ammrf NEWS

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AUSTRALIAN MICROSCOPY & MICROANALYSIS RESEARCH FACILITY

RESEARCH

Professor Tanya Monro with the Minister for Innovation, Industry, Science & Research, The Hon. Kim Carr.

Top science prize for AMMRF user

AMMRF @ SARF

University of Adelaide physicist Prof. Tanya Monro, has been awarded the Malcolm McIntosh Prize for Physical Scientist of the Year, which recognises outstanding research of global importance by early-career scientists. It is one of the prestigious Prime Minister's Science Prizes for 2008 and was awarded last month by Prime Minister Kevin Rudd and Minister for Innovation, Industry, Science & Research, Senator The Hon. Kim Carr.

Prof. Monro has created a new class of optical fibres with innovative potential applications. She and her team are regular users of the AMMRF facilities at Adelaide Microscopy, part of the South Australian node.

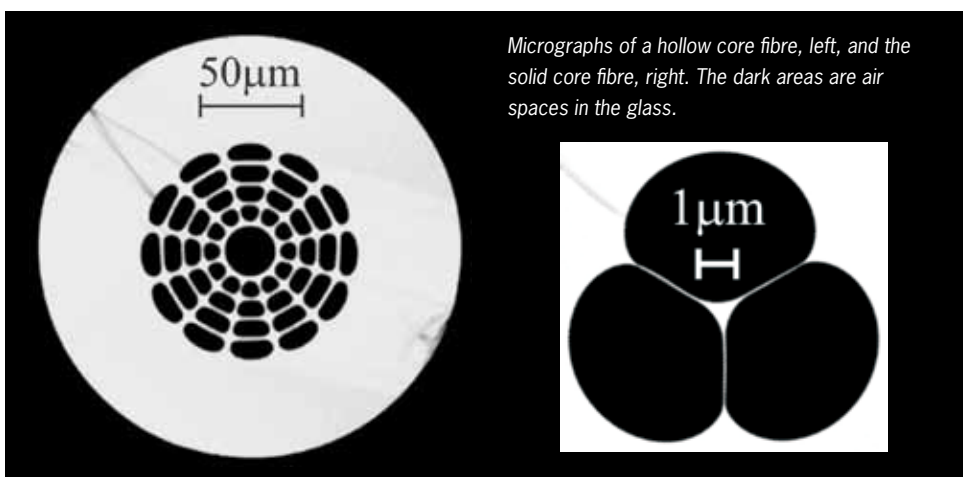
"Access to state-of-the-art microscopy is critical to support our work in the Centre of Expertise in Photonics. We use the facilities at Adelaide Microscopy to characterise the fibre structures we produce in our laboratories (using scanning electron microscopy and energy dispersive X-ray spectroscopy). Having these facilities on-site allows us to do this rapidly and accurately. Looking forward, we wish to increase our utilisation of advanced microscopy techniques to improve our understanding of extreme regimes and structures in our emerging optical fibres".

Prof. Monro is Director of the Centre of Expertise in Photonics within the University of Adelaide's School of Chemistry and Physics and, at just 35, is already regarded as one of the world's leaders in optical fibre technology.

The new class of optical fibres, containing air holes and made from soft glass, is broadening the role of optical fibres from communications to areas such as diagnostics – detecting trace quantities of chemicals or biomolecules – and a variety of medical and defence applications. Prof. Monro along with Dr Heike Ebendorff-Heidepriem and the rest of her team are perfecting extrusion techniques as a way of introducing millimetre-scale structure in soft glasses and polymers. These structures are then stretched to form optical fibres with micrometre-scale holes. A range of new types of fibres are being investigated, including fibres with extremely fine solid cores and fibres with rings of holes around a hollow core. Their solid-core fibres are the finest yet made and the solid core, which is smaller than the wavelength of light, acts as a 'rail' for the light, guiding it along the fibre and through the material filling the surrounding holes. The light is then able to interact with any materials located in the holes. This property forms the basis of the fibres' use as sensors for chemicals and biomolecules.

