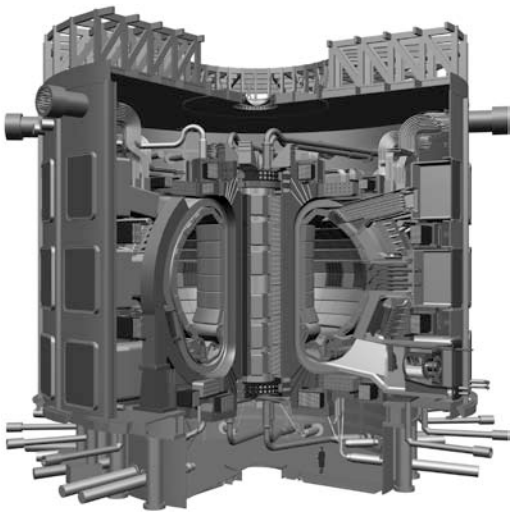
The University of Sydney School of Physics

Alumni News

November 2006

ITER: the Way for Australian Energy Research?

Physics Alumnus talks up the Future of Fusion



Artists's impression of the ITER fusion reactor

"World Energy demand will double in the next 50 years – which is frightening," said Dr Barry Green, School of Physics alumnus and Research Program Officer, Fusion Association Agreements, Directorate-General for Research at the European Commisison in Brussels, at a recent School research seminar.

"The availability of cheap energy sources is a thing of the past, and we have to be concerned about the environmental impacts of energy production."

Dr Green was speaking in Sydney during his nation-wide tour to promote ITER, the massive international research collaboration to build an experimental device to demonstrate the scientific and technological feasibility of nuclear fusion energy.

The need for new energy sources is evident when you consider population growth trends, especially in developing countries (China and India account for almost half of the world's population). "People in developing countries," says Dr Green, "living below the developed world's standard of living, want to use more energy to improve their standard of living. And at this time, 25% of the world's population doesn't even have access to electricity."

Amongst the many different energy sources on our planet, Dr Green calls nuclear fusion the 'philosopher's stone of energy' – an energy source that could potentially do everything we want. Appropriate fuel is abundant, with the hydrogen isotope deuterium and the element lithium able to be derived primarily from seawater (as an indication, the deuterium in 45 litres water and the lithium in one laptop battery would supply the fuel for one person's personal electricity use for 30 years). Fusion has 'little environmental impact or safety concerns': there are no greenhouse gas emissions, and unlike nuclear fission there are no runaway nuclear processes. The fusion reactions produce no radioactive ash waste, though a fusion energy plant's structure would become radioactive – Dr Green reckoned that the material could be processed and recycled within around 100 years.

"Despite all these benefits, a fusion-energy future is still a long way off. Fusion reactions require extreme conditions to turn on, temperatures in excess of 100 million degrees, where matter exists in the state known as plasma."

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Headline

Assoc Prof Brian James

In September the School took part in celebrations for the 50th anniversary of the official opening of SILLIAC, the School's first computer – in fact, the first computer to be built in an Australian university. Of the three computers in Australia at the time it was by far the most advanced, and also introduced the wider community to the benefits of computation. There was a well-attended dinner in the Maclaurin Hall, but a particular highlight was a 'Pioneers Reunion' for those involved in the construction of SILLIAC, where engineers, first users and operators reminisced about the early days.

This year has seen a major restructure of the University with the elimination of the three Colleges (Physics, in the Faculty of Science, was part of the College of Science and Technology). The new structure has a small number of faculty clusters reporting to a Provost, who is also one of six Deputy Vice Chancellors (Science is in a cluster with Agriculture, Food and Natural Resources, and Veterinary Science). The administrative role of the colleges has been split between faculties and a restructured central administration. The aim is to provide administrative services more efficiently so that more resources can be devoted to core activities of teaching and research. Although restructures on this scale cause some temporary disruption, there is already some indication of benefits in terms of more resources flowing to the School level.

Although the University (and particularly the School of Physics) has been very successful in obtaining competitive external research funding, and we attract very good students, the structure of our degree programs, which have changed little over a long period, are under discussion. Influences include the call by government for more diversity in the university sector, and the standardisation of degree structures across Europe (the so-called 'Bologna process') which will see a three-year undergraduate plus two-year masters structure widely adopted throughout Europe, along with uniform accreditation standards and portability of student entitlements. We can be proud of the high standards internationally of our honours program, as evidenced by the fact that our honours graduates are regularly offered postgraduate scholarships at the most prestigious universities. The changes in Europe, however, and the resources flowing to Asian universities means that we operate in an increasingly competitive international environment.

