The University of Sydney

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The University of Sydney
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The Secretariat
Senate Legal and Constitutional Committee
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Canberra ACT 2600

Senate Inquiry into Australian Expatriates

I write on behalf of my colleagues at the University of Sydney, at the NSW Department of Education and Training, and at Harvard University in the United States, to offer our thoughts on "ways in which Australia could better use its expatriates to promote our economic, social and cultural interests".[1]

Australia's capacity for innovation and achievement could be greatly boosted by exploiting the expertise and intellectual capital of the expatriate Australian research population. The Australian diaspora includes tens of thousands of our best and brightest scientists, engineers and researchers, working for leading universities, hospitals, government organisations and private companies in other countries. Collectively this group makes a vast economic and intellectual contribution, but very little of this benefits Australia. Most of these expatriates feel strong links to Australia, but feel frustrated at the lack of opportunities back home.

At the University of Sydney, we do not regard these people as a loss to Australia's research capacity, but rather see this community as a considerable untapped resource for Australian innovation. We encourage the Federal Government to develop schemes to mobilise this diverse group of highly achieving Australians, allowing them to direct their achievements and abilities back home, without forcing them to "choose" between the overseas and Australian experiences.

Such an effort would have the following outcomes:

- It would provide exceptional research and education opportunities to Australian-based researchers and students, by providing expertise and collaborative opportunities not otherwise available in Australia.

[1] This is item (f) of the terms of reference of the Senate's "Inquiry into Australian Expatriates".

- It would allow expatriate Australian researchers to establish and maintain links to Australian-based institutions (potentially paving the way to a full return home at a later point).
- It would facilitate long-term collaborations and new cross-fertilisations between Australian and foreign institutions.

As part of "Backing Australia's Ability", the Federal Government has already initiated the "Federation Fellowship" program, aimed at recruiting 25 outstanding researchers each year; many of the recipients of these fellowships are Australians based overseas. However, this program engages only a small fraction of the talent and expertise available amongst expatriate Australian researchers.

Various discrete programs have already been developed to partly address these goals. However, there is a lack of coordination and cohesion between these programmes, and many of them are not yet widely known. In some cases these initiatives lack sufficient funds or commitment to make a real difference. We propose an institutionalised program, supported by the Federal Government, with the capacity to tap into the ability and experience of our expatriates at all levels.

The University of Sydney will soon lead a submission to the Australian Research Council for funds to set up a "Network of Expatriate Australian Researchers" (NEAR) under the ARC Research Network Scheme. NEAR has already received seed funding; a WWW site detailing our goals and organisational structure is available at

http://near.chem.usyd.edu.au .

The aims of NEAR will include[2]:

- identifying Australian researchers overseas,
- establishing communication channels that will allow Australian researchers overseas to interact easily with each other and with those back home,
- developing substantive networks between Australian and expatriate researchers, and
- identifying ways of tracking future students and researchers leaving Australia.

We propose the following set of initiatives, which can all greatly benefit from substantial, institutionalised funding:

1. The core of such an initiative should be a hierarchy of "Return Fellowships", through which expatriates at varying levels of seniority could return home for repeated short visits (e.g. 2-3 months per year for up to five successive years). Such a scheme would provide Australia with access to high quality researchers from prestigious overseas-based organisations, at a cost vastly lower than that needed to fully support such individuals and their research programs. A Return Fellowship program also allows overseas-based Australians to put something back

[2]See the NEAR WWW site for details on all these efforts.

into Australia, without forcing our best researchers to have to choose between Australian and overseas opportunities (as is currently largely the case). The University of Sydney and NSW Department of Education and Training have together already carried out a two-year pilot programme, the **"New South Wales Expatriate Return Awards"**, which have brought back to NSW four high-achieving expatriate Australians for short periods. We attach to this letter a progress report on this programme: it can be seen that this has been a highly successful exercise, in terms of its research outcomes, potential for future collaborations, and its extremely positive impact on primary and secondary school students. This program could be greatly expanded, allowing hundreds of highly-skilled expatriates, from all disciplines, to share their knowledge and enthusiasm with colleagues and students in Australia.

2. To complement the above scheme, we propose a mentoring program, through which our highest-achieving expatriates will be able to provide advice and guidance to the next generation of Australian researchers. The first attempts at this are now underway in the form of the Young Australian Professionals in America (YAPA) scheme, initiated by New York Consul-General Ken Allen.
3. We propose a fully developed infrastructure for cohesion and communication between expatriates and Australian-based researchers, so as to facilitate new opportunities for collaboration and cooperation. The Victorian Expatriate Network (VEN) represents a preliminary effort at the State level in this regard.
4. To complete this picture, we propose a complementary visiting program through which Australian researchers could visit and liaise with their expatriate colleagues overseas. The existing International Science & Technology component of the Federal Government's Innovation Action Plan could be significantly broadened to include such efforts.

To summarise, we recommend a broadly-based initiative, aimed at bringing Australia's best researchers back home, creating and enhancing connections to the world's top institutions, and providing outstanding educational possibilities for the next generation of Australian researchers. The cost associated with such a programme is vastly smaller than that needed to entice our expatriate community to move home permanently. Providing our talented overseas citizens with opportunities to put something back into Australia represents a highly cost-effective way of boosting Australian innovation.

Yours sincerely,

Gavin Brown
Vice-Chancellor and Principal

EVALUATION REPORT FOR THE PILOT 2003 RESIDENCY AWARDS FOR EXPATRIATE SCIENTISTS

1. Executive summary

An initial proposal for short-term residency scholarships was put to the Premier in June 2002 by Professor Bryan Gaensler, Young Australian of the Year in 1999, with the support of Justice Kim Santow, OAM, Chancellor of the University of Sydney. That initial proposal envisaged support for researchers from other areas as well as science. The Premier's Department sought advice from the Minister for Education and Training and the University of Sydney and subsequently initiated a meeting with the Director-General of Education and Training to discuss the proposal.

An agreement was reached in August 2002 between the University of Sydney (USyd), the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and the NSW Department of Education and Training (DET) to fund two residency awards for expatriate scientists in 2003 and a steering committee, chaired by Professor Hesketh, the then Dean of Science at USyd, was established to manage the pilot program. The awards are to support the return (for up to three months in a given year) to NSW of expatriate scientists who have contacts with researchers in NSW and ideas for projects with potential benefits to the recipients, their sponsors and employers, NSW and Australia more generally.

Advertisements seeking applicants were made in "The Australian" newspaper and posted on USyd and expatriate email networks in December 2002. Professor Paul Franzon and Dr Theo ten Brummelaar, both working in the US, were offered inaugural Awards in February 2003. The pilot project for both expatriates cost the partners $69 000 (not including steering committee members time).