Prof. Monro was "absolutely thrilled" to receive what she regarded as the highest recognition possible by this stage in her career. "It's recognition that the research I and my fabulous team are doing is of world-class quality and importance", she said.

In 2005, Prof. Monro took up the inaugural Chair of Photonics at the University of Adelaide. Earlier this year she was awarded one of the 2008 Australian Research Council (ARC) Federation Fellowships. ■



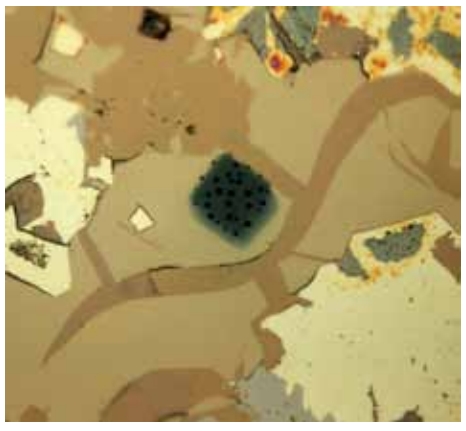
Micrographs of a hollow core fibre, left, and the solid core fibre, right. The dark areas are air spaces in the glass.

Nature paper for NanoSIMS work

AMMRF @ UWA

The special capabilities of the NanoSIMS have allowed scientists at the University of Western Australia (UWA) to rewrite the history of major groups of life on the planet. The importance of this work is reflected in its publication in *Nature*, accompanied by a substantial 'News & Views' piece. The paper is entitled 'Reassessing the first appearance of eukaryotes and cyanobacteria', *Nature* (455, 1101–1104).

It all hinges on the appearance of oxygen on Earth – a hugely significant event as it transformed the atmosphere and allowed the evolution of large organisms. This event took place between 2.45 and 2.32 billion years ago and is thought to have been the result of oxygen-producing cyanobacteria. However, some evidence from biomarkers extracted from rocks had placed the appearance of cyanobacteria and eukaryotes at 2.7 billion years ago. The inconsistency in these dates was causing a headache for researchers, but now this latest research has refuted the biomarker evidence and therefore removed the inconsistency. Being able to look at organic molecules *in situ* in solidified oil droplets within the rock, and to localise constituent isotopes with the NanoSIMS, enabled the WA researchers to show that the previously identified biomarkers were actually contaminants and not signs of the all important cyanobacteria.



Reflected light image showing pyrobitumen with sinuous shrinkage crack and a NanoSIMS raster area spotted with µm-sized caesium balls (from implantation). Raster area is about 10 x 10 µm in size.

The research team consisted of Prof. Birger Rasmussen and Dr Ian Fletcher from the Curtin University of Technology, Dr Jochen Brocks from the Australian National University, and Dr Matt Kilburn from the Centre for Microscopy, Characterisation and Analysis – the UWA node of the AMMRF. Matt says "This demonstrates the beauty of NanoSIMS in that it can create a much clearer picture of what's really happening by analysing the individual components in a system *in situ* rather than taking a averaged bulk measurement and losing the spatially resolved information". ■

RESEARCH

Grants come rolling in

Like the rest of the Australian research community, many members of the AMMRF's staff were eagerly awaiting the recent announcements from the Australian Research Council (ARC) of its grants for 2009. And it proved worth the wait – the ARC awarded more than $4.8 million in research funds to researchers and academics from the AMMRF in October, and then added a further $3.9 million in infrastructure funds to the nodes in November.

The new research funds came to support seven Discovery Projects and three Linkage Projects, which also included six new fellowships for young postdoctoral scientists. The grants cover the full spectrum of research, from functional nanomaterials to biological sciences, and from environmental sciences to archaeology. Several projects will use microscopy to explore the nanoscale structures of new functional materials and relate these structures to the performance of these materials. The materials in question include silicon-based photovoltaics for future solar cells, semiconductor nanowires for applications in new devices and electronics, and novel magnetic and superconducting materials. Another project will apply microscopy to understand the formation of 'biochars' (effectively activated carbon) as a by-product of converting brown coal (lignite) into liquid fuels. These biochars can be used to markedly increase soil fertility for agriculture and have the added benefit of reducing the carbon emissions associated with extracting the energy from coal.