In July we welcomed Bryan Gaensler as our fifth Federation Fellow. Bryan completed his PhD in the School in 1998; prior to his return to the School he was an associate professor of astronomy at Harvard. Many will recall that Bryan was Young Australian of the Year in 1999. Bryan is also International Project Scientist for the international Square Kilometre Array radio telescope (for which, incidentally, the potential sites have just been reduced to two: South Africa and Australia).

In 2005, when we were celebrating the centenary of Einstein's famous publications as the International Year of Physics, we overlooked a local centenary – the first description of the 'pinch effect' by Professor James Pollock (Professor of Physics at the University of Sydney, 1889-1922) and Henry Barraclough (Senior Lecturer in Mechanical Engineering at the time, then subsequently Professor of Mechanical Engineering, and later Dean of Engineering) in the Journal and Proceedings of the Royal Society of NSW (13, 131 (1905)). I was alerted to this earlier this year by Dr Michael Coppins of Imperial College, London who was seeking biographical details about the authors for a talk on the history of fusion research. In August, I was pleased to make amends for our oversight by giving a talk to the Royal Society of NSW on Pollock and Barraclough's paper and the significance of their work to early developments in fusion research.

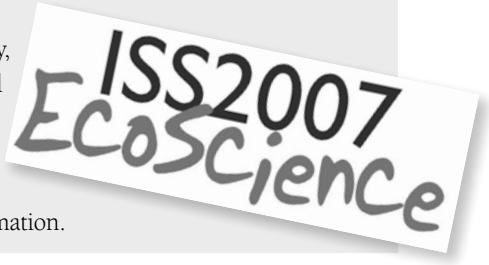
This is my last 'Headline' for the Alumni News as my four-year term as Head of School finishes at the end of 2006. I will also be retiring from the University, after a long association, which began in January 1962 when I attended the Summer Science School held in the School of Physics. I will however maintain contact with the School via an honorary appointment, which will allow me to continue research. I have great pleasure in reporting that Associate Professor Anne Green will be the next Head of School. Anne did her PhD in astrophysics in the School after completing her undergraduate studies at the University of Melbourne. Anne returned to the School as a member of staff in 1991, and in recent years has been Honours Coordinator and Director of the Molonglo Observatory. I wish Anne a very successful term as Head of School, and to all alumni, best wishes for 2007.

Head, School of Physics
The University of Sydney

34th ISS coming July 2007

The environment, ecosystems, atmospheric science, the Arctic and Antarctica, the future of energy, climate change … it's all coming in July 2007 at the 34th Professor Harry Messel International Science School for high-school students, EcoScience.

140 of the world's top high-school science students will stay at the University of Sydney for two weeks of talks, workshops, tours and activities by leading research scientists. Applications for the ISS will be available in January 2007 – visit **www.scienceschool.usyd.edu.au** for more information.



Prof. Clive Baldock, Director of the Institute for Medical Physics

Medical Physics comes of age

Medical physics is one of the fastest-growing areas in the School – the Masters of Medical Physics program has grown from six students when it started in 2004, to eighteen students this year. The Institute also has eighteen research students enrolled in MSc or PhD degrees. This year, state funding was secured for a professorial appointment in Medical Physics within the School, and the Institute's head, Clive Baldock, filled the position.

The School is now advertising for a new lecturer or senior-lecturer in the medical physics field, and four more adjunct appointments have been made, strengthening ties between the School and local and interstate hospitals, the Australian Nuclear Science and Technology Organisation and Australian Institute of Nuclear Science and Engineering.

On 1 December 2006, the Institute will host MedPhys 06, a conference for medical physics students and researchers across NSW. The meeting is being supported by the Science Foundation for Physics and the NSW/ACT Branch of the Australasian College of Physical Scientists and Engineers in Medicine.

Since medical physics is an option in the NSW HSC physics syllabus, high-school physics teachers are invited to attend the event – contact **c.stewart@physics.usyd.edu.au** for more information.

ITER: the Way for Australian Energy Research?

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As exotic as it sounds, 99% of the universe is comprised of plasma, including stars, nebulae and the solar wind. It's here on Earth that plasma becomes difficult to make, but physicists have been studying plasma for decades. Australia has a long history of plasma and fusion research, right back to the discovery of fusion by Sir Mark Oliphant and his colleagues in 1934. Yet after decades of very promising research, enormous scientific and engineering challenges still lie ahead.

