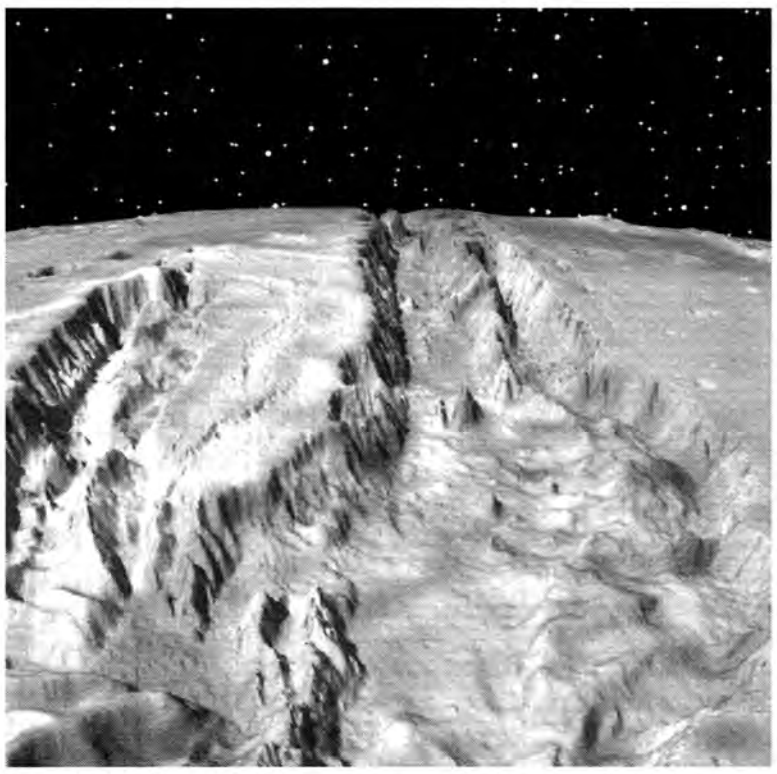
The Universe in 3D

by Matthew Bailes

Visualising the Universe is not an easy task.

Astronomers at the IAU General Assembly at Darling Harbour in Sydney have been gaining a special insight into the 3D structure of the Universe thanks to a new 3D visualisation system on display in the exhibition space. The new technology uses commodity, off the shelf projectors and the latest graphics cards to give astronomers a chance to fly through their immense data sets. The technology has proved so popular with the general public that Swinburne University's Centre for Astrophysics and Supercomputing now sells virtual reality theatres to museums and observatories around the world.

The general public have a chance to experience this technology during the weekend at Darling Harbour, or they can visit Sydney Observatory's 3D theatre.



Scene from a Virtual flight to Mars, copyright Paul Bourke, Swinburne University of Technology

Universality of Coriolis Force Effects Tested Down Under

by Wim van Driel

Rumor has it that one of the first things we scientifically oriented folks from Up There do when we finally arrive Down Under after an invigorating ride on a plane that seems to last only about half a Hubble time is to fill a sink with water, pull the plug and test if the Coriolis force really lets the water swirl out in a gracious whirlpool that turns the other way round from what we are used to Up There. It's also rumored that astronomers from Down Under could not care less and never, ever test this when they first get Up There. They'd rather do experiments on stubbies of beer.

It is a little known fact, though, that the effect of the Coriolis force can be easily tested on a truly cosmological scale from Down Under, without risking lives. Simply observe from a dark spot (for example where Ayers Rock used to be before it was recently removed for its 100,000 year sandblasting job) and see how even the Whirlpool galaxy (a.k.a. M 51 to its nearest and dearest) turns exactly the other way round from when viewed Up There.

Further proof of the universality of the Coriolis force is that the first hardy Dutch emigrants to reach New Holland (now better known as Australia) found that the windmills they built following age-old designs all started turning the wrong way round, as they saw it, which made them give up their efforts in despair and drove them to serious testing with stubbies as well.

[Van Driel is a Dutch bloke Down Under]

M51, an obvious example of the Coriolis force

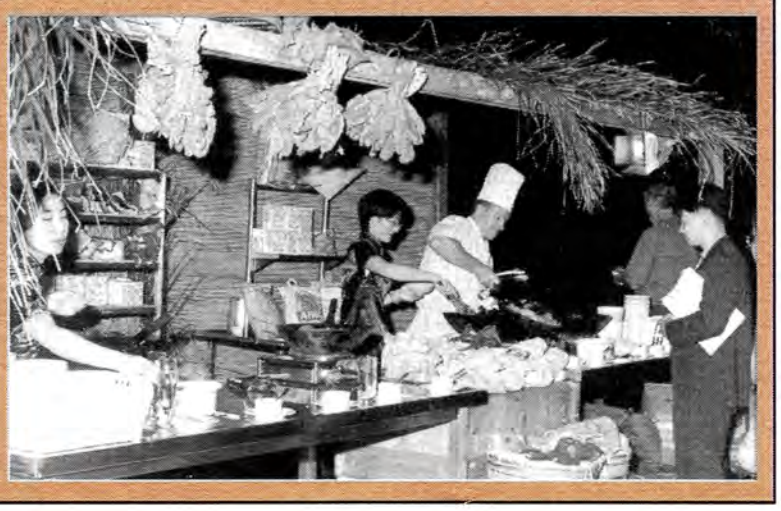
BIG PARTY - East Meets West

International Astronomical Union – 25th General Assembly 2003
19:00, Thursday, 24 July 2003 – The Banquet Hall
Sydney Convention Centre Centre, Darling Harbour

Don't miss this wonderful opportunity to network with old and new friends at the informal congress party. If you don't have time to visit Australia's outback, Bondi Beach or Chinatown – come to the party – we're bringing it all to you.

As you stroll around, you'll have the opportunity to meet some Australian native animals close-up, watch sheep being shorn, learn how to play the didgeridoo, try your skill on a mechanical surfboard, enjoy a Chinese massage and dance to the sounds of the fabulous band 'Tricky Hats'. And that's not all – expect more surprises on the night.

There will be lots of food stations where chefs will be busy throwing delectables on the barbie so you can fill up a plate and take a seat. Or you might choose to sample a hot pie and eat as you wander around. If you visit the beach area you must try our wonderful seafood – prawns and yabbies as well as fish and chips. And in Chinatown our chefs will be cooking up wonderful dishes in their woks. There's lots of food to tempt all tastes, and of course lots of bars where you can pick up a glass of wine, a beer, a soft drink, or who knows what else.



If you haven't registered yet, do so now. You'll be really sorry if you miss out. Get your ticket at the Registration desk.

They're $130, Australian.

Great Barrier Reef on the Move

Marine biologists have reported with some dismay that the Great Barrier Reef has broken lose from its moorings, and is headed across the Pacific.

'She's definitely outta here,' said researcher Dr. Coral Gabels in Brisbane last week. 'We're not quite sure what went wrong, but it could be that, in the end, the solvent power of sea water was simply too much.'

The Reef's remove will not be mourned by many. 'Frankly, it just got in the way,' says Wayne Barton of East Cairns. 'This thing has been holding up development of our ports for decades.'

The Reef was last seen in the vicinity of Norfolk Island, where locals are anticipating turning it into a major attraction.

HooRoo

by Shaun Amy

What is it about visitors to Australia and their fascination with the humble Aussie Kangaroo? It is probably true that most locals don't know that there are over 40 species of this native nocturnal 'beast,' which typically live for 5 years in the wild.

Although many species are endangered, they are generally considered a pest in many areas of Australia, where they have almost taken over parts of our wide, brown, sun-drenched land.

So what has this furry marsupial got to do with astronomy?

- There is a gamma-ray observatory located in the South Australian outback, aptly named 'Cangaroo.'
- There has been mention of this Aussie icon during a talk in Symposium 218 on Thursday with the subtitle being 'If it hops like a 'roo...'
- The Astronomical Society of Australia stand in the Exhibition Hall has a real 'roo on display which will hand you some printed information as you wander past.

So if you see a 'roo looking lost on the streets of Sydney, make sure you go up and say 'G'day!' Better still, why not adopt one, take it back home with you and help ease the crisis on the farming land in the outback.

The Depth of the Heavens

by Erik Hoeg

We see the Sun, Moon and stars on the sky as if placed on the inside of a sphere. But even early man had ideas about the distances to these heavenly objects. The Greek philosopher Anaxagoras living in Athens 2,500 years ago claimed that the Sun is a fiery rock larger than the whole Peloponnesian peninsula. This implies a distance to the Sun larger than 15,000 km. Anaxagoras, however, was accused of blasphemy and had to leave Athens for that reason. His contemporaries believed that Apollon drove his fiery wagon with the Sun across the sky in the day and returned at night sleeping on his ship.

Nonetheless, the Greeks were the first to develop an understanding of nature based on natural explanations rather than on a belief in various gods with human emotions. One of them was Ptolemaios living in Alexandria about 150 A.D. Ptolemaios is far from being the first to give distances to the planets and stars, but his distances gained the status of highest authority during the following 1,500 years. His values for the Earth's radius and distances to the Moon and Sun came from Greek astronomers working between 300 and 100 B.C. His value for the distance to the sphere of fixed stars was 20,000 Earth radii or 14 micro-light-years.

During the Middle Ages, Dante Alighieri (1265-1321) placed God and the angels beyond Ptolemaios' sphere of fixed stars.

The Greek value for the Sun's distance was 20 times too small, and not even Tycho Brahe knew better. After his time doubts arose, first for Johannes Kepler in 1617. But it took 150 years before the distance to the Sun was safely known from new observations, namely from Venus transits of the solar disk.

Erik Hoeg at close distance

The table shows the distances in the universe as given by Ptolemaios and the true values at various times in the development of astronomy.

The distance to the edge of the known universe has grown most quickly during the recent 100 years, from 30,000 light-years for Kapteyn's Milky Way to 14 billion light-years for the horizon of the visible universe.

The immediate question is: can this rapid growth continue? The answer is no, because we have now great confidence in the age of the universe being 14 billion years, and this defines the cosmic horizon.

Finally, outside the cosmic horizon is the invisible part of the universe which is very much larger than the visible universe, but probably of finite extent and forever expanding with the Hubble flow.

Historical and Contemporary Distances

Distance	Ptolemaios (~150 AD) Dante, Tycho Brahe	True Value
Center of the Earth	~6,000 km	6,400 km
Moon	33 – 64 Earth radii	60 Earth radii
Sun	1,210 Earth radii	25,000 Earth radii Since 1770
Stars	20,000 Earth radii = 0.000014 light-years	over 15 million Earth radii more than 10 light-years since 1838
Most distant stars in Milky Way	–	30,000 light-years in 1900
Extreme of the visible Universe	stars: 20,000 Earth radii =0.000014 light-years	14,000,000,000 light-years in 2003

The Role of the Science Museum in Astronomy

by Kevin Johnson

Kevin Johnson, on exhibit

In Western countries there is a perception, real or imagined, that there is a gulf in the public understanding of science. These misgivings, as outlined by at the opening address of the IAU General Assembly, clearly have some basis, if the public's knowledge of its own planet's orbital period is to be believed. Against this background it is therefore worth considering the role and purpose of the science museum with respect to astronomy today and in the future.

The term science museum covers a multitude of institutions and businesses ranging from repositories of historical artifacts to science centers solely involved with the public understanding of science. Between these two extremes other organizations provide a mixture of these two approaches. Whatever the style of the institutions, each is trying to motivate their audience to develop an interest, understanding and appreciation of the importance of science in a modern technological society. In the case of astronomy, most of these points apply, though not always in ways that might be expected.

The purely didactic approach to explaining astronomy in the museum has a long tradition. As far back as the 1880s the galleries and displays of what is now the Science Museum, London were used to educate trainee teachers in the basics of astronomy. Under the tuition of Prof. Sir Norman Lockyer they were taught the rotation of the Earth as demonstrated by the Foucault Pendulum in the museum. Likewise, the future science educators were expected to undertake observations of the stars and planets along with photography of the Sun. This training was undertaken using the facilities of the Solar Physics Observatory, South Kensington in London. A well-known former student was none other than H.G. Wells. No doubt Lockyer's extensive knowledge and observation of Mars influenced the then-unknown author, when he later wrote his famous work, 'The War of the Worlds.'

Today a variety of methods and approaches are employed to spread knowledge and interest in science and astronomy. Institutions such as the Boston Science Museum have pioneered the use of purely interactive exhibits. These try to convey various scientific principles and concepts through self discovery. In conjunction with planetarium shows and viewing of the night sky they have striven to engage the public in the wonders of astronomy. In marked contrast, other science museums have followed a more traditional path of instruction. In these cases objects, historical or otherwise, have been used in conjunction with working exhibits to expound astronomical concepts. The astronomy galleries and display of the Deusches Museum in Munich, Germany typifies this strategy. These particular displays assume and expect the visitor to have a thorough grounding in science.

Moving yet further away from the Boston model, other institutions try to inform through historical objects alone. In the case of the old Royal Observatory, Greenwich, in England, they have separated the historical displays from those using interactive exhibits. The astronomical icons of the site, such as the Airy Transit Circle that defines zero degrees longitude, have been left in place. Their value lies in their association and the narrative that can be drawn from these artifacts and conveyed to the visitor. Direct astronomical education is instead focused upon planetarium shows, science activities, such as viewing of the night sky using both modern and historical instruments. Although aimed at the general public, an important target audience for these activities is organized school visits.

While these examples provide a global picture of various approaches to astronomy in the science museum, there are places where these different methods are combined. Such an example can be found close by at the Sydney Observatory where interactive exhibits co-exist adjacent to historical relics in their original context. Likewise, the public can view the sky both day and night on a daily basis and discover the wonder of the heavens.

To conclude I ask the reader to consider why astronomy should be an important component of the science museum. Like most other sciences, there is a large gap between the public perceptions of astronomy in comparison to how it is carried out. As the work of professional astronomers becomes more remote both in concept and physically with far flung observing sites, they run the risk of alienating the public. As astronomy cannot be justified, in most cases, for its material benefits to the economy, it has to be championed for its intellectual value in understanding our universe. Issues such as the international campaign for dark skies are becoming vital issues. If the public cannot see the wonder of the night sky they are unlikely to enter into the debate regarding the progressive loss of dark skies around the world. As political influence is strongly driven by public opinion, professional astronomers ignore such issues at their peril. In astronomy as the desire for ever larger and more precise instruments grow the costs spiral. Astronomers will more than ever have to justify their worth and gain support from both public and privates resources. The cancellation of the giant atom smasher program in America is a warning that physicists have learned that big science projects need to have full public support to succeed.

The Sydney Observatory.

The Square Kilometre Array

by Russ Taylor

As amply demonstrated at this General Assembly, advances in observation and theory have brought the current generation of astronomers to the brink of understanding of the origin and evolution of the Universe. The next major steps, to explore the Universe's earliest epochs, before the dawn of first light and the creation of stars and galaxies, and to trace the subsequent formation and evolution of primordial galaxies, will require a giant telescope operating at radio wavelengths.

Scientists and engineers from 34 institutes in 15 countries have joined together with a common goal of designing and constructing a new radio telescope with a total collecting area of one million square meters, 100 times the collecting area of the Very Large Array, and 30 times larger than the largest telescope every constructed. Technological advances and innovative approaches to construction of large apertures promise to make it possible for such a telescope – the Square Kilometre Array (SKA) - to not only be built in the next decade, but to be affordable.

A cluster of three exhibits in the exhibition hall, 'The Square Kilometre Array', 'The Australian SKA Consortium' and 'SKA South Africa', highlight different aspects of the international collaboration on the SKA project.

The SKA will be an interferometric array operating at wavelengths from 2 m to 1.5 cm, with baselines from less than a hundred meters to thousands of kilometers. By combining interferometry and phased-array technology, the SKA will be the world's premier astronomical imaging instrument, instantaneously imaging wide-fields of view at high angular resolution and sampling large redshift domains with high spectral resolution.

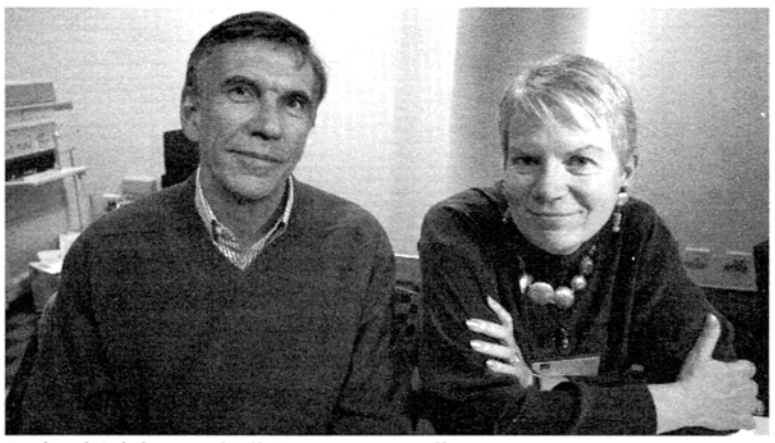
The frequency coverage of the SKA allows study of emission dominated by synchrotron processes and red-shifted atomic hydrogen at long wavelengths to free-free and molecular line radiation processes at the short wavelengths. The SKA will detect emission from atomic and molecular gas at extreme redshifts, allowing study of the 'dark ages,' before and during the transition phase when the earliest stars and metals formed and reionisation occurred. With a peerless combination of sensitivity, wide field of view and high angular resolution, the SKA will image the interstellar media and magnetic fields of galaxies to high redshift. Measurements of atomic hydrogen emission and continuum emission from galaxies will trace the star formation history of the Universe from primordial galaxies to the present.

Galactic star formation processes and magnetic phenomena in the gaseous ISM will be studied on linear scales down to a few A.U. Millions of stars will be detected as radio sources, protostellar and protoplanetary disk will be imaged on sub-AU scales without suffering the effects of dust extinction, the initial mass function of massive stars in our own and other galaxies can be measured, the surfaces of red giant stars will be directly imaged, and solar-type magnetic phenomena will be studied on hundreds of nearby stars. The poorly characterized transient radio sky will be explored in detail for both astrophysical and artificial sources on timescales from seconds to years.

Over the next several years the international collaboration for the SKA will continue a program of research and development, with the aim to converge on the optimal facility design by 2007 and to begin construction early in the following decade. The international cooperation on the SKA is steered by the International SKA Steering Committee (ISSC). The chair of the ISSC, Jill Tarter, will give a presentation on the SKA in Pyrmont Room 1 during session 4 of the Working Group on Future Large Scale Facilities on Tuesday, 22 July.

Many members of the ISSC and the international SKA Consortium are present at the General Assembly, but plan to depart for Geraldton, West Australia later this week for the 2003 international SKA workshop beginning on the 27th of July.

To learn more about this exciting project, drop by the SKA exhibit, visit the project web site at http://www.skatelescope.org, or have a chat with one of the ISSC members, or the International Project Director, Richard Schilizzi who can often be found in the area of the SKA exhibit during coffee breaks.



Richard Schilizzi and Jill Tarter, in a small array

Six innovative radio telescope design concepts under study by the International SKA Consortium for the array elements, including from top to bottom: a) large Arecibo-like spherical reflectors with dynamically shaped surfaces b) large, long focal-length parabolic reflectors with a receiver supported by an aerostat, c) an array of many small parabolic dishes, d) an array of spherical Luneburg lenses providing all-sky sensitivity, e) large cylindrical parabolic antennas and f) aperture-plane arrays of receiving elements.

Transit of Venus!

by Steven J. Dick

'We are now on the eve of the second transit of a pair, after which there will be no other till the twenty-first century of our era has dawned upon the Earth, and the June flowers are blooming in 2004. When the last transit season occurred the intellectual world was awakening from the slumber of ages, and that wondrous scientific activity which has led to our present advanced knowledge was just beginning. What will be the state of science when the next transit season arrives God only knows. Not even our children's children will live to take part in the astronomy of that day. As for ourselves, we have to do with the present ...' These were the words of U. S. Naval Observatory astronomer William Harkness, who led the American efforts to observe the transit in 1882.

That distant time has arrived, and the future is now! On June 8, 2004 an astronomical event will occur that has been witnessed only five times in human history – the passage of Venus across the face of the Sun. One of those – the transit of June 3, 1769 – is closely associated with the history of Australia, for one of the purposes of Captain James Cook's voyage of the Endeavor – the vanguard of European settlement of Australia – was to observe this transit. The colorful history of the worldwide attempts to observe these events will be the subject of two sessions sponsored by Commission 41 (History of Astronomy) on Tuesday afternoon, July 22.

When they last occurred in 1874 and 1882, transits of Venus were important because they held hope of determining the solar parallax, and thereby the scale of the solar system. At stake was reducing the uncertainty in the Earth-Sun distance by several million miles. Every difference of one hundredth of an arcsecond in the solar parallax translated into approximately 100,000 miles. At stake also were national interests. This is why in 1874 the British sponsored 12 expeditions, the Russians 26, France and Germany 6 each, Italy 3 and Holland one. More attempts were made in 1882, including the observations that H. C. Russell made from Sydney Observatory. The challenges were many, including the famous 'black drop' effect that prevented an accurate determination of Venus contacts with the Sun. This effect has recently been detected in TRACE spacecraft observations of the transit of Mercury in 1999, thus eliminating planetary atmosphere effects as an explanation.

In the end the results of attempts to determine solar parallax were disappointing due to the black drop and other effects. Although there was some improvement in the astronomical unit from transits of Venus, Simon Newcomb did not give the method much weight in his new system of astronomical constants adopted in 1896 and used for much of the 20th century. Aside from their disputed scientific results, the expeditions are of interest for the international disagreements over techniques and instruments, as an early example of international cooperation in astronomy, and for their place in two broader historical trends: the determination of the fundamental astronomical constants, and the great scientific voyages.

Surely 19th century astronomers would be amazed to know that today the astronomical unit is known with an uncertainty of only 2 meters based on spacecraft observations! And they would be equally amazed to know that we now observe transits of extrasolar planets, and that a spacecraft named Kepler will be launched for just this purpose in a few years. After the second transit of the current pair occurs on June 6, 2012, our descendants will have to wait until December 11, 2117 to view another. What will be the state of astronomy when the next transit season arrives, and the summer flowers are blooming in Australia?

Steve Dick in transit.

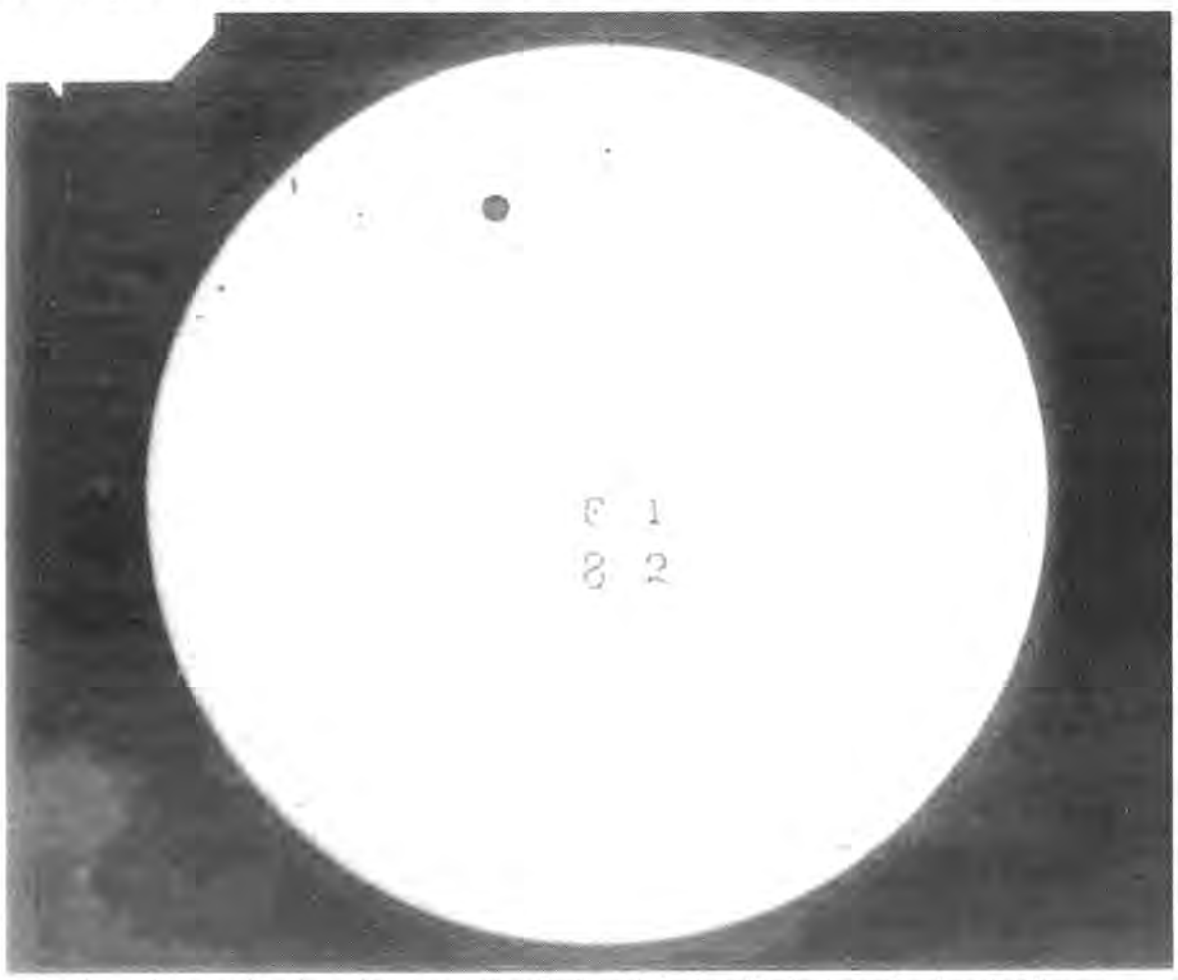


Image from photographic plate of Venus crossing the face of the Sun. The horizontal and vertical lines are about half an inch apart. Wet bromo-iodide plates were used in 1874, but by 1882 dry collodion emulsion plates were available. This photograph is one of only 11 plates surviving from the American 1882 expeditions; none of the plates from the American 1874 transit expeditions has survived.

Schools Day at the GA Thursday, July 24th

by Michael Burton

The Schools Day at the GA is the last event in Astronomy on the Go, the culmination of a series of astronomy outreach tours around Sydney and regional New South Wales (as described in an earlier edition of The Magellanic Times.) Having visited schools around the State for the past month, it's now time for the schools to visit the astronomers!

What better opportunity could there be than the presence of 2,000 of the world's leading astronomers to attempt to instill enthusiasm about the cosmos in the nation's youth? The Schools Day at the GA takes advantage of that opportunity. It also makes use of the fortunate timing provided by the General Assembly itself to free up one of the auditoria during the day for public talks, at the end of the first week back of the new school term in NSW.

The School's Day is a series of events focussed on four public talks about some of the most exciting topics in contemporary astronomy. The Astro Expo will be open, and special showings of three feature IMAX films will run from 11am to 2 pm in the IMAX theater, next door to the Convention Centre (Space Station 3D, Blue Planet and Antarctica.) The Powerhouse Museum (behind the Convention Centre) and Sydney Observatory (in The Rocks) are also open, with special showings. The Powerhouse has a planetarium as well as currently running a space exhibition. The historic Sydney Observatory, situated on one of Sydney's prime pieces of real estate, has a 3D Space Theatre, as well as an enthralling exhibition on the history of astronomy in Australia.

However the feature of the day are the four half hour lectures being given for the schools on some of the big questions we are often asked, as astronomers, about the Universe.

Charley Lineweaver will discuss, at 1 pm, 'Where is the Universe Heading,' talking about the Big Bang and the CMBR, dark matter, dark energy and the acceleration of the Universe. He will be followed by Michael Burton, talking on 'Stardust – the Stuff of Life,' covering the star-gas cycle, the origin of the elements, and our own origins as stardust. Following a half hour break (with a short science careers talk thrown in), Maria Hunt kicks off again at 2:30 pm, talking about 'The search for life in the Universe,' surely one of the most-asked questions we all encounter. Finally John Storey, one of the pioneers in the development of astronomy at the very end of the Earth, talks about 'Astronomy in Antarctica – the Quest to Build the Ultimate Earth-based telescope.' If you missed the Antarctic astronomy sessions on Friday and Saturday, here's a chance to get a quick synopsis about the efforts to develop observatories on top of the high, dry and cold Antarctic plateau.

While the Schools Day is indeed intended for the visiting school children, as well as any members of the public who have paid to attend, we anticipate there also being room for GA delegates. Please check in with the Schools Day registration desk beforehand, and let the school children in first, and stay at the back of the auditorium. And please, no chatter at the back while the teachers are talking!

Astronomers Rant on Radio

The IAU General Assembly receives its first systematic coverage on Australian radio through 'The Science Show' on ABC Radio National. The next broadcast heard in Sydney is on 576 (AM band) at 7:10 pm Monday, 21 July which is also available as audio-on-demand through www.abc.net.au/rn. The highly regarded 50 minute program, presented by Robyn Williams, is in its third decade as one of the most popular shows on Radio National.

Unusually, the program's regular theme music is being dropped in favor of the first performance of Andrew Batterham's 'Out There,' played on the Grand Organ of the Sydney Opera House Concert Hall by Australia's Chief Scientist, Dr. Robin Batterham. Reports from the meeting include interviews by Peter Pockley with Professor Ron Ekers, incoming President of the IAU, and Professor Jeremy Mould, the Australian who is Director of the National Optical Astronomy Observatory in the USA.

Dr. Pockley, Australia's pioneer science broadcaster and commentator, has been reporting astronomy since 1964. At the IAU he has been recording interviews with many visiting and local astronomers for publication in 'Australian Science' monthly, and internationally, for 'Physics World'. Some recordings will be broadcast in forthcoming programs on ABC RN.

This week's program will also include material from Professor Bryan Gaensler of the Harvard-Smithsonian Astrophysics Observatory and Professor Paul Davies, physicist author and lecturer of Macquarie University, Sydney.

The Magellanic Times

THE NEWSPAPER OF THE INTERNATIONAL ASTRONOMICAL UNION GENERAL ASSEMBLY SYDNEY 2003

IAUXXV General Assembly Sydney 13-26 July 2003

Day 7 **Tuesday 22 July**

Key ingredient for complex organic molecules found around solar-mass protostars

by Klaus Pontoppidan

Klaus Pontoppidan considers the attractions of methanol

Solid methanol, thought to be a necessary ingredient for making complex organic molecules, has been detected in the immediate surroundings of low-mass young stars for the first time. Until now, solid methanol was known to exist only around massive young stars. I have reported the discovery at Joint Discussion 14 on the 'Formation of Cometary Material.' The results were obtained with the ISAAC spectrometer on the ESO Very Large Telescope by analyzing high signal-to-noise infrared spectra which were then compared with laboratory data.

It has been known for decades from millimeter surveys that complex organic molecules like methylether (CH_3OCH_3) and methylformate (CH_3OCHO) can be present in massive star-forming regions like Orion and SgrB2. Their high abundances have been a puzzle to astrochemists for many decades, since traditional low-temperature chemistry models fall short by orders of magnitude. The current favored explanation, put forward by Steve Charnley (NASA-Ames) and collaborators, is that evaporation of methanol-rich ices can trigger a high-temperature gas-phase chemistry that can produce complex organic species with abundances close to the observed values.

Interstellar ices can form as mantles surrounding silicate grain cores in cold molecular clouds prior to star formation. Once stuck on the grain, an atom or molecule can react with other species to form molecules which cannot readily be produced in the gas. One such example is methanol, CH_3OH, which is thought to result from hydrogenation of CO. Ices can be observed through their vibrational bands at infrared wavelengths. One of the easiest transitions of methanol to observe from the ground is at 3.54 micron. Unfortunately, the band is weak and high signal-to-noise spectra are needed to extract the methanol feature.

The advent of 8-m class telescopes equipped with sensitive infrared spectrometers has opened up the possibility of obtaining high quality infrared spectra of a large number of solar-mass young stars. A Dutch-French team led by Ewine van Dishoeck (Leiden) has surveyed about 60 low-mass objects in southern star-forming regions for signatures of interstellar ices. To their surprise, solid methanol was detected in at least five objects with luminosities only a fraction of that of the Sun, four of them in the small cluster SVS 4 in Serpens, with abundances as high as 25% of the water ice abundance, comparable to the highest solid methanol abundances found toward high-mass protostars. For other sources, the limits on solid methanol are less than a few %, consistent with previous limits. We currently do not understand why there is such a large variation in the solid methanol abundance from object to object. Is its formation related to temperature, triggered by ultraviolet radiation or somehow connected to shocks? The fact that solid methanol is now detected in such abundance in this Serpens cluster should provide clues to its origin. Methanol has also been detected in cometary comae, suggesting that the disk from which our solar system formed contained methanol-rich ices.

Both high temperature gas-phase reactions and processing of methanol-rich ices can lead to complex organic molecules, perhaps even pre-biotic species like amino-acids. Future millimeter facilities, in particular ALMA, will be able to perform deep searches for such molecules in solar-mass protostars and disks, and greatly extend our knowledge of the inventory of material from which solar systems like our own are made.

Clues to Planet Formation

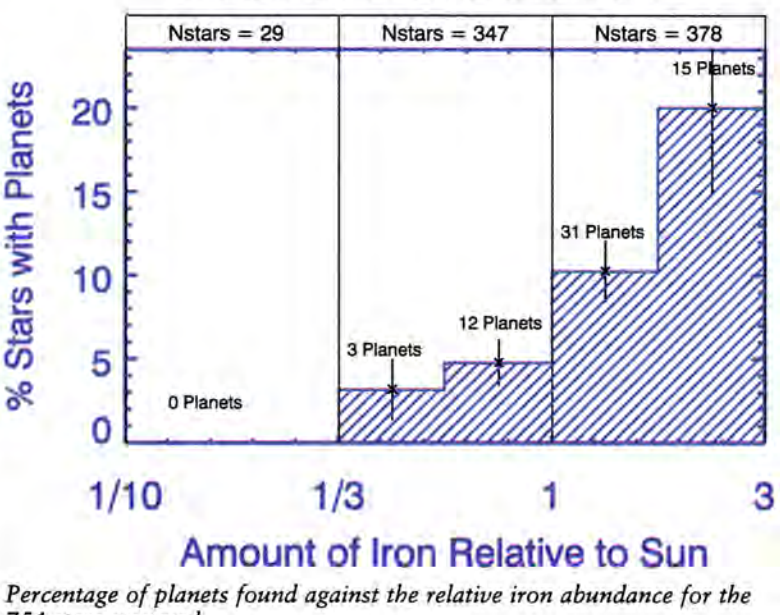
by Gareth Kennedy

There is now increasing observational evidence to support the claim that stars with planets tend to be metal rich. The claim (first postulated by Lin et. al. 1996) has been given a significant boost by the completion of a new survey involving Debra Fischer of the University of California, Berkeley.

The survey has found a significant correlation between the occurrence of planets and the iron content of their parent stars. The results from this work show that approximately 20% of metal-rich main-sequence stars have planets (see figure), compared to the usually quoted figure of 5% across all stars.