While these kinds of grants support the local research at the nodes, they also contribute to the AMMRF's service of the wider user community. This is because the local research seeks to apply advanced microscopy to specific research question and to develop new microscopy techniques, thereby generating new scientific insights and advances in techniques that the nodes can bring to bear on the research of its users.

Similarly, the nearly $4 million awarded for five Linkage Infrastructure, Equipment and Facilities grants will benefit the user community by allowing the AMMRF to continue offering researchers the latest in characterisation equipment. The forthcoming instrumentation will include a new electron microprobe and a cell-sorting facility at the UWA node; an expansion of the X-ray microtomography capability at the USYD node into nanoscale X-ray tomography; and an instrument for metastable induced electron spectroscopy (MIES) at the SARF node. ■

Smoothing the kinks in silicon chip design

AMMRF @ UQ

$1.5 million (over 3 years) from the ARC Linkage scheme has been awarded to Dr Kevin Jack and Prof. John Drennan at the University of Queensland (UQ) AMMRF node and Prof. Andrew Whittaker and Dr Idriss Blakey from the Australian Institute for Bioengineering and Nanotechnology at UQ, in a partnership with Intel Corporation. Focussing on designing materials for the fabrication of future generations of silicon chips, the project will develop new methods to reduce the level of roughness on the 20–30 nm features that are created during the lithographic production of chips. This roughness ultimately leads to defects, degraded performance and chip failures, adding significantly to production costs, and also limits the drive toward the production of increasing performance of devices.

To achieve these goals, the research team will set up an electron-beam writing facility within the UQ's Centre for Microscopy and Microanalysis to prepare samples that mimic those of the next-generation lithographic techniques such as extreme-UV lithography. In addition they will develop advanced characterisation techniques and metrology based on electron microscopy to test the performance and guide in the design of the new polymeric materials. ■

LAB NEWS

AMMRF welcomes additional Linked Laboratory

The John de Laeter Centre of Mass Spectroscopy at Curtin University is the latest facility to join the AMMRF as a Linked Laboratory. They bring single and multi-collector sensitive high-resolution ion microprobes (SHRIMPs) for quantitative isotopic and elemental analysis into the AMMRF family. Supporting research projects in the minerals and petroleum sector in Australia and overseas, the SHRIMPs allow *in situ* isotopic analysis of chemically complex materials with a spatial resolution of 5–20 micrometres and can be used for routine measurement of a wide range of isotopes. The addition of this facility compliments techniques in the area of isotopic and elemental analysis located at the University of Western Australia – namely the NanoSIMS and the soon to be delivered Cameca IMS 1280 ion microprobe. As with other Linked Laboratories, the partnership with the AMMRF enables a technical support engineer to be employed at the John de Laeter Centre. ■

Curtin University of Technology

EXECUTIVE DIRECTOR'S COLUMN

Recently, I attended an NCRIS Capabilities Meeting in Canberra. This was the second such meeting, and it was impressive to see the progress of the 12 NCRIS capabilities, as well as the burgeoning relationships among the various facilities. The AMMRF is at the forefront of building such synergies, as five current examples will demonstrate.

Two inter-capability relationships have been set up to provide important new tools to the national research community. The first is the flagship ion microprobe, the Cameca IMS 1280, which is being jointly funded by the AMMRF and AuScope, the NCRIS facility for national infrastructure in the earth sciences. The IMS 1280 will do the high-precision elemental and isotopic analysis required for geological analysis, geochronology, and environmental studies, and it will also be important for answering questions in materials science and biology.

The second set of tools is a live-cell microscope and TEM that will form the Australian Biosecurity Microscopy Centre. Part of CSIRO's Australian Animal Health Laboratory in Geelong, and a Linked Laboratory of the AMMRF, the centre will house the instruments within PC4 laboratories that are co-funded by the NCRIS Networked Biosecurity Framework. The new centre will enable Australian researchers to explore the molecular structures of organisms that require the highest level of containment.