Feedback from academics and researchers confirmed genuine interactive vitality between the expats and their NSW collaborators. Significant long-term projects in molecular electronics and stellar interferometry were initiated.

Feedback from DET schools visited by the expatriate scientists indicated heightened enthusiasm for science and greater awareness by students and science teachers of the range and benefits of scientific careers.

As a result of that positive feedback, the partners agreed to continue the pilot into 2004 with in-principle support given for 2005 as well.

Following advertisement in October 2003, two further awards for 2004 have been made. They are to Professor Ian Gardner (expertise in veterinary epidemiology) and Professor Kenneth Waldron (expertise in robotics). It is anticipated that they will take up their awards from the beginning of July until the end of September 2004.

Additional funding and support from other sources is being sought, including from potential NSW sponsors, to enable the pilot program to become an institution from 2005 that supports the return to Australia of researchers from science and other areas (as was envisaged in the original proposal).

This NSW initiative has anticipated the Australian Government's recently announced Senate inquiry into *Australians living overseas: the factors driving them there, their needs and concerns, as well as the economic and social implications for Australia* (announced in October 2003 and for report by September 2004).

Several recommendations relating to support for the program in 2004 and beyond are provided for consideration by the Premier at the end of the report.

2. Background

Professor Bryan Gaensler, Young Australian of the Year in 1999, with the support of Justice Kim Santow, OAM, Chancellor of the University of Sydney wrote to the Premier in June 2002 outlining a proposal designed to reduce the negative impact on the Australian economy and intellectual life when our young, brightest and best researchers accept jobs overseas (the media refers to this as the 'brain drain').

His proposal suggested setting up a scholarship fund to enable expatriate researchers based overseas, with a commitment to Australia, to be funded to return for short periods of time to work with Australian colleagues on projects that were of mutual benefit and that had broader educational and economic potential. Justice Kim Santow proposed that the scholarships be given the working title of *Foundation Return Scholarships*.

It was also proposed that each scholarship be worth up to $55 000 for three months in NSW and that each recipient would spend up to ten days of that time visiting schools and talking to students, teachers and related communities.

The Cabinet Office forwarded the letter to the then Minister for Education and Training for advice. At a meeting on 15 August 2002 involving Professors Beryl Hesketh and Les Field from USyd, the then Acting Director-General DET and other senior DET officers, a paper describing a scholarship proposal was considered.

The meeting agreed to support a pilot program offering two scholarships to expatriate scientists in 2003 jointly funded by a partnership involving USyd, the CSIRO and the NSW DET.

Advice was provided in December 2002 to the Minister for Education and Training to that effect and approval in principle to proceed was received from the Minister in January 2003.

The pilot Residency Awards for Expatriate Scientists program (the change from Scholarship to Award was suggested following advice from USyd about the tax

implications of scholarships verses awards) is managed by a steering committee whose membership includes:

- Professor Beryl Hesketh, now Pro-Vice Chancellor (College of Sciences and Technology) who is chair of the committee and from the University of Sydney
- Professor Bryan Gaensler from Harvard University
- Professor Ron Ekers, Foundation Director of the CSIRO's Australia Telescope National Facility (Professor Ekers withdrew from the Committee early in 2003 due to his appointment as a Federation Fellow. No CSIRO replacement has been identified as yet)
- Mr Jim Scott, Chief Education Officer, Science from the Department of Education and Training.

Mr David Rushton, a retired DET Science 7-12 Consultant, and personnel from the office of the Pro-Vice Chancellor (College of Sciences and Technology) at USyd provide administrative support for the program. An important role for David Rushton was the organisation and coordination of the school visits by the two visiting expatriate scientists.

An advertisement was placed in December 2002 by the steering committee in "The Australian" newspaper and posted to scientists on USyd and international expatriate email networks seeking expatriate scientists to work in Australia in 2003 for up to three months.

Seventeen applications (representing 8 countries on 3 continents) from highly distinguished scientists were considered by the steering committee against the following three criteria:

- the academic quality of the applicant
- the relevance and potential benefit of the applicant's collaborative research proposal for the research programs at USyd and/or CSIRO
- the ability of the applicant to communicate effectively and especially with high school students.

Two applicants were chosen. They were:

- Paul Franzon PhD, Professor of Electrical and Computing Engineering at North Carolina State University who is recognised as a leader in the emerging area of nanoengineering.
- Theo ten Brummelar PhD, an astrophysicist, who is the Associate Director of Georgia State University's Centre for High Angular Resolution Astronomy [CHARA] which is situated on Mt Wilson in California.

A more detailed profile of each recipient is attached as Appendix 1.

The cost of the 2003 pilot was $68 928.83 which was considerably less than anticipated (and appreciated by the steering committee because the CSIRO appears to have withdrawn from the initiative at this stage). USyd has met two thirds of that and the DET the remainder. The considerable "in-kind" support given to the project by steering committee members has not been included in the above figure.

The steering committee met early in September to evaluate the pilot. The partners agreed that the pilot *2003 Expatriate Scientists Program* had more than met expectations and it was agreed to support an extension into 2004, but to call it the *2004 Expatriate Researchers Program*. The change of "*Scientists*" to "*Researchers*" captures the committee's intention to encompass other disciplines as well as science.

To that end, ads were placed with a closing date of 21 November 2003 in the Australian Newspaper and posted on USyd expatriate email networks.

For 2004, nine very strong applications were received from highly achieving researchers in six countries. The lesser number of applications was attributed to the timing of the offer (when the Northern Hemisphere academic year is at its busiest) and the relatively short time to respond. After full consideration by the selection panel, offers were made to two applicants that were subsequently accepted.

Both recipients have science and technology related backgrounds and both have strong connections with NSW researchers who are keen to host their visits. They are:

- Ian Gardner, Professor of Epidemiology, University of California, Davis, USA. Ian is considered to be one of a handful of world-class, veterinary, epidemiologists.

- Ken Waldron, Professor [Research], Stanford University, California, USA. He has a peerless record of achievement across a wide range of engineering endeavours and particularly in mobile robotic systems where he is considered to be a world leader.

A more detailed profile of each recipient is provided at Appendix 2.

3. Homecoming

Professor Paul Franzon

Paul Franzon was in Australia from August to December 2003 during which time he returned to the US several times because of commitments made prior to his acceptance of the Expat Award.

Paul's visit was hosted by Professor Jeff Reimers and Professor Noel Hush of the University of Sydney's Molecular Electronics Group in the School of Chemistry.