This correlation seems to indicate that heavy metals play a vital role in planetary formation, and while the exact reason for this is unknown it may have to do with the planetary accretion process requiring a solid core to build upon. The survey may also have found evidence that as the galaxy get older, and the fraction of heavy metals increases, the presence of planets around stars may become the norm.

With the detected extra-solar planetary population already increasing on a weekly basis (117 found around main-sequence stars as of 18/7/03), it may be time to further investigate the mechanisms that operate in the formation and evolution of these potential havens of life.



Percentage of planets found against the relative iron abundance for the 754 stars surveyed

SETI Goes Optical

by Tobias Locsei

Laser signals from alien civilizations, if they exist, may be detected by new developments in optical SETI (Search for Extraterrestrial Intelligence). This was one piece of information presented by Jill Tarter at the Commission 51 meeting for Bioastronomy on Monday morning. Jill Tarter is the Director of the Center for SETI Research at the SETI Institute in Mountain View, California.

Jill Tarter, observed briefly in the optical

SETI has been existence for 40 plus years, and has become a 'household word' since the advent of the SETI@home program in 1998. Approximately 4 million home internet users have downloaded the SETI screensaver, contributing to the SETI efforts by processing radio data collected by the Arecibo radio telescope in Puerto Rico on their own PCs. Since its conception, SETI has focussed on the detection of microwave radio signals. However, recent developments in photo detector technology have made it possible to extend the search into optical wavelengths.

Optical telescopes at UC Berkeley, Harvard, Princeton and Lick Observatory are looking for very short pulses of light from nearby stars similar to the Sun. The idea is that alien civilizations using petawatt (10^{15} watts) power lasers for communication would produce signals that are extremely intense over a period of nanoseconds (such lasers already exist on Earth). No known astrophysical processes could produce such signals, so looking for laser pulse signals is ideal in that there are unlikely to be false alarms. Still, some care must be taken to filter out instrumental noise. Detector setups require at least two photo-detectors. A signal is only accepted if it triggers both detectors simultaneously.

Harvard and Princeton have collaborated to make an even more sophisticated detection scheme. Due to the physical distance between the two universities, light from target star systems would reach one university 1.6 milliseconds before the other. Researchers can reject pulses that don't arrive with this particular delay as being instrumental noise. In this way, the instrumental noise can be almost entirely screened out.

One of the advantages of optical detectors is that they are relatively inexpensive and can be deployed on 1 m class telescopes. Interesting science can be done on a limited budget.

In regards to future plans, Jill says that both microwave and optical SETI will continue. SETI researchers hope to extend the optical detectors down to infrared wavelengths, since infrared is less strongly absorbed by interstellar dust and can propagate more than 1000 or so light-years before being absorbed.

The Magellanic Times

The Magellenic Times is the official paper of the IAU General Assembly 2003

The IAU General Assembly 2003 is proudly sponsored by

CSIRO

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Deadline for daily issues
1pm on the day prior to publication

Text files for publication may be emailed to john@strangeplanet.com.au

Printed by
Marrickville Print & Design
Ph: 1300 888 490

21cm Line Interferometry and the Dark Matter Problem

by Albert Bosma, with Hoi Tak Leung

Albert Bosma, entirely baryonic

'Write me a piece, Albert. I'd really appreciate it, I won't have time to do it myself.' I am sitting opposite Seth Shostak, editor of the Magellanic Times, whom I have known for a long time, and known of for even longer. He and I owe a lot of intellectual indebtness and gratitude to a quiet man who patiently taught us the principles of 21 cm HI interferometry, David Rogstad. Rogstad was one of the first to use a two element radio aperture synthesis interferometer to study the 21cm line emission of nearby galaxies (he was LOC co-chair John Whiteoak's first student.)

Seth did his thesis on detailed synthesis observations of 5 late type galaxies with the Owens Valley Radio Observatory (OVRO) twin element interferometer. Dave Rogstad moved for a few years to the Kapteyn Laboratorium in Groningen in the late sixties, where he guided a couple of students in various projects – Henk Olthof on warps, Arnold Rots on data of NGC 6946 and IC 342, and me. He himself worked on his OVRO data of M101.

For me, it was my first research project. I had to read reams of charts to mark off phase zero measurements of fringes from the just completed Westerbork telescope. Rogstad taught me computing and offered valuable advice ('beware, if you start computing, you stop thinking.') After this, he gave me his 21 cm line data of M82 to reduce, along with all his programs – on punched cards. I was enthusiastic about this, looked up the literature on this 'exploding galaxy', and learned about the galaxy rotation work of Burbidge, Burbidge and Prendergast. The M82 HI data were interesting, and Dave encouraged me to speak about them at a YERAC (Young European Radio Astronomy Conference) in Dwingeloo.

Dave's work on M101 stimulated the young staff members in Groningen, led by Ron Allen, to push for a temporary receiver to do 21cm line work on nearby galaxies with the Westerbork telescope – which was not explicitly constructed for this purpose. By the time this project was completed, I was fortunate enough to use it for my thesis work on a pilot HI study of spiral galaxies of various morphological types. That was more or less a backwater project, the main attention for 21cm line work being the study of spiral structure of M51, M81 and M101 ('testing the density wave theory.')

Even so, I witnessed the debate about rotation curves in the outskirts of galaxies using HI data. I vividly remember a seminar by Mort Roberts, arguing that M31's rotation curve was flat, and all the young Turks of the Kapteyn lab arguing that he picked up signal of the main disk through the sidelobes of his single dish antenna (Ed Salpeter was subjected to a similar treatment a few years later when he reported on his Arecibo data, which had some after-effects if his Annual Reviews autobiography is any guide). So 21cm line interferometry was the creed.

My thesis work, with its basic result that the rotation curves of spiral galaxies of all morphological types stayed flat (or were even still rising) beyond the optical image, helped settle the debate of the presence of dark matter in the outer parts of spirals. I also was fortunate to be able to go to Palomar with Piet van der Kruit, to get H-alpha rotation data in the inner parts, and to obtain plates for surface photometry to determine the luminosity profile and the mass-to-light ratio as function of radius.

But the questions remain – how was the dark matter debate conducted, who said what when and why, and who had the 'correct' (i.e. present day accepted) picture first? This is not so easy as some people would have it. In Historical Development of Modern Cosmology (ASP conference series Vol. CS-252), I read two articles - one by Sydney van den Bergh and one by Jaan Einasto - and there seems to be little overlap. So there could be different stories, and different people were convinced at different times of the presence of the dark matter in spirals – just like the various events and characters which made up the French Revolution. In any case, as far as the HI line rotation curves is concerned, I can only cite Vera Rubin et al.'s (1978) paper where she writes that 'Mort Roberts and his collaborators deserve credit for first calling attention to flat rotation curves', credit he got only sparingly. What is clear now is that there is little need for a dark halo to fit the optical rotation curve data, a conclusion reached in an ApJ paper as recently as 2000. Mort Roberts himself confided to me once that he thought that my thesis work vindicated his contention that rotation curves of giant spirals are flat. Ostriker and Peebles, who pushed the idea for dark halos, first in a 1973 paper on disk stability (a paper which nowadays cannot withstand close scrutiny), and then, with Yahil, in their classic 1974 paper on various indicators pointing to a linear increase of the mass of a giant galaxy with radius, cite for the rotation data the paper by Roberts and Rots (1973) and Rogstad and Shostak (1972).

Which brings me back to Seth Shostak. Contrary to my thesis, which I had printed in 500 copies, and with its handy format became quite in demand (my thesis advisor had his copy stolen from his office somewhere in the 1980s, he told me recently), Shostak's thesis (1971) is not widely available. I found a copy of it in the VLA library, so I started reading it carefully, and yes, it contained the flat rotation curve of NGC 2403, and its implication that the volume density of matter drops off as r^{-2} (mass rises linearly with radius, therefore). So he had it! Okay, only for one case, but even so; and it was a clean observation with an interferometer, so unlike Roberts' observation of M31 (the primary piece of evidence in the Roberts and Rots (1973) paper). Oh well, it is unclear to me sometimes how scientific evidence is accepted in certain circles. Sometimes one has a result, correct after all, but at a time too far ahead of the pack, which is not yet ready to absorb it.

In any case, the amusing part of Seth's thesis is in the very end. A brief acknowledgement to Gordon Stanley, then director of OVRO. A warm thanks to David Rogstad for his patient advice. And then this fantastic flight of fancy – 'this thesis is dedicated to NGC 2403 and its inhabitants, to whom copies can be furnished at cost'. No wonder this man is now working on SETI! He just wants to know why nobody came along thus far to claim a copy. If somebody from that galaxy had come along, Seth would have been the most famous man on earth, offered an autographed copy of his thesis for free, and arranged for a public lecture at the current General Assembly. John Whiteoak would have been happy to schedule that, and the Harbourside Auditorium would have been way too small!

A Clear View of the Night Sky

Assembly participants will have the chance to view the night sky at a dark site close to Sydney on Wednesday, 23rd July.

The Crago Observatory located in the Blue Mountains provides an ideal opportunity to discover the delights of the southern sky.

You can come along. The bus departs from the Convention Centre at 5.45 pm sharp and returns at 11.30 pm. Cost is $20 per peson.

For more details, contact Brett McMillan on 0408 832 408.

A&AL: A Transient Source

by Donna J. Coletti

In early July, four years of Astronomy & Astrophysics disappeared. Astronomers looking for online access to full text articles in A&A found that the web site containing material published between 1997 and 2000 no longer existed.

The NASA Astrophysics Data System (ADS) was not helpful, unless you only needed an abstract. The ADS database does not have electronic versions of most journals. When you request electronic full text using ADS, it sends your request to the publisher, who verifies that your library maintains an institutional subscription, and then sends the requested material to you.

Access to A & A articles has been complicated for several years. ADS has page scans up through 1996; Springer's online site had electronic full text for 1997-2000; EDP Sciences, the current publisher, provides electronic versions for 2001 to the present. Springer changed its website several weeks ago, and, since it was no longer publishing A & A, decided not to provide access.

The problem for astronomers was discovered by librarians at the John G. Wolbach Library at the Harvard Smithsonian Center for Astrophysics who informed astronomy librarians via Physics Astronomy Mathematics Librarians online network (PAMnet). Worldwide protests persuaded Springer to temporarily resume access. A permanent solution has not been found.

This incident taught astronomers several lessons:

- Everything is not in ADS
- When dealing with a publisher, even a non-profit one, electronic versions of journals are often being leased, not purchased.
- Archiving of electronic material is not guaranteed.
- Don't cancel your paper copy yet.

Close Encounters of the Martian Kind

Heather Couper and Nigel Henbest

No, surely it can't have been just the wonderful hospitality at the Welcome Ceremony last Tuesday. That big bright reddish thing in the sky, under the Full Moon. It wasn't a bird or a plane... By Ares – it must be Mars!

Well, that put us back in the kindergarten. For the past two years, we've been telling folks that this August, Mars will be closer to the Earth than at any time in the past 59,619 years. Last time it was this big and bright in the sky, Neanderthal woman was watching it (having dispatched N. man to cooking and washing up duties.) Up in the northern hemisphere, Mars isn't rising 'til too late for those who have to worry about our beauty sleep – so nothing had prepared us for this astounding sight. The reaction was visceral. For the first time, we really felt how this baleful visitor had affected our ancestors.

And it's having a pretty profound affect on us today. As we speak, four space probes are on their way to the Red Planet. As well as NASA's two rovers, Spirit and Opportunity, there's the delayed Japanese orbiter Nozomi, and Europe's Mars Express – carrying on its side Britain's Beagle 2 lander (yeah!!) Beagle/ Mars Express was launched on June 2, Heather's birthday, which culminated in the ultimate birthday present in the form of the immortal phrase from Mission Control at the UK's National Space Centre: 'Heather – we're on our way to Mars.'

Beagle 2 is specifically designed to sniff out life on Mars, and will arrive at the Red Planet early on Christmas Day. It's '#2', by the way, because the original Beagle was the ship in which Charles Darwin discovered evolution on Earth; Beagle 2 will – we hope – do the same on a second planet.

But how successful will it be? We think that the answer will be very – if only because there's good evidence that life on Mars has been found already. In the research for our book, 'Mars – the Inside Story of the Red Planet', we have concluded that NASA has been backward in coming forward when it comes to the discovery of life on Mars – back in 1976.

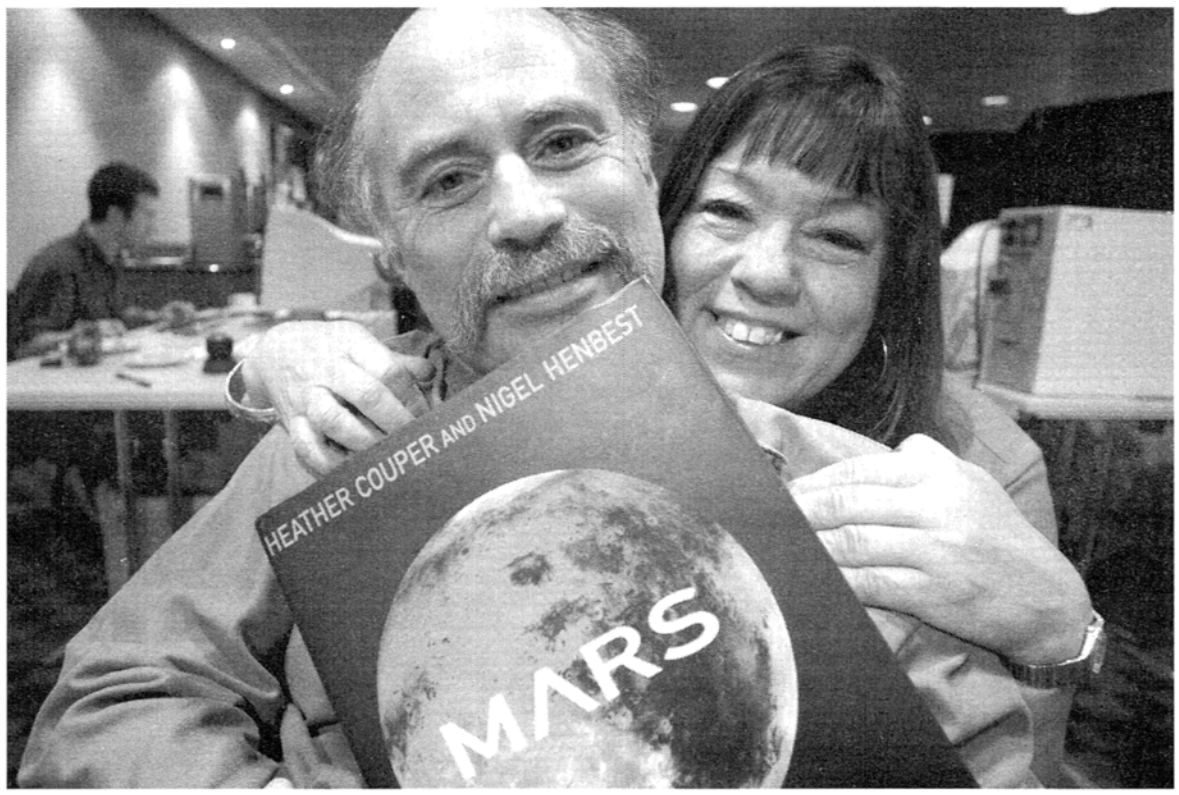
That was the era of the twin Viking landers, designed to provide a black-and-white answer to the question of life on Mars. The Red Planet didn't oblige. Two experiments were equivocal. A third met all the criteria established before launch for indicating life. This was the Labeled Release experiment, which fed nutrients to the soil samples incubated in the Viking probe's chamber. It was designed not by a NASA boffin, but by Gil Levin, a sanitary engineer. If you're looking for tiny quantities of microbes, perhaps you'd best turn to someone who made his fortune from tracking down Legionnaires' Disease in air conditioning plants. But NASA didn't see it that way.

They were more concerned that their Gas Chromatograph Mass Spectrometer (GCMS) didn't pick out any organic chemicals in the soil. No organics; ergo, no life. Of course, zero is a slippery concept in science. At the Scripps Institution of Oceanography in La Jolla, we tracked down Danny Glavin and his colleagues who are designing a new organics detection experiment for future Martian missions. A pretty odd thing to do, we thought, if Viking proved there are no organics there anyway.

Not quite so, says Glavin. They ran a version of the Viking GCMS, testing simulated Martian soil laced with E. coli. The GCMS gave a zero results. Oops. The Viking GCMS was not nearly as sensitive as NASA thought, Glavin concluded: 'we estimate that Viking would have missed on the order of 30 million bacterial cells per gram of soil.'

And that limit is a lot higher than the concentration of microbes needed to produce Levin's positive result. If Occam were looking at the Viking results, we suspect his cutting edge would home in on a low of level of bacterial life on Mars today...

Heather Couper and Nigel Henbest have been put on the road during the GA as touring astronomers. Otherwise, they make and present TV and radio programs, newspaper and magazine articles on space and astronomy – and books, of which the latest is Mars – the Inside Story of the Red Planet (Hodder Headline).

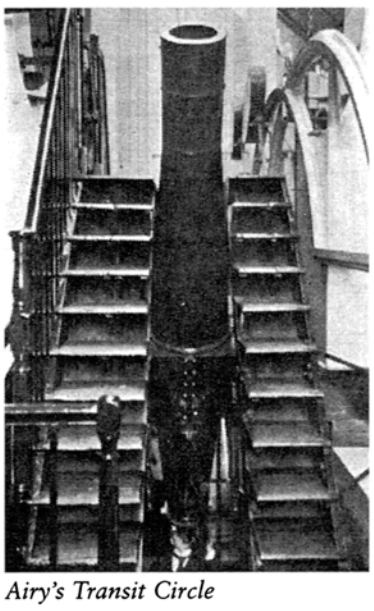


Red planet wonders: Heather Couper and Nigel Henbest

Airy's Transit Circle - An Influential Instrument for Over a Century

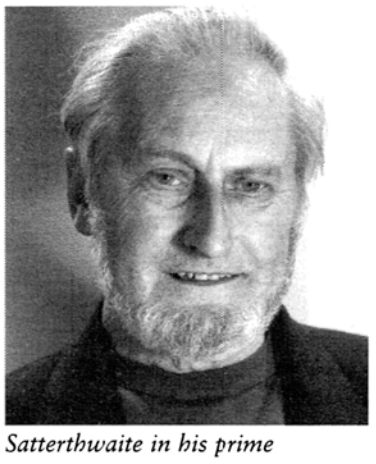
by Gilbert E. Satterthwaite

When Sir George Airy became the seventh Astronomer Royal in 1835, he expressed his satisfaction with the state of the meridian instruments at the Royal Observatory, Greenwich. A decade later, however, although they continued to perform well, Airy felt the need for new positional instruments of greater aperture, not least in order to obtain positions of newly discovered faint asteroids. He designed a suite of new instruments, including an altazimuth instrument to obtain off-meridian positions of the moon, and most notably a transit circle of 8 inches aperture to replace the existing transit instrument and mural circle.


Airy's Transit Circle

Airy's positional instrument designs utilized a massive superstructure of cast iron in bolted sections, with no provision for the adjustment of instrumental errors; instead he made provision for these to be measured and allowed for in the subsequent reduction of the observations. The success of his approach is clear from the long and successful working life of the transit circle, and influenced the design of positional instruments for more than a century.

The first observation with the transit circle was made on January 4, 1851 and the last on March 30, 1954. During that time some 670,000 observations of the Sun, moon, planets and minor planets were obtained, in both right ascension and declination, together with hundreds of thousands of star positions for the long series of Greenwich catalogs. Its basic design enabled the methods of measurement to be up-dated from time to time, greatly increasing the accuracy of observation obtained.

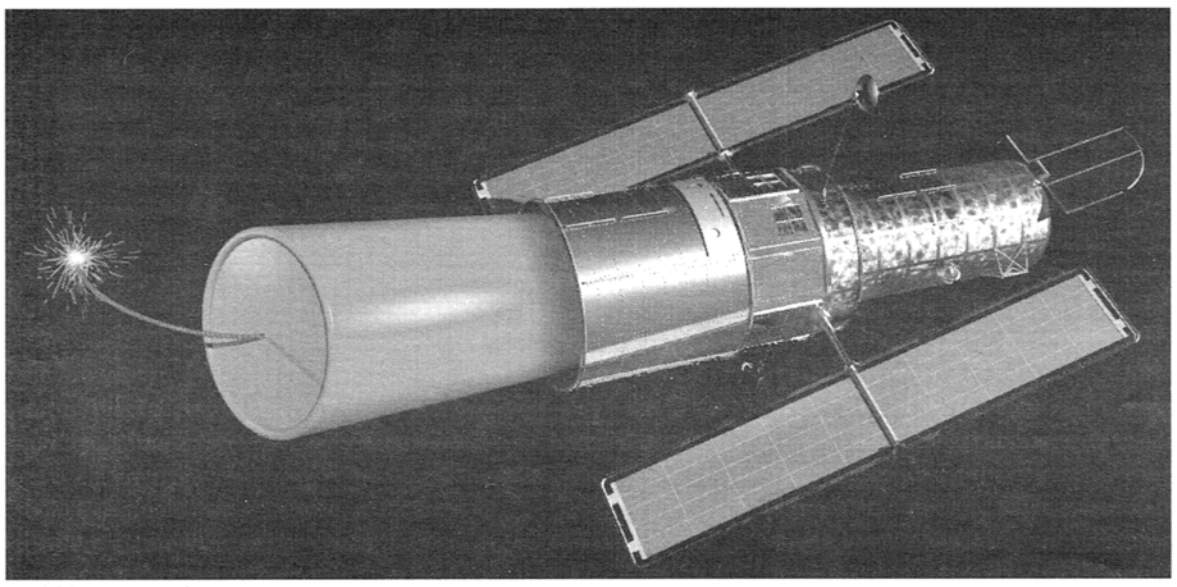

Satterthwaite in his prime

Observations with the transit circle also provided the basis for Greenwich Time until 1927, and its lasting history was assured when, in 1884, it was chosen by an International Conference held in Washington, D.C. to mark the prime meridian and zero of longitude. Today, half a century after its working life ceased, and in the good care of the National Maritime Museum, it continues to exercise that function and helps to attract many visitors to Greenwich who delight in standing astride the meridian line.

Gilbert Satterthwaite started his working career at the Royal Observatory Greenwich, and made the last published observations (of Jupiter and Pallas) with the Airy transit circle in 1954. He will be describing Airy's positional instruments at Scientific Meeting 1 of Commission 41/Interunion Commission for the History of Astronomy on Tuesday, July 22.

The End of the Hubble Space Telescope Mission Is Near

by Ron Allen



Hubble Space Telescope in a precarious situation

NASA has convened a panel under the chairmanship of Prof. John Bachall to consider how to make the transition from the Hubble Space Telescope (HST), arguably the most successful space astrophysics mission in history, to the James Webb Space Telescope (JWST), which is the astronomy community's highest priority for the next decade.

During the fourth HST servicing mission (SM4), presently expected to occur in mid-2005, HST will be equipped with a new UV spectrograph (COS) and a new wide-field UV/Opt/IR imager WFC3). Along with repairs to gyros and other support systems, we can expect HST to continue operation into about 2009. At that time we anticipate that components will be failing and science operations will be coming to an end.

NASA is considering how to dispose of the HST spacecraft safely. This is not trivial, since it is virtually certain that substantial pieces of the spacecraft would reach the Earth's surface upon re-entry. The present plan is to arrange for a controlled re-entry, probably by attaching a booster rocket to the telescope. The alternative of bringing the telecope back to Earth with the Shuttle is possible, but risky.

While we can look forward to the new James Webb Space Telescope after ~2011, it is primarily a near-to-mid-IR machine (2 – 10 microns). Our research community needs to come to grips with the prospect that HST and its optical-UV capability will not be available after ~2009.

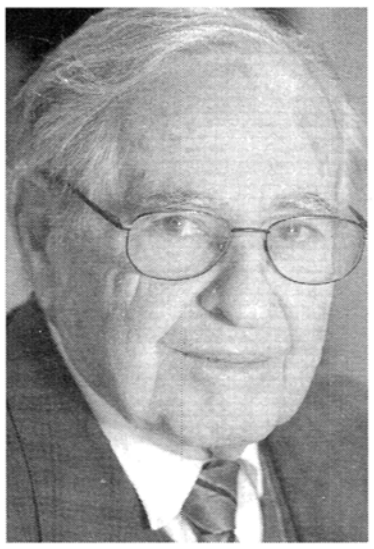
You are urged to provide your opinions and suggestions to Prof. Bahcall's panel, officially known as the 'HST-JWST Transition Plan Review Panel.' See the web site at *http://hst-jwst-transition.hq.nasa.gov/hst-jwst/home.cfm*.

Some important comments on these matters from the Association of Universities for Research in Astronomy (AURA), the organization which manages the Space Telescope Science Institute (STScI), are available at http://www.aura-astronomy.org in the box titled 'What's New', where Garth Illingworth and Mike Shull urge consideration of a fifth servicing mission (SM5) to HST. A start on making the science case to maintain HST is on the web page http://www.stsci.edu/resources/ in the box titled 'REPORTS'.

Make yourself heard. As Garth and Mike say, 'HST is widely recognized as an extraordinary scientific, educational and inspirational national asset. It is ours to lose.'

It Ain't Necessarily So!

by Jayant V. Narlikar and Jean-Claude Pecker



Jean-Claude Pecker considers the alternatives

When we started our researches, cosmology was regarded as a highly speculative subject in which theoretical speculations far outnumbered observed facts. Thanks to modern observational programs, such as the 2D Field, SDSS, and WMAP, observations are catching up.

Today, despite observed data in great abundance and quality, cosmology continues to be highly speculative. Today's standard cosmology, despite its description as 'precision cosmology' by the believers, rests in fact on physics that has not been tested in the laboratory, and on stipulated initial conditions that are very from being observable. For example, the various parameters of the theory have no compelling rationale, but had to be introduced into the theory for survival. The original big bang cosmology of Alexander Friedmann had ordinary (dust) matter and zero cosmological constant. Today we are told that only 4% of all matter and energy is ordinary baryonic matter. The rest is dark non-baryonic mater (23%) and dark energy (73%). Neither the non-baryonic matter nor the dark energy have any distinct observational evidence or an agreed-upon physical basis. These are the present day epicycles.

The only distinctly measured constant of cosmology is the Hubble constant, whose value (despite the precision claimed!) remains unsettled in the range 50-75 $kms^{-1}Mpc^{-}$. The lower values are obtained from the more distant observations and the higher values from the nearer ones. Still lower values (~25) for the more distant objects cannot be ruled out as an average value as suggested by Dr. Shanks.

The directly observed universe up to redshift of ~ 6 gives $\Omega_{}$ ~0.04. If we extrapolate the WMAP results to the standard interpretation of the last scattering surface, this has a reshift of ~1088. Beyond that, the universe remains unobservable.

So the claimed necessity to have $\Omega = 1$ rests on the inflationary paradigm that occurred at redshift of $\sim 10^{2^{-}}$. Such a large extrapolation of physical conditions may be a luxury permitted to mathematical model makers, but can hardly qualify as a physical description. It is like trying to infer the shape of a curve from the tangent drawn at one point.

Given the speculative foundations of the standard model, it is premature to regard cosmology as a closed book. We invite astronomers to keep an open mind towards alternative ideas and to examine them critically.

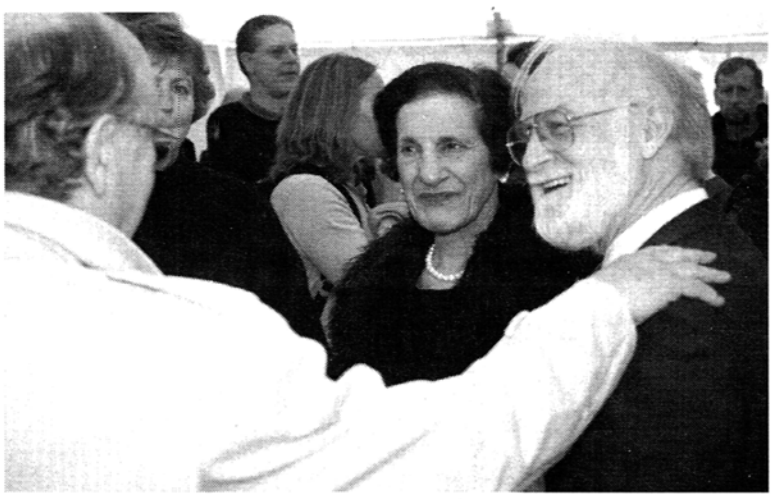
Remembering the Pioneers

by Shaun Amy

Miller Goss of the VLA, and Master of Ceremonies, addresses the crowd

Although Australia's pioneering spirit has been well documented, it is a little known fact that Australia has been involved in the science of radio astronomy since World War II. Rodney Reserve at Dover Heights in Sydney (an ex-World War II radar station) was the location for one of the early field-stations run by the CSIRO Division of Radiophysics. This involved the use of ex-radar equipment, many different types of antennas and the development of novel observing and analysis techniques that were later to form the foundation of modern radio astronomy.

Between 1946 and 1954, numerous breakthrough discoveries were made at Dover Heights. Early yagi antennas were used to study the Sun and other "radio stars." Further antenna developments allowed the southern sky to be surveyed at radio wavelengths, significantly increasing the number of known radio sources. Arguably the most interesting radio telescope was the so-called "Hole-in-the-Ground" antenna. This consisted of a fixed parabolic surface made by hand-excavating sand in Rodney Reserve, with the receiver mounted on a movable mast allowing different regions of the sky to be studied. This radio telescope led to the indentification of Sagittarius A as being located at the center of the Milky Way.



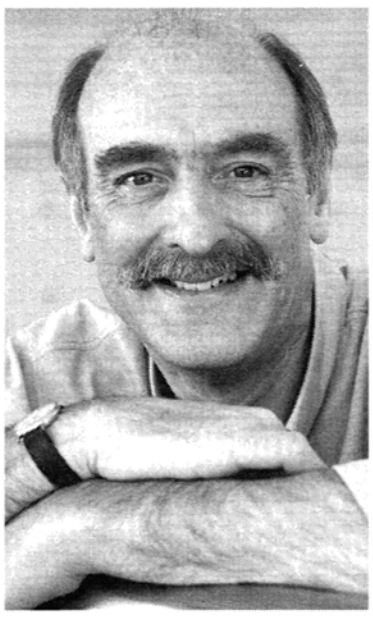
Bob Frater tries to put the touch on Ron Ekers. Next to Ekers is the Governor of NSW, Her Excellency Marie Bashir

To coincide with the International Astronomical Union's (IAU) 25th General Assembly and in association with Waverley Council, a display and replica of one of the earliest antennas was unveiled at Rodney Reserve by the Governor of NSW, Her Excellency Marie Bashir and the President-Elect of the IAU, Professor Ron Ekers on Sunday 20 July.

Further information is available on-line at http://www.parkes.atnf.csiro.au/people/jsarkiss/dover_heights/

An astronomer that can communicate

by James Hitchcock



Fred Watson explains all

The David Allen Prize is awarded to those who are best able to communicate science to the public. On Saturday, July 19th, this prestigious award was presented to Fred Watson of the Anglo-Australian Observatory.

The David Allen Prize was established in memory of David Allen, also of the Anglo-Australian Observatory. Allen made major contributions to astronomy before his untimely death in 1994. Allen had a commitment to communicating science to the public and this is the main quality on which the judges award the prize. The prize is awarded for the best contribution or contributions during a year, in any medium, that portray astronomical information to the general public in both an accessible and informative manner.

Watson has demonstrated his ability to bridge the gap between the scientific world and the general public in numerous ways, the most prominent being his guest spots in the media, such as his regular appearances on ABC radio. Watson has also had many articles published in Australian Geographic and Sky and Space magazine, authored the book Binoculars, Opera Glasses and Field Glasses and most interestingly has collaborated with Australian composer Ross Edwards on the piece 'Star Chant.'

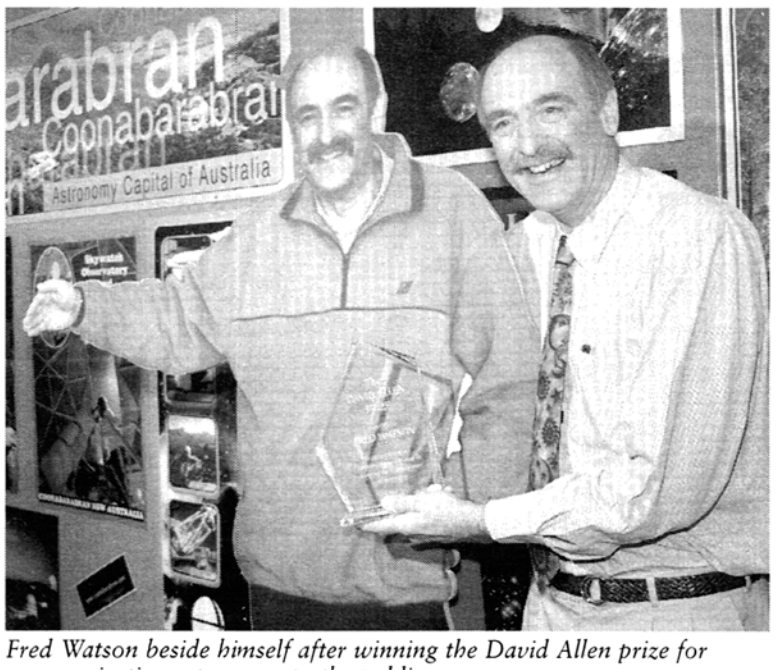
Speaking to the energetic Watson yesterday, he said 'I was thrilled to receive the award. It has added significance to me as I knew David Allen quite well.' Watson commented on Allen 'He was an extremely gifted person, not only did he contribute to a wide area of science, he could also communicate it well to non-scientists.'

Watson was appointed astronomer-in-charge at the Anglo-Australian Observatory near Coonabarabran in NSW. Watson said of his working location, 'I think the rural environment is one that really nurtures you, it brings out the best in people.' Watson is responsible for the scientific output and management of the Anglo-Australian and UK Schmidt Telescopes.

Watson is also well known as a pioneer in the use of fiber optics in multiple-object spectroscopy during the 1980's, a technique which is now practiced worldwide. Watson's own scientific interests are the motions of stars and galaxies, and the development of new instrumentation for astronomy.

'Astronomy is the easiest of the sciences to get into peoples' minds, it is very accessible. Astronomy has the potential to give us the answers to our origin' he comments on his work on promoting astronomy to the public.

Watson is currently working on his second book based around the history of the telescope, which he said will be able to enjoyed by the public and scientists alike and should be finished by the start of next year. Watson will also be chair of 'Science in the pub' this Wednesday. You might wish to come along to see Watson try to control this heated debate.



Fred Watson beside himself after winning the David Allen prize for communicating astronomy to the public

Controversial Pluto

by Hoi Tak Leung

Ever since Clyde Tombaugh discovered it in 1930, Pluto has been acknowledged by the International Astronomical Union as the farthest planetary member of the solar system. In recent times, however, there has been increasing debate over whether Pluto should be reclassified – perhaps as a comet or an asteroid.