ITER is a proposed experimental plasma fusion experiment developed by one of the largest international scientific collaborations, with representation from the European Union, Japan, the People's Republic of China, India, the Republic of Korea, the Russian Federation and the USA. At a cost of many billions of dollars, it is also one of the most expensive science experiments in history. But Dr Green believes the investment will be worth it – and emphasises that the cost is tiny in comparison to the world's energy consumption.

"Less than 0.1% of the energy costs in OECD countries like Australia is put back into energy R&D," he says. "We should be investing much, much more."

A site for ITER was decided in 2005, in Cadarache, France, and funding was agreed in May this year. Several researchers in the School of Physics are members of the Australian ITER Forum, run by Dr Matthew Hole at ANU. On 11-13 October 2006, the Forum will bring together international ITER team-members, Australian industry, the research community and government to discuss Australia's role in this grand science experiment.

For more information on ITER:
www.ansto.gov.au/ainse/fusion/index.html

Dr Barry Green holds a PhD in theoretical plasma physics from the School of Physics. In 1973 Barry worked on the design, construction and operation of the European fusion experiment, JET – he was the JET Engineer in Charge on November 1991 when JET produced the first significant amount of fusion power ever in a man-made device. From 1993-2003 he was a member of the ITER international design team at its Joint Work Site in Japan. This international team prepared the design of the device, the construction of which has been now been formally agreed by the representatives of the governments of the 7 parties involved: China, Europe, Korea, India, Japan, Russia and the USA.

Since March 2003 he has worked in the Directorate General Research of the European Commission in Brussels, Belgium, in the Directorate of Energy and is specifically involved with the European fusion research and development programme. The Directorate of Energy directs all the European Commission-supported energy research programs.

Profile: Peter Poole

For Emeritus Professor Peter Poole, SILLIAC Pioneer and the man credited with bringing the Internet to Australia, it seems the further south he travelled the better his career opportunities. Starting in Brisbane with a BSc (physics and mathematics) and a Dip. Ed. at the University of Queensland he taught high school science and mathematics for 4 years before returning to postgraduate studny in the area of his first love: Physics.

A young Peter Poole in 1960

Alumni News: You've credited Professor Harry Messel in playing an important role in your career – can you tell us about that?

Peter Poole: In 1955 while on the staff of the Charters Towers State High School, I read an article in the local newspaper about the appointment of a new Professor of Physics at the University of Sydney. His name was Harry Messel, and what he had to say about his plans for the future I found very exciting. It made me realise that, while I quite enjoyed teaching, it still left me feeling somewhat unfulfilled as I had always dreamed about becoming a scientist, in particular, a physicist.

In 1955 I decided to write to him to enquire about undertaking an MSc in the School of Physics. A couple of days after posting the letter, I received a reply from Prof. Messel. As usual, he pulled no punches! The letter commences with the salutation 'Dear Poole' and goes on to say that I would have the qualifications to apply to sit for the M.Sc. Qualifying examination – which was the 4th year honours Physics paper. If I obtained the equivalent of 1 st Class Honours I would receive a Research Studentship to proceed to an M Sc degree.

He was at pains to point out that the Sydney courses had been drastically revised and were of a rather advanced nature compared to Queensland. That was enough for me! I resigned from teaching at the end of 1956, packed all my worldly goods in my little Morris Minor and travelled down to Sydney to enrol in the School of Physics. At the ripe old age of 25, I was unemployed and a student once again!

AN: So you moved to Sydney ... what then?

PP: True to his word and even better, Prof Messel appointed me to the staff of the School of Physics as a Teaching Fellow at a princeley salary of £2000 per annum which enabled me to pursue a part-time higher degree. After completing my PhD in 1964, I was appointed to a Temporary Lectureship in the Basser Computing Department.

In 1965, I left Australia to work overseas in the UK and USA, returning in 1975 as the Foundation Professor of Computer Science at the University of Melbourne. In 1992, Prof. Messel contacted me to suggest that I should apply for the position of Dean of the School of Information Technology at Bond University where he had become the Chancellor after retiring from Sydney. I did and took up the position in 1993, remaining there until I retired in 1997.

AN: SILLIAC was in operation at the School of Physics when you arrived at the University of Sydney – what was its impact on you?