To quote from the Group's home page, "The Molecular Electronics Group is engaged in research in single molecule electronics of a wide-ranging nature. Molecular electronics is the ultimate form of Nanotechnology. In the area of information processing, single molecule electronics is the inevitable enabling technology for the essential next major

step in computer architecture development. Concepts derived from it will also underpin revolutionary advances in post-silicon photovoltaic systems."

Paul was engaged in four main areas of activity, nanotechnology, wider technical engagement, "commercialization" and educational presentations in a range of DET schools.

The outcomes from school visits are described in *Educational outcomes* section below.

Research outcomes

Paul Franzon worked with Sydney's Jeff Reimers and Noel Hush and their colleagues have begun joint projects in highly promising research areas that are outlined below in extracts from Paul's report to Professor Hesketh.

"*Molecular Photovoltaics*. These have tremendous promise to revolutionize electricity production – 40% efficient cells costing $\$50/m^2$. We collaborated on building an initial experiment, which is still being completed. We wrote a joint $US6.5M proposal to the US Defense Advanced Research Projects Agency (DARPA), which is still under consideration. We are also pursuing other avenues for funding, including the US DOE. This joint project is very likely to have sticking power. It is a very high quality project... *Molecular Flash Memories*. We are collaborating on circuit and integration issues for molecular flash memories. A joint proposal to DARPA is currently in formulation. *Molecular Modeling for Circuit Simulation*. We are preparing a joint journal publication in this area."

Jeff Reimers has expressed extreme satisfaction about the progress thus far. He has praised in glowing terms Paul Franzon's intellectual input, strategic project skills and development of funding proposals. He has indicated a significant immediate value-added contribution to his group as well as a clear long-term benefit. These were described in the advertised requirements as key outcomes expected from an Expat Scientist Award recipient.

Working with this group was greatly valued by Paul who wrote, "I have learned a lot about the true potential and limitations of molecular electronic nanotechnology. I would like to add that this is a very high quality group with an excellent international reputation".

Paul also initiated a broad spectrum of technical engagement by way of discussions, talks and presentations including at CSIRO, Edith Cowan University, University of Newcastle National Science Week Dinner; Rotary Club of Tamworth; University of Adelaide, The Institute of Physics, and the NSW Section of the IEEE. In his report Paul also notes technical interaction with faculty in USyd's Department of Physics, with faculty at the University of Newcastle, and with engineers at several local companies (Cisco, Agere, STI, Intel).

For much of his professional life Paul Franzon has had a strong interest in the commercialization of technological developments and he writes in his report: "I wanted to make a contribution to the Australian scene on this front. To this end, I talked to local entrepreneurs as well as did some background research. I wrote (a) white paper outlining two programs I have experienced in the US that could be adapted to the Australian scene. I intend to continue distributing this white paper after I leave for the US. However, my immediate goal is to determine if it makes sense to run a 5-day TEC workshop in Australia, and if so, how to organize it".

Paul's integrity and commitment to the program coupled with his outstanding work ethic ensured that his program of research and educational presentations was well in excess of requirements.

A copy of Paul's full report to Professor Hesketh on the residency award experience is provided as Appendix 3.

Dr Theo ten Brummelaar

Theo ten Brummelaar was in Australia from mid-July to late October 2003.

Theo's visit was hosted by Professor John Davis and the Sydney University Stellar Interferometer (SUSI) group from the Institute of Astronomy in the School of Physics.

To quote from SUSI's home page, "The Sydney University Stellar Interferometer (SUSI) is a long-baseline optical interferometer located approximately 20km west of the town of Narrabri in northern New South Wales, Australia. SUSI is operated by staff from the Astronomy group (formerly the Chatterton Astronomy Department) within the Institute of Astronomy at the University of Sydney. It is located at the Paul Wild Observatory, alongside the Australian Telescope radio interferometer, a facility operated by the Commonwealth Scientific and Industrial Research Organisation (CSIRO)".

SUSI has been designed to use the combined optical power of a number of linked telescopes aligned on a north-south baseline of up to 640m to tackle a range of problems in stellar astrophysics such as binary or double stars. Sophisticated design features to increase the optical capability of SUSI while minimising the effects of atmospheric turbulence.

Theo's visit focussed on putting into place a Memorandum of Understanding [MoU] for international cooperation between USyd and Georgia State University that would cover joint research projects, control-software development, post-graduate exchanges, and remote-access opportunities between the SUSI and CHARA groups.

He was also enthusiastically involved in the DET school visits program (see section below on *Educational outcomes*).

Research outcomes

The MoU formalized and extended an existing framework for significant and long-term interaction between the Sydney University Stellar Interferometer [SUSI] group and Georgia State's Centre for High Angular Resolution Astronomy [CHARA] Array.

The MoU will create opportunities for both institutions to pursue:

- joint research programs.
- joint teaching programs
- more funding to support these initiatives

Joint research programs have begun. The initial program is a study of local binary stars which is expected to expand to include many other areas of stellar astrophysics. Observations of the first binary star began with both instruments during 2003 with more planned for 2004. Already enough data has been collected to establish a new orbit for a nearby binary star system. This is expected to yield new masses for the two stars involved with unprecedented accuracy. These data will be published in mid 2004.

The *joint research programs* have clear research advantages of comparative image analysis and improved validation processes. The significant staff and post-graduate exchanges envisaged will clearly build on the internationally recognized stature of Australian astronomy by developing the skills and experiences available to Australian astronomers as well as encouraging the depth in their ranks in the profession.

Scientists in both institutes have been preparing *joint observing proposals* for the two instruments and are pursuing funding to continue the work, including more opportunity for travel. Planning is underway for a proposed visit by Dr. Peter Tuthill of the SUSI group to the CHARA site in California this February, and it is expected that Professor ten Brummelaar will return to USyd and SUSI in late 2004.

Joint teaching/research programs will provide students in both institutions opportunities to spend time at both observatories and eventually enable the joint supervision of graduate students. The funds have already been procured to allow one of SUSI's graduate students, Julian North, to travel to California and spend some weeks working at the CHARA Array in early 2004. His efforts will be focused on the transfer of remote operations capability discussed below while also learning how to operate the CHARA Array.

Remote control of telescopes. The CHARA array has in place a full remote operations capability allowing control of the instrument from anywhere on the internet. Since the CHARA control software was originally based on the SUSI control system it will be comparatively simple to transfer this remote capability back to SUSI. This will allow the joint operation of both instruments from the same location and give students and academics in both institutes access to these two unique instruments.

Theo's full report to Professor Hesketh about the residency award experience is attached as Appendix 4.