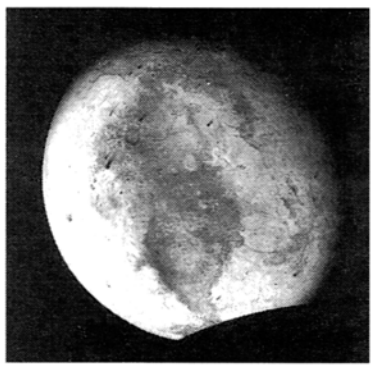
Paul Francis – from the Australian National University – goes further in suggesting that the use of the term 'planet' should be abolished entirely. Instead, he suggests that such bodies should be reclassified into three categories – 'large rocks' (e.g. Earth, Mars), 'gaseous objects' (e.g. Jupiter), and 'miscellaneous' (e.g. Pluto).

While astronomers debate the merits of the term 'planet' and what status Pluto should be accorded (the IAU declared in 2001 that it will remain as a planet), the public remains skeptical of any changes to these definitions. Having seen little attention devoted specifically to the public's understanding of Pluto and its place in our solar system, the Magellanic Times set out to investigate. In a survey of random IAU participants (some scientists, some not), this reporter found that:

- 80% of surveyed participants opined that Pluto should remain defined as a planet.
- 75% of surveyed participants had no idea what a planet actually can be defined as.

The IAU has already acknowledged public opinion – for instance, the American Astronomical Society had previously stated they 'feel that there is little scientific or historical justification for such an action' – as a factor for why Pluto will continue to be defined as a major planet, and this has generally been agreed. Inherently confused about what a planet is and comfortable with its status, the majority of the public do not feel compelled to make any changes (even if there are some significant scientific reasons to do so.)

However, just as importantly there has so far been little consensus in agreeing on a rough public definition of 'planet.' Therefore, while Mr. Francis' statement may at first be extremely controversial, there is at least some justification for it. The public has no idea as to what a planet actually is – even some astronomy students could not do this – and amongst those in the know, there



are wide differences in opinion about the definition of planet – ranging from Mr Francis' opinion to 'an orbiting object around the sun' to 'something big in the galaxy'. It is a gray area, and perhaps the reclassification of this term into smaller subcategories will help the public better understand these diminutive bodies.

Draft notice for the IAU meeting newspaper

Commission 50's Working Group is holding an unusual meeting on Tuesday, 22nd July (PM1, morning sessions, PM3 afternoon sessions), jointly hosted with the International Dark-Sky Association. This meeting has been billed in Lighting Magazine as what promises to be "the most important discussion on this subject yet held in Australia." The IAU astronomers will be joined by specially-invited lighting engineers from the Australian and Chilean communities - their advice is crucial to the achievement of reasonable compromises between the public's obvious need for well-lit towns and cities and the requirements of our profession for dark skies.

Sessions 1 and 4 will concentrate on the astronomers' perspectives, with an international emphasis on key astronomical sites - as appropriate to the IAU's interests. Sessions 2 and 3 will allow us to hear from lighting engineers - mainly from Australia - who have much experience and advice on how to work out suitable technical and pragmatic compromises that are reasonably acceptable to society.

Look around the Darling Harbor. It is a remarkably glare-free, yet well-lit environment.

Obviously we would not build a major observatory next door, but many of the principles we are trying to achieve in combining the needs of society at large and those of astronomy can be found here.

The final session will include an update on the IAU Working Group's highest priority - a second "World Atlas of the Artificial Night-Sky Brightness." This will build, ten years later, on the baseline DMSP satellite data provided and interpreted in the enormously successful publication by Cinzano, Falchi and Elvidge. This work is eagerly awaited by those charged with selecting sites for the next generation of Extremely Large Telescopes.

Their work also warned humanity that "Assuming average eye functionality, about one fifth of the World population, more than two thirds of the US population and more than one half of the EU population have already lost naked-eye visibility of the Milky Way."

The update on the World Atlas will be followed by remarks from Dave Crawford, Executive Director of the International Dark Sky Association. (David gave a Public Lecture on Sunday entitled "Who has stolen the Milky Way?")

The oral sessions are backed up by an outstanding sample of posters describing the efforts to "protect the skies over my country." The meeting will end with a brief review and discussion of the priorities of this IAU Working Group.

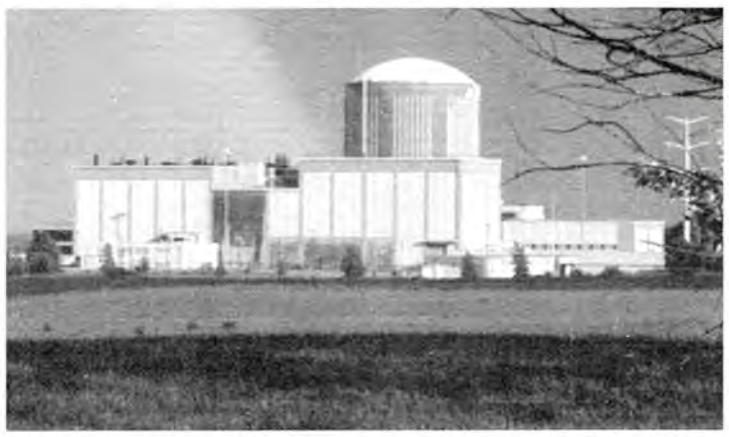
Come early! Seating is very limited during the morning sessions in PM1.

Lucas Heights Reactor to be Moved to Double Bay

A spokesman for the NSW Isotope Institute confirmed today plans to move the Lucas Heights reactor to Double Bay.

'Sure, Double Bay has a bit of a population, but we expect that the impact will be pretty small, so long as folks stay indoors or use lead sheathing in their cars,' said Nigel Bruce, an Institute research director.

The move, designed to eliminate controversy about the reactor's present location, is expected to increase property values in Double Bay. 'It will be easier for them to walk their dogs at night, that's for sure,' notes Bruce.



What the new 'Double Bay Nuclear Reactor' may look like when it replaces the exclusive Sydney shopping precinct a few years from now

Free Stuff

by Melanie Johnston-Hollitt

Tired of going to meetings and receiving innumerable glossy brochures on the latest planned but not yet funded telescopes? Looking for a unique memento for the IAU GA in Sydney? Well, this year you may be in luck.

Hidden away amongst the bright lights and glossy stands with glazed looking attendants, the Astro Expo offers some unparalleled freebies. Sure, there are the usual array of old journals and institutional pamphlets, which next weekend will likely make for a brightly colored garbage collection, but there are also some excellent finds.

For the practically minded, there are mouse mats from ALMA, pens from Siding Spring and data CDs from the AAO and Caltech/IPAC. However for me, and judging from the reaction of many others, the most popular freebies have that certain 'cool' factor so rarely attributed to pamphlets. This GA's best and coolest finds include: the star shaped stress reliever from the AAS (just the thing for long business sessions and it works well as a projectile too), the colored LED keychain torch from ANU's Mt. Stromlo Observatory (low powered so guaranteed not to start a fire), and the illustrated frog poem booklet from the IAU 2006 stand. However, the clear winner in the 'Freebie of the GA' stakes is the plush echidna toy from the AAO promoting the instrument of the same name.

Now for those of you that are less familiar with Australian fauna, you may not be aware of what a truly unique and bizarre creature the echidnas is. Rarely seen in the wild due to their shy nature, echidnas appear to be oversize hedgehogs with long snouts. Echidnas like that other unique Australian creature, the Platypus, are monotremes or egg laying mammals. So forget the ubiquitous kangaroo, the 'look it pissed on me' koala-holding experience or the American tourist-eating crocodile, if you want a real memento of both the GA and Australia get down to the Astro Expo and pick up an echidna today! MT7-25

Boomerang Plane Not a Success

A recent attempt by Ansett Airlines to capitalize on indigenous aerodynamics has proven less than positive.

'Boomerangs have been taking to the air for a long time,' pointed out Ansett engineering honcho Spruce Bruce. 'Clearly the design works.'

But apparently not for jet liners. Ansett's $500 million project to build four aircraft based on boomerang aerodynamics resulted in a jolting ride for passengers.'They were spinning to beat the band,' admitted Bruce, 'and it took a lot of work with high pressure hoses to keep the cabins tidy. At least they always came back to Kingsford Smith.'

Admitting that the new approach wasn't a winner, Ansett eventually sold the planes to the Flying Doctors.

Correction

In yesterday's Magellanic Times, a photo of Simon White was mistakenly substituted for one of Kevin Johnson. The mixup has undoubtedly been confusing to readers of this newspaper, as well as causing identity crises for those involved. We offer our sincere apologies.

Simon White

SMART-1 and Mars Express Briefing

When: 12:45 – 1:45 pm Where: Merino Room

SMART-1 and Mars Express Briefing

SMART-1 is Europe's first mission to the Moon. Mars Express will be ESA's first visitor to another planet.

Don't miss the opportunity to hear about the technologies, operations and goals of these missions from ESA Project Scientist Bernard Foing on Wednesday 23 July.

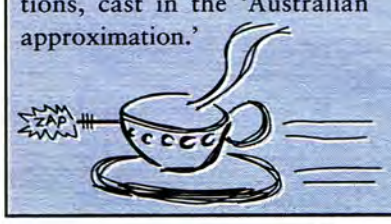
How to order a coffee in straya

by Vince McIntyre

When coming to a new country, it's important to become fluent in food terminology. Learning the words for coffee is even more critical - especially when you are stumbling, jet-lagged and grumpy, into an early morning session.

Since mathematics is the universal language of science, here are the fundamental coffee equations, cast in the 'Australian approximation.'

short black	=	espresso
macchiatto	=	espresso + equal volume of hot milk
long black	=	espresso + hot water
flat white	=	espresso + hot milk
latte	=	espresso + hot milk + foam
cappucino	=	espresso + hot milk + foam + chocolate powder on top
iced coffee	=	espresso + milk + icecream
Irish coffee	=	any of the above, with a shot of spirits, e.g. whiskey



Back Where We Belong!

by Miroslav Filipovic

The family of IAU member countries has been increased by two members; Serbia and Montenegro, and Nigeria.

Serbia and Montenegro originally became an IAU member in 1936. After the Second World War, as part of the so-called second Yugoslavia, Serbia and Montenegro was a full member of IAU. During this period, it boasted of some 25 individual members and constituted one of the largest astronomical communities in the region.

In his address after the unanimous acceptance at opening night in Sydney Opera House last Tuesday, the president of the National Committee for Astronomy of Serbia and Montenegro, Dr. Zoran Knezevic, said: 'Even if astronomy in our country has a long tradition of organized activity and professional research, today's re-admission of our astronomical community into the IAU represents a new beginning, and opens new perspectives.'

The most prominent astronomy research centers in Serbia and Montenegro are the Astronomical Observatory (AOB) and the Department of Astronomy at the University of Belgrade. The history of the AOB dates back to 1887 when the observatory was founded. Astrometry was the dominant branch of astronomical research in Serbia for some time, but these days a broad spectrum of various astronomical activities is pursued. Serbian astronomers are also involved in several ongoing collaborations with well-known research centers around the world. The Serbian Astronomical Journal and Publications of the AOB are the major scientific journals published in Serbia and Montenegro, and have a 70 year tradition behind them.

The Coolest Telescopes On the Planet

by David Frew

The second special session at the Assembly, on Astronomy in Antarctica, has began. Chaired by Michael Burton (University of NSW), the program summarized the current state of astronomy on the white continent, before describing the main astronomical results in the infrared, sub-millimeter and high-energy fields. The official meeting concluded with a session on the future of astronomy in Antarctica.

Burton opened the proceedings with an excellent overview on the potential for astronomy in Antarctica. He spoke on the melange of features that make Antarctica such a unique place for astronomical observations, especially the great potential for Dome C on the Antarctic plateau as a base for a future observatory, which promises conditions superior to the South Pole itself. Antarctica is 'high, dry and cold, and the conditions open up new windows for astronomy,' states Burton. He also emphasized the opportunities for continuous observing in mid-winter.

Dome C lies at an elevation of 3,250 meters, some 1,600 km from the South Pole, directly inland from Australia's Casey station. The new French-Italian scientific base, Concordia Station, is currently being built at this location, and will offer logistical support for the proposed 2 m Douglas Mawson Telescope. The conditions there are extremely cold, dry, and stable. The wind speed averages only 2 meters per second, with none of the fierce katabatic winds that plague coastal stations.

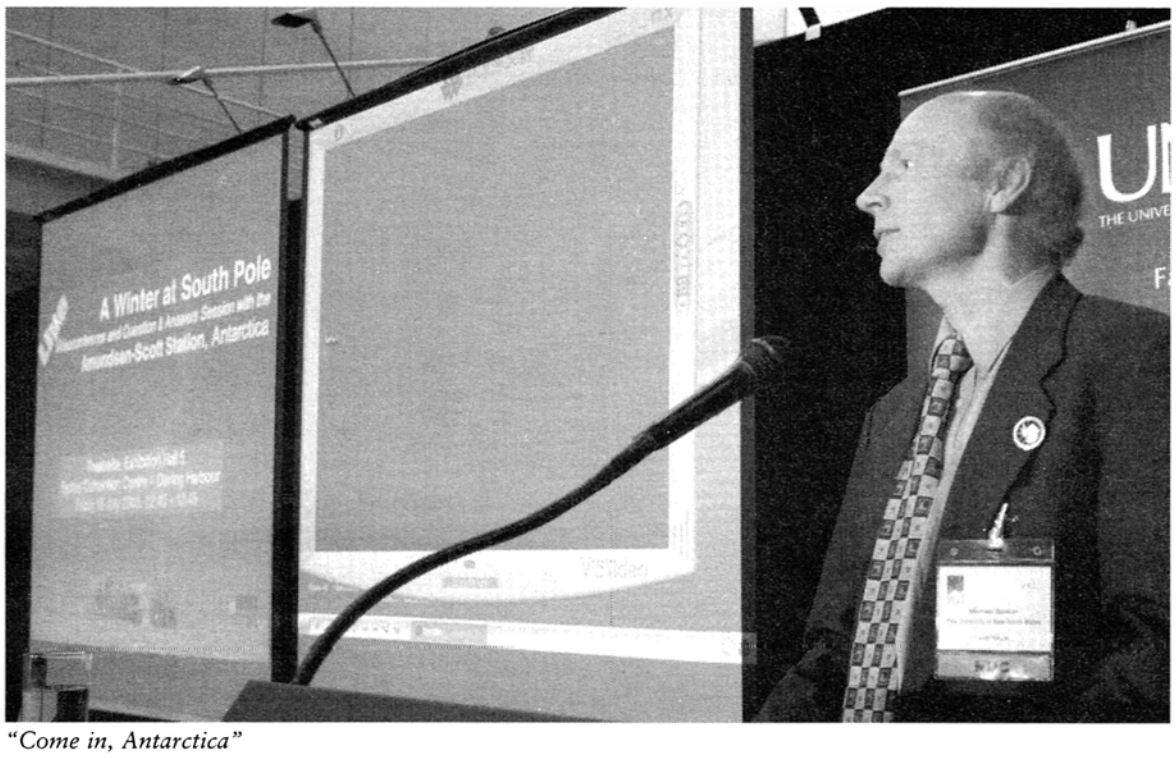
The seeing is generally superb, and the atmosphere unusually transparent, with extremely low levels of atmospheric aerosols. The amount of precipitable water vapour in the atmosphere is also extremely low, and the sky is consequently very dark and transparent in the thermal infrared and sub-millimeter bands. This offers unique observing opportunities at these wavelengths, superior to both Mauna Kea and the high Andes. In the optical and near-infrared, 'the absence of high-altitude turbulence has profound implications for astrometry, photometry and interferometry,' states Burton.

The long winter nights offer unprecedented opportunities for uninterrupted observational coverage, particularly for the fields of asteroseimology and tomography. On the other side of the coin, the continuous sunlight in the austral summer offers grist for the helioseismological mill.

Particle physicists also relish the conditions on the Antarctic continent which is covered with the deepest and most transparent ice-sheet on the planet. The Antarctic Muon and Neutrino Detector Array (Amanda) at Amundsen-Scott base has already produced seminal research on high-energy physics. Work will soon begin on Amanda's successor, IceCube, a kilometer-scale Cerenkov detector.

Another highlight of the day was the live video-conference link with Amundsen-Scott Station at the South Pole, in the meeting's lunch break. Technical difficulties with the video feed failed to dampen the enthusiasm of all involved, as this was the first time that scientists at the South Pole had the opportunity to talk in real time with participants at an IAU General Assembly. Paolo Carlisse, Chris Martin and the other 'overwinterers' spoke on the instrumentation at the Amundsen-Scott base, including the AST/RO and Viper sub-millimeter telescopes and DASI, the Degree Angular Scale Interferometer. And in case you were wondering, the temperature at Amundsen-Scott was a beautiful –57C with a moderate 8 to 9 knot breeze. Definitely some of the coolest telescopes on the planet!

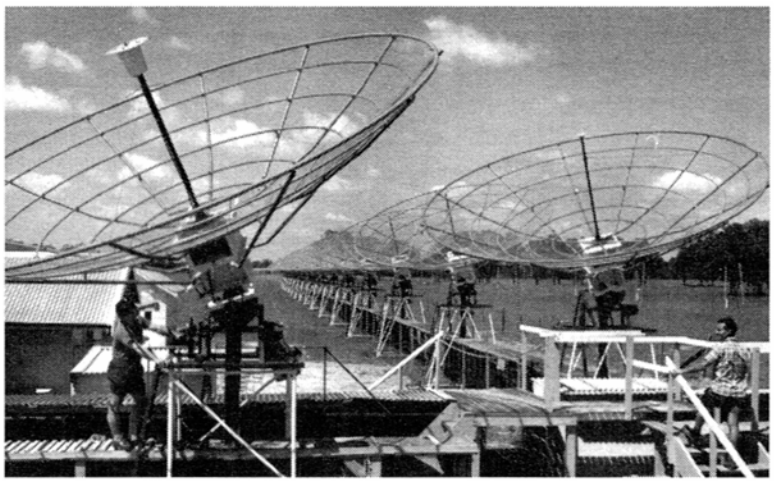
Further information on Antarctic astronomy can be gleaned from the Antarctic Astronomy Portal at *http://oldnewt.phys.unsw.edu.au/~pcalisse/antarctic_astronomy/antarctic_astronomy.html*



"Come in, Antarctica"

Cross Purposes: Preserving the History of Radio Astronomy

by Brent Groves



The Chris Cross in an early incarnation

A new resolution on the formation of a working group on preserving the history of radio astronomy was passed by this General Assembly. The idea for this working group originally came from Wayne Orchiston, archivist and historian at the ATNF.

Orchiston's current work involves the documentation of the development of radio astronomy, from observations made during the war to advances made in the post-war era, when small teams around Australia developed new instruments and techniques, including the Chris Cross and the Parkes radio telescope. His research not only deals with the early instruments and techniques, but also with the people who promoted these advances, and the observations made with these early instruments.

While doing this work, Orchiston noticed that a large number of the early telescopes and ancillary hardware were slowly decomposing, or had even been lost altogether before they could be properly documented. In addition to this, Orchiston noted that those that knew the most about these early instruments, the pioneers of radio astronomy in Australia, were now passing from the scene.

Working with Bruce Slee (a retired research astronomer at the ATNF), Orchiston wanted to tap this available database of knowledge while it was still here, to get the research experiences and memories of these pioneers noted before they passed away. They also wished to preserve those telescopes and instruments of historical significance that still existed.

In researching a list of the historically significant telescopes in Australia pre-1962, Orchiston and Slee discovered that only ~5-10% remain. They are hoping to preserve these, such as has been done for some of the early US radio telescopes at Greenbank, West Virginia.

Of course, cognizant of the losses in Australia, Orchiston realized that this work should be extended to the rest of the early pioneering nations in radio astronomy, such as the UK, to prevent losses there as well.

They thus decided to form a working group through the IAU to preserve the history of radio astronomy. This working group is actually the first working group to be a collective of both IAU commission 40 (Radio Astronomy) and 41 (History) as well as the Inter-Union Commission for the History of Astronomy.

The working group has been officially formed to identify and document significant instruments and people, and to preserve early documents on the research programs carried out on these instruments. It will also define new criteria for what is historically significant in radio astronomy, and preserve all instruments that meet these criteria. Finally it intends to put into place the infrastructure of preservation such that losses such as have occurred do not occur in the future.

The working group consists of eight members of countries that were key early pioneers of this field; R. Davies (UK), J.-P. Denisse (France), K. Kellermann (USA), M. Morimoto (Japan), W. Orchiston (Australia, Chair), S. Slysh (Russia), G. Swarup (India), and H. van Woerden (Netherlands). All members are well known and respected radio astronomers, and will work with their respective countries and the group to save the history of radio astronomy.

To consider the history that does exist in the field, IAU Commision 41 and the Inter-Union Commission for the History of Astronomy are holding a two day meeting on the development and pioneering research in radio astronomy in the Merino Room starting Monday 21 at 9:00 am, and finishing Tuesday at 12:30 pm.

The Submillimeter Array

by James Moran

The first telescope capable of making images with arcsecond resolution at wavelengths from 300 to 1500 microns has begun operation on Mauna Kea in Hawaii.

The Submillimeter Array (SMA) is a joint project of the Smithsonian Astrophysical Observatory and the Institute of Astronomy of the Academia Sinica (Taiwan). The completed array will have eight six-meter diameter elements that can be configured along the arms of Reuleaux triangles with baselines from 10 to 500 meters, providing resolutions as fine as 0.1 arcseconds at the shortest wavelength. The surface accuracies of the elements is about 12 microns. Five elements of the array are now operating at wavelengths of 450, 870 and 1300 microns. The elements are equipped with SIS mixer receivers cooled to 4K that convert the received radiation to a wavelength of 5 cm for transmission over fiber optic cables to a central processor. A large digital correlator enables the measurement of high resolution (less than 1 km/s) interferometric spectra.

The partially completed submillimtre array in late 2002 on Mauna Kea

The Array will have an important impact on a wide variety of astronomical problems. In the area of evolved stars the Array has been used to image the the highly excited CS(14-13) emission at 450 microns from the inner envelope of IRC10216, providing new insight into its sulfur chemistry. The dual bipolar molecular outflows in the Egg Nebula have been imaged in their CO emission at 870 microns. CO outflows have also been measured in numerous newly formed low mass stars such as L1551-IRS5 LkCa15, HD163296 and TW Hydra. Star formation on the galactic scale has been studied through images of CO in the spiral arms of nearby galaxies M51 and M83.

One of the SCUBA submillimeter galaxies has been detected, and future observations should help with the identification and spectroscopic characterization of these objects.

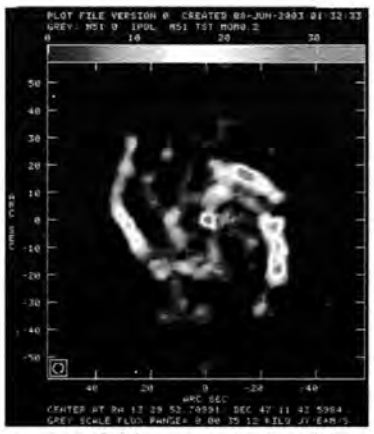
The Array is routinely used to track the submillimeter luminosity of Sgr A*, the source associated with the black hole in the center of our Galaxy. Numerous flares have been detected, and coordinated observations are being made with the Chandra X-ray telescope and other instruments.

Spectroscopic imaging of the CO emission and absorption from Mars have revealed the anomalous atmospheric temperature distribution during the recent dust storms on the planet. Mars will be a major target for the Array during the coming opposition. The distribution of the HCN in Titan has also been studied.

Jim Moran seen at optical wavelengths

The Array will be dedicated in November of this year and will be opened to the general community on the basis of competitive proposals in mid-2004. Starting in 2005 the JCMT and CSO instruments will be added to form a 10 element array with enhanced resolution and sensitivity.

Details of the instrument and the early scientific results will be presented in IAU 219 and 221 this week. More information can be found on the project website (http//sma-www.harvard.edu).



A seven field mosaic image of the CO(2-1) emission from M51

Leonids Whip Up a Storm of Interest

by Peter Jenniskens

Peter Jenniskens offers a video view of a celestial storm

Back in November 2001, the Sydney public missed out on what was called by Astronomy Magazine 'the astronomical news event of the year:' the Leonid meteor storm. Clouds prevented the viewing again last Saturday, when Sydney University astronomers had planned to show Saturday shoppers the magnificent fireball that is our Sun. But this time, SETI Institute astronomer Peter Jenniskens came to the rescue with canned video of last year's meteor storms.

Parents and children alike were thrilled to see the rain of meteors against a backdrop of northern lights over a moor.-lit cloud deck. One young astronomer thought it looked like a snowstorm. Jenniskens led a team of 36 scientists from seven countries in a two-aircraft mission from Spain to the USA on November 19 last year. This final mission of the NASA sponsored Leonid NAC project observed two meteor storms caused by dust ejected from comet 55P/Tempel-Tuttle back in 1767 and 1866, respectively.

Jenniskens looks back with satisfaction, having completed four such missions since the early announcement at the Kyoto IAU General Assembly six years ago. Since that time, meteor showers are more than ever an astronomical event, and much has been learned about how meteors may have delivered a unique blend of molecules are debris to life's origin on Earth.

Doing the Wash

by Michele Kellermann

Okay, we've all been here about a week now, and getting down to that last pair of underwear. It's time to do some wash. I've never understood why the guide books and the information given out at conferences don't include where the self-service laundries are. I actually make it a point when we are traveling to try to find them almost as soon as we settle in. Of course there is always the option of using the hotel laundry service. Our Hotel Ibis laundry sheet says: shirt-plain, clean and press A$8.00. $8 for a shirt! That's outrageous! They don't even list underdrawers. And anyway, who wants underwear cleaned and pressed. All we need is a nice tub and accompanying dryer with some slots for coins, and about one and a half hours of our time, if you choose to stay with your load(s).

Fortunately, for those in the Darling Harbor area, I can give you the laundry scoop. In the Pyrmont neighborhood, on Harris Street, near the corner of Harris and Allen, and just a block back from the Pyrmont Bridge Road, is the Harris Street Laundry, tended by a very nice laundryman. The cost of doing a single load and drying is A$6. And you have the option for a mere A$7 of leaving your bag to be picked up later that day. An entire load of dirty clothes, nicely washed and dried and folded. (Compare THAT to the A$60 charged by the hotel for a laundry load!)

The precise address of this wonderful establishment is 151 Harris Street, or actually 151/313 Harris Street, as it is part of the 313 Harris Street shopping center. In fact, while you're doing the wash, you can stop in a few doors down at the wonderful sandwich shop where you can have a far better sandwich made on your choice of fresh bread that puts Subway to shame.

Harris Street Laundry hours are: Mon. thru Thurs. 7:30 to 18:30; Fri. 7:30 to 18:00; Sat. 8:30 to 18:00, and Sun. 8:30 to 15:30. Dry cleaning and alterations are also available.

Common Causes of Confusion
—from Working Group Designations (Cont.)

by Helene Dickel and Marion Schmitz

2. JUST A "J" but it needs to be inserted in front of the coordinate part of a designation based on the standard equinox of J2000.0; otherwise the standard equinox of B1950.0 is assumed. Source positions are normally referred to the mean catalog equator and equinox of a standard epoch. Remember that numerical coordinates of sources change with equinox due to precession of the Earth, even without any proper motion of the object. Furthermore, coordinate-based designations must not be altered even if the positions change or become more accurately known.

3. ROUNDING-UP RENEGADES ignore the truncation rule at their peril! An "ACRO" source at J2000 RA=12h54m22.28s, DEC=-12d16'32.5" should be designated as ACRO^J125422.2-121632 (where ^ stands for a space) and NOT ACRO^J125422.3-121633 (rounding up) The number of significant digits for the coordinate part should be adjusted to the density of objects or their positional accuracy, so that the name is in general unique, and a SMALL amount of exceptions (ambiguities) can be handled with appended letters "a", "b", etc.

The Magellanic Times

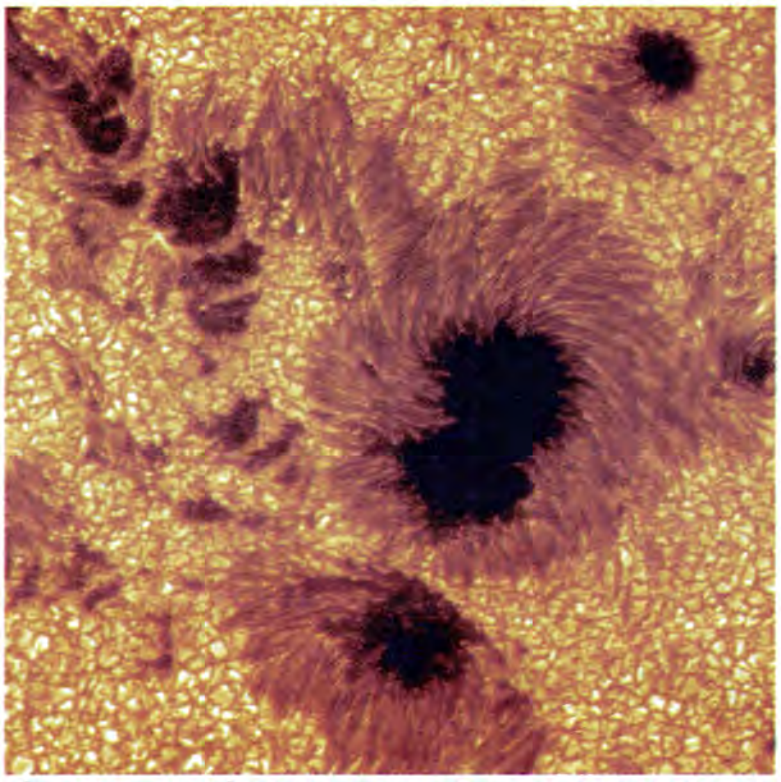
THE NEWSPAPER OF THE INTERNATIONAL ASTRONOMICAL UNION GENERAL ASSEMBLY SYDNEY 2003

IAUXXV General Assembly Sydney 13-26 July 2003

Day 8 **Wednesday 23 July**

What Lies Beneath?

by Gareth Kennedy



The Sun's spotty epidermis

It seems that the inner workings of our closest stellar neighbour are still a mystery. Despite the recent progress in the physics of the Sun and other stars, there remain many unsolved problems, acknowledges John Brown of the University of Glasgow.

There have been many exciting advances in stellar physics since the last General Assembly, one of the most important of these has come from the field of particle physics. The solar neutrino problem had threatened to undermine our theories of stellar physics, but luckily for the physicists, it turns our that neutrinos can change their type, meaning that what we expect the Sun to output, and what we observe, are finally in agreement.

However, as is often the case in science, solving one problem merely highlights another. While we have a reasonable understanding of the Sun's general properties, we still have sketchy knowledge of the stellar dynamo, and the rotation and sound speed of the solar interior.

The problem of these interior physical processes, particularly the solar dynamo, is important since the dynamo determines the way magnetic field manifests in the solar atmosphere. By solving this problem and increasing our knowledge of the structure of the atmosphere, we will be in a position to better understand solar flares and other energy release events that contribute to the 'space weather' we experience on Earth.

Despite any progress made in solar physics, one big question remains: How well can we apply what we know of solar physics to the stars in general? This is a question that is being asked more often now by people such as Klaus Strassmeier of the Astrophysical Institute Potsdam. It has been known for some time now that approximately 26 billion of the 400 billion stars in our galaxy are 'Sun-like', but just how Sun-like is Sun-like? Our Sun is classified as a G2V, and while these stars are abundant, our own star has a particular chemical signature that is incredibly rare (only one other star is thought to be a twin candidate of the thousands observed).

When we resolve the difficulties in solar modeling and extend these findings to other stars, stellar physics will become an important tool in understanding the formation and evolution of both stars and planets.

Bring out 'The Thing' aka the SKA Demonstrator

by Ron Beresford and Brad Pethers

A strange and wondrous device is stalking the precincts of CSIRO's Telecommunications and Industrial Physics and Australia Telescope National Facility Headquarters Facility at Marsfield in Sydney. Looking suspiciously like a 21st century Dalek doing rap impersonations, it is in fact the physical manifestation of the inevitable consequence of a barely controlled meeting of scientific and engineering minds - the Square Kilometre Array Demonstrator (SKA). This device is the brainchild of research engineers from the CSIRO with design input from engineering consultants Connell Wagner who are supporting the Australian bid for the SKA and working with the CSIRO.

We are not sure if this is exactly what Mrs Luneberg's son had in mind when the first Luneberg lens was developed, but the Demonstrator is a working model of how the SKA's antenna concentrators are intended to work. It is the marriage of sixty year-old theory with modern plastics technology, and holds much promise as a potentially inexpensive antenna for SKA. The Demonstrator can perform all the electro-mechanical and control functions intended for the full size concentrators and is currently fitted with a 0.9 meter diameter Russian-made Luneberg lens.

The CSIRO concept takes full advantage of multiple feed arms for several fields of view. It is a forward path to multi-beam capability, and will enable different astronomy programs to be undertaken simultaneously. With the lightweight and potentially cheap translator robotics, a feed can be positioned to better than 500 um anywhere in the focal plane. Closed loop torque control servos can slew the feed to new positions in a matter of seconds.

CSIRO Manufacturing and Infrastructure Technology currently has a new generation 0.9 meter Luneberg lens nearing completion in Melbourne. Initial testing has shown that this new lens has performance characteristics significantly better than theoretically predicated with an exceptionally low microwave loss. On its completion in August, it will be fitted to the Demonstrator to assess RF performance and to prove the package capabilities ready for a larger scale prototype Luneberg Lens manufacture.

The CSIRO is developing new wideband 1-4 GHz feeds, matching networks and low noise amplifiers for the specific requirements of the Luneberg lens. This will also be tested on the Demonstrator. The performance of the rotating arm mechanisms and the electro-mechanical feeds, positioning and controls will be evaluated for design, mass production suitability and survivability in the final harsh environment in which the lens will be required to operate.

For more information on the Australian bid for the SKA, visit the Connell Wagner and CSIRO stands in the AstroExpo, or http://www.atnf.csiro.au/SKA/

The Demonstrator in natural habitat

The Magellanic Times

The Magellenic Times is the official paper of the IAU General Assembly 2003

The IAU General Assembly 2003 is proudly sponsored by

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Designed by
Strange Planet Design
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Office: Promenade Room 4
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Deadline for daily issues
1pm on the day prior to publication

Text files for publication may be emailed to john@strangeplanet.com.au

Printed by
Marrickville Print & Design
Ph: 1300 888 490

From (Almost!) the Antipodes: A Letter and a Book for Mount Stromlo

by Jean-Claude Pecker

During ceremonies held on Tuesday morning, Penny Sackett was presented with a letter and an historic book. The letter was from Professor Etienne-Emile Baulieu, a biologist, now President of the Academie des Sciences. He, together with many other scholars worldwide, have expressed great concern and sorrow about the dramatic fire on Mount Stromlo. This has brought to the fore the strong feelings of solidarity which unify the astronomers of all countries, as astronomy is perhaps the most international of the sciences. It also expresses the hope that, as for the mythical Phoenix, Mount Stromlo will emerge from its ashes more beautiful, more active, and more fruitful than ever.