PP: There is no doubt in my mind that SILLIAC changed the course of my life forever. I did not make much use of the computer in 1957 but once I became a researcher and joined the Cosmic Ray Air Shower Group, that all changed. The group was operating an air shower array comprising 92 detectors. When a large air shower hit, information about its characteristics would be stored and then punched out on 5-hole paper tape – when I joined the group, they were literally drowning in paper tape. I designed and wrote what today would be called a 'database system', however it operated on magnetic tape rather than disc. The tapes were made available to other members of the group, which greatly facilitated their research as it did mine. I wrote many other programs during the course of my research and became very adept at programming SILLIAC.

AN: What do you feel is the future of information and communication technology within Australia?

PP: Fifty years working in the ICT field have taught me to be very wary about trying to predict the future in this discipline. Thomas J Watson, the founder of IBM, predicted in the late 40s that half a dozen machines would satisfy the needs of the world for the next 25 years. Ken Olsen, the founder of Digital Equipment Corporation, once remarked that he could see no future for the home computer – today, DEC is no more! The most fascinating aspect of these 50 years is to see how the computer and the human being have moved closer and closer together. A good example of this is the bionic ear where Australia is a world leader. Perhaps it is in such niche markets that our future lies.

The day that Pluto died …

By Phil Dooley, roving reporter

Pluto: dwarf planet

The t-shirt reads 'RIP Pluto, 1930 – 2006'. On Thursday 24 August this year at their annual General Assembly in Prague, the International Astronomical Union ruled that Pluto was no longer a planet. On that fateful day the news raced around the world – but now, three months on, what impact has the decision had?

Mario from Sydney's Sky and Space Astronomy shop reports that the general public are pretty unperturbed. 'No, no one's really talking about it,' he says. No, they don't stock the t-shirt, and no, nobody's asking for it.

There is no mention of Pluto's demise on the Disney website (for whose lovable dog the ex-planet was named, not for the Roman God of the Underworld). [Really, Phil? Have our lawyers checked this? – Ed]

And at Hans Smallgoods, makers of the iconic Pluto Pups battered-sausage-on-a-stick, the impact has been not a crumb in the ketchup bucket. 'Pluto Pups are popular,' says Josh Deans, Account Executive. 'Yeah, they're going really well.'

But the astronomers are still excited: over 300 objections have been submitted since August from IAU members who weren't present at the crucial session in Prague. Here in the School of Physics, Associate Professor Anne Green, who was lucky enough to be at the meeting, still gets a sparkle in her eye when she talks about it. 'Yes, it was fun! The most exciting session we've had in years!'

'Pluto's really irrelevant,' points out her colleague Professor Dick Hunstead. Although Pluto was the 'star of the show' [Boom boom – Ed] the real science being hammered out that day was in the categorisation: how to name not just Pluto, but its entourage of largish rocky bodies scattered through the void out beyond Neptune.

The controversy arose as increased resolution allowed detection of bodies of a similar size to Pluto, such as Xena and Ceres, suggesting that there might be a host of far-flung planets waiting to be discovered. Evidently some ruling was needed to sort the wheat from the chaff, and this year's 26th IAU General Assembly was the chosen forum.

Scientists can get fiercely territorial about their subjects, and Astronomers are no exception. The early hearings heard raised voices and fists thumping desks as the Dynamicists lived up to their title, vociferously demanding that the planet definition include a clause regarding the body's ability to dominate its orbit by clearing the neighbourhood of smaller bodies.

The week progressed and the debate swung back and forth – a cartoon in the daily newsletter depicting the council still debating, even as a red-giant Sun swallowed the planets they were debating about, must have hit a nerve.

This is when the real star of the show emerged in Jocelyn Bell Burnell, the chair of the final session. Recognised as the discoverer of Pulsars (although she missed out on the Nobel Prize for it), Professor Burnell showed another string to her bow. Not only did she bring a 'didactic model' – including beach balls for the classical planets, a Pluto soft toy and box of cereal (for Ceres) – she also ruled the final session with a firm hand and made sure a decision was made. Perhaps she'll get her Nobel prize for her identification of the smallest quantum of astronomical debate: she allowed points from the floor 'the time it takes a lift to get from the first floor to the second'.

'At the end of the day,' says Associate Professor Green, 'I think the ruling was fair and made sense.

'Note, though, this is only for the Solar system! When we get the resolution to pick out planets around other stars, we'll have to do it all again,' she says with a chuckle.

I think she's looking forward to it.

The IAU Resolutions

A planet is a celestial body that is in orbit around the Sun, has sufficient mass for its self-gravity to overcome rigid body forces so that it assumes a 'nearly round' shape, and has cleared the neighbourhood around its orbit.