Educational outcomes

In total Paul and Theo contributed twenty days between them to school visits. They gave over 30 presentations to more than 2000 students and 90 teachers from 36 schools as well as 270 science consultants, tertiary educators and community members. A more detailed report and complete list of school visits is attached as Appendix 5.

The Department of Education joined the Expat Program as a sponsoring partner with a number of outcomes in mind, including:

- access by government school students to a high quality science-based experience
- the provision of examples of science specifically addressed in NSW science syllabuses for students in Stages 4, 5 and 6
- to inspire students in their science studies
- to encourage students to consider science-related areas for future study and career options
- to add to the development in all students of an informed perspective on science, its strengths and limitations, its methodology and its economic contribution to society.

Feedback from students and teachers overwhelmingly vindicated the committee's choice of visiting scholars with typical comments such as "inspirational and enriching", "easy to understand and very informative", "great speaker and motivator", "the response of the students was amazing" and "a real buzz".

Given that success, it is proposed in 2004 to take the two scientists to different secondary schools and to visit more rural and regional areas (only Tamworth was visited in 2003).

4. Growing the program

The pilot program has demonstrated both immediate and on-going benefits of collaboration with expatriate scientists. The potential value of this kind of collaboration is obviously behind the proposal for a Senate inquiry into the Australian diaspora referred to above in the Executive summary.

To ensure the transition from pilot to institution, a model for growing the expatriate program in NSW (and possibly Australia) will need to be developed and supported. The pilot experience suggests that a NSW-only model supporting up to 25 expatriate researchers each year will cost $1.25M (including administration costs). An Australia-wide model supporting up to 100 expatriates per annum would cost $5M (including administration costs).

The pilot has demonstrated the value placed by school communities on contact with real scientists who have been successful in their chosen careers. Any model (either state-based or national) should retain and support school visits in regional and rural as well as metropolitan areas by visiting expatriate researchers. Both Paul and Theo have advised that in the US, a proportion of any research and development grant must be expended to provide an educational outreach activity (such as establishing a website or providing information, presentations and public lectures to the wider community, including schools.

Discussions with the Australian Research Council (ARC) about how to fund the Australia-wide model have been promising. Following discussions with members of the NSW Expat Awards Steering Committee, the guidelines for the ARC's Linkages International program have been changed to better reflect the intention of the NSW program. The possibility of ARC funding should complement and enhance the NSW Expatriate Awards initiative.

If the NSW model is to grow as originally envisaged, funding sources for a longer-term commitment (at least 5 years is suggested) will need to be found and an agency to manage the program created or designated. Possible existing agencies such as the Standing Committee on Commercialisation of Science or the group managing the Biofirst Strategy or the proposed Innovation Awards may be appropriate. Growing the program will provide opportunities for applicants from a broader range of disciplines, from women and from minority groups, including Aboriginal expatriates.

To attract attention from potential donors, a prominent, appropriate patron should be identified. The Premier might like to consider that role for himself or the Minister for Education and Training and Aboriginal Affairs or another, such as the Honorable Frank Sartor (in his capacity as Minister for Science and Medical Research).

The steering committee continues to seek publicity for the project in the popular press, using the media resources of their respective organisations. Additional support for publicising the program is sought from the Premier's Department.

5. Recommendations

On the assumption that the proposal to institutionalise the Award program has merit, the following recommendations are proposed.

Recommendation 5.1
That the Premier (or his delegate) consider establishing a working party to investigate the best form of agency and mix of participant skills needed to secure funds, advertise, select, allocate and manage up to twenty five annual, short-term residency awards in NSW for expatriate researchers, including scientists).

Recommendation 5.2
If established, the working party should include the steering committee members for the 2003-4 pilot programs and be funded from government sources to complete its investigation and report to the Premier (or his delegate) within six months from establishment.

Recommendation 5.3
That the agency so recommended should be established as soon as practicable thereafter to ensure continuity of and momentum for the program.

Recommendation 5.4
That contingency plans be made to ensure that the current initiative is maintained in the interim period.

David Rushton prepared this report for the Steering Committee managing the 2003-4 pilot Residency Awards for Expatriate Scientists program.

11th February, 2004

Signature **Date**

Signed for and on behalf of the Steering Committee by Professor Beryl Hesketh,
Pro Vice Chancellor (College of Sciences and Technology), University of Sydney

APPENDIX 1

Profiles of 2003 Expat Scientist Award Winners

Professor Paul Franzon

Paul Franzon studied at the University of Adelaide where he gained his Ph.D in 1989. He is currently Professor of Electrical and Computer Engineering at North Carolina State University, USA. He has attracted substantial research funds, written numerous books and book chapters, published over 120 journal and peer-reviewed conference papers and supervised some 29 Ph.D and M.Sc students.

The winner of "Science" magazine's "Breakthrough of 2001", Paul is an acknowledged international leader in nanoengineering with a particular interest in molecular computing where he is involved in exciting developments around high-density non-volatile memories or, simply, molecular memories.

Certain molecules have properties, shape, conductivity etc which characteristically vary when they are electrically charged. In the computing sense this ability to store charge means storing information. Such molecular memories have the theoretical capacity to store on computing chips perhaps 100,000 times the information of conventional semi-conductor technology.

Paul is looking forward to working with the Molecular Electronics Group in the School of Chemistry at the University of Sydney and with associated groups in the CSIRO. The joint program envisaged has the potential to provide significant current and future research benefits for the University of Sydney, the CSIRO and North Carolina State University.

As a winner of a number of teaching awards Paul is very keen to work with high school communities not only to share his expertise with students but also to show how exciting working at the frontiers of scientific knowledge can be.

Dr Theo ten Brummelaar

Theo ten Brummelaar attended Heathcote High School before studying at the University of Sydney where he gained his Ph.D in 1994. He is currently Associate Director of the Centre for High Angular Resolution Astronomy [CHARA] Array of Georgia State University at the Mt Wilson Observatory in California, USA.

Regarded by peers and colleagues as "truly exceptional" and "world class" Theo has an international reputation in stellar interferometry particularly in instrumentation, software development and data analysis. He is considered pivotal in the on-going success and international standing of the CHARA Array.

Theo was a key member of the original team which developed the Sydney University Stellar Interferometer [SUSI] at Narrabri in the early nineties and is excited by the prospect of working with the SUSI group again. Theo says, "…in the burgeoning field of optical/IR interferometry, SUSI and CHARA should be regarded as sister instruments and …a collaboration between the two groups will yield more fruitful science than either group can achieve in isolation".

Theo has also indicated that there is the potential for expanding the wavelength coverage by combining optical/IR data with the CSIRO's Australian Telescope National Facility.