The book is from Professor Pecker's private library. It is a first edition (1880) of the famous Astronomie Populaire by Camille Flammarion. This represents a symbolic contribution to the library's reconstruction. It is a very personal expression of sympathy for Stromlo, but also of an everlasting love for Australia. This feeling dates back to 1930, when Pecker's father and mother attended an X-ray meeting in Sydney. They were the subject of several articles in the newspapers at the time. Pecker's remembrance of that event is vivid: he received a beautiful boomerang, which, the first (and only!) time it was used, broke two windows. Since then, Pecker has come several times to Australia. He remembers with great feeling his many friends: R. Pawsey, R. Giovanelli, R. Hanbury Brown, B. Bok, W Christiansen, J. Bolton, P. Wild, to list only those who are no longer with us. Pecker's love for Australia increased when, in 2003, he discovered Sydney, a city he did not know.

Professor Sackett said she was pleased and particularly honored to accept on behalf of all Stromlo staff the words of sympathy and support from the Academie des Sciences and the rare 'Astronomic Popularie' from Professor Pecker. The former will be framed and the latter will become one of the first volumes to grace the shelves of a new library on the mountain.

Professor Penny Sackett, Director of Mount Stromlo Observatory, receives a letter and a book from the hands of Professor Jean-Claude Pecker, former General Secretary of the IAU.

Side Effects of a Giant Telescope

by S. Ananthakrishnan and Rajaram Nityananda

The Giant Meterwave Radio Telescope (GMRT), located at Khodad in western India, is a major facility for radio astronomy at wavelengths from 0.2 to 2 metres, and has been operating from 1999. This short piece is not on the science or the opportunities for use, (for all this, you should visit http://www.gmrt.ncra.tifr.res.in) but on some of the interesting sidelights of the decade long period of construction. Some of them must have parallels in the history of other observatories, but others are peculiar to the country and the region.

The acquiring of land, nearly a square kilometer in size, was a major exercise involving interaction with officials and political figures at all levels from the nation's capital to the village. (We are not competing with the Square Kilometer Array, the SKA, since less than one per cent of our square kilometer is filled with the telescopes collecting area.) But the fortunes of politicians fluctuate. When invitations had to be sent out for the formal inauguration by the Prime Minister to all those who had helped, at least one of them could not have come. He was in jail! As it turned out at the last minute, the Prime Minister could not come either, but we learnt a lot about who tastes his food before he eats it, how the police check the credentials of all those who are to come (including astronomers), etc. One interesting thing is that the hosts were the last to know, both when the visit was scheduled and when it was cancelled. The machinery that took care of the formidable logistics was a day or more ahead of us!

When you do things on a large scale, like sixteen one hectare patches for distant antennas, and land records are not always clear, and everyone has the same surname, interesting things can happen. One of the antennas happens to be on the plot adjacent to where it should have been, leaving two irate farmers, the one whose land was formally acquired, and the one whose land is occupied by a forty five meter diameter antenna. The matter is under serious discussion, while the antenna continues to observe.

The best view of the equipment at the prime focus and the antenna surface is from the cherry picker, which hoists you some thirty meters up. This seemed to be the best way to impress our overall Director from the Tata Institute of Fundamental Research, in Mumbai, who usually does solid state physics from a lab bench. It worked. But he must have gone away thinking that radio astronomers are weak when it comes to knowledge about the birds and the bees. Clearly, these creatures have been around for a hundred million years, give or take a few, and efforts by the human upstarts who have been around for just fifty thousand are rarely successful. Bee removal, like painting, is a continual contract job. Some of the birds built nests at the prime focus with galvanised iron wire of which some was unavoidably left over littering the site after the telescopes were put up.

Going back billions of years, the land on which the telescope stands was a lava flow, the so called Deccan plateau, which geologists assure us is the most massive in the Earth's history - it covers hundreds of thousands of square kilometers, most of peninsular India. The low, layered hills are a major feature of the landscape, and a small shrine often adorns many of these peaks. A few have forts, which reminds us that this region bred the founder of the Mahratta empire, Shivaji, and the fighters who followed him in the seventeenth and eighteenth centuries. He was born in a fort at Shivneri, only a few kilometers from one of the western arm antennas. If one had to pick a site associated with a regional or even national hero, the GMRT could have hardly done better. With the added condition that a champagne factory should be within ten kilometers, the site is surely unique.

Back to the future. Govind Swarup and his colleagues planned the GMRT in the mid-eighties, to look at redshifted neutral hydrogen, pulsars, and the low frequency sky in general. It has started doing all that. It could be a good place to warm up and whet your appetite while waiting, or better still working, for the SKA. At wavelengths a meter and longer, we can promise you a lively ionosphere, especially in autumn and spring, and enough radio frequency interference to try your ingenuity, though not enough to wipe out your observations. These are of course two of the many challenges faced by the SKA.

Tasmania Not Part of Australia

Geologists at the University of Eastern Sydney are presenting new research proving that Tasmania is not a natural part of Australia.

'The evidence is in the rocks, and I don't mean Circular Quay,' says Dr. Sheila Mundayne. 'And that evidence reveals the unpleasant fact that Tasmania is actually part of New Zealand. It's really the third major island.'

Representatives from Wellington are reportedly pleased by the report, but are trying not to gloat. 'We're perfectly prepared to give the Tasmanians four months – or even six – to move back to the mainland,' a spokesman said. 'After that, of course, we move in the sheep.'

Does Dark Matter Exist?

by Jerry Sellwood

Newtonian mechanics indicates that galaxies and galaxy clusters are much more massive than we would have guessed from their luminosities – a fact that is generally interpreted as evidence for dark matter halos.

An alternative hypothesis to account for this fact without invoking dark matter is that accelerations in very weak gravitational fields are larger than predicted by Newton's laws. Even though there is no satisfactory theory associated with this rival hypothesis at this point, we can ask whether there are any observational tests that could rule it out or prefer it over the dark matter hypothesis.

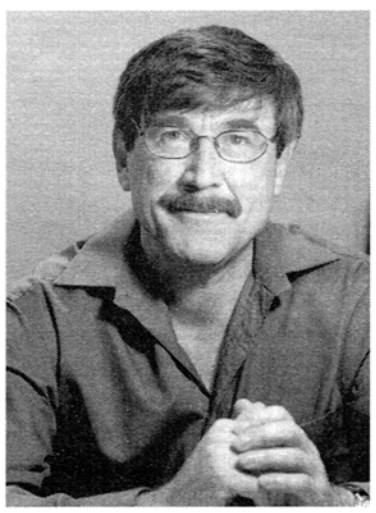
The laboratory experiments to attempt to detect dark matter particles directly have not yet reached interesting sensitivity limits, so I have tried to think of astronomical observations that might favor one or other interpretation and have come up with essentially two: the acoustic oscillations in the cosmic microwave background, and whether the light in galaxies is a good tracer of the mass. Whether light traces mass is a many faceted question, ranging from the issue of whether the rotation curve of a galaxy can be predicted from its luminosity profile (it can), to whether the dark matter halos have a different shape, or are misaligned with the light, or have substructure not associated with luminous features.

Current evidence suggests that neither hypothesis enjoys a decisive advantage over the other. If dark matter turns out to be the correct interpretation however, then theories of galaxy formation face some quite severe fine-tuning problems.

Jerry Sellwood, after fine tuning

Beyond the Black Hole: Entropy and Cosmological Horizons

by Paul Davies



Paul Davies, well within the event horizon

When Stephen Hawking proved that black holes are not totally black, but glow with heat radiation, he firmed up a claim by Jacob Bekenstein that the area of a black hole represents a new type of entropy. This enabled the second law of thermodynamics – perhaps the most basic law of nature – to be generalized to scenarios where black holes trade energy and entropy with their environments.

The association of entropy and black hole area can be traced back to the concept of information. Black holes are bounded by 'event horizons'– surfaces beyond which no event can be witnessed from the outside however long an observer waits for light to emerge. Information hidden by a black hole translates into entropy as far as the outside universe is concerned. When heat is swallowed up by black hole, the entropy of the outside universe goes down, but the black hole gets bigger, so its own entropy rises by at least enough to compensate, and to save the generalized second law.

Black holes are not the only objects to possess event horizons, however. They also occur in cosmological models where the universe expands at an accelerating rate, as recent observations suggest is the case in our Universe. The simplest example arises for a Universe in which the Hubble constant is truly constant, and the cosmological scale factor grows exponentially. This is known as de Sitter space, and it possess a constant-area event horizon situated at the Hubble distance from the observer. Can the generalized second law of thermodynamics be extended to that case too? Theoretical studies by Don Page, Larry Ford and this author confirmed this expectation for small perturbations to the de Sitter universe involving heat flowing across the de Sitter horizon.

More complicated situations arise when the universe starts out with a big bang, undergoes an intermediate phase of evolution, and asymptotes to de Sitter space at late time. Again, this pattern of behaviour seems very much in accord with the predictions about our own universe. In such a model, the event horizon area changes with time. Can a situation ever arise in which the horizon area goes down, or heat is lost across the horizon without a concomitant rise in horizon area? Some years ago I proved that so long as the so-called dominant energy condition was satisfied – roughly, that the pressure or energy density of the cosmological material is never very large and negative – then the horizon area would never go down, even in these more complicated time-dependant cosmological models.

That was a start. I wanted to know, however, whether a bit of black hole horizon is always 'worth'the same – entropically speaking – as a bit of cosmological horizon area. I conceived of a way to test this. Imagine a big bang universe with a cosmological constant (or 'dark energy,' to use the currently fashionable jargon) which is devoid of matter save for a gas of small black holes spread uniformly. As the universe expands, so some of the black holes retreat across the cosmological horizon and are lost to view. Thus, within the volume of space bounded by the cosmological horizon, the total area of black hole horizon entropy declines. But there is a trade-off: the loss of mass to this region of the universe represented by the outflux of black holes reduces the overall gravitational pull of the black hole gas, which results in an altered rate of cosmological expansion. This in turn should increase the area of the cosmological horizon. But would the latter change in event horizon area always offset the former?

To find out, I persuaded Tamara Davis of the University of New South Wales to help me. She had already developed some handy computer simulations of expanding universes, and we soon found that these could be readily adapted to my problem. With the assistance of her UNSW colleague Charley Lineweaver, Tamara confirmed that the second law of thermodynamics could indeed be generalized to this unusual model universe. Apart from some peculiar special cases that we attribute to a breakdown in the uniformity assumption for the black hole gas, the total horizon entropy never decreases, even though the universe may depart substantially from de Sitter space.

The significance of these studies is that the second law of thermodynamics is normally discussed in conditions at, or close to, thermodynamic equilibrium. This is the case for an isolated black hole or for pure de Sitter space. In these examples it is possible, using quantum field theory, to define a temperature for the system that goes with the associated entropy. But when the universe is expanding in an arbitrary manner, there is no well-defined concept of temperature, even though a horizon may still exist. It seems from our work that, nevertheless, the association of event horizon area with entropy, and the corresponding generalized second law of thermodynamics, may still be consistently applied. Whenever there is an event horizon, static or time-dependant, it possesses an associated entropy that dovetails correctly with conventional heat entropy.

In a broader context, calculations such as ours form part of an emerging new paradigm known as the holographic principle. This seeks to revise the way events are described in three-dimensional space by specifying information on a two-dimensional bounding surface, much like in a hologram. Studies of this principle have enabled several powerful theorems to be proved about horizons, dark energy and entropy. When Hawking first established the thermodynamic credentials of black holes, many theorists saw it as the first step to a radical advance in which quantum mechanics, thermodynamics and gravitation would be linked in a grand synthesis. Such expectations have yet to be fulfilled, but results such as ours, together with studies of the holographic principle, continue to hint that deep linkages are indeed there, if only we could uncover them.

Paul Davies is a theoretical physicist in the Australian Centre for Astrobiology at Macquarie University, Sydney. His latest book is 'How to Build a Time Machine'.

New Opportunities in Long Baseline Interferometry: Observing with the VLTI

by Andrea Richichi, ESO

Catherine Cesarsky and Andrea Richichi on a short baseline

Long-baseline interferometry is often regarded as black magic rather than regular astronomical science. Bringing together the light from two distant telescopes and correcting the different optical paths to a fraction of a wavelength in spite of atmospheric turbulence, is a task with sufficient technological challenge to scare away most astronomers. However, in the morning of July 21, the IAU Working Group on Optical/IR Interferometry gathered together in Promenade Room 2 and discussed the big steps being taken to make interferometry a standard tool for every astronomer.

Chaired by P. Lawson from JPL, the meeting saw a succession of presentations which all seemed to have a common theme of cooperation and dissemination of information. A. Quirrenbach (Leiden Observatory) discussed the European Interferometry Inititiative, which includes institutes from 15 countries in a 4 year program aimed at joint research, researcher exchanges and organization of schools and workshops.

A. Richichi (European Southern Observatory) and A. Boden (Michelson Science Center) presented the specialized software tools and the lists of calibrators being assembled on the two sides of the Atlantic for the needs of the new giant interferometers Keck (Hawaii) and VLTI (Paranal). Both stressed the benefits of sharing the insider knowledge of their respective groups. Good intentions confronted reality when T. Pauls (Naval Research Laboratory) illustrated the new Data Exchange Format, which will permit the complicated data structures produced by interferometry to be exchanged across the world.

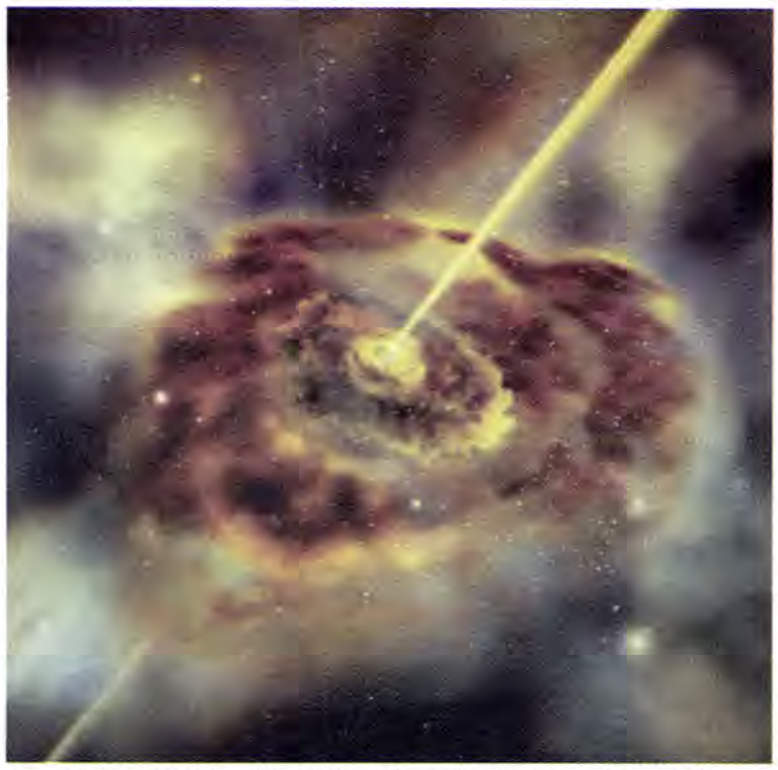
Already today, half a dozen different facilities are equipped to exchange their data in this fashion, a breakthrough simply inconceivable just a few years ago. This will permit researchers to analyze the data taken with one interferometer at another, using different software and thereby opening new possibilities to double-check results and foster new collaborations.

This session of the Working Group was perfectly timed to match two important events which took place in recent weeks:

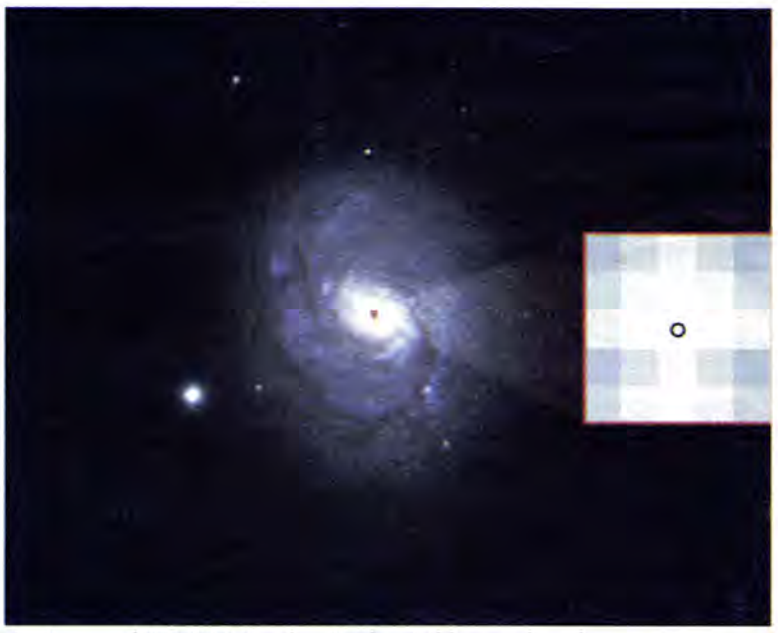
- The Keck group is celebrating the first scientific paper based on data obtained with their interferometer, a study of the young star DG Tau (Akeson et al. 2003).
- The VLTI managed to obtain for the first time interferometric fringes in the thermal infrared on an extragalactic object, the nucleus of the AGN galaxy NGC 1068, using the recently commissioned MIDI instrument (ESO PR 17/03).

The future of ground-based interferometry looks promising, with a number of large facilities being inaugurated or expanded: in addition to the Keck and the VLTI, these include the NPOI, CHARA, IOTA, and Australian-based SUSI interferometers to mention just some. In this group, the VLTI is noted for its commitment to make interferometry a tool for every astronomer. Since its first fringes in early 2001 with the VINCI instrument (a 2-way K-band beam combiner led by the Observatory of Paris), the VLTI has observed almost uninterruptedly with either small siderostats or with the large 8.2 m VLT telescopes. All on-sky commissioning data (almost 10,000 observations!) are being made public at regular intervals, and are being used by several groups, resulting in a number of papers already published even before the first observations with the regular facility instruments (see URL). These latter are MIDI (a 2-way 10-micron beam combiner led by Max-Planck-Institute for Astronomy), and AMBER (a 3-way near-IR beam combiner led by the University of Nice). MIDI is about to be offered for regular observing proposals, while AMBER will see its first light next year. These instruments will work like any other VLT instrument, with data being processed by automatic pipelines, quality-checked, and delivered to the observers in a standard format. Proposers will use the standard ESO forms, and both visiting and service observations will be possible. Interferometry will finally feel like any other astronomical technique.

The future of high-angular resolution holds the promise of many new discoveries, and the meeting of July 21 was a clear indication that these goods are in store not just for the black-belts of interferometry, but for any interested astronomer. Keep tuned!



An artist's impression of an active galaxy that has jets. The central engine is thought to be a supermassive black hole surrounded by an accretion disc and enshrouded in a dusty doughnut-shaped torus. The torus of dust and gas can be seen orbiting a flatter disc of swirling gas. In the centre, the supermassive black hole is surrounded by a flat accretion disc of rapidly orbiting material. The jets are emitted at right angles from the plane of the disc. Courtesy Aurore Simonnet, Sonoma State University.



An image of NGC 1068 taken in the visible wavelength range (courtesy NOAO/AURA/NSF). The image has 820x680 pixels. A blow-up of the central 5x5 pixels is displayed inside the figure on the right. The circle on the central pixel indicates the size of the structure that was observed with MIDI

An Elliptical Liquid Core for the Moon

by Alexander Gusev

Alexander Gusev, liquid to the core.

The nearness of the moon to the Earth allows the use of a wide variety of scientific methods for its investigation. Traditional astrophysical data (albedo, spectral and magnetic analyses) are combined with results obtained by geophysical (seismic ranging) and geochemical methods, with laser ranging data and spacecraft experiments (Apollo 1969, Galileo 1989-1991, Clementine 1994, Lunar Prospector 1998) etc.

Global topographic and gravitational field models derived from data collected by the last two missions reveal a new picture of the shape and internal structures of the moon.

These data give evidence of a liquid lunar core. The investigation of the two-layer Moon can have application to explanations of some observed phenomena, such as the great dissipation of the lunar body obtained from lunar laser ranging (LLR), the existence of free lunar libration in the presence of great dissipation, and, at last, the great gravitational signatures at the thick continental areas of the far side.The presence of a layered lunar structure, discovered from seismic studies, indicates melting and differentiation in the past.

An improved gravity field from the Lunar Prospector gives a value for the moment-of-inertia factor equal to 0.3931+/- 0.0002, and it was found that the radius of an Fe core is 320 +50/-100 km and its mass is 1.4 +0.8/-0.9 % of the Moon's mass. The corresponding radius and mass of an FeS core are 510 +80/-180 km and 3.5 +1.9/-2.6 %, respectively. From additional LLR data and and an improved gravity field from Lunar Prospector we have for a liquid iron core an estimated core radius of 352 km. For a Fe-Fes eutectic composition, the radius would be 374 km (Williams 2001.)

The study of the lunar physical libration and in particular the free core nutation of the moon (Petrova, Gusev 2001) gives one more observational opportunity to clarify the question of lunar core characteristics. There is an enticing prospect in this regard presented by the RISE and ILOM projects of the SELENE I, B, and II missions (Japan, 2005). These data will allow us to improve the physical libration theory of the moon, and together with theoretical and observational libration data will enhance futher study of the lunar interior and, as a consequence, the moon's origin and evolution.

Comet 67P/Churyumov-Gerasimenko to be Targeted

by Klim Churyumov

Rosetta, a European space vehicle 15 years in development, will head for the short period comet 67P/Churyumov-Gerasimenko in March, 2004.

In September, 1969 I went to the Alma-Ata Astrophysical Institute with fellow astronomer Svetlana Gerasimenko to conduct a survey of short period and new comets. Later that month, I examined an exposure of comet P/Comas Sol made by Svetlana Gerasimenko on September 11.92 UT, and found a cometary object near the edge of the plate which I assumed was the expected periodic comet. Later investigations at Kiev University revealed that this comet's position was 1.8° from the predicted calculations.

The comet had an apparent magnitude of 13, the diameter of its coma was 6 arcmin, and the diameter of its central condensation was about 0.3 arcmin across. There was a faint tail about 1 arcmin in length at position angle 280 degrees. Additional position observations conducted by astronomer Nikolay Belyaev from Saint-Petersbourg showed that the comet followed an elliptical orbit. In 1982, it came closest to the Earth at 0.3910 AU.

The Rosetta Space Mission will obtain valuable information about the chemical composition and the physical and geometrical properties of the comet, data that will help to solve the fundamental scientific problem of the origin and evolution history of our solar system.

A Pinch of SALT?

by David Buckley

FOR SALE
10 years of telescope time on a 10m telescope in the Southern Hemisphere. Last remaining share of US $2.7M must be sold! Offers considered.

First seven segments of the SALT primary mirror

The Southern African Large Telescope (SALT) is well on track for completion in ~1.5 years. When it is finished it will be the largest single optical telescope in the southern hemisphere. The 'green light'-for the SALT project was given by the South African government in late 1999, after sufficient matching funds had been committed by the SALT partners, which now number 11 institutions in 6 countries. At a cost of ~US $32M, including the first generation instruments and operations costs for the first 10 years, SALT represents a cost effective means for access to 10 m class astronomy. Currently the project is ~90% funded, with the remaining ~US $2.7M required primarily for the High Resolution Spectrograph and also to cover some cost escalation in the telescope subsystems.

SALT is based on the pioneering Hobby Eberly Telescope (HET), which represented a new paradigm in telescope design. However, significant problems were encountered with HET, primarily associated with the control of the 91 mirror segments, for which the SALT designers have been fully cognizant. As a result, with SALT following several years behind HET, it has managed to avoid these pitfalls, and at the same time improve on the design in various areas. The major improvement is the redesigned prime focus aberration corrector, which will deliver an 8 arcmin diameter field of view: four times the area coverage of HET. In addition, the image quality, vignetting and efficiency are all greatly improved. From the outset SALT has incorporated active optics control, utilizing ~480 capacitive edge sensors and 273 precision actuators. Once the 91 individual 1 m hexagonal spherically figured segments are aligned, using a Shack-Hartmann wavefront sensor at the center of curvature, a closed loop control system (at 0.05-0.1 Hz) will maintain the alignment for many days at a time.

Daytime air conditioning and nighttime natural ventilation, using controllable louvers, plus the use of a false floor with fan-forced ventilation, will ensure dome seeing is kept to a minimum. Likewise, an aggressive policy of removing all sources of heat inside the telescope chamber has been employed, with all heat generating equipment, electronics racks, etc, being housed in sealed insulated cabinets ('igloos') with plumbed-in glycol to remove heat.

Although the SALT design limits some types of observations that can be undertaken, it is still well suited to many science programs for 10 m class telescopes, particularly spectroscopic surveys. SALT will access over 70% of the southern sky, from declination +10° to -75°, and will be able to observe suitably placed targets from 1 to 3 hours at time (twice a night for optimal positions), depending on their declination. SALT will be operated entirely as a queue-scheduled telescope by SALT operations staff, avoiding the expense of sending observers to the facility. This modus operandi is well suited to synoptic or monitoring observations and survey follow-up science. SALT's pre-eminent role will be as a spectroscopic telescope, operating initially in the optical regime (320-900 nm), but with capability to the near IR (to at least the H-band).

In addition, SALT is designed to target some niche areas, with the three first generation instruments (being built by some of the SALT partners) capable of the following types of observations:

* Low and medium resolution VPH grating spectroscopy (R < 6,500 with 1 arcsec slits) down to the atmospheric UV cutoff at ~320 nm.

- Multiple Object Spectroscopy (~100 objects in 8 arcmin diameter field of view) with laser cut slit masks.
- Polarimetry and spectropolarimetry (linear, circular and 'all-Stokes').
- Fiber-fed high resolution (R ~17,000 to 80,000) single-object spectroscopy over 370-850 nm in one exposure.
- Nod and shuffle spectroscopy and all-Stokes spectropolarimetry.
- Fabry-Perot imaging spectroscopy (up to R ~13,000).
- High-speed spectroscopy and photometry (~10Hz observations with minimal deadtime).

The UV capability is possible through the use of new high efficiency multi-layer reflective coatings and optical materials with good UV throughput, namely fused silica, CaF_2 and NaCl (yes, salt, but encapsulated in sealed triplets!) Custom made frame transfer 2k x 4k CCDs from E2V are used in mosaics in the two prime focus (f/4.2) instruments which will enable high time resolution observations.

SALT has recently achieved two significant milestones: the 'first light'of the imaging camera CCDs (on another telescope) and the installation and control of the first seven segments. Later this month the first batch of edge sensors will be installed and it is expected that full active control of these segments will follow shortly thereafter. Over the next few months the prime focus tracker will be installed, which will lead to the commencement of the first on-sky engineering tests by the end of this year. Commissioning will take place during 2004, which will see installation of the remaining subsystems, the delivery of the prime focus instruments and the final batch of mirror segments by the end of the year. Science verification observations will then begin late in the year or early in 2005. The final first-generation instrument, HRS, will be commissioned in 2006.

The SALT Foundation would be pleased to consider any approaches to join the consortium at this time, particularly if the potential partner could solve the current funding shortfall. Please contact David Buckley at dibnob@saao.ac.za.

Star Formation Explained

by Michael Ireland

One of the greatest mysteries being unravelled by new high-resolution techniques is that of star formation. Frank Shu, President of the National Tsinghua University in Taiwan, began the IAU Symposium 221 with an overview of the theoretical difficulties of forming stars in the manner we observe them. He explained that star formation is so efficient because 'gravity never gives up,' but to some extent, 'magnetic fields are anti-gravity.' In fact, to zeroth order, magnetic tension prevents star formation from happening at all, and it is only a complex interplay of Magneto-HydroDynamical (MHD) effects that allow star formation to happen.

Frank Shu

He outlined four main problems in star formation today:

1) The mass problem: Why does a 10^4 solar mass molecular cloud fragment into many pieces of roughly solar mass, and how is the observed initial mass function produced?
2) Magnetic flux: The collapse of a protoplanetary core results in fields of mega-gauss strength at the stellar surface, unless there is a mechanism to lose magnetic flux.
3) Angular momentum: Even the smallest amount of rotation in a protoplanetary core can prevent it from collapsing, so there needs to be a mechanism for losing this angular momentum.
4) Binaries: Why do some stars form alone, while others form binaries or even triples at a wide range of separations?

This theoretical introduction began four days of new and exciting observations accompanied by in depth models of all stages of star formation. The first stage, the collapse of molecular clouds to form protostellar cores 10,000 AU across, will be mainly covered by millimeter observations. Half of the mass of this core collapses inwards to form the star's progenitor, in the form of a protoplanetary disk roughly 100 AU across. These can be seen in finer detail then ever before using the latest adaptive optics and optical interferometers. One third of this central mass is 'blown off' in the X-wind and jets which are seen again using high resolution techniques at multiple wavelengths. Finally, a young star is formed, completing the process of stellar birth.

The densest nearby star-forming region in Orion, seen at visible wavelengths (left) and near infra-red wavelengths (right), from Ohio State University.

A protoplanetary disk as seen by the Hubble Space Telescope

The Making of Australian Astronomers

by Ragbir Bhathal

Ragbir Bhathal pays tribute to the high priests.

Australia is a world leader in astronomy. This eminent position has been gained through the work of a few brilliant astronomers who have scaled the heights of international astronomy. Their scientific achievements were published in my book Australian Astronomers which was placed on the best seller list when it was first published in 1996.

The contributions of this remarkable group of Australian astronomers have been recognized by their peers. They are either Fellows of the Royal Society of London and/or the national science academies in the USA and Australia. Two of them (Ron Ekers and Richard Manchester of the Australian Telescope National Facility) have just been awarded the Australian Government's prestigious Federation Fellowships each worth $250,000.

Who are these astronomers and how did they become prominent was the subject of a recent study that I carried out as part of a national project on elite scientists in Australia. Eighteen of Australia's top astronomers [Bart Bok, Ronald Giovanelli, Chris Christiansen, Ben Gascoigne, Paul Wild, John Bolton, Hanbury Brown, Richard Manchester, Russell Cannon, Ron Ekers, Jeremy Mould, Harry Minnett, Bernard Mills, Ronald Brown, Donald Mathewson, Ken Freeman, Donald Melrose and Robert Frater] were interviewed a few years ago to find out what elements entered into making them eminent. Were there special qualities of personality, home background or upbringing that mark a person for this calling or did they become astronomers by chance or by force of circumstances? Did they muck around with telescopes or things of a scientific nature and did they show an interest in astronomy when they were young, etc.

The results of the study were surprising but it also confirmed some of the findings of a study carried out by Harriet Zuckerman on the American scientific elite. Some aspects of this study are highlighted below.

The majority came from middle class or professional homes where money, although not in plentiful supply, was sufficient for a comfortable life and for providing access to a good education. Slightly less than half went to private schools. According to Ken Freeman, a Fellow of the Royal Society of London, "My family was relatively well to do, there was money to send my sister and me to private schools, with some sacrifice." As young boys they mucked around with scientific and technical gadgets. Most of them had a happy childhood, unlike creative intellectuals in the humanities and in the world of art.

Except for Freeman, Giovanelli, Bok and Christiansen who came from continental European backgrounds, the rest came from Anglo-Celtic protestant backgrounds. Only a couple came from Catholic backgrounds. Unlike the American scientific elite there were no astronomers from Jewish backgrounds. This is partly because most prominent Jewish scientists from Europe settled in the United States; very few ventured to Australia. Most of the astronomers came from families that were not religious in the formal institutional sense. This meant that there was enough freedom for the expression of diverse views in the home which seems to be a prerequisite for a growing scientific mind. A couple of the astronomers see religion as having had an adverse impact on science. Don Matthewson, a former director of the Mount Stromlo and Siding Spring Observatories said, "I think religion has set back science enormously. So it has been a bad impact. I think the dogmatic teachings and the [fact] that they burnt a few astronomers at the stake... shows that the church is restrictive on free thinking."

It is rather surprising to note that most of the astronomers did not show any interest in astronomy in their secondary schools years. Their decision to become professional astronomers was usually not made until they were in their third or fourth year at university. They became astronomers by chance, force of circumstances or were influenced to take up astronomy by attending a summer science school and in a couple of cases, after having completed a PhD in a different area of physics. "Pawsey gave me the choice of either continuing with the computer or doing astronomy. At the time Bolton had made his first discovery of point radio sources, and this really intrigued me. So, as far as I was concerned, there was no choice, I went into astronomy, although I was by no means an astronomer," said Bernard Mills, the inventor of the innovative Mills Cross.

Just as in the study of the American scientific elite, the importance of mentors was extremely important for their progression up the ladder of international recognition. According to Freeman, "contact with Sandage - was very good for my career... Sandage became a mentor and a patron and has helped my career greatly."

All the eighteen astronomers established linkages not only amongst themselves but also with the international world of astronomers. They are a small select group of elite astronomers in Australia with international links. They also belong to the international 'invisible college' of elite scientists. They are the gatekeepers and high priests of Australian astronomy. *MT8-08*

Perth Completes New Opera House

City Fathers of Perth recently snipped the ribbon on a new opera house, thus initiating a major redevelopment project on the Swan River.

'It was all pretty grotty around here, what with the brewery remains and the horse knackery,' noted Alderman Malcolm Mullet when speaking of the erstwhile shoreline. 'But this opera house will give the blokes some alternative to the clubs at Scarborough Beach.' In an economy move, the Perth City Council borrowed an existing opera house design.

'Now all we have to do is find some mob who can sing,' Mullet added.

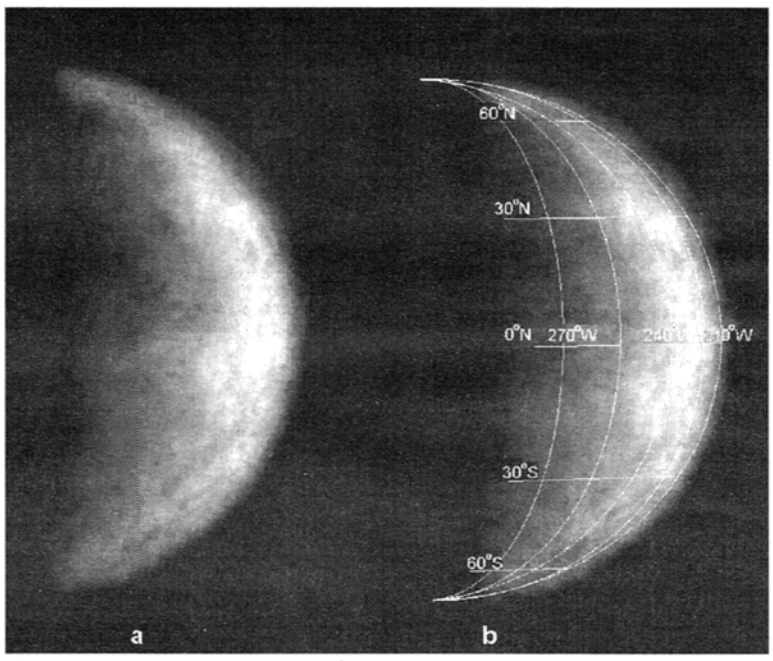
The new Perth Opera House

Giant Basin Found in Unknown Part of Mercury

by L. Ksanfomality

A new method for the synthesis of images of Mercury was presented at the JD 2 meeting, during which we unveiled an image of part of the planet in the longitude range 250 - 285W, an area that remained unknown after imaging by the Mariner 10 spacecraft in 1973-75.