A dwarf planet orbits the Sun and is 'nearly round', but differs in that it has not cleared the neighbourhood around its orbit.

SILLIAC TURNS 50!

SILLIAC, the first high-performance, automatic, stored program digital computer to be built in Australia, celebrated its 50th Anniversary on 12 September 2006 in appropriate style.

The panel at the Pioneer's Reunion enjoy a laugh

Guest speaker Drew Kelton, Telstra International

John Deane's book sets the SILLIAC story straight

The SILLIAC Pioneers Reunion was held in the afternoon in the Slade Lecture Theatre at the School of Physics. Eight panellists, including some of the original engineers, operators and users of SILLIAC, recounted their time working on the giant computer. An audience of fellow pioneers and enthusiasts made for a lively discussion, recalling an era of early computing that is still a strong part of people's memories fifty years later.

Professor John Bennett's role as a leader in Computer Science was acknowledged by Professor Greg Hancock, Dean of Engineering, and Professor Albert Zomaya, Head of School of Information Technology, who announced that henceforth the School of IT's vacation scholarship program would be known as the John Bennett School of IT Vacation Scholarships.

After the reunion, the crowd migrated to the Nicholson Museum for the launch of computer historian John Deane's book, **SILLIAC: Vacuum Tube Supercomputer**. Emeritus Professor Harry Messel AC CBE introduced the author, commenting that the book would 'at last tell the real story behind SILLIAC'. A complimentary copy of the book was available for all attendees.

The celebrations did not stop there – nearly three hundred attended the SILLIAC 50th Anniversary Celebration Dinner, held in beautiful MacLaurin Hall. Guests arrived to the sight of actress Emily Taheny as the 'SILLIAC Operator', sitting on stage studiously working an original SILLIAC punch card machine and cheerfully waving and chatting to the crowd.

The evening's MC Karina Kelly welcomed guests to the event, and introduced the premiere of the SILLIAC DVD, a collection of interviews with key individuals in the history of SILLIAC and Australian ICT, narrated by the ABC's Adam Spencer. Throughout the evening guests enjoyed four episodes from the DVD as they wined and dined.

The Chancellor, Justice Kim Santow OAM, warmly introduced Professor Messel, who has never had difficulty holding the stage before a large crowd. The Vice-Chancellor, Professor Gavin Brown AO, after telling of his love of horse racing, expressed his appreciation for 'any machine funded by the prize money of a Melbourne Cup winner'. (For the full story, you will have to read John Deane's book!)

"Guest speaker Drew Kelton, Managing Director of Telstra International, admitted to being 'overwhelmed at being chosen to be the speaker on such a significant occasion in such memorable surroundings'. He used his address to pay tribute to the pioneers and leaders of the Australian computing and communications industries."

Eventually, a long but successful celebration came to an end, but not before many old friends had been reunited and old stories shared.

For more SILLIAC event photos visit **www.physics.usyd.edu.au/foundation**

ISS Reunion

On Friday 7 July ISS alumni from 2003 and 2005 gathered for an informal reunion on the roof of the School of Physics. The two House Parents from ISS05 came down from Queensland to attend, and some of the staffies and lecturers joined in as well. The reunion was due to wind up at 3pm, but some scholars sat catching up until the sunset, when it got too cold to stay up on the roof.

Some of the scholars are studying for the HSC this year; others are heading off to uni (one to study medicine at Columbia in New York!); still others are old hands in their third year of tertiary study. It's great to know that the ISS has had such a positive impact on this interesting and diverse group of alumni.

Check out a few photos at:
www.physics.usyd.edu.au/foundation/reunion

Excitement Reignited

The 2006 Science Teachers' Workshop for Physics Teachers

Learning the physics of the build-it-yourself hovercraft at the Wagga Wagga STW

In June, the School of Physics and the Science Foundation for Physics hosted the 2006 Science Teachers Workshop (STW), titled Reignite your Excitement for Physics. The biennial STW traditionally aims to provide physics teachers in NSW and the ACT with professional development specifically tailored to the local syllabus – STW2006 also aimed to remind the 120 attending teachers of the excitement and passion inherent in physics research.

The 2006 STW featured a series of lectures on current research within the School of Physics, including Dr Peter Tutill, Eureka prize-winning astronomer, on the birth and death of stars; Prof. Ben Eggleton on the photonics revolution and the development of the all-optical chip for communications and computing; and Dr Stephen Bartlett on the strange world of quantum computers. Award-winning physics teacher Dr Mark Butler, from Gosford High School, challenged the teachers to seek and nurture the next generation of scientists and engineers.