Besides interferometer instrumentation and operation, Theo's research interests focus on atmospheric turbulence, the experimental problems it can cause and their solution as well as binary stars, twin stars which orbit together about a common point. Interferometry and other research techniques allow characteristics such as stellar masses and interstellar distances to be calculated.

With a background as an actor and musician as well as radio production for SBS it's no wonder that Theo is renowned for engaging an audience with his articulate presentation offset by a wry sense of humour. He is enthusiastic about working with high school students and inspiring them to take on the scientific challenges that lie ahead.

APPENDIX 2

Profiles of Expatriate Researchers Award Winners for 2004

Professor Ken Waldron

Ken Waldron was a student at the then Manly Boys High before attending the University of Sydney where he studied Engineering. He moved then to Stanford University in California, USA, where he gained his Ph.D in 1969. He is currently Research Professor and James H Clark Faculty Scholar in the Department of Mechanical Engineering at Stanford.

Regarded by peers and colleagues as "truly exceptional" and "world class", Ken has an international reputation in Mechatronic Engineering, particularly in the design of robotic "all-terrain" vehicles and legged robotic vehicles.

A former Fulbright Scholarship winner, Ken has earned a vast number of honours and awards during a distinguished career including the American Society of Mechanical Engineers' Leonardo da Vinci Award in 1988 and a Doctorate of Engineering in 1999 by the University of Sydney for his contributions to engineering, especially in robotics]

Hosting Ken's visit are Professor Hugh Durrant-White and his colleagues in the Australian Centre for Field Robotics [ACFR] in the University of Sydney's Faculty of Engineering. The Centre has an international reputation for research excellence so the input from Ken is likely to produce outcomes with both immediate and long-term benefits for Australian robotics research.

Specifically, Ken will be working with the University of Sydney's ACFR group on:

- the control of robotic vehicles in rough terrain that might be found in mining and agriculture
- sensor capabilities of robotic vehicles in extreme conditions,
- legged robotic vehicles

As well Ken will be working with the CSIRO and Royal Prince Alfred Hospital

- surgical and anatomical training through simulation
- remote diagnosis of skin problems in rural patients

Ken has been honoured with a number of awards of excellence as an educator. He is renowned for engaging an audience with his articulate presentations and "hands-on" workshops. He is enthusiastic about working with high school students and inspiring them to take on the scientific challenges that lie ahead.

Professor Ian Gardner

Ian Gardner went to school at North Sydney Boys High School before attending the University of Sydney from where he graduated in 1975 as a Bachelor of Veterinary Science. He then worked as a Veterinary Officer with the NSW Department of Agriculture at Glenfield and Orange until 1985 when he took up a research position at the Davis Campus of the University of California, USA.

Awarded his PhD by the University of California in 1987 for his studies in comparative pathology, Ian joined the Davis Faculty in 1988 where he is now Professor of Epidemiology in the School of Veterinary Science.

Regarded by his peers as a "stellar research scientist, one of a handful of world-class epidemiologists", Ian has built "an internationally renowned epidemiology program [at Davis] in the largest veterinary school in the world".

Ian has a broad range of research interests ranging from diagnostic test evaluation and risk analysis in food safety and disease freedom certification to the epidemiology of Johne's disease* in cattle and of bacterial and protozoal contamination of coastal ecosystems as well as catastrophic musculoskeletal injuries in racehorses.

Ian is looking forward to taking up his 2004 Expert Researcher Award. He says, "The program will provide an exciting opportunity to strengthen links with fellow researchers at the Faculty of Veterinary Science and NSW Agriculture. During my visit, I will be working on control programs for Johne's Disease in cattle and effects of management interventions." The University of Sydney's Farm Management Group at Camden will host Ian's visit. The Group's Dr Richard Whittington is a world leader in Johne's research so the collaboration may yield significant benefits for NSW agriculture and beyond.

During the tenure of his Award [from July 1 to Sept 30] Ian's activities will cover

- research into Johne's disease
- lecturing in the Veterinary Public Health Program on the Camden Campus
- delivering a training course in diagnostic test evaluation and application to disease surveillance

As an award-winning teacher Ian is excited about the opportunities to work with students and teachers in NSW DET schools not only shedding light on relevant aspects of science and agriculture syllabuses but also informing and encouraging students to explore rewarding career options in science and agricultural research.

*Johne's disease [JD] is a chronic, debilitating bacterial disease that affects the intestines of all ruminant animals. It exhibits as diarrhoea and rapid weight loss. Currently, there is no treatment for JD which causes significant farm income losses in NSW and Australia. More detail can be found at http://agspsrv38.agric.wa.gov.au/pls/portal30/docs/folder/ikmp/pw/ah/dis/cat/f10499.pdf

APPENDIX 3

Report by Professor Paul Franzon on his involvement in the 2003 Expat Scientists Program

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Professor Beryl Hesketh,
Pro-Vice Chancellor, Colleges of Science and Technology

20 December 2003

Dear Professor Hesketh:

Final Report – Expatriate Award

Please accept this as my final report on the activities during the period of this award. Overall, there were four major activities during my time here in NSW:

- Technical interaction with Professor Jeff Reimers, Professor Noel Hush, and their group on areas of joint interest in electronic nanotechnology.
- Career presentations discussions with high school children, as organized by Mr. David Rushton.
- Interaction with the broader technical community, including CSIRO, other Departments and local companies.
- Exploration of Commercialization and Innovation agendas.

I will outline the major outcomes in each of these areas.

Nanotechnology Research

We pursued several agendas:

- *Molecular Photovoltaics*. These have tremendous promise to revolutionize electricity production – 40% efficient cells costing $\$50/m^2$. We collaborated on building an initial experiment, which is still being completed. We wrote a joint $US6.5M proposal to the US Defense Advanced Research Projects Agency (DARPA), which is still under consideration. We are also pursuing other avenues for funding, including the US DOE. This joint project is very likely to have sticking power. It is a very high quality project.
- *Molecular Flash Memories*. We are collaborating on circuit and integration issues for molecular flash memories. A joint proposal to DARPA is currently in formulation.

- *Molecular Modeling for Circuit Simulation*. We are preparing a joint journal publication in this area.

I would like to comment that working with this group has been very valuable for me. I have learned a lot about the true potential and limitations of molecular electronic nanotechnology. I would like to add that this is a very high quality group with an excellent international reputation.

Department of Education and Training

David Rushton will provide a separate report on this activity. With his help, I had the opportunity to speak with well over 1,300 High School students. My goals in talking to students were as follows: (1) To get them interested in careers in Science and Technology, especially ones that spring from doing a Ph.D.; (2) To show them that research is done by people like them; (3) To show how research makes a direct impact on society and the economy, and; (4) To teach them the basic principles behind micro- and nano- electronics. It was interesting to note that I did not include item (4) until it was suggested to me by some students at a school in Woollongong. I find the talk significantly more engaging after I included these learning points, and would commend this technique to the 2004 awardees.