This image was obtained by processing a large number of electronic photographs obtained in April – May, 2002 during the evening elongation of the planet, using the 1.3 m RC-telescope of the Skinakas Astrophysical Observatory (Crete, Greece). On the image a number of unknown formations are seen. The double rim basin with interior dimensions of about 1,000 km and an external rim about 2,000 km in size are revealed on Mercury's side. This is one of the largest basins known for terrestrial planets. Other large formations of global extent are present on the same side of this world, which allows us to speak about the same sort of global asymmetry on Mercury as is known on the Moon.



Giant Basin on a not-so-giant planet. MT8-13

Aboriginal Tales of the Southern Cross

by Wim van Driel

There are two aboriginal stories regarding the Southern Cross, the Pointers (Alpha and Beta Centauri) and the Milky Way I picked up while traveling through the outback before reaching Sydney, while I watched my billy boiling under the old Coolabah tree. It is clear we Europeans are only told part of these intriguing stories, being uninitiated in the local lore.

In the time when men were still immortal, a great drought struck the land and people were starving. Some started eating animals, but one man refused to do so, and told everybody else to leave him alone as he wanted to die. As he went to lie under a large gum tree, a dark spirit with burning eyes emerged from the Earth, put the dying man inside the tree and launched them all into space. The Southern Cross are two pairs of burning eyes, one from the first man to die, the other from the sprit. The pointers are two cockatoos that lived in the gum tree, and which now are forever flapping over the firmament trying to reach their nest.

The second story is more incendiary. Two spirit beings had just discovered fire and were running over the Earth, cavorting and throwing their fire sticks. Suddenly they stopped as they heard wailing and crying behind them. Unaware of what fire can do, they had set the land on fire and people were dying because of it. Ashamed, they threw their fire sticks high up in the sky, where now they shine as the Pointers. The fires never went out and the Milky Way is their eternal smoke still wafting over the heavens – a sign used by aboriginal parents to point out the danger of fire to their children. MT8 17

New Space Experiment Images Solar Mass Ejections Out to Earth's Orbit

A space experiment to study solar activity from Earth orbit, the Solar Mass Ejection Imager (SMEI), launched in January 2003 from Vandenberg AFB on the Air Force Space Test Program's CORIOLIS spacecraft, has made the first-ever images of an Earth-directed ('halo') coronal mass ejection out to the Earth's orbit.

Built as a proof-of-concept experiment to detect, track and forecast the arrival at Earth of solar coronal mass ejections (CMEs), SMEI has 'seen' dozens of CMEs since launch. The most important source of space weather at Earth, CMEs are vast clouds of plasma (ionized gas) and magnetic fields that periodically erupt from the Sun. CMEs trigger geomagnetic storms that can adversely affect spacecraft and communications, increase radiation doses for astronauts and high-flying aircraft, and damage ground-based electrical power systems. If CMEs were more fully understood and accurately forecast, steps could be taken to mitigate their effects.

SMEI orbits 840 km above the Earth along the day-night terminator. It uses three carefully baffled CCD cameras that reject unwanted light. To image CMEs from 90 solar radii to beyond Earth orbit, SMEI must see objects as dim as 1% of the starlight and zodiacal background. The cameras point away from Earth and 'sweep out' nearly the entire sky during each orbit.

In late May, SMEI observed a halo CME event that caused a geomagnetic storm at Earth. This erupted from the Sun following two very bright (X-class) flares from an active region (NOAA 365) near the Sun center on May 27-28. The two ejections likely merged together as a single halo seen moving outward through the 7 deg. field of view of the SoHO/LASCO C3 coronagraph.

The halo appeared as a broad, bright, outward-moving ring with the Sun located at its center. From SMEI, the halo was visible as an arc over ~150 deg. of sky. The CME reached 1 AU (Earth orbit) and passed over the Earth late on May 29 and early on May 30. Examination of the data suggests that SMEI observed the CME pass over the Earth and onward. The halo trailed two interplanetary (IP) shocks that hit the ACE spacecraft at L1 (1 million miles in front of Earth) on May 29 at 11:55 and 18:30 UT, implying speeds of 1,160 and 992 km/s, respectively. A strong geomagnetic storm commenced on May 29, ~12:00, and lasted until May 30, 03:00. From the LASCO data the speed of the CME near the Sun was ~1,170 km/s, consistent with the speed measured by SMEI of ~1,000 km/s and with the IP shock speeds.

David Webb will discuss the SMEI experiment and these observations in his presentation during the S219 symposium at 15:30 on Wednesday, July 23.

The SMEI instrument was designed and built by a team of scientists and engineers from the Air Force Research Laboratory, the University of California at San Diego, the University of Birmingham (UK), Boston College and Boston University. It has been supported by the Air Force, the University of Birmingham, UK, and NASA.

Meeting Announcement

When: August 25 - September 5, 2003
Where: Kazan University, Russia

In honor of the bicentennial celebration of Kazan State University, the Organizing Committees of the Joint International Scientific Conference (JISC) will hold a conference on "New Geometry of Nature: Mathematics, Mechanics,Geophysics, Astronomy & Biology", August 25 - September 5, 2003, at Kazan University, Russia.

This conference is open to all interested scientists, and will feature a broad consideration of such areas as: geometrical, analytical, qualitative, bifurcation and structural analysis of Nature on micro, meso, and macro scales; dynamical systems, resonant structures and natural rhythms; fundamental physics from ground and space, grand unification theory, discrete models, quantum optics, physical cosmology, pulsar astronomy, micro-arcsecond astronomy, extra-solar planet systems; physics, dynamics and chemistry of the Earth, moon, planets, comets, small bodies, meteorites; geological budget of planetary rotation, plume and plate tectonics, the generation of magnetic fields and surface magnetic anomalies; marine biology, microbiology, decoding of the genome, genetic and molecular fundaments of adaptive reaction in living systems, effects of microgravitation; modern ground observation, space missions and future prospects.

Contact: JISC "GEON-KAZAN-2003",
25 Aug. - 5 Sept., 2003, Kazan, Russia
http://www.ksu.ru/GeoN-Kazan-2003,
e-mail: GeoN2003@ksu.ru

IAU Symposium 221,
Star Formation at High Angular Resolution

Tuesday July 22nd through Friday July 25th, Tumbalong Auditorium **by Michael Burton**

Everyone always leaves the best till last, and so it is with the IAU GA! Tuesday July 22nd will see the kick-off of the last of the six Symposia, numbered 221 'Star Formation at High Angular Resolution.'

Star formation is at the heart of the evolution of the Universe. Yet the phenomena of star formation itself is poorly understood even within our own Galaxy. This Symposium concentrates on understanding galactic star formation.

S221 has six principal scientific themes relating to studies of star formation:

- Molecular clouds to protostellar cores, where star formation is initiated.
- Low mass star formation, in particular the investigation of the formation of multiple systems and clusters.
- Massive star formation, and the hidden world of hot molecular cores.
- Extragalactic star formation, and the superstar clusters that are now being resolved.
- Jets, outflows and disks, and how their structure is now being uncovered, and
- Planets, how they might influence the formation of the central star and what signatures they may leave in the disk.

To accompany these themes there are also talks which describe particular high spatial resolution techniques at different wavebands, with emphasis on the new insights this can provide for star formation. The full program is on the S221 website, www.phys.unsw.edu.au/iau221.

Science in the Pub II: What is a Planet?

Harlequin Inn, Pyrmont, Wednesday July 23rd, 7:00 – 9:00 pm.

by Michael Burton

The second Wednesday of the GA also sees the second Science in the Pub event. Science in the Pub is a discussion on issues on science with practicing scientists, moderated slightly by a compere, in an environment that forces it to be accessible to the public – the local pub!

Science in the Pub began in 1998 as a series of three events for National Science Week in the Harlequin Inn, and quickly blossomed until it became a monthly event through much of 1999-2000. We are returning to our origins, but with a slightly different slant tonight, for the discussion is aimed at a professional audience, rather than just the public. However the topic is one that many will have an opinion on, whether they call themselves an astronomer or not, 'What is a Planet?' So we hope tonight's discussion will be able to engage a wide audience at a number of different levels.

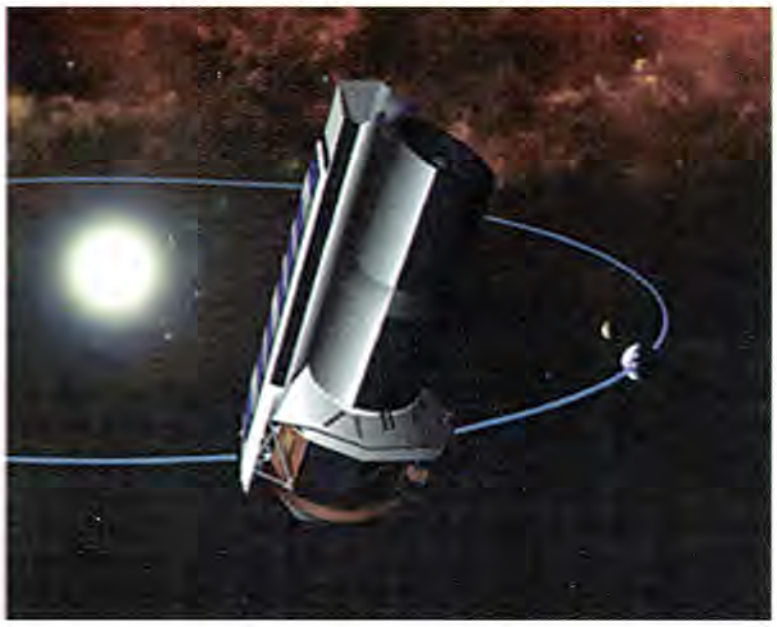
Our panel tonight is going to try and help us clear the waters and make sense of what we all once thought we knew. Penny Sackett, director of Mount Stromlo Observatory, is one of Australia's leading planet hunters, instigating new programs to hunt out and understand exo-planets, including the use of gravitational lensing. Chris Tinney, of the Anglo Australian Observatory, has been an active participant in that observatory's planet search program using the Doppler reflex motion, and well as being an expert on Brown Dwarfs (when planets stop being planets). Pat Roche of the University of Oxford caused quite a stir a few years ago when he proposed there may be 'free-floating' planets in Orion. And our fourth panel member, Gibor Basri from the University of California at Berkeley, has proposed his own definition for what a planet is, and which contains a few surprises! Compere tonight is Fred Watson, star of last weeks Science in the Pub. Fred can sit happily in the scientists chair or the comperes chair, and is sure to rein in our panel if they start getting too technical!

Science in the Pub will start at 7:00 pm, but be sure to be there promptly if you want a seat, for there's room for only 150 in the upstairs bar of the Harlequin Inn! Meals are also served in the Thai restaurant which forms a part of the pub. The Harlequin Inn is five minutes walk from the Convention Centre, past the end of Pyrmont Bridge at the west side of Darling Harbour.

SIRTF Set to Go

by Michael Bicay and Vikki Meadows

The Space InfraRed Telescope Facility (SIRTF), the fourth and final element in NASA's Great Observatories program, is (once again!) poised for launch, with lift-off currently scheduled for the early morning hours of August 23, 2003. The 0.85-meter diameter telescope, with three cryogenically-cooled science instruments, offers wavelength coverage from 3 to 180 microns. SIRTF's innovative engineering design and thermally benign heliocentric orbit will allow it to achieve a cryogenic lifetime of five years. SIRTF will offer capabilities that can be exploited for a vast array of scientific research topics, extending from the solar system to the distant Universe.



SIRTF was within ten days of launching in April, before NASA postponed the launch to replace two of the nine solid rocket motors affixed to the Delta-II launch vehicle. Because of the impending launches of the Mars Exploration Rovers, the SIRTF Observatory was removed from the launch pad at Cape Canaveral, Florida and returned to a clean room at the Kennedy Space Center for four months. With both Mars missions now on their way to the Red Planet, erection of the SIRTF launch vehicle has begun and should be completed by the end of July, for the August launch. After launch, there will be three months of In-Orbit Checkout and Science Verification (IOC/SV), and initial results will be released by NASA one month after IOC/SV.

The Cycle-1 Call for Proposals (CP) was issued by the SIRTF Science Center (SSC) in November, 2002. An update to the CP, incorporating the on-orbit performance of the Observatory, will be available in mid-December (assuming a late August launch). The electronically submitted proposals are due about February 14, 2004; the exact deadline will be specified in the CP Update.

For the 11 month Cycle-1, the GO program offers 3,700 hours of SIRTF observing time to investigators worldwide, starting in June, 2004. The CP and accompanying technical documents and software, including the SIRTF Observer's Manual and the SIRTF Planning Observations Tool (SPOT), are available online in the Proposal Kit section of the SSC Web site (http://sirtf.caltech.edu/SSC/). Proposers will use SPOT to plan the science investigations, specify their detailed observing programs, and submit their GO proposal.

A limited supply of free CDs, containing SIRTF mission and instrumentation overviews and the SPOT software, are available at the IAU IPAC/Caltech booth (Booth G06, near the entrance to Hall 5). The SSC also maintains an electronic HelpDesk (sirtf@ipac.caltech.edu <mailto:sirtf@ipac.caltech.edu>) designed to provide rapid and accurate replies to queries, and a community e-mail list for SIRTF news and updates (To join this list, send an email to majordomo@ipac.caltech.edu <mailto:majordomo@ipac.caltech.edu> with subscribe sirtf-astro, and your email address, in the first line of the body of the e-mail).

The SSC will also host Observation Planning Workshops, with a 'hands-on' SPOT demonstration, on the days preceding the upcoming AAS/Division of Planetary Sciences meeting in Monterey, California (on Sept 1st) and the winter AAS meeting in Atlanta, Georgia (January 4). Registration for the AAS/DPS workshop is currently open at http://sirtf.caltech.edu/SSC/ost/ workshops/2003c/

Comets: Interstellar and Nebular Memories

by S.B. Charnley, P.C. Ehrenfreund, and D.H. Wooden

The composition of comets provides important clues to the processes that occurred during the formation of our solar system. The study of presolar matter in comets allows us to reconstruct conditions within star-forming disks, such as radiation, temperature, density and turbulence.

During the early evolution of comets, amorphous ice formed at low pressure and temperature. Gases may have been trapped in those amorphous ice phases. The physical properties of ice, the main component of comets, depends on the structural parameters of the material, such as porosity, grain size, material strength and local density. Organic molecules may act as glue within ice dust mixtures that enhances material strength and also the thermal conductivity. The so-called CHON particles are composed of a blend of carbon-bearing and silicon-bearing materials. During the lifetime of comets, the inner parts were more strongly affected during the early evolution of the parent bodies and the outer parts more by recent activity.

A team based at NASA's Ames Research Center (Diane Wooden and Steven Charnley) and at Leiden Observatory (Pascale Ehrenfreund) is investigating the fundamental question of the formation of small bodies in the solar system from nebular and interstellar material. Wooden is observing and analyzing crystalline silicates in comets and young stars, using radiative transfer models. Charnley is modelling the complex chemistry of interstellar clouds and cometary comae. Ehrenfreund performs laboratory simulations of ices and carbon compounds observed in interstellar space as well as in the analysis of meteoritic materials. Together they try to solve the puzzle of the formation of cometary materials.

The comparison of abundances of interstellar ices to cometary volatiles shows a general link with the interstellar solid phase, but does not provide accurate constraints for a direct heritage. Laboratory studies indicate that many prebiotic molecules would be too fragile to survive interstellar radiation, and it is likely that these molecules form on meteoritic parent bodies. The infrared signature of silicates in comets and stellar regions suggests that stardust silicates are amorphized by ion bombardment in the interstellar medium, and a fraction of these glassy grains are annealed back into crystals in the solar nebula, prior to their incorporation into cometary grains. The combined picture shows that comets are a mixture of interstellar and nebular components and the degree of mixing may be individual for each comet.

Pascal Ehrenfreund, Steve Charnley and Diane Wooden

Future work that would enhance our knowledge of the interstellar/solar system connection will include astronomical observations using new and sensitive instrumentation. Such observations will focus on the isotopic ratios in comets, the detection of more cometary organics as well as solar-type star-forming regions and their corresponding disks. Theoretical models investigating the processes affecting the infalling molecular cloud material and radial mixing in the disk are vital for determining the conditions in the early solar nebula. Laboratory simulations and theoretical models aimed at studying the sublimation characteristics and stratified nature of comets will strongly contribute to our understanding of cometary properties. The analysis of extra-terrestrial matter (in particular carbonaceous chondrites) remains a crucial method for studying refractory matter, including silicates and organics.

The ultimate goal to understand cometary physics and chemistry and their relation to the parent interstellar cloud will be achieved with future space missions that perform in situ-experiments and possibly bring a cometary sample back to Earth.

The Magellanic Times

THE NEWSPAPER OF THE INTERNATIONAL ASTRONOMICAL UNION GENERAL ASSEMBLY SYDNEY 2003

IAUXXV General Assembly Sydney 13-26 July 2003

Day 9 **Thursday 24 July**

Puzzling Wind Properties of Very Young Massive Stars

by Fabrice Martins and Daniel Schaerer

N81 in the Small Magellanic cloud

The beautiful nebula N81, a very compact young star forming region in the SMC, is thought to represent an intermediate stage between ultra-compact and normal HII regions. With the HST it has been possible to resolve its stellar content, revealing through STIS spectroscopy very puzzling properties of the massive newborn stars in this region. Indeed, UV spectra of these stars were already found at first inspection to be very unusual, showing nearly no wind features in contrast to all known early-type O stars, including Galactic and Magellanic Cloud stars.

A detailed spectral analysis (using sophisticated non-LTE line blanketed atmosphere and wind modes) has now allowed us to determine quantitatively the main parameters of these stars. Most strikingly we find very low mass loss rates of the order of 10^{-9} solar mass per year, typically 100 times less than normal O stars of the same luminosity! This can also be illustrated by noting that the so called modified wind momentum is proportional to the mass loss rate and the wind velocity. This result is puzzling for a variety of reasons. First this behavior is in stark contradiction with the most recent predictions of the radiation-driven wind theory even accounting for a metallicity dependence. In addition we also have preliminary results showing that some Galactic O stars also show such exceptionally weak stellar winds. This seems to rule out explanations based on metallicity. Generally the radiation-driven wind theory describes quite successfully the properties of hot star winds, but it has not been tested before for stars of young age. Although an exact physical explanation for such weak winds remains to be found, we strongly suggest that this phenomenon is related to the very youth of these massive stars. In fact our observations may reveal the onset of mass loss in massive stars shortly (less than ~ 1-2 million years) after their birth - a 'turn-on' phase of stellar winds before they reach the properties of full blown 'adult' O stars. If this is general to the first mass loss period of massive stars this would imply that during their formation – a process that still largely remains unclear – the direct mechanical feedback from massive protostars on their surrounding parental cloud should be of minor importance. In the near future additional young candidate O stars will be scrutinized with ground based optical to near-IR telescopes, FUSE, and hopefully the new HST observations. It is the hope that such studies of compact HII regions and their stellar content will shed new light on the formation of massive stars. More details on this research and topics related to massive star forming regions are found on: http://obswww.unige. ch/sfr

Formation of Massive Stars via Accretion

by Robert Lipka

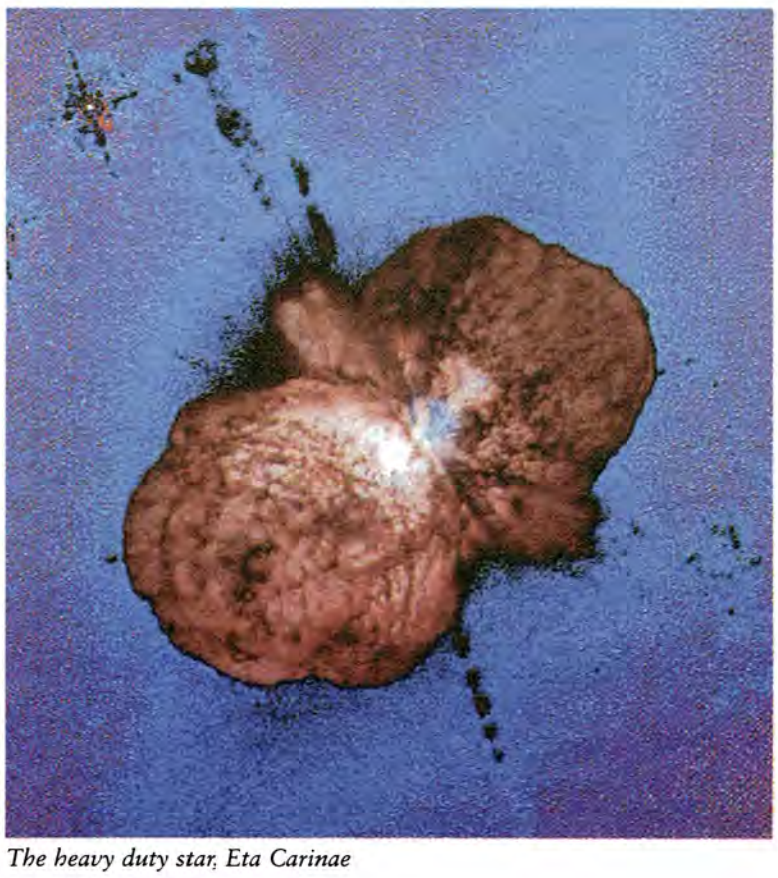
The formation of massive stars is 'near and dear' to Harold Yorke, at least their formation via accretion is. These objects influence the formation of other stars and drive galaxy evolution. They are the factories where heavy elements are formed, a source of UV, a source of turbulence in the ISM, stellar winds, supernovae, and more. People in the field agree that OB stars are nasty violent troublemakers, a source of much disturbance in galaxies.

To understand massive star formation you cannot simply scale up what happens with low mass stars. The shorter time scales in the massive stars' case make different processes dominant. Neither can you scale down what happens in accretion around supermassive black holes. The question boils down to how does a gravitationally unstable giant clump of material turn into a massive star? The clump has a size on the order of 0.1 pc. The product is a star with a mass tens of times greater than the Sun, and a radius around ten times larger.

The process can start with material accreting on Jupiter-sized objects. Of course the angular momentum has to be lost before the mass can be added onto the forming star. Hydrogen burning starts when the core is sufficiently compressed, and the material has to infall against the additional radiation pressure as well. The mass accretion rate must exceed losses from all processes, and it must happen quickly enough to build up a massive star – after about 10 Myr the game is over! The star lives a fast and furious life. Gravity is the dominant force in this, and it competes against angular momentum and radiation pressure.

The accretion is highly variable and episodic, perhaps with large blobs of material falling onto the star. The accretion rate is such that a massive star of a few tens of times the mass of the Sun could form in around 10 Kyr. However, the star takes around 100 Kyr to grow to its full mass, in bursts of accretion punctuated by quiet periods. It is possible to form a 100 solar mass star with an accretion rate on the order of a thousandth solar mass per year, and do it in a process with less than the Super-Eddington accretion (when radiation pressure from the potential energy of the infalling material matches gravity), and hydrogen burning-dominated luminosity.

Before it blows away the surrounding material, the resulting star is not entirely visible. It appears brightest from the direction of the poles of the surrounding disk where there is least obstruction from the enveloping dust and gas, and where extra flux is redirected by scattering in the disk. In the end the star will shed its outer layers and end up as a helium core remnant.



The heavy duty star, Eta Carinae

The Magellanic Times

The Magellenic Times is the official paper of the IAU General Assembly 2003

The IAU General Assembly 2003 is proudly sponsored by

CSIRO

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Strange Planet Design
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Printed by
Marrickville Print & Design
Ph: 1300 888 490

Without the 'T' he would be Odd: An Australian Story

by Le Tran

Charles Todd was fond of puns. One of his favorite sayings when accepting an offer of tea would be, 'Oh yes, without T, I would be odd.' But perhaps odd is an understatement. This astronomer, constructor, and pioneer helped put Australia on the map in the fields of telegraphic communications and astronomy.

Coincidently the son of a tea merchant, Charles Todd was born on July 7, 1826 in Islington, London. He worked at the Royal Observatory at Greenwich for seven years until he landed the job of Assistant Astronomer at Cambridge University Observatory in 1848. Here he first met twelve year old Alice Bell, who promised to marry him.

In 1855, Todd accepted his appointment as Observer and Superintendent of Telegraphs in South Australia. Todd and his wife Alice made their voyage to South Australia not knowing that they would both become monumental names in Australian history.

Todd was responsible for setting up and supervising a network of meteorological stations, and the design and construction of a number of major telegraph lines. His best and most famous line was the Overland Telegraph, which ran through the center of Australia. The line was completed in August, 1872 and Todd was given an award for this accomplishment.

As an astronomer he rendered important services to science by observing the transit of Venus in 1874 and 1882. Todd observed the 1874 transit in Adelaide. The cloudy morning prevented Todd from seeing the start of the transit, but he was able to record his observations of the egress. The Black drop, however, caused inevitable problems.

In 1882 Todd observed the transit of Venus at Wentworth. On this occasion Australia did not have such a good view of the transit, and only the end could be seen. Philip Edwards from the Institute of Space and Astronautical Science comments that in comparison to the recordings of other observers around the world, Todd's results of the 1874 and 1882 transits were very accurate.

Todd's other observatory work included the transit observations of stars for astrometry, observations of Jupiter and comets.

Todd retired in 1906 at the age of seventy eight. Despite the passing of legislation that made it compulsory for public servants in South Australia to retire at seventy, the Government withdrew the Bill for as long as Todd wished to remain in office.

Todd's work on the overland telegraph in central Australia made such an impact that Alice Springs – a city in the heartland of Australia, is named after Todd's wife. The Todd River, Mount Todd, and Todd Mall, are all named after him. There is also a marble column that was erected in 1954 on the Stuart Highway in memory of Todd's achievements.

Charles Todd

Giving Future Astronomers a Chance

by Catherine Drake

Those of us who are graduate students in wealthier countries complain occasionally about lack of equipment or access to first-rate facilities. But have you ever thought how difficult it must be for students in less wealthy countries without the computers and teachers we take for granted?

An important part of the role of IAU Commission 46 is to promote the development of astronomy in developing countries. The Commission is successful in getting young people in these countries interested in astronomy, but needs to offer 'more substantial and continuous support,' according to Professor Armando Arallano Ferro of the Institute of Astronomy of the National Institute of Mexico. The current programs being run by the IAU are successful in the short term, Ferro believes, but a new strategy is needed to create self-sustaining professional astronomy communities in developing countries.

Currently, Commission 46 of the IAU promotes astronomy with such activites as courses on basic astronomy for students and high school teachers, as well as training workshops on observational and data reduction techniques. The loan and donation of astronomical books and equipment are also a vital part of fostering the study of astronomy in less wealthy countries. However, Ferro has argued that a more effective strategy is to identify good students in poorer countries, then assist them to become professional astronomers. Assisting one student per year in a region will allow the growth of a professional astronomy community over several years. This is more effective, Ferro claims, than trying to promote astronomy by teaching high school teachers and students. Keen students often lose interest due to lack of access to ongoing teaching or higher education. 'We are hooking them in but losing them back in the water,' he said.

The scheme would involve financial assistance from the IAU for one year to allow a student to travel to another country to begin a masters or PhD. Ferro has found from experience in Central America that, once students have begun their studies and shown promise, local groups and authorities are often willing to provide follow-on support. It is in providing support for the first year that the IAU could form a bridge necessary to allow students to begin their studies. Especially important is the agreement of local universities to provide jobs for the graduates when they return home. The outlay per year is relatively small. Ferro notes that a grant of only $2,000 is enough for a student to live in Mexico for a year.

One difficulty faced by this proposal is that students may be reluctant to return to their home country once they have graduated. Larger salaries and better access to facilities and instruments are strong reasons for them to remain in more developed countries. The only solution may be a contract between the student and the IAU stipulating that the student will return to his home country after completing their studies. Prof. Arallano Ferro himself studied under a Mexican scholarship which obliged him to work in Mexico when he graduated. Despite the difficulties it faces, we hope the new strategy he has suggested will be adopted by Commission 46 to assist our less well-off colleagues to join the world astronomical community, rather than being lost to astronomy altogether.

Subterranean Attraction

While many Conference delegates are familiar with the Sydney Bridge Climb, which offers the opportunity to shell out cash for what 1930s steel workers actually got paid to do, most GA attendees are unaware of a superior experience on a comparable traffic artery: the Harbour Tunnel Spelunking Adventure.

Imagine the thrill as you go down the tubes together with thousands of tons of hurtling sheet metal. You'll revel in the sight of actual trucks, up close, and enjoy spectacular views of blank walls while inhaling satisfying whiffs of combustion by-products. During peak hour, you can indulge in chats with frustrated Sydney-siders as they stew in their own fumes.

Tours leave from the tunnel's northern toll plaza on the hour, and start at $3.00, depending on your axle weight. Please remember to leave explosive substances at home. If traffic is particularly viscous, you can earn pocket money by bringing a squeegie.

Solar X-ray Spectrometer (SOXS) onboard GSAT-2 Indian Spacecraft Tested Successfully

by Rjmal Jain

The Solar X-ray Spectrometer (SOXS) mission onboard the GSAT-2 Indian spacecraft, launched by a GSLV-D2 rocket on May 8, 2003, has been tested successfully. The SOXS mission aims to study the energetic and dynamics of solar flares. It measures the full disk integrated X-ray emission in the energy range of 4 keV to 10 MeV. The SOXS is the first space-borne solar astronomy experiment of India. This mission is a team effort of many institutions in India, including the Physical Research Laboratory (PRL), Ahmedabad; the Tata Institute of Fundamental Research (TIFR), Mumbai ISRO Satellite Centre, Bangalore, and many other institutes of Indian Space Research Organization (ISRO).

The GSAT-2 spacecraft is deployed in a geostationary orbit that will enable SOXS to observe almost 10 hrs continuously.

The SOXS is composed of two independent payloads, namely the SOXS Low Energy Detector (SLD), and SOXS High Energy Detector (SHD) payload. The SLD is designed and developed by Physical Research Laboratory and ISRO Satellite Centre, while SHD is developed by TIFR. The SLD payload employs, for the first time, Si PIN (4-25 keV) and CZT (4-60 keV) solid-state detectors for a solar X-ray astronomy experiment. These detectors have superb sub-keV energy resolution and millisecond temporal resolution capabilities. Such high resolution enables the SLD payload to measure break energy point more precisely in the energy range 10 - 60 keV, to study the contribution of micro flares in heating the active corona, and FeXXVI X-ray emission line sensitivity to explore the connection between chromosphere and corona.

The SLD payload observed a series of small flares on June 8, 2003 and the first results were presented in JD17 of the IAU on 22 July. The SOXS is now commissioned for regular observations.

We plan to organize coordinated observations, ground-based and space-borne, with other missions to obtain multispecral observations. PRL plans to establish a Data Analysis Centre for the SOXS mission from which multispecral data taken simultaneously with SOXS observations may be obtained. All interested scientists, teachers and students may participate in the SOXS research program. For more details, please contact the author at rajmal@prl.ernet.in or Hemant Dave at hemant@prl.ernet.in.

Guess Who?

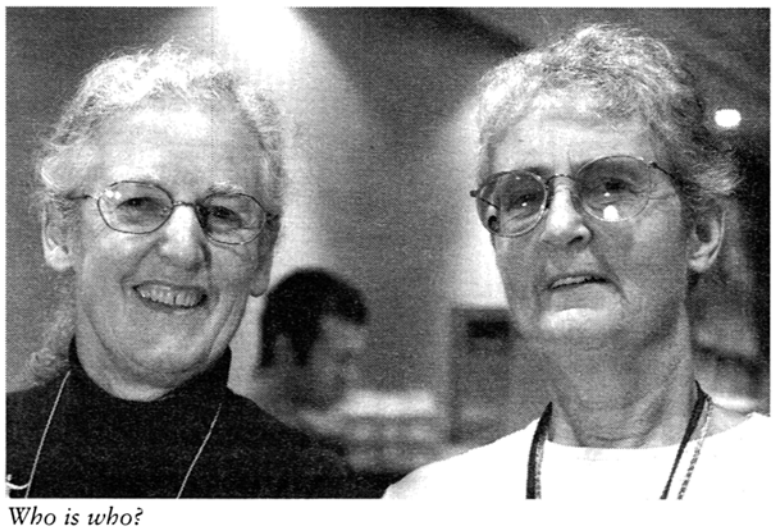
Can you tell these 2 astronomers apart? Who are they? And more importantly, which is which?

They have been mistaken for each other several times during the General Assembly. At a distance, even their spouses get confused!

Clues to their identities:

1. They both do radio astronomy but they didn't start out that way
2. Both are Americans from the mid-west and recently retired
3. They have both worked in Australia: one at Mt Stromlo, the other at ATNF
4. One studies objects in our Galaxy; the other studies AGNs
5. In the early 1970s both carried babies on their backs at the IAU General Assembly and Symposia but one has 2 girls, and the other has 2 boys (and no – they didn't both have 4 children).
6. One likes long distance bicycle trips; the other is an avid ice dancer
7. Currently, one is the chair of the IAU WG Designations; the other is a scientific editor of the ApJ.

Who are they? If you think you know, tell Seth Shostak or another Magellanic Times staff member. The first person with the correct answer will win an all-expense-paid vacation to Paramatta.



Who is who?

NOTICE FROM THE NATIONAL ORGANISING COMMITTEE TO ALL PARTICIPANTS

Please do not forget to return your questionnaire to the registration desk before you leave the conference.

Astronomical What?

by Le Tran

Supernovae. Decrypting. Thermonuclear. Supercomputing. Intergalactic. No, it's not Bulgarian – it's 'Science Speak'. And you thought Astronomical was a big word.

For those of us whose scientific expertise extends as far as knowing that what goes up must come down, sitting through a seminar in a room full of professional scientists where technical terms are being thrown around like hot spuds can feel a bit like being an alien in another universe.

This problem has occurred to professionals in the science world who are becoming increasingly aware of the need to communicate their ideas to a public that does not have a science background.

This effort has earned the moniker Public Outreach – which is a good start! The aim is to communicate and educate the broader community by using accessible language, and presenting concepts in a way that is engaging and understandable. Such programs reflect the importance of maintaining public support by explaining how the tax payer's money is being used.