Over the two days, more than a dozen small-group sessions gave the teachers a chance to update their physics knowledge and learn new classroom techniques. Staff from the School ran sessions on quantum physics, medical physics and solar energy. Dr Rob Hollow from CSIRO's Australia Telescope National Facility, presented workshops on astrophysics and cosmology.

About half of the participants attended the STW Dinner in the fine surrounds of St John's College. Over dessert, they were enthralled and entertained by UNSW physicist Prof. Joe Wolfe, who mused over the interface between science and music and attempted to understand where exactly the information resides within a musical composition.

For more information on the Science Teachers' Workshop 2006, go to www.physics.usyd.edu.au/foundation

A happy KickStart student

Some of the dedicated physics outreach team

Dr Phil Dooley

Physics goes Bush

Every two years, the School and the Foundation take the Science Teachers' Workshop to several regional areas of NSW. This year, the STW combined forces with the School's most popular program, the KickStart workshops for high-school physics students, to visit Wagga Wagga in July and Armidale in August.

KickStart is run throughout the year at the School in Sydney, and this year alone more than 2,000 students have come for the hands-on workshops. IBM Australia generously donated funds to help get the physicists on the road in 2006.

Dr Phil Dooley, the School's Science Communicator, runs KickStart. 'It's very exciting, we've never taken this program out of the labs before,' he says. 'The workshops are very popular in Sydney – schools come from as far afield as Gunnedah and Murwillumbah to spend a couple of hours playing with our equipment.'

> **"But not everyone can afford to get to the city. IBM sponsored us to get KickStart out of Sydney, to hit the road and spread the love around. Most schools don't get to see equipment from a uni lab – equipment that actually works!"**

The regional trips were a great success, enjoyed by many teachers and students – one teacher who attended the Armidale workshop drove for over a day to get there from far-western NSW. Phil and the outreach crew are already planning the next KickStart road-trips for 2007.

For more information on the School's outreach programs, go to www.physics.usyd.edu.au/outreach.html

Where are you now?

Diana Londish

In this special edition of WAYN, we introduce Diana Londish, one of two physics alumni recently elected to the Standing Committee of Convocation, which represents the alumni of the University of Sydney — all 210,000 of you!

I graduated from the University of Sydney in 2004 with a doctorate in Astrophysics – at the ripe old age of 54! Astronomy had always fascinated me, but as a girl from a working class family in England in the 1960s I left school at age 16 and took a secretarial course without ever experiencing the joy of mathematics and the wonders of physics!

"In my mid-40s and then in Australia, I was spurred on to enrol in HSC maths, physics and chemistry by my son's obvious interest and keen understanding of the sciences. What a joy to discover calculus and the laws of the Universe! Completing my undergraduate and graduate degrees was hard work and my poor old brain struggled to keep up with the brilliant youngsters who were my fellow students – a mathematician's brain peaks at age 25 so I was well and truly over the hill and in the tail of the bell curve!"

After receiving my degree I took up a postdoc at NASA's Jet Propulsion Laboratory in Pasadena, California, working on quasars. Although the experience of working in a thriving (and well-funded!) astrophysical community was stimulating, I elected to return to Sydney after the initial one year of my contract and am now working at CSIRO's Australia Telescope National Facility (ATNF) at their Epping headquarters. My position there is with the team that is promoting Australia as the host nation for the next generation radio telescope, the Square Kilometer Array (SKA – see **www.atnf.csiro.au/projects/ska** for further details).

I sought election to the Standing Committee of Convocation at the end of last year as I wished to remain involved in the life of the University and also wished to bring to Australian university associations some of the ideas I had picked up while in Pasadena where I joined a mentoring program for women students at Caltech. Also as a mature student with a son who was at the University of Sydney I was aware that, for some students (often the more serious science students and particularly the teenage boys) it can be difficult to feel comfortable socially. I feel some form of mentoring or social interaction between young students and postgrads in their same fields could be enormously beneficial, and would foster a strong sense of belonging that is the norm at American universities but generally lacking among Australian students and graduates.

The mission of the Standing Committee of Convocation, as the peak alumni body of the University, is to play a central role in building a life-long partnership between the University and its alumni, commencing as undergraduates, that seeks to reach, engage and represent them in the life and work of the University.

We welcome contributions to this column

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TANDEM 11734 10/06