The anecdotal evidence is that this activity was very effective. In the main, the students were clearly engaged and interested in what I had to say. Teachers reported students investigating Nanotechnology courses after my talk. Several students indicated a new interest in doing a Ph.D. as a result of this talk. We ended up mainly talking to selective schools. I think a modified version of the talk would be effective at Comprehensive schools but I never developed that version of the talk.

In addition to the school visits, the DET-related activities also lead to the following:

- Reports in three local papers;
- An interview on local radio;
- (Eventual) posting of a copy of the talk on the DET web site;
- An article in the DET Newsletter; and
- Preparation of an article for eventual distribution to Science Teachers (attached).

Broader Technical Engagement

This was mainly in the form of talks, including at CSIRO, Edith Cowan University, University of Newcastle National Science Week Dinner; Rotary Club of Tamworth; University of Adelaide, The Institute of Physics, and the NSW Section of the IEEE. I've also interacted technically with faculty in the Department of Physics, with faculty at the University of Newcastle, and with Engineers at several local companies (Cisco, Agere, STI, Intel).

Commercialization

A long-term interest of mine has been the development of technologies to the point of commercial decision. I wanted to make a contribution to the Australian scene on this front. To this end, I talked to local entrepreneurs as well as did some background research. I wrote the attached white paper outlining two programs I have experienced in the US that could be adapted to the Australian scene. I intend to continue distributing this white paper after I leave for the US. However, my immediate goal is to determine if it makes sense to run a 5-day TEC workshop in Australia, and if so, how to organize it.

Program Comments and Recommendations

I would like to close with some comments about the program. Overall, I think the program went well, as conceived. This fact reflects well on those that planned it. There were no significant difficulties, and everyone I worked with was pleasant and efficient. From my perspective, it was rewarding both professionally and personally, and about the right length of time. I've received very positive feedback from the people I worked with. I feel that my American "attitude" and

perspectives, and access to networks were useful to my new colleagues here. Yet, I leave feeling closer to Australia and being more Australian than I have in a decade. I also learned a lot from Jeff, Noel and their group. I intend to maintain this relationship. I do have one minor recommendation and that is to retain the January submission deadline. The Northern Fall semester tends to finish just days before Christmas, leaving little time for anyone to meet a December submission date. That time of year is too busy.

Closing Comments

It has been very interesting to observe the Australian academic and industrial research scene after 13 years in the United States. If you permit me, I have some closing comments:

- There are many Australian academics and academic groups who are excellent in themselves and have excellent international reputations. There are real opportunities for more Australian Universities to enter the top 100 list.
- Most Government programs that relate to the Universities are generally well thought through, frankly better so than in the United States. My comments apply across the board, from HECS to many of the ARC programs. However, the overall resource level per student and per researcher are definitely lower, possibly more than two times lower, even when adjusted for relative GDPs.
- Understanding and respect for wealth creation through Education, Science and Technology are at low levels here. One value of this joint program with the DET is to address that issue via engagement with the next generation.
- The Universities are not very good at producing commercializable technologies and commercializing them. However, it is not their fault. The incentive structures are in many ways inappropriate. The feedback mechanisms available to guide the technology development are poor. The available knowledge on how to really start and grow a company through to a successful exit is diffuse and often hidden. In addition, the generally low resource level per project can make it difficult to get a technology to the point of commercial decision with enough rapidity to be first or second in the market.

Thanks again for your support of this program and of my time here. I wish you my best on future programs.

Sincerely,

Paul D. Franzon, Ph.D.,
Alumni Professor of Electrical and Computer Engineering

APPENDIX 4

Report by Dr Theo ten Brummelaar on his involvement in the 2003 Expat Scientists Program

NSW Residency Awards for Expatriate Scientists
Final Report for 2003

Dr. Theo ten Brummelaar
CHARA – Georgia State University

1. Introduction

As part of the first trial program of the NSW Residency Awards for Expatriate Scientists in 2003 I spent three months in Sydney. In this report I will outline the highlights of my working during this time and will conclude with some more general remarks.

I was engaged in three programs during my stay in Sydney. The first of these involved initiating a joint research program between the Sydney University Stellar Interferometer (SUSI) group in the School of Physics of the University of Sydney (Usyd) and the Center for High Angular Resolution Astronomy (CHARA) group at Georgia State University (GSU). This involved working both at the observatory in Narrabri N.S.W. and on campus at USyd, and has resulted in an ongoing joint research program, as well as a Memorandum of Understanding (MoU) between the University of Sydney and Georgia State University which will allow more collaboration in the future, including student exchange and the sharing of telescope time. I also spent several weeks working in High Schools speaking to students about astronomy, science in general, and the possibilities of a career in science. This program was managed by the Department of Education and included trips to many regional centers and schools. The third element of my work was a collaboration with the C.S.I.R.O. Australia Telescope National Facility (ATNF) in which I investigated the possibility of using part of the SUSI infrastructure to aid in an experiment using the Australia Telescope. This would be the first, and arguably the only possible, combination of optical and radio interferometers, and represents a unique scientific opportunity.

2. Joint Research Program

In my original proposal for this award I argued that the SUSI and CHARA Array stellar interferometers are extremely well match instruments and are ideally suited for a joint astronomical research program. The CHARA Array represents, in many ways, the next generation of stellar interferometer and is largely based on the pioneering work done within the SUSI group. SUSI, though, remains a vibrant instrument, and due to its position in the southern hemisphere, is a perfect match for the CHARA Array. Far from being competitors, these two instruments should be regarded as sister instruments.

2.1 Binary Star Research

There is a great deal of overlap between the SUSI and CHARA groups in binary star research. Binary stars provide one of the only ways for us to measurement the fundamental parameters of the local stellar population, and Interferometry is one of the few techniques available that makes these measurements possible from the ground. Work was begun on a joint program of observing binary stars and a list of targets was identified that both instruments can study. Of the three months of the award I spent four weeks at the SUSI observatory in Narrabri N.S.W, both helping with instrumentation development and observing. Throughout my stay in Australia the CHARA Array was in regular use and spent a large fraction of the available observing time studying one of the binary stars on our joint observing list. I have yet to fully reduce these data, and more data will be forth coming in the next observing season, however, I expect to publish the results later in 2004. We will return to this object when it is once again high in the night sky in August 2004, and it is but one of the possible targets in this program.