Max-Planck Gesellschaft (MPA) is at the forefront of developing Public Outreach. Its most innovative project - the Cosmic Cinema, is a multimedia, bilingual presentation of current research topics that feature 3D-movie sequences. The movies are available on CD ROM or on the internet. Cosmic Cinema is a permanent exposition in the astronomy exhibition of the "Deutsche Museum" in Munich, which is one of the biggest museums for technology and science in the world.

MPA member Simon White explains that 'Cosmic Cinema is effective because it combines observational, instrumental and personal elements which appeal to the general public. It stimulates interest and involvement through the use of visualisation, non-technical narration, and music'.

The CD-ROMs have been popular with primary and secondary schools, universities, citizen groups, rotary clubs, and funding committees.

White believes that Public Outreach is particularly important in astronomy because the field involves concepts that are more accessible than other areas of scientific study. 'Astronomy is very visual. It has an abundance of great pictures of planets and galaxies. Seeing a comet passing through space can create an immediate understanding, which is probably more effective than trying to explain it.'

Public Outreach is also important in helping to establish the cultural importance of science. 'The public should know that science is not only used for the production of technology. It has a greater significance. It encourages scientific thinking that is both constructive and critical. This can have a wide application that extends beyond science to include areas of socio-political issues,' adds White.

Bull Sharks in Darling Harbour

GA Attendees should be aware that ravenous bull sharks, whose respect for the sanctity of human life is less than ideal, occasionally make aggressive leaps towards people takingleisurely strolls along the foreshore. Should this happen to you, it's recommended that you not flinch, which merely upsets the sharks, but simply regard these finned fiends assertively. If bitten, bite back.

Sydney-siders have turned this fishy inconvenience into an annual event, the running of the bull sharks, held in the early spring. Although there are inevitable casualties associated with this event (termed 'wastage'), the general glee attendant upon the running is considered more than adequate compensation.

Visitors are advised to keep small pets and children away from the water's edge. Minder dingos for children can be hired at hourly rates near to the IMAX theater.

A&A Rediscovered

by Guenther Eichhorn

Due to circumstances that were only partially under control of Springer Verlag, the A&A issues for the years 1997 - 2000 were temporarily unavailable on the new Springer web site. Once Springer realized this problem, they workled hard and fast on a solution.

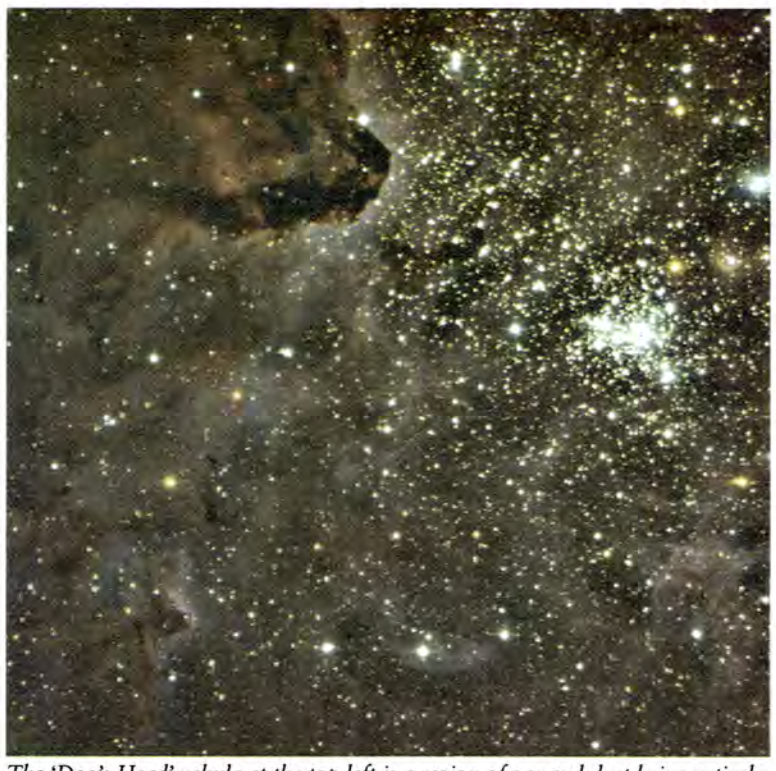
During the week before the IAU General Assembly they set up a web server that contained these issues of A&A. Access to this web server is free without access control. The ADS immediately changed the links to this new website. The ADS links have been working again since before the IAU GA began, and all the missing issues have been available since then with links from the ADS. The ADS is working with Springer and the Board of A&A to make sure that a permanent solution that satisfies everybody will be found. In the meantime these articles will be available freely from the new Springer web site with links from the ADS.

The Biggest Little Observatory in the World

Innovation Enabling Science at the AAO

by Chris Tinney

8' x 8' image of the Galactic Centre captured as a single image with the IRIS2 imager and spectrograph on the AAT. Seeing is 0.5'. The density distribution of the star cluster at the Galactic Center can be clearly seen, along with 'fingers' of extinction leading away from the Center. ***Photo: Cotera, Leistra, and Tinney.***



The 'Dog's Head' nebula at the top left is a region of gas and dust being actively photo-dissociated by the OB association. Isolated dark globules can be seen scattered across the field, as well as what looks like a 'bow shock' nebula in the OB association. Seeing is 0.9'. ***Photo: Jeffries and Tinney.***

The Anglo-Australian Observatory has always prided itself on the excellence of the science it enables Australian and UK astronomers to undertake. So it has been interesting to see that scientific excellence reflected back at us, through the mirror of the presentations at this General Assembly (or at least, based on this astronomer's sampling of the scientific program).

Our impact began with the GA's start and the impressive WMAP announcements at the 'Maps of the Cosmos' symposium - almost every one of which was tied down by a local Universe normalisation which would have been impossible without the 2 Degree Field Galaxy Redshift Survey (2dFGRS). The 'Maps of the Cosmos' symposium then proceeded as an almost continuous advertisement for the 2dFGRS with speakers either presenting results from the 2dF Galaxy and Quasar surveys, or measuring their past programs or future plans against its volume coverage.

It has been interesting to see the number of talks at the 'Stars as Suns' symposium which have highlighted the Doppler and Zeeman-Doppler images of nearby stars made with the UCLES spectrograph on the AAT over the last 10 years. Other major results have highlighted the paucity of planets around metal-poor stars as revealed by planet searches including the Anglo-Australian Planet Search. And that was only the talks I was able to get to.

What is it that leads to a small (around 60 staff), 4 m-class Observatory to punch so far above its weight? This Director's personal view is that moderate size and, above all, an innovative, motivated and flexible staff are critical. These all enable an institutional culture of innovation and customer focus, so that maximizing science outcomes for our communities can drive everything we do, while allowing us to respond to changing challenges.

The AAO's track record of scientific and technical innovation is amazingly strong. We almost single-handedly pioneered the use of optical fibers on astronomical telescopes in the eighties with the FOCAP plug-plate multi-fiber system, followed by astronomy's first fiber robot system, AUTOFIB. In the early nineties, the AAO 'upped the ante' again, with its humungous 400-fiber 2 Degree Field (2dF) facility – enabling the 2dF Galaxy and Quasar Redshift surveys, and a host of other previously impossible scientific outcomes.

And the innovations don't stop with optical fibers – the exploitation of tunable filter technologies has been pioneered at the AAO, together with innovations in the use of charge shuffling CCDs. The same shuffling techniques enable 'nod-and-shuffle' observing for photon-counting limited spectroscopy of the very faintest objects, now being exploited on 8 – 10 m telescopes, including the Deep Deep Redshift Survey on Gemini. The same CCD systems allow the Anglo-Australian Planet Search to deliver the best long-term planet search precision from the Lick, Keck and AAT 'family' of planet searches.

But all of that is the past, what of the future? Clearly a 4 m telescope cannot compete in pure photon-collecting power with the current generation of 8 – 10 m telescopes. So the AAO has instituted an 'AAO of the Future' strategic plan to refocus Australian and UK resources in the AAO to the production of one last round of forefront instruments for the AAT (IRIS2 and AAOmega), while also moving increasing resources to the development of instruments for ESO's telescopes via our UK partners for Gemini telescopes in the UK and Australia.

Instruments for 8 – 10 m telescopes are now our next priority. The OzPoz fiber positioner constructed by the AAO has been in regular operation at the VLT since the start of this year. Our Echidna fiber-spine positioning will see operation on Subaru in just a few years. Amazingly the Instrument Science team at the AAO have developed a technique for turning the same Echidna spine-positioning technology, into a free running self-positioning fiber 'Kickbot' system, which means 10 – 30 m telescopes may never need fiber positioning robots. (Don't miss the AAO stand at the AstroEXPO for your chance to play with, and win your very own Echidna, and to play 5-cent soccer with a Kickbot.)

The UK and Australian communities have recognised the innovative instrumentation and scientific strengths of the AAO, and agreed to continue its growth well into this century. We're bullish on the future at the AAO – bring it on.

Unveiling Massive Star Formation with ATCA-mm

by Vincent Minier and Michael Burton

The Australia Telescope Compact Array (ATCA) - the radio interferometer of the Australia Telescope National Facility ñ has recently been upgraded to become the first millimeter interferometer in the Southern Hemisphere. ATCA, a telescope that traditionally operates at radio frequencies, will henceforth allow observations at wavelengths of 12 mm and 3 mm.

The full array is now operational at 12 mm and to date three of the six antennas have been equipped with the 3 mm receiver. Once fully upgraded, the ATCA millimeter interferometer (ATCA-mm) will perform in the frequency ranges 16-26 GHz and 85-110 GHz (the 12 and 3 mm bands, respectively). ATCA-mm will be particularly suitable for studying processes in which molecular line emission at 12 mm (e.g. ammonia and water vapor masers) and 3 mm (e.g. methanol and silicon monoxide) are predominant. It will also be suitable for observing continuum emission (e.g. free-free emission and dust grain thermal emission).

These new instruments in the Southern Hemisphere have already attracted interest from various astronomy groups overseas (e.g. USA, France, Sweden) as well as in Australia. To date, the ATCA-mm receivers have been used to study star formation process in the Milky Way and in the Large Magellanic Cloud, stellar astrophysics (AGB stars) and in research related to astrobiology.

The star-forming group in the School of Physics at the University of New South Wales has studied the formation of the most massive stars in the Galaxy using molecular line surveys and methanol MASER sources.

The formation of O and B stars are central to the understanding of galaxies and their behavior. Such massive stars are characterized by prodigious luminosity, rapid consumption of their supply of nuclear fuel, and a catastrophic end in a supernova explosion.

Massive stars are rare, live for short times (millions of years) and are far away (thousands light years.) This means a reliable tracer of massive star formation is needed and the use of a high angular resolution instrument.

Recently, we have demonstrated that methanol MASERs - like a LASER operating in the radio - are exclusively associated with regions of massive star formation and allow us to locate the youngest and most massive stars in the galactic plane. In some regions, methanol MASERs reveal nurseries of massive stars and the protostellar phase of these short-lived objects.

5 antennas of the ATCA by night

Observations with the newly upgraded ATCA at 3 and 12 mm have been undertaken and will be of prime importance to understanding the chemistry and the kinematics in massive star-forming regions. In the past year we

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Jodrell Bank's Instruments Undergo Major Revamp

by Philip Diamond

The University of Manchester's Jodrell Bank Observatory (JBO) runs two major instruments: the 76 m diameter Lovell Telescope, the third-largest fully-steerable radio telescope on Earth, and MERLIN, a 7-antenna radio interferometer with baseline lengths of up to 217 km and with the same angular resolution as the HST, ALMA and the new generation of optical/IR telescopes. Both instruments are being upgraded and will provide impressive new capabilities in the very near future.

First, the Lovell Telescope (LT). Constructed in 1957, the LT has been a major research instrument as both a single dish and as an element of MERLIN and the European VLBI Network. However, its surface was deteriorating and the telescope was facing an uncertain future. Three years ago funding was obtained from the British Government and the Wellcome Foundation to upgrade the dish. This 2.5 million pound (A$6.25M) program permitted the installation and painting of a new galvanized steel surface, and the installation of a new and much more accurate pointing system. The major engineering work is now complete and over the next two months each of the 340 panels that make up the 76 m diameter surface will be adjusted to make the whole surface follow the optimum parabolic shape to an accuracy of between 1 and 2 millimeters. When this final task is completed, the telescope will have its frequency range quadrupled thus allowing a wide range of new science to be carried out.

The Lovell Telescope tilts toward the cosmos.

Complementary to this work JBO is building, as part of the e-MERLIN program, a new broad-band 5 GHz receiver and a 7-beam focal plane array to work in the range 6-7 GHz in order to survey the Galaxy for excited-state OH and methanol masers. To celebrate the end of the project the LT was re-dedicated in May during a visit to the Observatory by Prince Charles.

The second major project at JBO is e-MERLIN, the upgrade of the UK's MERLIN high-resolution radio-imaging National Facility. A funding package worth about 7.5 million pounds (A$18.75) was put together in late 2001. e-MERLIN will provide a factor of 30 - 40 increase in sensitivity over the current array. This will be achieved primarily by replacing the current narrow-band microwave link system, used to transmit data from the telescopes to Jodrell Bank, with broad-band fiber-optic cables. Once installed and connected to a new broad-band correlator, each telescope in the e-MERLIN array will transmit data at 30 Gbps back to Jodrell Bank Observatory. The total data rate will be a staggering 210 Gbps; more than the combined Internet traffic of Western Europe. Work has been underway for some time, and is currently on schedule to deliver the new instrument by early 2007. The first fruits of this upgrade will see a factor of 3 improvement in the array's sensitivity at 5 GHz in early 2004 as new receivers are installed and the revamped LT is incorporated into MERLIN.

With its augmented capabilities, e-MERLIN will allow new areas of science to be opened up, particularly in the fields of extra-galactic astronomy and cosmology, star formation, stellar evolution and studies of the extreme conditions around black holes.

Where Is All the Interstellar Molecular Oxygen?

By Roy Booth and Pierre Encrenas

On February 20, 2001 a combined submillimeter astronomy and aeronomy mission, the ODIN satellite, was launched from Svobodny in eastern Russia. ODIN was conceived by Swedish astronomers and aeronomers, joined by colleagues from Canada, Finland and France to develop the mission. The satellite was built by the Swedish Space Company.

The astronomical objectives of ODIN are the study of physical and chemical properties of those molecules that cannot be detected from Earth because of atmospheric absorption. Species of special interest are water, whose ground state transition occurs at 557 GHz and molecular oxygen with important lines near 119 GHz and 487 GHz.

The aeronomers concentrate on studying the mechanisms behind the depletion of atmospheric ozone on a global scale and the mesospheric water vapor emission. They are interested in many of the same species as the astronomers, with water as an important common molecule.

The early astronomical results from ODIN have been published in a special issue of Astronomy and Astrophysics Letters for May, 2003. Like those from its predecessor, SWAS, they are surprising and challenging for interstellar chemists. NO molecular oxygen has been detected at a limit approaching 10^-8 relative to molecular hydrogen whereas most chemical modelling schemes require several orders of magnitude more! Perhaps all interstellar oxygen is in the atomic form, or alternatively it has reacted with atomic carbon making CO.

Our data suggest that interstellar water seems to be ubiquitous, although it has a strong propensity towards self-absorption. It too is somewhat less abundant than expected e.g., relative to ISO infrared measurements and it may be that cooler water exists as ice. H218O has also been detected allowing accurate abundances to be calculated.

Abundant water has also been found in several comets – both

ODIN on the lookout.

H216O and H218O have been detected and accurate water production rates have been derived. Water is the main constituent of cometary ices and its production rate is a prerequisite for the determination of the relative abundances of cometary volatiles. Since water can only detected from space, ODIN has an important role to play in cometary physics.

Delving into the Milky Way

by Nicole Scardino and Nicki Kofiotis

Amina Helmi, galactic sleuth

An avid stargazer at an early age, Amina Helmi has always been fascinated by astronomy. Originally from Argentina, Amina found that her passion in cosmology led her to The Netherlands, a country renowned for its strong tradition in the study of galaxies and our Milky Way. It is this tradition that Amina hopes to build upon with her own studies of the billions of stars that form the Milky Way.

Helmi's research interest is to understand how and when galaxies form. Often, astronomers have tried to catch galaxies forming in action in an attempt to better understand their nature. However, Amina uses what she describes as a complementary approach; instead of looking at the process in action, Amina has been deciphering it in reverse.

'Like a family tree, we are trying to reconstruct the branches in reverse, trying to identify the progenitors of our Galaxy,' Amina explains enthusiastically.

Amina's research in this area is an attempt to answer the question of how the halo of our Galaxy formed. By using the ages, metallicity, and the velocity of halo stars, she has been trying to work out how the stars came to their present situation within the Galaxy. For example, stars which have a common origin, such as an accreted satellite galaxy, should not be distributed randomly through the Galaxy, but are expected to retain some memory of their origin in their dynamics. They define coherent kinematic structures known as streams or moving groups.

The last decade has seen a large increase in the amount of data available in this area, something that has greatly facilitated this type of research. Four years ago, Amina discovered the first such streams, traceable to one small satellite that merged with the Milky Way several billions of years ago. In the next five to ten years, large surveys such as RAVE and, in particular, the European space mission GAIA, will provide us with incredibly detailed maps of our Galaxy from which it will be possible to uncover all of those substructures and streams, and thereby understand how our Galaxy came into being.

This in-depth analysis and reconstruction of the Milky Way will also provide a clearer understanding of how other galaxies form, on the premise that all galaxy formation is similar. This became apparent with the discovery of the dwarf galaxy in Sagittarius. Found nine years ago, this object, situated in close proximity to our own, reveals 'that merging is still going on in our Galaxy,' Helmi notes.

Key players Discuss US $10 Billion Investment

by Erica Belling and Judy Lai

World leaders in satellite technology gathered at the International Astronomical Union General Assembly for Industry Day, July 23, to discuss proposed investment prospects within the astronomy industry.

Over the next ten years, US $10 billion will be invested in astronomical observatories and their instruments. Astronomy is a largely untouched market and is set to boom.

Presentations at Industry Day, hosted by Connell Wagner and the CSIRO with the support of the Department of Industry, Tourism and Resources, provided key decision makers in world astronomy an insight into Australia's excellence in this field and an overview of the investment and opportunities in industry and technological developments. The presentations showcased the advantages of the synergy between industry and astronomy.

A potentially beneficial proposal discussed at the event was the $2 billion Square Kilometer Array Telescope project (SKA) which is intended to answer fundamental questions about the formation and the evolution of the universe. Connell Wagner has donated $500,000 for the development of the Australian bid for the SKA project.

If Australia was to secure this venture, it is likely there would be significant developments in antenna and communications technology, extensions in Australia's fiber optic network, improvements in community infrastructure in remote areas and the creation of thousands of jobs.

Jocelyn Bell Burnell — A Life Less Ordinary

by Caroline Andrzejewksi

Jocelyn Bell Burnell at the time of the discovery of the pulsars

Jocelyn Bell Burnell is best known for her involvement in the discovery of pulsars. Since then, she has pursued a fascinating and diverse career. While here at the IAU as a national representative, I had the privilege of talking with this remarkable woman.

In her current position as Dean of the University of Bath, Jocelyn is involved in the management and direction of the University with no time for her own scientific research. Her schedule involves 'on a good day 3 to 4 meetings, on a bad day 7 to 8.' For the previous ten years she was full-time professor at the Open University, an appointment that doubled the number of female professors of physics in the UK.

When asked if she misses the science she answers 'yes, but I find I am missing the teaching more than the research.' Jocelyn has always enjoyed communicating science to the public. 'I seem to be able to explain things to the public.' It is not a skill that is necessarily rated very highly in academia. A great number of visiting lectureships, including the Jansky Lectureship in the USA in 1995, an Australian lectureship in 1999 and a year as a visiting professor at Princeton University are testimony to her great abilities and enjoyment in 'outreach lecturing.'

Her primary scientific interest is, not surprisingly, neutron stars. More specifically, X-ray binaries and gamma-ray sources. This would be her chosen field of study, but most of her life she did not have a choice. This is mainly due to beginning her career in a generation of women who were pioneers in striving for both a family and a career. Following her peripatetic husband and working part-time while raising her son she 'landed' in many different jobs.

Jocelyn agrees that the position of women in astrophysics has improved since her time as a solo female student in a class of 50, where it was practically 'a tradition for men to stamp and whistle when a woman walked into the lecture theatre.' Concerns remain, however, as to why 'proportionally more women than men drop out or go ahead very slowly' in this profession. Her response to working in a male dominated climate was to 'grit your teeth and get on with it.' As indeed she did.

When she first discovered the strange 'scruffs' in the miles of data from the radio telescope she helped build during her PhD work, she was 'terrified at being kicked out of Cambridge' for 'literally getting the wires crossed.' After an anxious month trying to ascertain the source of these bizarre pulses, they discovered a second source and, 'eureka,' a new population of stars was found. These neutron stars were coined pulsars by the science correspondent to the Daily Telegraph in early 1968, one of the many journalists who were intrigued by the fact that Bell was a young female astronomer.

Her supervisor was awarded Nobel Prize in Physics in 1974 for this discovery. Jocelyn was pleased, as it was the first time the award was given to astronomy, and flattered that it was 'her baby' that was the pioneering research. She has discovered that one 'can do very well out of not getting the Nobel Prize,' and she has since received a whole string of prestigious awards and honorary doctorates.

Subsequently she worked in many facets of gamma ray, X-ray, infrared and millimeter astronomy considering herself very lucky

Jocelyn at the Sydney IAU MT9-04

that most fields were 'booming and hugely exciting' at the time. Her impressive 'portfolio career' extends far beyond astrophysics, including time as editor of The Observatory, chairing and serving on many research council boards, committees and panels. She has been both an inspiration and mentor to many people both in and outside her field, and will no doubt continue to do so through more visiting lectureships and other ventures.

Grote Reber - Radio Astronomy Pioneer

by Ken Kellermann

Although cosmic radio waves were first detected by Karl Janksy in 1932, it was Grote Reber, an ambitious young radio enthusiast, who built the world's first radio telescope, made the first maps of the radio sky, and laid the foundation for the tremendous growth in radio astronomy over the last half of the 20th century.

Reber had a lifelong interest in electronics. At the age of 16 he received his amateur radio license, W9GFZ, signed by then-Secretary of the Interior, Herbert Hoover. After contacting over 60 countries, he was looking for new challenges. He had read about Karl Jansky's discovery of cosmic radio emission but encountered only indifference when he tried to interest the astronomy community in cosmic radio waves. 'So,' as he later related, 'I consulted with myself and decided to build a dish.' Using $2,000 of his own funds, (about his annual salary) he built a 32 ft parabolic transit dish in a vacant lot next to his mother's house. He designed, built and tested a series of sensitive radio receivers, and in the spring of 1939, he finally succeeded in detecting Galactic radio noise.

He observed only at night to minimize the effect of automobile ignition interference, laboriously writing down every minute the readings from his detector output. In the daytime, he returned to his job in Chicago, catching a few hours sleep each evening before returning to his observations; and on weekends he analyzed his data. At first, Reber's discoveries were received with skepticism by the astronomical community, and he had great difficulty in getting his papers accepted for publication in the astronomical literature. As he later claimed, 'The astronomers of the time didn't know anything about radio or electronics, and the radio engineers didn't know anything about astronomy.'

Following his mother's death in 1945, Grote reluctantly accepted a position with the National Bureau of Standards in Washington. But he was frustrated with government bureaucracy, and disillusioned by the growing atmosphere of McCarthyism in Washington. In 1951 he moved to Hawaii where he pursued a variety of research programs in radio astronomy as well atmospheric and ionospheric physics from the top of Haleakula on the island of Maui.

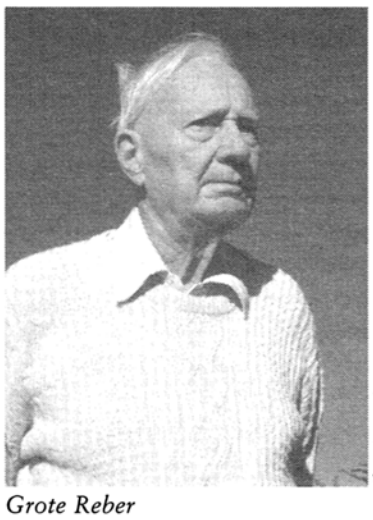


Photo: Martin George

Grote Reber

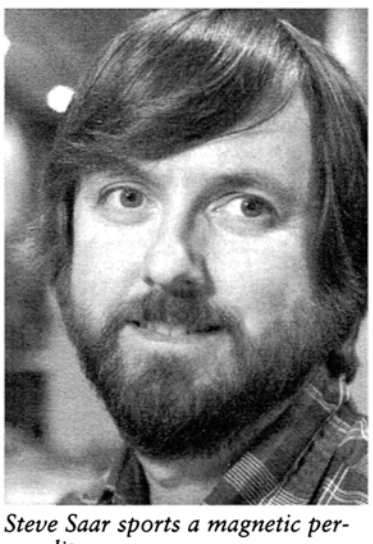
From Hawaii, he moved on to Tasmania in 1954, to exploit the relative transparency of the ionosphere associated with the south magnetic pole. While radio astronomers in the rest of the world were exploiting the newly emerging microwave technology to move to shorter and shorter wavelengths, Reber, characteristically departing from conventional 'wisdom,' built a series of very long wavelength arrays, including one which had more than a square km of collecting area.

Throughout his life, Reber maintained a strong interest in political and social issues. He argued against big science and big funding for large radio telescopes such as the VLA. He questioned the conventional interpretation of the redshift and authored a widely distributed paper on 'The Endless Boundless Universe,' in which he challenged 'big-bang' cosmologies. He was greatly concerned about the consequences of world population growth and preserving our natural resources, particularly the overuse of fossil fuels, which motivated his research on electric cars and consideration of increased use of sailing ships. He had no tolerance for scientific or other activities that did not meet his high standards. A college era friend recently described Grote as 'nervously energetic, enthusiastic, with a keen mind that went everywhere, and an ever-present, lively, sardonic, iconoclastic sense of humor, and strong opinions.'

In addition to his pioneering work in radio astronomy, Reber also pursued and published research in a variety of fields ranging from radio circuitry and ionospheric physics to studies of cosmic rays, the atmosphere, archaeology, and the growth of beans. He was a true scientist motivated only by his curiosity. Throughout most of his career, he worked as an amateur relying on his imagination and skills as an electronics engineer combined with his persistent, forceful personality and stubborn disregard for conventional opinion. He valued his independence, and was skeptical of the strings that would be attached to any institutional support. He preferred to work alone and was scornful of establishment science, with its 'self appointed pontiffs,' but he was ultimately recognized by the astronomy community with all of its major prizes.

Possible Detection of Exoplanet Magnetosphere

by Michael Ireland



Steve Saar sports a magnetic personality

In an invited review in Symposium 219, Steve Saar of the Harvard-Smithsonian Centre for Astrophysics showed some new results demonstrating the magnetic interaction of an exoplanet with its parent star. He reported on recent unpublished observations of the star HD 179949 in the calcium H and K lines by Shkolnik et al. which showed line strength enhancements with the same periodicity as the star's large exoplanet's orbit.

This particular star is the best candidate for this kind of measurement or three reasons. Firstly, this exoplanet is close (0.04 AU, or only 7 stellar radii) from its parent star, which increases the strength of the interaction. Secondly, the exoplanet is about the size of Jupiter (0.98 Jupiter masses), which means that it probably also has a metallic hydrogen core and could have a magnetic field induced by a dynamo. Thirdly, the rotation period of HD 179949 is roughly 3 times the orbital period of its planet, which means that stellar rotation effects can't be confused with the effects of the planet.

This variation must be due to magnetic fields and not tidal effects because the periodicity of tidally induced variability should be double the orbital period, while the observed periodicity is equal to the orbital period. This system could be a scaled-up version of the Jupiter-Io system (no planetary magnetic field – a unipolar inductor), or could be due to interaction of the planetary magnetosphere with the magnetic field of the star. An interesting finding is that the enhancement of the Calcium H and K lines leads the planet rather than lags. One explanation is that charged particles from the planet travel down field lines which are spiral-shaped due to the rotation of the parent star.

Exciting future measurements will occur at X-ray wavelengths, where one will be able to detect the interaction between this planet and the active corona of HD 179949. Further analysis of this phenomenon will provide information about the nature of the stellar wind close to the star and the magnetic field around a planet. Both are entirely new kinds of measurements.

continued from page 4

have used the newly upgraded ATCA at 3 and 12 mm to image hot molecular cores, to probe density and temperature conditions with methanol MASERS and to observe ammonia and deuterated ammonia in regions of star formation. Molecules such as NH3, NH2D, HCO+, CH3OH, HCN and HC3N were detected and imaged. This is the first exploration at high angular resolution of the southern molecular cores. For instance, the ATCA-mm receivers have isolated a hot molecular core in the methanol MASER source, G318.95-0.20. The hot core has a mass of more than 15 solar masses and is associated with bipolar outflows. These results suggest that methanol MASER sites harbor very young massive stellar objects, and perhaps massive protostars.

More ATCA-mm receiver results will be presented in the IAU symposium 221 and further information can be found on www.atnf.csiro.au.

Feedback

by Jim Roberts

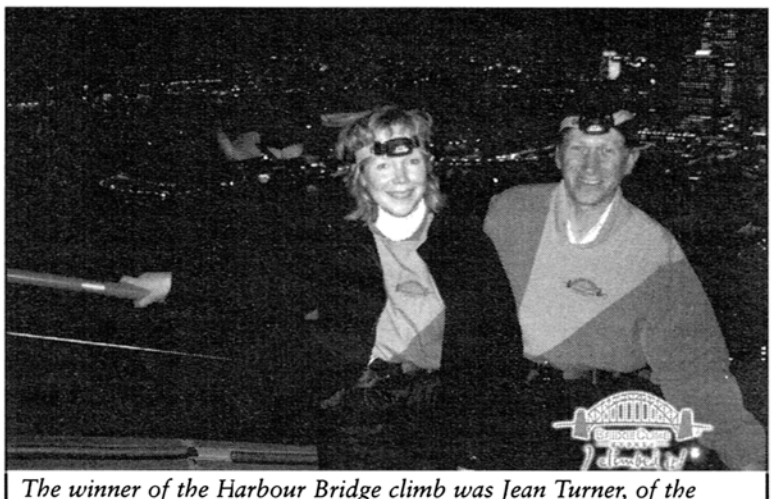
Narlikar and Jean-Claude Pecker injected some fresh air into cosmology with their article 'It Ain't Necessarily So!' in Tuesday's Magellanic Times. I loved their comment: 'These are the present day epicycles!'

It does seem an appropriate time to stand back and look at the torturous route that has brought cosmology to its present form. Probably time to think of a fresh start based more firmly on what experience has to ask about our surroundings.

There isn't just one star or one galaxy, but billions of them. Why then should we imagine that there is only one expanding bubble of galaxies? Surely experience suggests that there will be oodles of them.

If we start out assuming that our lowly expanding bubble is but one of many, then we won't require it to obey concepts that would be applicable to the totality of everything, The Universe. If we do not expect every part of a galaxy to be the same as every other part of the galaxy; neither should we expect every part of our galaxies to be the same as every other part of the growing bubble.

So, if we started off with the idea that there are lots of these expanding bubbles then we certainly would not have reached the present ridiculous state – believing that we are observing a substantial part of all that there is.



The winner of the Harbour Bridge climb was Jean Turner, of the University of California, Los Angeles. She's seen here together with Jay Lockman at the apogee of their ascent.

IRAS Data Lives On

by Joanne Abi-Younes, Debbie Ng and Nicole Scardino

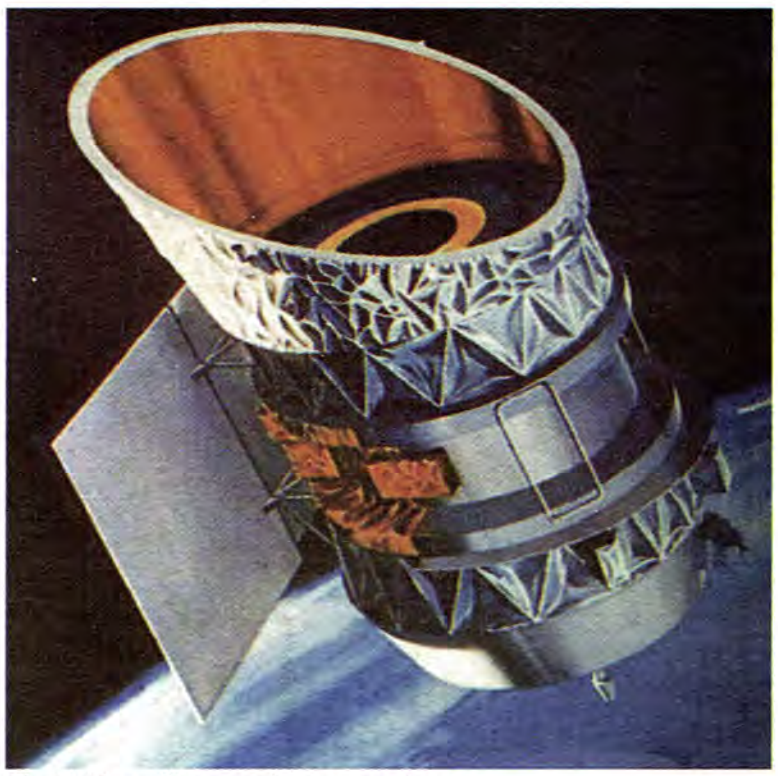
On the eve of the launch of the Space InfraRed Telescope Facility (SIRTF), the work of IRAS shouldn't be forgotten.

Launched in 1983, the Infrared Astronomical Satellite (IRAS) was a joint project by the United Kingdom, the United States and the Netherlands. The main objective of the mission was to map the sky using infrared wavelengths. Although the mission was intended to last up to 12 months, it came to an end after 10 months due to an early loss of helium.

Constantly pointed away from the Earth, the satellite was able to cover 95 per cent of the sky. The IRAS mapped 20,000 galaxies, 130,000 stars and 90,000 other space objects, and became the first satellite to discover a comet. Another famous discovery of IRAS was a new type of galaxy - the starburst galaxy.

Previous to the IRAS mission, the size of asteroids was determined by stellar occultations. The IRAS was able to establish the diameter of approximately 2000 asteroids through measurement of heat emissions of asteroids.

The mission, and consequent survey of the sky, led to the accumulation of a massive amount of data, the value of which is still in evidence 20 years after the end of the mission. These data are consulted every time a new asteroid is observed.



The IRAS satellite poses for its own picture

'As new asteroids are discovered, we can look back at data to assist us with size determination,' says Edward Tedesco, Senior Scientist at TerraSystems Inc. By doing so, scientists can ascertain whether the asteroid passed through the IRAS field of view in 1983.

Is the usefulness of data obtained from the IRAS reaching its limit?

Tedesco believes this to be so. There is a greater demand for data about asteroids smaller than 10 km in diameter, but such asteroids could not be seen by IRAS. Tedesco believes that the upcoming launch of the Space InfraRed Telescope Facility (SIRTF) will address this demand for data because of the new telescope's increased sensitivity compared to IRAS. Hopefully, according to Tedesco, the SIRTF will provide greater information about smaller asteroids, including asteroids formed through collisions.