Both the SUSI and CHARA groups are seeking funds to continue this collaboration, and we are very confident that these funds will be forthcoming. Already Dr. Peter Tuthill has procured the funds to allow a Usyd graduate student, Julian North, to visit the CHARA group in early 2004. During his visit, Julian will learn how to operate the CHARA Array and continue the work on the transfer of remote operations technology from CHARA to SUSI discussed below.

2.2 Remote Operations Technology

The CHARA array group has developed a remote operations capability allowing us to control the array from anywhere on the Internet. With a minimal investment in infrastructure it will be possible to control the CHARA Array from the USyd campus. Furthermore, since the CHARA Array control system was based on the SUSI control system, it is a comparatively simple task to transfer the remote operations technology back from CHARA to SUSI. During my time spent at the SUSI observatory this work was begun and the Siderostat controller (the SUSI equivalent of a telescope) was ported to the new CHARA software environment. This allows full control of the SUSI siderostats across the Internet. The work of changing the rest of the SUSI control system

continues and should be nearing completion by the time of my next proposed visit in late 2004.

2.3 Memorandum of Understanding

While the SUSI and CHARA groups have been collaborating for many years, I undertook making this relationship more formal by writing a Memorandum of Understanding (MoU) between the University of Sydney and Georgia State University. I have attached a copy of this MoU in its current form. This MoU spells out the main areas of joint interest between the two research groups, speaks to methods of ongoing collaboration, and provides a path towards the joint supervision of graduate students. A formal agreement such as this will also be very helpful to us in the search for further funding to support this research program. The MoU has been vetted by USyd and is currently in the hands of the GSU lawyers. I expect to finalize the agreement in early February 2004.

3. Outreach Program

During my time in Australia approximately three weeks where devoted to High School visits, speaking to both the students and the teachers. One of these weeks was spent on preparing the material for these talks, while the rest of the time was spent visiting schools. I prepared and presented three presentations:

Weighing the Stars: This talk was most closely related to my own research and centered on the methods, both past and present, of measuring the fundamental parameters of the stars. It includes mention of Kepler's laws of planetary motion, Newton's laws of motion, Captain Cook's trip to measure the transit of Venus, and binary stars research.

Taking the twinkle out of the stars: This concerns the problems faced by astronomers when trying to look through the earth's atmosphere. In it I discuss Adaptive Optics technology, Interferometry and space based telescopes.

Science careers talk: Since the other two presentations where based on the physics curriculum, I felt it was also important to address the students' obvious desire to better understand what it is like to have a career in science. This presentation was rather shorter than the other two, but prompted much more discussion. I spent some time simply explaining what it is a research scientist actually does on a day-to-day basis and how one becomes a research scientist. During the remainder of the talk I attempted to dispel some myths and misinformation concerning science and a career in science.

All three talks have been made available to the DET.

While the DET will have more specific statistics, I spoke to approximately 2000 students and 100 teachers, including schools in many regional areas. It was my impression that these talks where very well received, and judging by the questions after each talk, I think many of the students took an active interest in what I had to say. From a personal point of

view, while I was at first a bit concerned about this aspect of the award, in the end I found it the most immediately satisfying and engaging element of my stay. Since returning to the U.S., and based on my experience in Australia, the CHARA group has begun an outreach program for Los Angeles based schools. I would most certainly be willing to work with High School students again on future trips to Australia.

4. C.S.I.R.O. Collaboration

The CSIRO Australia Telescope National Facility (ATNF) has under development a new, high bandwidth, correlator. This new device will allow new and unique astronomical research programs. Since the ATNF is a radio interferometer and the SUSI is an optical interferometer it is highly unusual for any overlap in instrumentation to exist. Nevertheless, such an overlap has been identified. Since the ATNF uses optical fibers to transport its data from the antennae to the central facility the information is, for a short time, in the form of an optical signal, and can therefore be manipulated by the optical systems at SUSI. Ron Ekers at the ATNF, suggested that I investigate the possibility of using the SUSI delay lines as part of the ATNF system. The final report of this study is included as a pdf file with this report. In summary, I concluded that this project is entirely feasible, would not be very costly, and would help develop the relationship between the ATNF and SUSI researchers.

5. Other Work

During my stay in Australia I was asked to present colloquia to a number of groups, including the Australian Institute of Physics, the CSIRO, the University of Melbourne, the DET Science Advisors conference, and of course the School of Physics at Usyd. I also had many informal talks with staff at USyd, UNSW, the University of Melbourne, the University of Technology, and CSIRO.

6. Concluding Remarks

All three elements of my work during the award where thoroughly enjoyable, and I believe very successful, from both a professional and a personal point of view. The SUSI and CHARA groups are now seeking funds to continue this collaboration. Peter Tuthill of the SUSI group will be visiting the CHARA Array in early 2004, and I plan a return visit to SUSI in late 2004. I also believe that the outreach program sponsored by the DET helped encourage at least a few students to think more about a career in science.

I would not hesitate to recommend that over expatriate scientists try to come back to Australia for a short period of time, both to build bridges with Australian researchers and to re-familiarize themselves with the Australian research environment. Indeed, I have encouraged a number of my colleagues to apply for this award should it be offered in future years. Should there be anyway in which I can help promote this award please do not hesitate to contact me.

APPENDIX 5

EDUCATIONAL OUTCOMES FROM THE SCHOOL VISITS IN 2003 BY THE TWO EXPATRIATE SCIENTISTS

Expected educational Outcomes

The Department of Education and Training [DET] joined the Expat Program as a sponsoring partner with a number of outcomes in mind, including:

- access by government school students to a high quality science-based experience
- the provision of examples of science work specifically addressed in NSW science syllabuses for Stages 4, 5 and 6
- to inspire students in their science studies
- to encourage students to consider science-related areas for future study and career options
- to add to the development in all students of an informed perspective on science, its strengths and limitations, its methodology and its economic contribution to society.

Feedback – Survey Results

Below is a table which summarises surveyed teacher and student views of the presentation[s]. These results, which are discussed in detail below, confirm the value of the DET's participation in this Program.

Expat Scientists Exit Survey Results

Q No	Category	% Responses		
		Yes	**No**	**Unsure**
	Teacher			
1	Did you enjoy the talk[s]?	100	0	0
2	Was the content relevant to current studies?	95	0	5
3	Have any of your own or your students' ideas about science and scientists changed?	58	26	16
4	*Give an **overall rating***	***4.7/5***		
	Senior Students [Stage 6]			
1	Did you enjoy the talk[s]?	93	4	3
2	Was the content relevant to current studies?	85	5	10
3	Have any of your ideas about science and scientists changed?	36	47	17
4	*Give an **overall rating***	***4.4/5***		
	Junior Students [Stages 4-5]			
1	Did you enjoy the talk[s]?	97	3	0
2	Was the content relevant to current studies?	54	23	23
3	Have any of your ideas about science and scientists changed?	49	29	22
4	*Give an **overall rating***	***4.3/5***		

School Visits

Below is the summary of visits made to schools and related communities.

Expatriate Scientists Program 2003 – School Visits

Date '03	Where	Schools	Which Scientist[s]	No. of Sessions	Numbers Attending*		
					Students	Teachers	Comm-unity
22/08	Newcastle	Hunter/ Central Coast Districts – 8 HS	Theo	1	240	15	30
22/08	Newcastle – National Science Wk Dinner	N/A	Paul	1		15	120
25/08	Tamworth – "Science in the Bush" Preview	N/A	Theo, Paul	1	15	10	30
26/08	Tamworth – "Science in the Bush"	Tamworth District - 11 HS/CS	Theo, Paul	5	300	15	5
27/08	Tamworth – "Science in the Bush" Rotary Meeting	N/A	Theo, Paul	2		5	55
29/08	Syd Sec College - Black Wattle Campus	Port Jackson District – 6 HS	Theo, Paul	3	130	5	
11/09	Gosford	Gosford HS	Theo	2	160	2	
12/09	Merewether	Merewether HS	Theo	3	170	2	
14/10	Penrith	Penrith HS	Theo, Paul	6	450	15	
16/10	Wollongong	Wollongong District – 4 HS	Theo, Paul	2	80	4	
20/10	Sydney – DET District Science Consultants Conf.	N/A	Theo	1		25	2
13/11	Warners Bay	Warners Bay HS	Paul	2	130	3	
24/11	Asquith	Asquith Girls HS	Paul	1	80	3	
24/11	Hornsby	Hornsby Girls HS	Paul	1	120	2	
25/11	Manly	Manly Senior Campus	Paul	2	220	4	
	Totals	36 Schools		32	2,095	120	242

* In this table DET Science Consultants have been counted as teachers while tertiary educators have been counted as community

Communication/interaction

The Program Committee selected Paul Franzon and Theo ten Brummelaar, each of whom received referee comments such as "world-class" scientist and "outstanding communicator".

In total Paul and Theo contributed more than 20 days, gave over 30 presentations to more than 2000 students and 90 teachers from 36 schools as well as 270 science consultants, tertiary educators and community members.

Feedback from students and teachers vindicated the committee's choices with typical comments such as "inspirational and enriching", "easy to understand and very informative", "great speaker and motivator", "the response of the students was amazing" and "a real buzz". These comments are supported by the survey's overall ratings of 4.3/5 by junior [Y7-10] students, 4.4/5 by senior [Y11-12] students and 4.7/5 by teachers.

Curriculum Relevance

To assist in their development of interesting and curriculum-relevant presentations, Paul and Theo

- accessed the NSW science syllabuses for Stages 4, 5 and 6
- were supplied with copies of text books written for these new syllabuses
- discussed content with David Rushton, former DET Head Teacher and Science Consultant, and Expat Program Co-coordinator
- sought out and acted on feedback from students and teachers.

Particular attention was paid to meeting syllabus objectives, outcomes and content. A common feature of all the new [post 1998] science syllabuses is the Prescribed Focus Areas [PFAs], overarching themes which must be covered over the 4 years of Stages 4 and 5, and 2 years for Stage 6. Paul and Theo structured their presentations to clearly illustrate, drawing from their own careers, relevant aspects of all five PFAs in Stages 4, 5 and 6, viz:

- 4/5/6.5 current issues, research and developments – the principal focus for each of these outstanding Australian scientists, leaders in their respective fields, as they explained clearly yet succinctly the nature of their current research activities and their own career paths
- As well as covering PFA 4/5/6.5 in considerable depth, Paul and Theo also included aspects of
- 4/5.1 [and 6.1] the history of science [for Stage 6: physics/chemistry/biology etc]
- 4/5.2 [and 6.2] the nature and practice of science [for Stage 6: physics etc]
- 4/5.4 [and 6.3] applications and uses of science [for Stage 6: physics etc]
- 4/5.3 [and 6.4] implications for society and the environment

Both Theo and Paul sought ground their presentations in relevant areas of the so-called Knowledge and Understanding [KU] domain of the Stages 4-6 syllabuses

Theo's presentations, "Weighing the Stars" and "Taking the Twinkle out of Stars", aligned with a number of the units of the Stage 6 Physics syllabus and numerous of their outcomes and content points, viz:

- The Cosmic Engine – core material
- Space – core material
- Astrophysics – one of the most popular options.

As well Theo treated relevant Core outcomes and content from the Stage 4/5 syllabus,

- 4/5.6 Newton's laws of motion and gravity
- 4/5.6 electromagnetic waves especially light
- 4/5.9 cosmology
- 4/5.12 technology

Paul's presentation, "Micro and Nano Technologies", took cues from a number of the units of Stage 6 Physics and Chemistry syllabuses and numerous of their outcomes and content points, viz:

- 9.4 Phys From Ideas to Implementation - core material
- 9.7 Phys The Age of Silicon - an option which is not popular and needs support
- 8.2 Chem Chemical Earth - core
- 8.3 Chem Metals - core
- 9.8 Chem Chemistry of Art - an option also not popular and needing support

As well, Paul treated relevant Core outcomes and content from the Stage 4/5 syllabus:

- 4/5.7 elements, atomic theory
- 5.11 energy resources
- 4/5.12 technology

The syllabus alignment was clearly recognised by teachers [survey: relevance = 95%] with comments including "highly relevant", "very incisive" and "brought the syllabus alive". Stage 6 students were similarly impressed [survey: relevance = 85%] with comments like "excellent revision material" [from Y12 students]. However for Y7-10 only 56% of students were aware of the syllabus relevance although there were many favourable comments such as "made me want to study science for the HSC". Teachers of junior students need more detail in advance to help prepare students to take most advantage of the presentations.

In their presentations Paul and Theo modelled the syllabus skill of presenting information [effectively] while exemplifying from their working life syllabus skills of critical thinking, problem solving, creativity and lifelong learning as well as working in teams.

General Comments

Paul and Theo presented “terrific”, “humorous” presentations “really powered by personal experiences” which positively influenced many students. As one wrote, “I now realise that science and scientists can be fun” and another, “it was really relevant for future career/uni options in science”. Perhaps the most encouraging was “to research and discover things [like Paul and Theo] – how cool is that!”. Question Time was really appreciated bringing for such positive feedback as “students asked heaps of questions”, “he was interested in all our questions” “and “he explained everything so well”.