The Macquarie/AAO/Strasbourg H-alpha (MASH) Planetary Nebulae Project

by Quentin Parker

The recently completed AAO/UKST H-alpha survey is unique in leading directly to the discovery by our team of unprecedented numbers of Galactic planetary nebulae (PNe), the detached ionized envelopes of evolved stars. This is due to the survey's unparalleled combination of depth, spatial resolution, areal coverage and uniformity. The PNe found are typically more evolved, obscured and of lower surface brightness than in most other surveys, and the international MASH consortium of about a dozen astronomers (in Australia, France, UK, USA and Canada) has been set up to scientifically exploit this rich new vein of PNe. When completed MASH will double the number of Galactic PNe accrued from all sources over the last 75 years.

MASH has the significant advantage that all discoveries originate from the same observational data, yielding the largest, least-biased and most homogeneous catalog of PNe ever compiled. MASH will impact significantly on almost every aspect of PNe research via sheer statistical weight and the sampling of new phase space. For the first time we can address serious deficiencies in the PNe luminosity function at both extremes, and probe under-represented evolutionary stages of PNe and their central stars. The MASH sample will facilitate research into the evolution of PNe, the chemical enrichment of the ISM, the PNe-ISM interaction, Galactic abundance gradients, and bulge dynamics, for example. Alan Peyaud (Macquarie University) presented the first results on the new bulge sample, as part of Joint Discussion 5 last week.

A new MASH planetary nebula, imaged with the 3.9 m AAT at Coonabarabran

The MASH team is currently establishing a comprehensive and complete scientific description of the 1,200 new PNe discovered so far, including provision of positions, sizes, morphologies, velocities, multi-wavelength images, spectroscopy and, where possible, spectral energy distributions that will provide the key enabling data for evolutionary studies. We will refine the PNe density and population estimates, which will have important implications for the Galaxy's chemical evolution. See http://www-wfau.roe.ac.uk/sss/halpha/ for the latest on-line H-alpha survey atlas.

Martian Explorer

by James Hitchcock

Mars, with its seductive red hue and barren landscape, continues to beckon. Attempts to find answers the question of martian life have so far proven inconclusive. In June this year, the European Space Agency (ESA) launched the Mars Express, in a bold attempt to answer such questions. Yesterday, ESA Project Scientist Bernard Foing gave a briefing of the mission's technologies, operations, goals and current status.

Mars Express was launched with a Soyuz-Fredat launcher from the Baikonur Cosmodrome in Kazakhstan. The mission is Europe's first mission to the Red Planet, and groundbreaking in its high-resolution spatial and spectral global coverage. Mars Express will be carrying two components, the Mars Express orbiter and the Beagle-2 Lander which will descend to the surface.

It was named the Mars Express, as Foing explains, because 'it was developed on a 3 year time scale.'

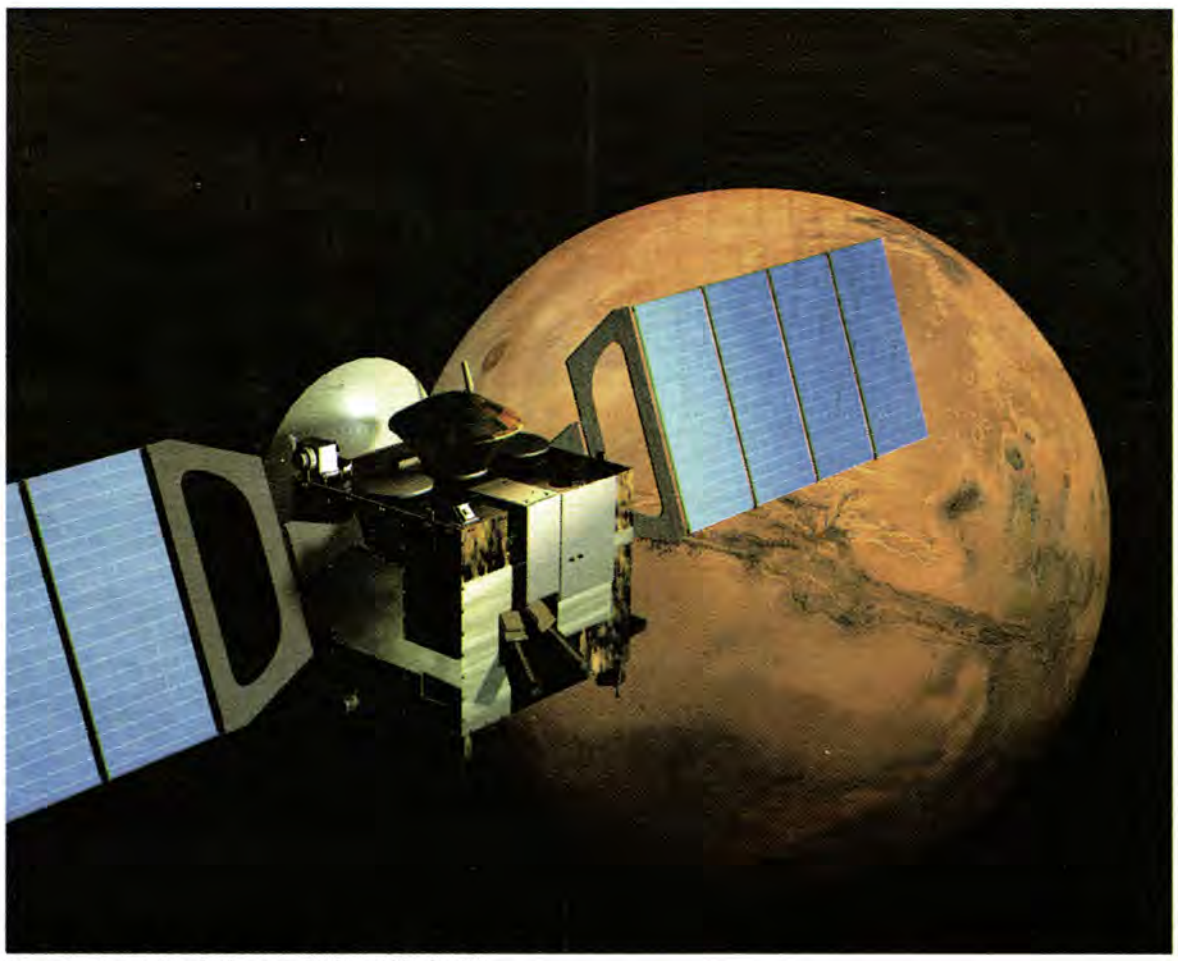
The principal goals of the mission are, as elucidated by Foing, 'to understand Mars as an Earth type planet, what is it made of and how it has evolved. By studying other planets we can also study the fate and evolution of our own.'

The main objectives that the mission hopes to achieve are as follows:

- Produce a map of the mineral composition of the surface at 100 m resolution
- Map the composition of the atmosphere and determine its global circulation
- Determine the structure of the subsurface to a depth of a few kilometers
- Determine the effect of the atmosphere on the surface
- Determine the interaction of the atmosphere with the solar wind
- Determine the geology and the mineral and chemical composition of the landing site
- Search for signatures of life
- Study the weather and climate

Foing notes that the 'top surface [of Mars] is sterile because of UV light and oxidizers.' He comments that the 'possibility of life will be in the subsurface and niches' of the planet.

The mission will indirectly look for life by studying ancient riverbeds, subsurface water ice and water within the atmosphere. Directly it will study methane and both C12 and C13 abundances.



Mars Express heads for our little ruddy buddy.

The Mars explorer will sport many advanced technologies including a High Resolution Stereo Camera [HRSC], Visible and Infrared Mineralogical Mapping Spectrometer [OMEGA], and other various spectrometers and instruments. Both the HRSC and OMEGA instruments have been tested in space.

Orbit insertion of Mars Express will occur on December 25th of this year. Beagle 2 will parachute down to the Martian surface, where its solar panels will unfold and its integrated suite of instruments will begin operations.

According to Foing, 'Mars is a fascinating planet, it's like the little brother of the Earth'.

The Magellanic Times

THE NEWSPAPER OF THE INTERNATIONAL ASTRONOMICAL UNION GENERAL ASSEMBLY SYDNEY 2003

IAUXXV General Assembly Sydney 13-26 July 2003

Day 10 **Friday 24 July**

Planets and More Planets

by Nuno Santos

Since 1995, when the first exoplanet was discovered, the number of such known bodies has grown rapidly. A good example is the recent announcement of seven new such systems by the Geneva extrasolar planet search team.

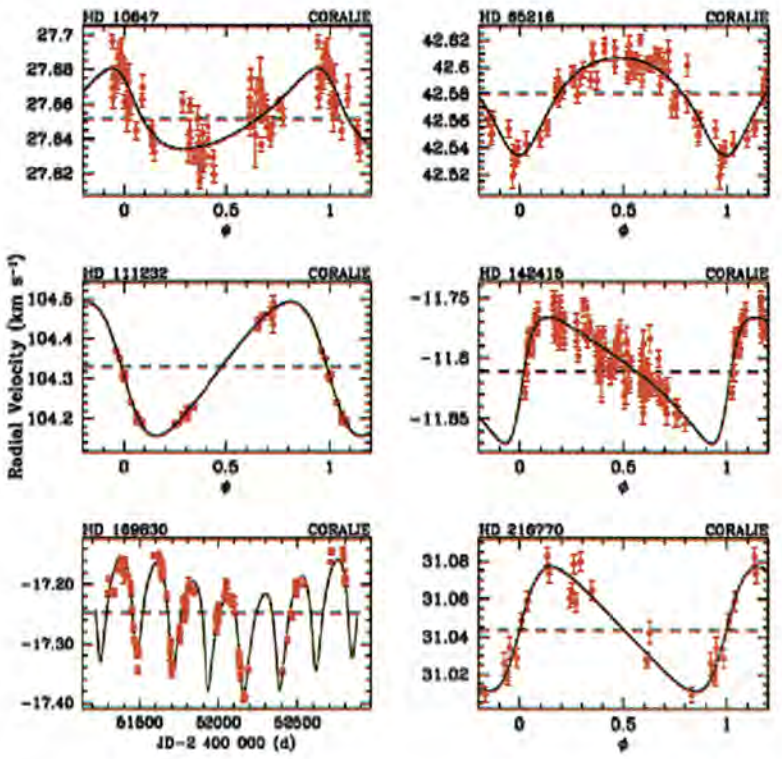
The discovery, made using the CORALIE spectrograph at the 1 – 2 m Swiss telescope (ESO, Chile) has now raised the number of extrasolar worlds to about 115 (about 50 of them discovered by the Geneva team), and revealed some very interesting cases. For example, the new results include a new two-planet system orbiting the star HD169830, and a planet around the Vega-type star HD10647, a 'sun' that still harbors a dusty disk that reveals itself as an excess infrared flux.

With the number of new planets growing, statistical studies of their properties start to give us a a method of understanding the evolution of planetary formation. For example, the analysis of the mass distribution of planetary companions tells us that these bodies do not share the same physical origin as the stellar companions to solar-type stars. Clearly, extrasolar planets are not low-mass stars.

Similarly important results come from the analysis of the relation between the orbital period of the planets and their masses. Interestingly, no massive planets are found in short-period orbits. Furthermore, it seems that all planets with a mass lower than about 0.75 times the mass of Jupiter orbit very close to their parent stars. These two results are helping us constrain the models of planetary migration and evolution to those that actually seem to agree with the observational results.

Exoplanet host stars are providing information too. These were in fact proven, as early as 2001, to be very metal-rich when compared to average field dwarfs. The current results, showing that the frequency of planets increases with the iron content of the stars, seem to show that planetary formation (or at least that of the systems now discovered) is strongly dependent on the metal content of the protoplanetary disk. This result gives strong support to the 'traditional' model for the formation of giant planets: core accretion.

While the current discoveries are already opening new windows towards the understanding of planetary formation, the quest is not over. With instruments like the new HARPS spectrograph (at the 3.6-m ESO telescope, La Silla, Chile) capable of attaining a radial-velocity precision of better than 1 m/s, many new planets are expected to be found. These will certainly open the way to discovery of 'solar systems' where Earth-like planets may exist.



Radial-velocity measurements for six of the new extrasolar planets (from Mayor et al. 2003.)

Ron Ekers Takes the IAU Reins

by Veronica Lipthay

Ron Ekers

CSIRO astronomer, Professor Ron Ekers, yesterday became President of the world's largest professional body for astronomers, the International Astronomical Union (IAU). Appointed President-elect of the IAU at the last General Assembly – held in Manchester, England in 2000 – his initial term runs from July 2003 until 2006.

His selection was met with widespread acclaim. 'He is a leader in radio astronomy, a very active, forceful person who will establish important collaborations across continents to the benefit of the Union and of the various astronomical communities in the world,' said outgoing President of the IAU, Professor Franco Pacini.

The Co-chairman of the National Organizing Committee, Dr. John Whiteoak – a colleague of Professor Ekers for almost 40 years – believes that Professor Ekers' strength lies in having 'a very wide vision,' being a 'creator-innovator,' and that he will bring 'innovation, enthusiasm and lateral thinking' to the IAU. Others hailed his appointment as a credit to the Australian scientific community. Dr. Bob Frater, member of the AT Steering Committee and Chair of the Australian SKA Consortium Committee, stated that 'it's a great honor for Australia to have the IAU President – it gives recognition to the status of the whole astronomy field in Australia.'

Professor Ekers said that the principle challenge the IAU faces will be 'to adapt to the rapidly changing global research environment,' and for the IAU to find new roles, one of which is bringing together scientists from all areas of astronomy. Professor Ekers witnessed many exciting developments in the beginning of his radio astronomy career. These included the discovery of quasars, pulsars, and the cosmic microwave background, and these experiences paved the way for him to lead the IAU in an era in which new findings about the Universe continue to proliferate.

Professor Ekers is disappointed that the Australian community doesn't recognize and value its scientists. 'This theme is exaggerated in the movie 'The Dish', which correctly portrays Australia's involvement in the Apollo moon landing and the part played by the Parkes radio telescope,' he said. 'However, the depiction of the Australian scientists as 'country bumpkins' with a telescope in a sheep paddock, in stark contrast to the highly professional NASA operation, is almost the inverse of reality. The Parkes dish was built before NASA existed, and was used by NASA as a model for its Deep Space Network antennas.'

For a long time Professor Ekers has been an advocate for developing the local scientific community. 'He has played a key role in fostering the careers of a whole generation of Australian scientists. In addition to this, he has created an internationally competitive radio observatory,' said Chair of the Academy of Science's National Committee for Astronomy, Professor Rachel Webster.

'Ron is an astronomer's astronomer,' added Seth Shostak, an astronomer at the SETI Institute in California. 'He has more ideas per unit time than anyone I've ever met. You can imagine how stimulating that can be in a research environment.'

Professor Ekers was appointed Foundation Director of the CSIRO's Australia Telescope National Facility (ATNF) in 1988. He was born in Victor Harbour, South Australia, and graduated from the University of Adelaide in 1963. He gained his PhD in astronomy at the Australian National University in 1967.

He has worked at the California Institute of Technology, USA; the Institute of Theoretical Astronomy in Cambridge, UK; the Kapteyn Laboratory in Groningen, The Netherlands; and the National Radio Astronomy Observatory in New Mexico, USA. He was also director of the VLA Very Large Array), the world's largest radio telescope array, from 1980 to 1987.

Acclaimed astronomer Professor Brian Boyle, Director of the Anglo-Australian Observatory, will take over Professor Ekers' position as Director of the ATNF. MT10-18

The Magellanic Times

The Magellenic Times is the official paper of the IAU General Assembly 2003

The IAU General Assembly 2003 is proudly sponsored by

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Substitute: Francoise Genova

PUBLIC ACCESS TO ASTRONOMICAL ARCHIVES

The General Assembly of the International Astronomical Union
Recognising
1 That scientific advances rely on full and open access to data.
2 That it is in the interests of astronomy generally that archive data be made as widely accessible as possible, and that the technology exists via the world-wide web to do so cheaply and effectively
3 That the development of the Virtual Observatory will enable effective use to be made of such archives, thus increasing the effectiveness and scientific return of astronomical research
Considering
1 That access to observing time on major astronomical facilities is sometimes necessarily and legitimately restricted for funding or other reasons,
2 That after data have been obtained on such a facility, that access to such data is often necessarily and legitimately restricted for some period (the 'proprietary period', typically of one to two years), to the observer, students, instrument builder, or other defined groups, so that they may have a reasonable opportunity to publish their results, and thereby capitalise on their investment of time and resources put into the observations,
3. That in many cases, after this proprietary period the data are placed in a data archive where they are made more widely available
Recommends that
1 Data obtained at major astronomical facilities should, after a reasonable proprietary period in which they are available only to observers or other designated users of the facility, be placed in an archive where they may be accessed via the internet by all research astronomers. As far as possible, the data should be accompanied by appropriate metadata and other information or tools to make them scientifically valuable.
2 Such data should not be subject to intellectual property rights. The form in which data are made available, and the subsequent processing of such data, may be appropriately protected by copyright laws, but the fair usage (including educational purposes) of the archive data themselves should not be subject to restrictions.
3 Funding agencies provide encouragement and support to enable data produced by astronomical research that they fund to be deposited, after some proprietary period as defined above, in recognized data archives which provide unrestricted access to these data.

2009: THE YEAR OF ASTRONOMY
recalling
that the introduction of the telescope in astronomical observations brought about a fundamental revolution in humankind's perception of the world outside the Earth,
recognizing
that the series of developments initiated by this event led, in time, not only to the vast and richly detailed view of the Universe and humankind's place in it which is modern cosmology, but to the entire framework of fact-based empirical investigation and analysis which underlies contemporary science and technology,
and considering
that the immediate appeal of astronomy to the imagination of humans in all walks of life remains one of the most powerful ways to kindle the interest of young people everywhere in scientific research and education, and thus to contribute to the progress of the quality of human life,
recommends
that the year 2009, the 400th anniversary of Galileo's accomplishments and the real birth of modern telescopic astronomy, be declared the "Year of Astronomy", in which the potential of astronomy to enlighten and enrich humans will be brought to the largest possible audience all over the world,
and requests
that the Officers and Executive Committee with support from Commission 41 initiate prompt and effective action to organize this important worldwide event, in collaboration with all appropriate national and international organizations.

RESOLUTION PROPOSED BY COMMISSION 46

The International Astronomical Union
Considering
1. that scientific and mathematical literacy and a workforce trained in science and technology are essential to maintain a healthy population, a sustainable environment, and a prosperous economy in any country
2. that astronomy, when properly taught, nurtures rational, quantitative thinking and an understanding of the history and nature of science, as distinct from reproductive learning and pseudo-science
4. that astronomy has a proven record of attracting young people to an education in science and technology and, on that basis, to careers in space-related and other sciences as well as industry
5. that the cultural, historical, philosophical and aesthetic values of astronomy help to establish a better understanding between natural science and the arts and humanities
6. that, nevertheless, in many countries, astronomy is not present in the school curriculum and astronomy teachers are often not adequately trained or supported, but
7. that many scientific and educational societies and government agencies have produced a variety of well-tested, freely-available educational resource material in astronomy at all levels of education
Recommends
1. that educational systems include astronomy as an integral part of the school curriculum at both the elementary (primary) and secondary level, either on its own or as part of another science course
2. that educational systems and national teachers' unions assist elementary and secondary school teachers to obtain better access to existing and future training resources in astronomy in order to enhance effective teaching and learning in the natural sciences,
3. that the National Representatives in the IAU and in Commission 46 call the attention of their national educational systems to the resources provided by and in astronomy, and
4. that members of the Union and all other astronomers contribute to the training of the new, scientifically literate generation by assisting local educators at all levels in conveying the excitement of astronomy and of science in general.

Studying Interacting Binary Stars for their own Sake

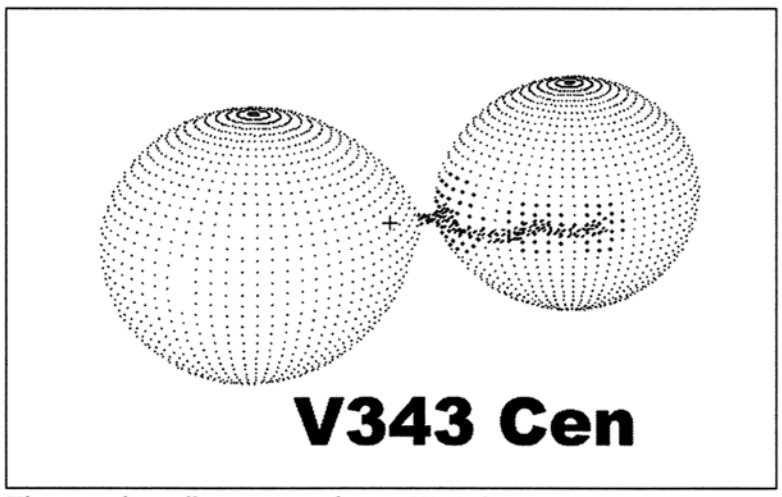
by Ron Samec

Eclipsing Binaries (EBs) have been studied for years as 'tools' for the determination of stellar masses, radii, and stellar atmosphere phenomena such as limb darkening. More recently they have been used to determine distances to the LMC, SMC and in the near future, other members of the Local Group like M31.

The results of this work are used for calibrating the cosmological distance scale. Now that this problem is nearly solved, binary star modelers have only one world to conquer: namely, the study of eclipsing binary stars for the sake of studying binary stars themselves. For determining stellar masses, researchers have traditionally chosen very plain, well-separated EBs so that the stars will be as similar as possible to normal single stars. This type of binary is called a detached eclipsing binary (DEB). The same type of binaries (and occasionally the semi-detached type) are used to determine distances to clusters and local group galaxies. In doing this, many interesting and unusual binaries have been overlooked.

Recently, the OGLE project discovered EBs with RR Lyrae components. Delta Scuti variables have long been known as members in DEBs. Again, EBs will be used as tools to probe these objects to determine masses and radii and other important astrophysical parameters. However, any interactions between the pulsator and the other component are likely to 'spoil' the results. But this 'spoiling' is exactly what should be important. How exactly does a pulsator interact with a nonpulsator in a binary system? This is a crucial question, emphasizing again that studies of binary systems for their own sake is important science!

Both Divisions 5 and JD 13 (Extragalactic Binaries) came to this conclusion at the IAU. Magnetic activity, winds, disks, spot activity, their location and persistance, plages, coronal activity and binary evolution scenarios all await detailed and further study. Astomography and asteroseismology will figure prominantly, along with the usual photometric and spectroscopic related techniques. With the tens of thousands of newly and soon-to-be discovered EBs by OGLE, MACHO, GAIA, KEPLER, etc., researchers can choose the particular type of binary they are interested in from a huge data set, and concentrate their observational and theoretical efforts on those.



The astrophysically interesting binary V343 Cen

My particular interest are the 'transition' zones between semi-detached and contact systems and the contact to single star configuration. These transitions evidently occur on very short time scales and therefore are rare. Only a few candidates are currently known, but with the advent of thousands of newly discovered EBs, I expect to find many more examples of these systems for study. So, while many researchers are looking for planets, the rejects (which are EBs) will be of great interest to the binary star community. These will supply a gold mine of EB systems for us to study for their own sake!

Koalas on Rampage

In a move that Canberra residents say is mostly unprecedented, hordes of otherwise docile koalas descended from their gum trees last weekend and ravaged the center city.

'There was a lot of flying fur here, I can tell you,' said Sydney Ocker, a Canberra resident whose two blue heeelers were mauled by the marauding ursines. 'Every now and then, these bitty bears get into a mess of bad eucalyptus, and the results aren't pretty.'

Fortunately, three hours after the bears descended on the Central Business District, their metabolism ebbed, and they dropped in their tracks. They were collected by street sweepers and returned to the woods.

Prague to Host IAU GA in 2006

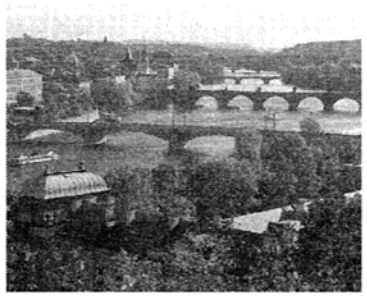
by Jan Palous, Chairman of the next NOC

The next General Assembly of the IAU in 2006 will take place in Prague, capital of the Czech Republic. It will be 39 years after the first GA in 1967.

Prague has a long and rich history of astronomy and physics. Among the well known scientists who have worked in Prague were Tycho Brahe, Johannes Kepler, Christian Doppler, Ernst Mach, and Albert Einstein.

There are other outstanding personalities that have an intimate link to this city. For example W. A. Mozart, whose opera Don Giovanni was performed for the first time in Prague. It was hardly surprising that film director Milos Forman shot 'Amadeus' in Prague. The writer Franz Kafka spent all his life in Prague. The novel 'The Castle' was probably inspired by Prague Castle.

We would like to invite all the IAU members and the participants of the GA in Sydney to the XXVI General Assembly of the IAU, August 14 – 25, 2006, in Prague.



Announcement

A Repeat Performance of 'Experiencing the Cosmos, Symbolically and Musically'

a presentation of the new scientific picture of the universe by Prof. Joel Primack and Nancy Abrams, will be given on

Friday, 25 July, between 6:00 – 7:00 pm.

The Theosophical Society
Theosophy House
Level 2, 484 Kent Street, Sydney
(not far from the Conference Centre)

Everyone's favorite archaeo-astronomy site, Stonehenge

Beyond the Photon

by Virginia Trimble

Electromagnetic radiation is no longer the only astronomical game in town. This is probably not news to you, though it could have been if your only previous contact with the subject had been GAs before Sydney. At GA I (Rome, 1922), astronomy meant optical astronomy. GA V (1935) could have included particles (cosmic rays) and radio astronomy. GA VII (1998), or at the latest XII (Hamburg 1964) might have featured X-ray results, and GA XVI (1976, Grenoble) could have hosted a gamma ray burst session. But they did not. Similarly, we have perhaps been slow to recognize that neutrino astronomy, cosmic ray astrophysics, gravitational radiation, and the dark matter particles are part of our subject.

Recognizing this, an executive committee meeting a couple of years ago declared incorporation of non-photon astronomy to be one of the goals of GA XXV. Marco Salvati (Italy) responded to this challenge by chairing the SOC of Joint Discussion 1. Incidentally it became JD 1 because the executive committee, remembering its previous charge, declared the proposal its highest priority for Sydney. What did all the speakers, posterers, listeners and readers learn from each other?

1) The Sun is a neutrino source (in the MeV band) with very close to the luminosity you had expected, once you understood neutrino oscillation and all.
2) SN 1987A (capital A, curse you editor Shostak; there is an IAU resolution declaring it so) was also an MeV neutrino source also at close to the expected flux. And with luck, it will NOT be the 'supernova of the century.'
3) Neutrinos of much higher energies are produced by cosmic rays hitting the upper atmosphere and have been recorded by a South Pole detector called AMANDA that records passage of the particles through ice. Other detectors, using processes that happen in thin air, have also seen these.
4) There are some exciting potential sources of VHE neutrinos including gamma ray bursts, microquasars, and great big fat Greek quasars, which the next generation of detectors called Ice Cube, Nemo, and so forth should see come straight from their sources, which charged particles do not, so neutrinos of TeV to EeV (and beyond) from a particular source, in addition to their intrinsic interest, will show that acceleration to very high energy happens there.
5) The acceleration of cosmic rays in general is not very well understood beyond the level at which we invoke Fermi mechanisms and supernovae (but most known remnants have a ratio of protons to electrons much smaller than 100, the cosmic ray number).
6) Current detectors for cosmic rays with energies greater than or equal to 10^{18} eV actually disagree at the 2-3 sigma level on whether there is the expected, (Greisen-Zatsepin-Kuzmin) cutoff at ~10^{20} eV caused by particles losing energy in collisions with CMB photons, which should limit our sight lines to about 100 Mpc within which there are not many obvious sources. The next generation of detectors should sort this out; either answer would be interesting, and a particularly charming glitch in the typesetting of abstracts lead to the description \$ > 10^{20} which may be an over-estimate.
7) The first generation of laser interferometric detectors for gravitational radiation, TAMA, LIGO, and Virgo have collected data for a couple of hundred hours (compared to more than 200,000 hours for bar detectors) and have set some upper limits to galactic black hole mergers etc. which would emit near 300 Hz.
8) Unless we are very lucky in a statistical sense, or there are unexpected sources, another generation of detector improvement will be needed before there are positive results, perhaps in 2007. In contrast, the first space-based detector, LISA, is almost certain to record lower-frequency radiation from AGNs etc. No one who talks about gravitational radiation now mentions Joe Weber.
9) Whether devices searching for neutrinos, high energy cosmic rays, dark matter particularly and so forth get called experiments or observatories depends mostly on whether the builders started as physicists or astronomers. My prejudice is that they are experiments until they start seeing something. Then they are observatories.
10) 'Direct detection' of dark matter particles means that the WIMPS, LSP, neutralinos or whatever scatter off a particle in your laboratory detector. An important signature is annual variation in event rate because the Earth carries us back and forth relative to the galactic halo. There has been one claim of this signature and several marginally inconsistent upper limits. The theoretical best estimate of the scattering cross section is a factor about 100 below the present sensitivity of 10^{-5}, 10^{-6} picobarns. The detectors aim for 'first dark' rather than 'first light.'
11) 'Indirect detection' means that you see neutrinos, photons or particles that come from annihilation, decay, or scattering of DM particles in the galactic halo, the solar core, or whatever. This hasn't happened either.
12) Every successful project in non-photon astronomy (and many of the unsuccessful ones) has cost twice as much and taken three times as long as the initial estimates, but if the initial estimates were maximally, pessimistically honest, no project would ever get started. MT1 -12

Traditional Astronomy Around the World

by Jeremy Mitchell

Astronomy has played an important part in many of the world's cultures, both ancient and contemporary. In fact, some of the world's most inspiring monuments have some astronomical significance, such as the great pyramid of Giza and the stone circles in Britain and northern Europe. As well as leaving behind these colossal structures, traditional astronomical practices are still in use in many cultures today. A group of researchers came together on Wednesday at the Ethnoastronomy and Archaeoastronomy meeting to discuss some of these.

Many people are aware of the interest in astronomy of the ancient cultures of Egypt, the Near East and Europe, as well as those in South America, and many documentaries and books on these subjects are widely available. Recently, however, researchers have turned their attention to African cultures south of the Sahara, and have found much of interest. Anthony Fairhall, from the University of Cape Town in South Africa, gave a presentation on the astronomical knowledge of the Xhosa people (of whom Nelson Mandela is one.) The position of the constellations is important in regulating agriculture (as in many other cultures) and enabled the Xhosa to determine when to begin sowing or start the harvest and so on. Astronomy also had some impact on social life. An interesting example of this was that dating was only allowed when Venus was visible in the evening sky. The idea was that Venus wouldn't be out very late, and the young couples should follow its example.

An overview of the practice of archaeoastronomy was given by Clive Ruggles of the University of Leicester. There are many stone monuments in Britain, Ireland and northern France which are aligned to astronomical events throughout the year. The most imposing of these is perhaps New Grange aligned to the sunrise on winter solstice. Many other monuments exist such as hundreds of structures in Portugal aligned to the sunrise. In Hawaii there are also structures dedicated to the local deities which are thought to have astronomical significance. In fact, for these people astronomy was of particular importance as it enabled them to navigate the vast expanses of the Pacific Ocean.

In recent years the traditional calendar of people of Central Java has been studied, and the agricultural practices associated with it have been re-implemented to determine whether it could have some practical use for modern farmers in the region. A presentation on this calendar, known as Prasanta Mangsa, was given by A. Kusumowardani. According to this calendar, the year, which begins around the southern summer solstice, has 365 days and is divided into twelve months (called a Mangsa). Each Mangsa has some agricultural task associated with it. Trials conducted in Java suggest that using this system can lead to increased crop yields and avoids many of the devastating environmental issues associated with modern farming practices.

The RAVErs Hit the Galaxy

by Fred Watson and Matthias Steinmetz

Matthias Steinmetz

How many stellar radial velocities do you think the world's astronomers have in their published data archives? Astonishingly, it is only about 20,000. Thanks to 2dFGRS, SDSS, 6dFGS and other galaxy surveys, we now know far more about the geography of the local and intermediate-redshift Universe than the kinematics of our own Galaxy.

There is a growing awareness today that many clues to the fundamental problem of galaxy formation in the early Universe are locked up in the motions and chemical compositions of stars in our own Galaxy. It is the idea of tapping into this rich source of data that has spawned ambitious space projects such as ESA's GAIA, which will provide astrometry, radial velocities and chemical abundances for a billion or so stars.

While GAIA is some years down the track, we already have parallaxes and proper motions for several million objects in the Hipparcos and Tycho-2 catalogues (118,000 and 2.5 million stars respectively.) Moreover, planned missions for the medium-term future are likely to yield astrometry for stars numbered in the tens of millions.

If the existing and medium-term space-astrometry data are going to be fully exploited, it is clear that there is a pressing need for radial-velocity data on an all-sky scale. And if metallicities and abundance ratios can be obtained at the same time, so much the better.

In work such as this, field of view is more important than aperture, so a large Schmidt telescope is the perfect tool for carrying it out. The Anglo-Australian Observatory's 1.2 m UK Schmidt Telescope, with its 6dF multi-object spectroscopy system, is available during bright-of-moon when it is not being used for the 6dF Galaxy Survey.

It is this logic that has led to the idea of RAVE (RAdial Velocity Experiment), an all-sky stellar spectroscopy survey to be conducted on the UK Schmidt Telescope and a yet-to-be-identified northern counterpart during the period 2006 - 2010. It is an ambitious project, aiming to observe the brightest 50 million stars in the Galaxy, with completeness to I = 15. An initial pilot survey – begun in April, 2003 – will obtain spectra of 100,000 southern-hemisphere stars by 2005, using

RAVE against the night

unscheduled bright time on the UK Schmidt. All the data will be non-proprietorial and VO-compliant.

With the moderately high-precision radial velocities (~1 km/s) yielded by 6dF's stable bench-mounted spectrograph, and commensurate accuracies in metallicity and abundance ratios, it has become clear that RAVE has the potential to be an invaluable stand-alone resource, whether or not it is complemented by space-based astrometric data.

In fact, the complete RAVE dataset stands to revolutionize our understanding of the formation and evolution of all the major components of the Galaxy: the disk, the bulge and the halo. A compelling science case has been prepared by members of the RAVE consortium, and the RAVE White Paper can be downloaded from the web-site (http://www.aip.de/RAVE/).

Since the RAVE pilot survey started in April, 2003, some 9,000 spectra have been observed. It is likely that by the end of the year, RAVE will have more than doubled the world's store of stellar radial velocities. Even if the survey were to proceed no further, it would be a remarkable achievement for one of the world's most unassuming telescopes. However, there appears to be every prospect that the full RAVE survey will proceed, providing a spectacular finale to the UK Schmidt's long career in wide-field astronomy.

New Space Agency to Rise From Three in Japan

by Philip Edwards and Hisashi Hirabayashi

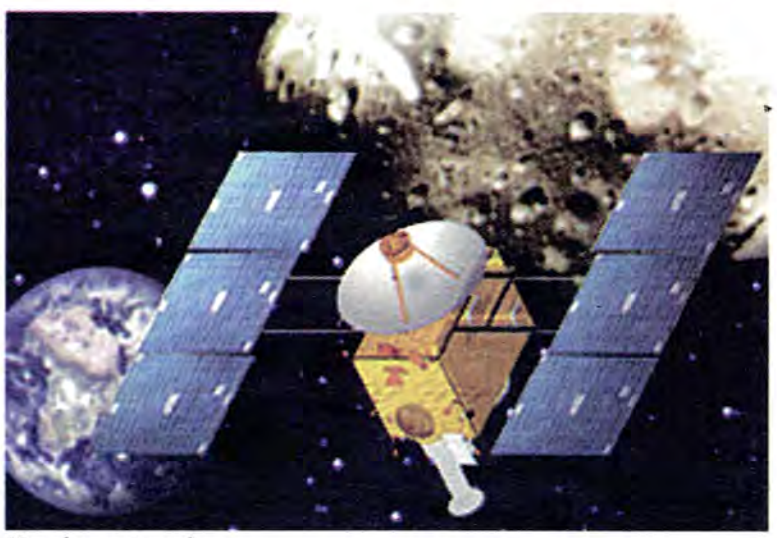
Philip Edwards

Japan's Institute of Space and Astronautical Science (ISAS) is to merge with the National Space Development Agency (NASDA) and the National Aerospace Laboratory (NAL) on October 1. The three will be known collectively as the Japan Aerospace Exploration Agency (JAXA).

ISAS started life as the Institute of Space and Aeronautics Science, which in 1970 launched Japan's first satellite, Ohsumi, into Earth orbit. Satellites have been launched at a rate of almost one a year since then, with the most recent being on May 9 this year when the MUSES-C satellite was launched. MUSES-C has been renamed Hayabusa ('Falcon') and is an ambitious asteroid sample-return mission that will return to the Woomera range in South Australia in 2007 with samples picked up from the asteroid 1998 SF36.

ISAS's successful series of X-ray satellites, Hakucho, Tenma, Ginga and ASCA, will be complemented by the launch of ASTRO-E2 in 2005, and the first infrared mission, ASTRO-F, is scheduled for launch in late 2004. As is appropriate for the land of the rising sun, ISAS's Hinotori, launched in 1981, and Yohkoh, launched in 1991, conducted a long series of observations of our nearest star. The HALCA satellite is involved with Very Long Baseline Interferometry (VLBI) radio observations with arrays of ground-based radio telescopes for the VLBI Space Observatory Programme (VSOP). It had been out of action for much of this year following a loss of attitude control, but during the IAU-GA we learned that attitude control has been regained (on July 18) and that observing will re-start next month.

In contrast to the astronomical missions undertaken by ISAS, NASDA has been pursuing the development of larger sized rockets capable of placing commercial satellites in geostationary orbit, as well as launching Earth observation satellites and providing Japan's contributions to the International Space Station. The National Aerospace Laboratory has been studying next generation aviation as well as space research and development. There has naturally been collaboration among the three institutions in the past, and the merger will facilitate and encourage further collaboration in the future.



Hayabusa at work

In the logo for the new institution, JAXA, the 'A' for Aerospace is depicted as a star to symbolize hope, and to represent a guidepost for the future. In addition, perhaps, it recalls the many contributions to astronomy made by ISAS missions that will continute as part of the new Japan Aerospace Exploration Agency.

The Bare Facts about Naked Galaxies

by Aaron Romanowsky

Aaron Romanowsky, unshifted

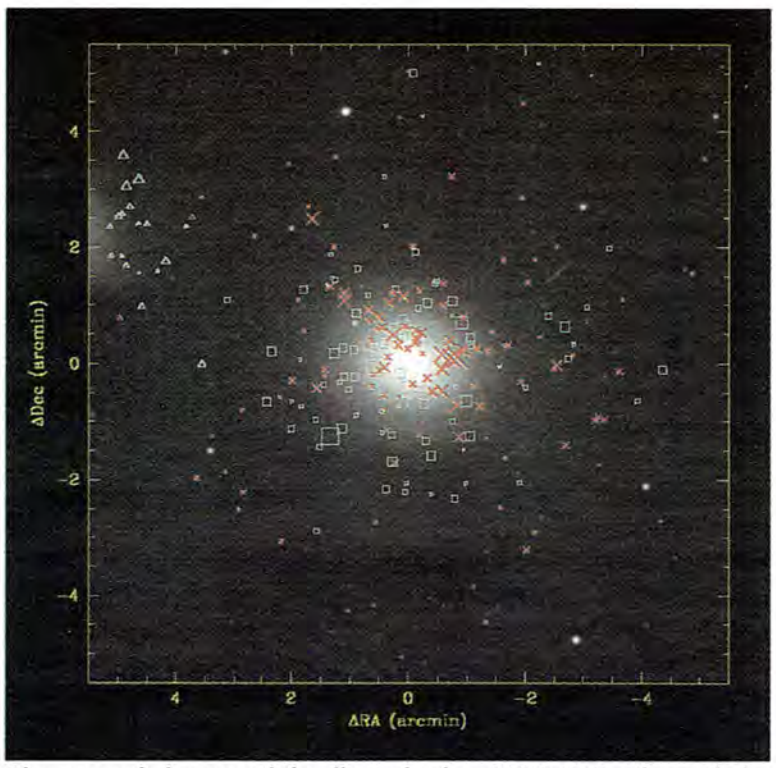
The universe is thought to be permeated by cold dark matter (CDM), an exotic substance which has clumped together under its own gravity into massive dark halos. The dark halos have acted as sinks for baryonic matter, fomenting the assembly of all types of stellar systems, and remaining in place as invisible cloaks around the galaxies and clusters we see today. Dark halos were detected in the 1970s around spiral galaxies through the rotational speeds of their gas disks: outside the visible disks the rotation did not show the expected Keplerian decline, but instead remained constant, implying vast reservoirs of unseen gravitating material.

Similar kinematic studies have not been successful in elliptical galaxies because they lack cold gas, and so the presence of dark halos has remained unverified for this major class of galaxy. This gap in our knowledge may now be filled by using planetary nebulae (PNe) as tracers of the diffuse stellar light around galaxies which is otherwise too faint to study. Their bright emission in the [O III] line at 5007 Angstroms means that they are detectable in other galaxies, and their velocities can be measured.

Our international team has constructed the Planetary Nebula Spectrograph (PN.S), an instrument designed specifically for the task of harvesting PNe data in large numbers in nearby galaxies. Using the PN.S on the 4.2 m William Herschel Telescope on La Palma, we have measured over 100 PN velocities around each of three average-luminosity elliptical galaxies – some of the first kinematical measurements in the halos of such ordinary ellipticals.

The results are surprising: instead of the PN velocities remaining constant, they decline rapidly with radius – so rapidly that the amount of mass enclosed could be accounted for by the visible stars. This suggests that the galaxies are composed of 'naked' stellar bodies, unburdened by any dark matter halo; any primordial halo has somehow been lost or severely stripped away over the galaxies' lifetime.

Another possibility is that there are still large quantities of dark matter spread out at still larger radii than we can probe. However, such diffuse halos run counter to the expectations from CDM of dense, centrally concentrated halos.



Planetary nebulae around the elliptical galaxy NGC 3379. The symbol sizes are proportional to their speeds relative to systemic; red are receding, blue are approaching. The image scale is 35 x 35 kpc

We are now making an extensive survey with the PN.S of a broad range of ellipticals, and so should soon have a better idea of the pervasiveness of this phenomenon: are most ellipticals unclothed, or are just a few of them streakers?

First Light for the World's Largest Robotic Telescope

by Le Tran

On July 21 2003, the Liverpool 2 m telescope achieved first light. Located at the La Palma Observatory, Canary Islands, the telescope is the world's largest and most technically advanced robotic telescope. The timing of the telescope's first light coincides with the 24th anniversary of the first steps on the moon, making the achievement a small step for some commissioning engineers, but a giant leap for Telescope Technologies Limited (TTL).

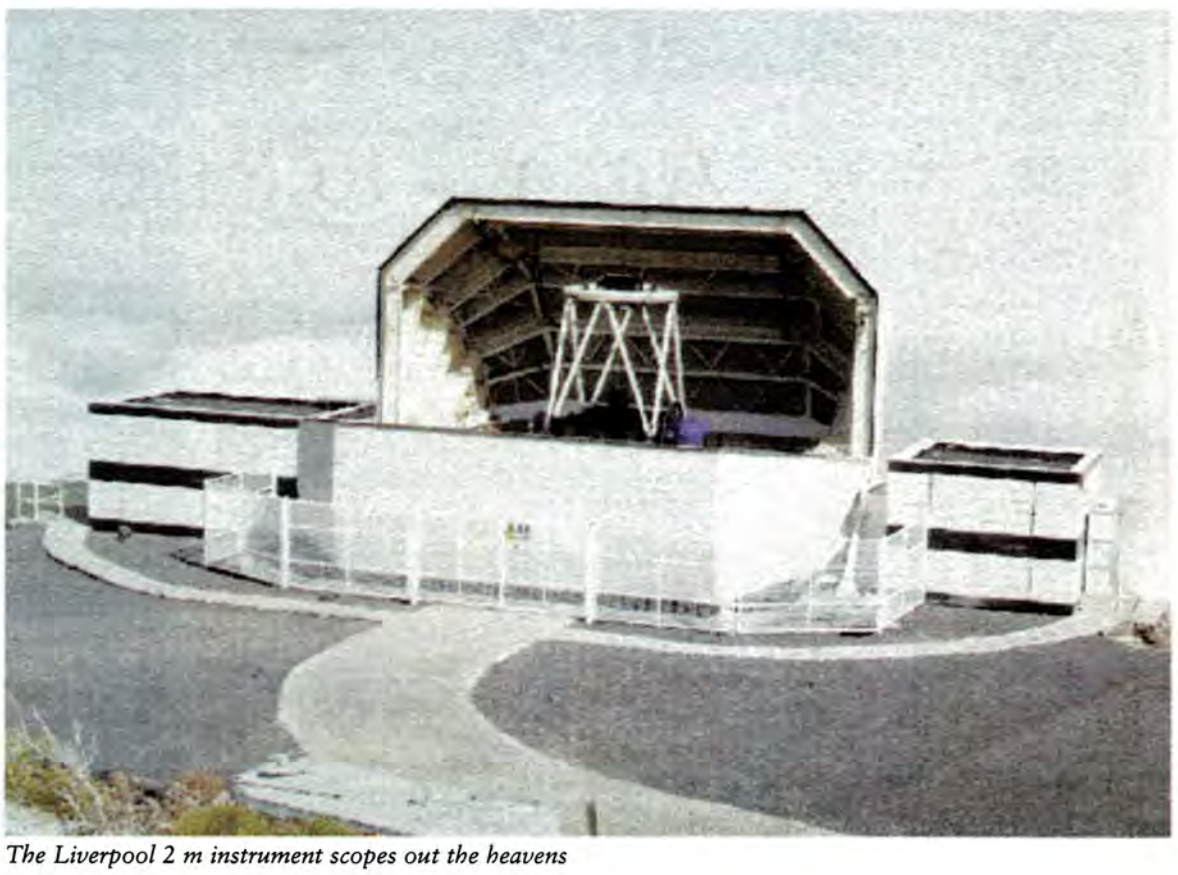
Purposely designed for the study of variable objects such as supernovae, CV's, novae, gamma-ray bursters, and binary stars, the telescope is particularly suited to searching for planets by the observation of microlensing events, and astrophysical tomographical studies of objects such as accretion disks.

The commissioning engineers involved said that 'The telescope was remarkably well-behaved and was a delight to operate. The sky was fabulously clear and conditions were perfect. Only the north portal of the enclosure was opened to still leave a shield to the other telescopes, should it have been necessary to switch internal lights on. However the night was so successful that it wasn't necessary to perform any remedial work.'

The development of the 2 m class robotic telescopes was pioneered by Professor Michael Bode, Head of the Astrophysics Research Institute of Liverpool John Moores University. TTL is a company set up and wholly owned by the University. The design team consists of mechanical, optical, control, electrical and software engineers from the Royal Greenwich Observatory as well as from industry.

The TTL 2 m class telescope features unique motion control engineering to allow the correction of wind-buffeting of the telescope in real time. A special clam-shell opening enclosure has been designed so that once the clam-shell is fully open, the telescope operates in the open air. Unlike conventional enclosures there, is no degradation of stellar images due to local dome seeing effects.

TTL U.K is currently manufacturing four more similar robotic telescopes. These are the 2 m telescope for IUCAA (Inter-University Centre for Astronomy & Astrophysics) Pune, India; two 2 m telescopes, the Faulkes I for Maui, Hawaii and the Faulkes II for Siding Springs Observatory, Australia. The fourth is a 2.4 m telescope for the Yunnan Astronomical Observatory, which will be the largest telescope in Asia once it is installed.



The Liverpool 2 m instrument scopes out the heavens

The Faulkes I and II are intended to be used for educational purposes. They will be linked to schools in the UK and Australia to stimulate interest in astronomy amongst students, and encourage them to get involved in research projects in astronomy.

Opportunities exist for institutions or individuals to have 'time-share' observations in the world-wide network of TTL telescopes which are becoming a global distributed observatory.

For further information, please contact Chris Moss, Telescope Technologies Limited, located at Stand G14, Exhibition Hall. Email: cmm@ngat.com.

Molecular Gas Found in the Very Early Universe

by Fabian Walter and Pierre Cox

Cox and Walter as seen in the late Universe.

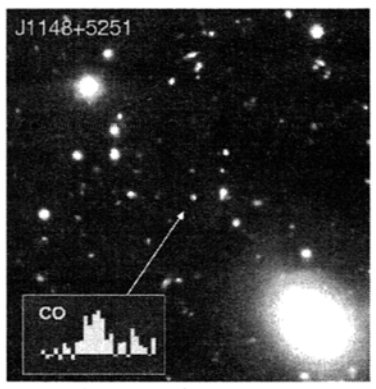
Scientists in Europe and the United States have discovered a huge mass of gas in the most distant quasar yet found. Carbon monoxide gas emitted the radiation from the quasar at a time when the Universe was only one-sixteenth its current age, 850 million years after the big bang. These observations allow us for the first time to probe the conditions within the regions where the very first stars and massive black holes were forming.

'We were much surprised to detect such vast amounts of molecular gas present so soon after the big bang,' says Fabian Walter from the National Radio Astronomy Observatory, Socorro (USA). 'Since carbon and oxygen are created through nuclear fusion reactions within stars, the enrichment of the interstellar gas must have been unusually fast, through the explosions of the first massive stars.' adds Pierre Cox from the Institut d'Astrophysique Spatiale, Orsay (France). The CO emission was detected in observations made at the NRAO Very Large Array in New Mexico and the IRAM Plateau de Bure Interferometer.

At a redshift of 6.4, J1148+5251 is the most distant quasar known, and was discovered using the Sloan Digital Sky Survey. It contains a very massive central black hole of several billion times the mass of our Sun. Being among the first such massive structures to have formed in the Universe, it provides scientists with a direct view of the physical and chemical conditions in galaxies when the Universe was very young, near the end of the 'Dark Ages.' The discovery of molecular emission in its host galaxy makes it the first object to allow detailed studies of star formation during this important epoch, when the Universe transformed from a grey fog to a bright space in which galaxies, stars, and black holes were forming.

The CO emission traces the dense molecular gas out of which stars form, revealing crucial information about the mass, density, temperature, and size of the host galaxy. 'Ten years ago no one would have thought that such huge masses of molecular gas, about 20 billion solar masses, already existed so soon after the big bang,' notes Cox. Walter adds that 'this means that even at a very early time in the history of the Universe, galaxies already had huge amounts of molecular gas that would eventually form new generations of stars.'

The CO detection is reported in today's issue of Nature, and in a complementary article for Astronomy and Astrophysics.



Optical image of J1148+5251 with the CO spectrum of the quasar shown as an insert. Due to its distance the quasar's light is shifted to redder colors by a factor of 7.42, and stands out as an unusually red object (optical image by S.G. Djorgovski, Caltech.)

Special Session #4: Effective Teaching and Learning of Astronomy

by John Percy

At the opening session of this IAU GA, you may have noticed that several speakers – both scientists and politicians – referred to astronomy's role in promoting public awareness and appreciation of science. You may also have heard that, in one large "developed" country only half the population knows that the Earth orbits the Sun once a year. What's wrong? First of all, in many parts of the world, astronomy is not part of the school curriculum. Second, even if it is part of the curriculum, most teachers have little or no training in astronomy or astronomy teaching. In fact, research shows that they have the same misconceptions about astronomy as the general public. Before we criticize them, we should remember that, unlike university instructors who generally have no training in teaching, schoolteachers do know about teaching and learning, and most of them are keen to improve their professional skills.

The goal of SPS4 is to encourage and support more and better astronomy teaching and learning in schools. [Remember that teaching and learning are not the same thing!] One means to this goal is to support teacher training in astronomy, and the development of suitable activities and resources. There is obviously a limit to how much the IAU can do in this area, but IAU Commission 46 (Education and Development), which has organized SPS4, can use its expertise and its network of National Liaisons as a two-way channel of communication. It can partner with international or local organizations to leverage its efforts.

The emphases, in SPS4, are on teaching strategies which can be shown, by research and evaluation, to be effective. The strategies should be simple and flexible enough that they can be implemented widely around the world, not just in the most affluent schools. SPS4, which began yesterday and continues today in Pyrmont 2, addresses curriculum, relevant education research, teacher training, technology, and public education as it relates to schools. Multicultural astronomy, and the needs of the astronomically-developing countries, will also be addressed.

In retrospect, considering the importance of education and outreach in astronomy, it is sad that only one special session at this GA is devoted to this topic.

Commission 46's Resolution to this GA, regarding the need for more and better astronomy in the schools around the world, was just approved. We encourage every interested astronomer at this GA to read the Resolution, attend SPS4, and think about how they can help us to achieve our goal. We plan to publish both a short and a long Proceedings of SPS4 (editors: Jay Pasachoff and me) as a permanent contribution to astronomy education in the schools.

Common Causes of Confusion — from Working Group Designations (Cont.)

by Helene Dickel and Marion Schmitz

4. AMBIGUOUS ACRONYMS ABOUND When introducing a new acronym, first check for uniqueness by searching the on-line "Dictionary of Acronyms" at URL http://cdsweb.u-strasbg.fr/cgi-bin/Dic. The Dictionary shows many different catalogs with the same acronym N, similarly for P, BR, and two entries for the acronym DR.

5. FILLING THE GAP in a designation can cause confusion. Does ACROJ125422.2-121632 stand for ACROJ^125422.2-121632 with B1950 coordinates in the ACROJ catalog or ACRO^J125422.2-121632 with J2000 coordinates in the ACRO catalog?
[Caution: avoid creating an acronym ending in B, J, or G.]

6. "B" SMART! Although not required, including the B in the designation with B1950 coordinates is wise because too many authors are leaving out the required J when J2000 coordinates are used. The addition of a "B" would remove any ambiguity in your coordinate-type designations.

7. NEVER TRUNCATE OR ALTER ACRONYMS! e.g. do not use N (nebula in Magellanic Clouds) when NGC is meant; or CXOP (99 Chandra X-ray sources in the Pleiades) when CXOPZ (215 Chandra X-ray sources in IC 348 by Preibisch+Zinnecker) is intended; or FCSS (Fornax Cluster Spectroscopic Survey ~7000 objects) when FCOS (Fornax Compact Object Survey 120 objects) is meant.

8. IGNORANCE ISN'T ALWAYS BLISS If you are guilty of sloppy designations, such as altering or shortening the acronym, omitting the J, and/or leaving off the ending digits, you are courting disaster because it will be difficult, if not impossible, for others to locate your source(s) in the data bases such as NED or SIMBAD.

9. WHEN IN DOUBT, ASK! If you are creating a designation for your newly discovered sources and are unsure about your choice of acronym, etc., please do not hesitate to contact a member of the WG Designations for advice. (e.g. consult the list at the end of the "IAU Recommendations for Nomenclature" at URL http://cdsweb.u-strasbg.fr/iau-spec.html)

10. PREVENT COMMON CAUSES OF CONFUSION by preregistering your new acronym (and designations) for your upcoming catalog about a month or so before submitting the paper for presentation or publication. Go to the on-line "Registry for new acronyms" (for astronomical sources of radiation outside the solar system) at URL http://cdsweb.u-strasbg.fr/cgi-bin/DicForm. Your submission will be checked for conformity to IAU Recommendations.

11. "FAST CHECK FOR objectname" COMING SOON (we hope) to your favorite journal. Currently both Astronomy & Astrophysics and the Astrophysical Journal are working with the Centre de Donnes astronomiqes de Strasbourg (CDS) on a web-based object name verifier, which will allow an author or editor to input a list of object names and confirm whether they are legal SIMBAD names (eventually also NED names). This will check nomenclature along the way and also provide the object-code for linking.

Women in Astronomy: Two Early Antipodean Pioneers

by Diana Londish

Diana Londish

A recent Science Meeting on Pioneering Observations in Radio Astronomy introduced us to two amazing women who might be considered the 'grandmothers' of Australian radio astronomy.

The little known English-born scientist, Dr Elizabeth Alexander (1931-1958), whose PhD from Cambridge was in fact in geology, not physics, was probably the first female radio astronomer. Evacuated from Singapore before it fell to the Japanese in WWII, she fled with her three children to her husband's native New Zealand, where she was appointed Head of the Operational Research Section of the Radio Development Laboratory. During this time she arranged for observations (at 200 MHz) to be made at 4 different radar stations in the north of New Zealand's North Island, and one on the Australian-owned Norfolk Island, investigating what became known as the Norfolk Island Effect – that is the increase in radio 'noise' at sunrise and sunset. Dr. Alexander deduced that the radio emission was connected with radiation from the Sun, and went on to figure out that periods of intense sunspot activity were also correlated with increased radio activity. A little known paper on this topic was published in 1946 in the NZ Journal, Radio and Electronics. After the war Elizabeth returned to England, and did not continue in radio physics, however her work proved to be an important trigger to further pioneering work in Australia.

This work was continued by an Australian-born graduate from the University of Sydney,

Ruby Payne-Scott (1912-1981). Ruby completed her BSc in Maths and Physics in 1933 and then her Masters in 1936. Until WWII she worked in medical physics and as a science teacher in South Australia. In late 1941 she joined the newly formed CSIRO Division of Radiophysics working on radar developments with Joe Pawsey. In 1944 they carried out their first observations at 11cm (2.3 GHz). Although no emission was detected this was probably the first radio astronomy observation in Australia. In 1947 Payne-Scott, Pawsey and McCready detected Type II bursts from the Sun; in their paper they allude to 'unpublished' work carried out in New Zealand on this same topic.

As well as being a brilliant scientist, Ruby was a campaigner for equal recognition for women; she had to keep her marriage (in 1944) a secret in order to avoid dismissal. She fought for equal pay for women, and was vehemently against married women being treated as second-class citizens. She also had outspoken political views, and was investigated by ASIO and suspected of being a communist.

Ruby was finally forced to resign in 1951 before the birth of her son, and never returned to radiophysics. Her forced departure was no doubt a tragedy for Australian science, nevertheless she set the stage for ground-breaking work that was later done in the area of solar radio physics.

Many thanks to Wayne Orchiston and Miller Goss for two inspiring talks.

Monique Orine Reminisces

IAU Executive Assistant, Monique Orine, has worked for 43 years, 41 of them for the benefit of astronomy. Her career began at the age of 12, working as an administrative clerk in a garage, a year later as typist in a re-insurance company, then in a chemical planet, and various other positions that lasted throughout her teenage years and took her to England and Germany. When she returned to Paris, she had to find a position in order to help her family. She decided to find a job in an intellectual arena.

She replied to an advertisement seeking a bilingual secretary to work in a space research laboratory. At that time, Charles de Gaulle was the country's leader, and he pushed space research, not only in France but at the European level. She had the pleasure to work in laboratories such as the Service d'AÈronomie and the Laboratoire de Physique Stellaire et Planetaire.

After taking a short break from astronomy, she was eventually hired by Jean-Pierre Swings, who was by then the IAU General Secretary.

Her introduction to the IAU was dramatic. The Administrative Assistant had suddenly left, and no transfer of power could occur. The next General Assembly was only 10 months away, and she had to cope with everything on her own. She confesses that, for once, she thought she could never do it. However, she has very good memories from the Baltimore GA, although the staff who asked specifically for French keyboards in order not to lose time, actually received Spanish keyboards.

Her following boss, Derek McNally, was in charge of the Buenos Aires GA. Although less professional than their American colleagues, the enthusiasm of the Argentinian staff was contagious and again, Orine came home with nice memories. She also adds that, by that time, she had a wonderful colleague, Julie, of Spanish origin and educated in the UK. Julie left her job after the General Assembly in Kyoto.

After Buenos Aires, Jacqueline Bergeron took over Derek's position, and was in charge of the GA in The Hague. Thanks to the effort of Ernst Raimond and his wife, Freddy, things went very smoothly in Holland. Kyoto, during the term of Immo Appenzeller, was one of the best GAs Orine ever knew. The organization was shouldered by a very devoted team that dealt with all the aspects of the organization without the hiring of a professional conference organizer).

Johannes Andersen was in charge of the following GA in Manchester. Hans Rickman has been in charge of this GA, one we are fortunate to hold in a beautiful city and conference center. In 2006, Oddbjorn Engvold will be in charge of the GA in Prague.

The Prague GA will be a special one for the IAU Executive Assistant, who will retire by the end of 2008. Thereafter, she has plans to work as a volunteer, teaching French to migrants, to visit Paris and its numerous exhibitions, to listen to more concerts, and more. Finally, and not least, she also would like to devote time to her almost one month old granddaughter.

Orine thinks she has been very lucky to have spent so many years with people who love their work and who conduct science at the forefront of research in general. For all this, she is very thankful to all of you.

WAM Summary

by Sarah Maddison and Anne Green

Sarah Maddison and Anne Green mug the photographer

The Women in Astronomy Meeting (WAM) was held in the lovely Skyline Terrace on Monday, 21 July and was attended by 180 IAU delegates. The event was booked out, showing a very encouraging level of interest in the status of women in astronomy. The meeting was attended by the IAU Executive, including the current President, the Presidents-elect for this and the next GA, several holders of the position of General Secretary and many senior astronomers, including directors of observatories and presidents of professional bodies, as well as many students and young astronomers.

The keynote speaker of the working lunch was Dr. Andrea Dupree from the CfA, who reported on the 'Women in Astronomy II' meeting held in Pasadena in late June this year. Her summary of that meeting reported that women are not represented at the highest levels; women do not receive the top honors and prizes; the number of women in astronomy positions is not increasing at a rate commensurate with the availability of qualified female students; that 'the playing field must be leveled' in hiring and rewards (as gender bias is alive and well in our society – even if it is unconscious); and that astronomy is challenging, creative, and exciting! The conclusion is that for scientific excellence, we cannot afford to lose the intellectual power of 50% of the gene pool.

The main goal of the WAM lunch was to review the status of women in astronomy and to plan strategies and actions for improvement. In particular, we aimed to establish an IAU Working Group on the Status of Women in Astronomy. We were delighted to be able to report that the proposal was approved by the IAU Executive a few days previously. The IAU Working Group will ensure that women in astronomy have a session at every IAU GA. The WG will establish a comprehensive database of statistics of women in astronomy and coordinate the global collection of such statistics, and work to provide a useful network for women in astronomy.

All WAM participants received a flyer with a subset of the percentage of women IAU members, a summary of the 1992 Baltimore Charter, and seven suggested issues for discussion including career paths and recruitment issues, role models and mentors, child raising and childcare. Each of the 18 tables had a scribe who took notes during a 40 minute discussion to report back to the meeting in a plenary session. Some of the recurring issues discussed included:

1. Hard statistics are essential. There exist bodies of evidence from the USA, UK, Australia, France and maybe other countries. It is essential that we compile a uniform set of statistics.
2. There are some countries (e.g. France, Italy) which have definite programs to provide permanent jobs for young astronomers, particularly women.
3. Cultural differences exist – clearly no one approach works for all situations
4. Family support and flexible working conditions are essential.

For a complete record of the day, we have collected all the notes from the 18 scribes and a more complete summary will be reported in the next IAU Information Bulletin. We will also ask for wider contributions to goals of the WG (which clearly should include contributions from people who did not attend the WAM lunch or the Sydney GA) and constituents of WG Executive Committee, which is expected to comprise about 20 people.

We are greatly encouraged by the support and enthusiasm from participants at the WAM lunch and anticipate success with our Working Group objectives.

Catherine Cesarsky is President-Elect

Catherine Cesarsky

The new President-elect of the IAU is Catherine Cesarsky, a woman of great accomplishment and astronomical reknown.

Having received her first degree in Physical Sciences at the University of Buenos Aires, Dr. Cesarsky obtained her PhD in Astronomy in 1971 from Harvard University. She later worked at the California Institute of Technology.

In 1974, Cesarsky joined the Service d'Astrophysique (SAp), Direction des Sciences de la Matiere (DSM), Commissariat à l'Energie Atomique (CEA) (France). As Director of DSM (1994 - 1999), she led about 3,000 scientists, engineers and technicians active within a broad spectrum of basic research programs in physics, chemistry, astrophysics and earth sciences.

Dr. Cesarsky has worked on the theory of cosmic ray propagation and acceleration, and galactic gamma ray emission. Later, she led the design and construction of the ISOCAM camera onboard the ESA Infrared Space Observatory (ISO) and the ISOCAM Central Program that studied infrared emission from many different galactic and extragalactic sources.

As ESO Director General since 1999, she has been a driving force for the realization of the full potential of ESO's Very Large Telescope VLT/VLTI, and also for the recent European-North American agreement on the construction of the Atacama Large Millimeter Array (ALMA).

Dr. Cesarsky received the COSPAR (Committee on Space Research) Space Science Award in 1998.

Key players Discuss US $10 Billion Investment

by Erica Belling and Judy Lai

World leaders in satellite technology gathered at the International Astronomical Union General Assembly for Industry Day, July 23, to discuss proposed investment prospects within the astronomy industry.

Over the next ten years, US $10 billion will be invested in astronomical observatories and their instruments. Astronomy is a largely untouched market and is set to boom.

Andrew House (Connell Wagner) chats with Bob Frater (ResMed)

Industry Day attendees listen up

Presentations at Industry Day, hosted by Connell Wagner and the CSIRO with the support of the Department of Industry, Tourism and Resources, provided key decision makers in world astronomy an insight into Australia's excellence in this field and an overview of the investment and opportunities in industry and technological developments. The presentations showcased the advantages of the synergy between industry and astronomy.

A potentially beneficial proposal discussed at the event was the $2 billion Square Kilometer Array Telescope project (SKA) which is intended to answer fundamental questions about the formation and the evolution of the universe. Connell Wagner has donated $500,000 for the development of the Australian bid for the SKA project.

If Australia was to secure this venture, it is likely there would be significant developments in antenna and communications technology, extensions in Australia's fiber optic network, improvements in community infrastructure in remote areas and the creation of thousands of jobs.

Centrepoint Tower to be Launched

The Sydney Department of Pointy Edifices announced last night that Centrepoint Tower will soon be trucked to Woomera for launch. The spiny construction, which has served the city for 22 years as a municipal fertility symbol and part-time dirigible mast, will be fitted with booster rockets and blasted into space.

'Australia's space program could use a boost,' said Dr. Wally Northrop, 'and this is really a bargain path to orbit.' Payload plans for the unconventional craft are rumored to include an automated emu experiment, forty pounds of letters to aliens from Australian school children, and a record containing the phrase 'no worries, mate' in 214 languages.

The site of the former tower will be redeveloped as a horse knackery. MT10-27

Designing to a Deadline

by Shaun Amy

Many of you are probably curious as to how the erstwhile publication 'The Magellanic Times' has been produced during this conference. Editor-in-Chief Dr. Seth Shostak and Graphic Designer John Tierney allowed the author exclusive, behind-the-scenes access to their expansive production offices.

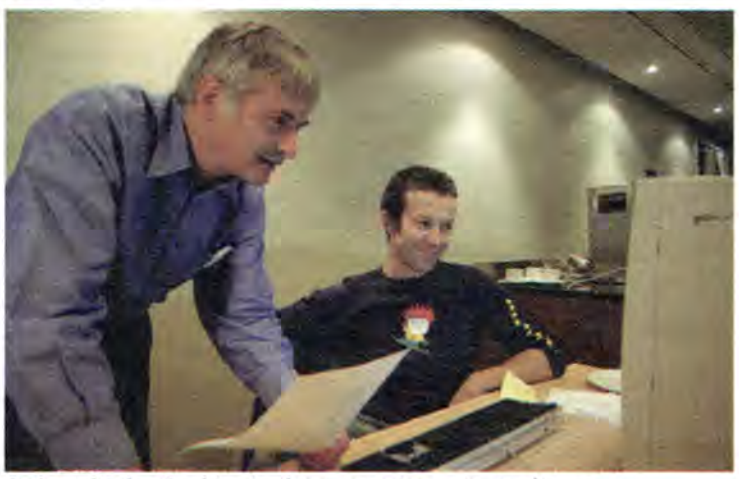
The production team can be, at best, described as 'lean and mean.' A typical day starts with the crack team of reporters being dispatched to various locations around the Convention Centre to sit-in on presentations, hunt down astronomers for interviews and to line-up authors for a brief photography session. Editor Shostak doubles as head photographer.

The editing process needs to be done quickly and often multiple stories are being worked on in parallel. One of the most common problems is that many of the submitted articles are far too long for publication, and have to be culled significantly to meet the demanding production standards. A fine balancing act is required to ensure that the key points are presented to the reader in a clear and concise manner.

Although the nominal deadline for material is 1:00 pm on the day prior to publication, articles are often still being submitted late into the afternoon, pushing the production process well into evening. The final layout is often not completed until around 10:00 pm. As John finishes the layout of a page, it is printed out and passed back to Seth for final checking whilst John works on the next page. As the layout nears completion,

Seth begins work on the following days edition. The final version is sent via e-mail to the printers who ensure 2000 copies (now in color) are delivered early the following morning allowing conference delegates get their early morning 'news fix.'

Note from the Editor: While Dr. Amy has been kind in describing our efforts, John Tierney and I should like to point out that the real work in the production of this newspaper was expended by you, the participants, and The Magellanic Times' team of 'cub reporters.' The latter, whose by-lines you have seen for the last two weeks, are mostly students. Their enthusiasm, effort, and endless good humor have been both inspiring and an unmitigated pleasure. We thank them profusely.



Seth and John double-checking some last minute changes

The Magellanic Times is no more...

...but feel free to keep submitting your articles. However, be aware that you'll have to wait three years for the next General Assembly and a new incarnation of this IAUGA Newspaper before they will make it into print. See you all at the IAU General Assembly XXVI, Prague in 2006.