Another inter-capability relationship was formalised earlier this year with the Australian National Fabrication Facility (ANFF). Given the complementarity of fabrication and characterisation, the ANFF and the AMMRF signed a memorandum of understanding in February to share best practice in facility management and to pursue common business opportunities.

The fourth example is the AMMRF's involvement in Bioscience Australia, a collaboration among the characterisation capability, the ANFF and the bioscience facilities funded by NCRIS, which support areas such genomics, proteomics, phenomics, bioinformatics, and biotechnology manufacturing. Bioscience Australia enables efficient marketing of the full range of tools needed for modern life-science research in a single portfolio of facilities.

Data-MINX, the new data management project across the NCRIS Characterisation capability, is the fifth example; it is covered on page 3 of this broadsheet.

I am confident that each of these synergistic relationships will prove of real benefit to Australia's R&D efforts to tackle the big questions.

As a final note, this month sees the release of the AMMRF's 2008 Profile, which gives an overview of the facility's achievements to date. I hope you will find it an informative and interesting read. ■

Regards,
Simon Ringer, Executive Director & CEO

Right: 3-D reconstruction of a christmas beetle from 3.2 GB of X-ray microtomography data (beetle is approx. 10 mm in length). Left: four greyscale images from a set of over 1000. Data-MINX will support transfer, searching and storage of such large data sets such as these.

E-RESEARCH

Data-MINX: a common interface for data management

In the last quarter of 2008, the AMMRF finalised planning for Data-MINX, an exciting new e-Research initiative to address the difficult issue of data management for microscopy and other national characterisation platforms.

Supported by the National e-Research Architecture Taskforce (NeAT), Data-MINX is a collaborative project that aims to provide e-Research services and resources to the characterisation research community. Partners in the project are numerous and include the Australian Microscopy and Microanalysis Research Facility (AMMRF), the Australian National Data Service (ANDS), the Australian Nuclear Science and Technology Organisation (ANSTO), the Australian Research Collaboration Service (ARCS), the Australian Synchrotron Facility (ASF), the NSW Institute for Trans-disciplinary e-Research Services and Technology (INTERSECT), the Victorian eResearch Strategic Initiative (VeRSI) and the UK Science and Technology Facilities Council (STFC).

The central intent of Data-MINX is to provide services for data capture, location, access, transfer and storage for instrument users across the NCRIS Characterisation capability. These services will provide a common interface for data management at facilities across Australia so that users access a 'one-stop shop' that supports data search and retrieval in a uniform way. Services will include automated data and metadata capture and, where appropriate, conversion of data streams into internationally recognised interchange formats. DataGrid-based file transport services and searchable metadata catalogues will provide an efficient and general means of tracking and managing facility data.

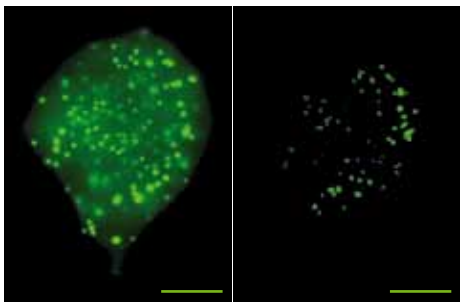
In addition, building on ARCS and the Australian Access Federation (AAF), Data-MINX aims to provide single-sign-on authentication that supports private, controlled (shared) and public access to data, as well as services for the storage of data in a distributed, federated data repository system, underpinned by the ARCS Data Fabric. ■

TECHNOLOGY

What is TIRF microscopy?

Total internal reflection fluorescence (TIRF) microscopy is an imaging technique that overcomes the limited axial (or depth) resolution of conventional fluorescence microscopy. It does so by exploiting the formation of an electromagnetic field, or evanescent wave, that is generated when laser light undergoes TIR at the interface between a glass cover slip (or similar) and an aqueous or cellular sample. The evanescent wave excites fluorescent molecules in the sample, but only to a depth of approximately 100 nm, thereby giving outstanding axial resolution. As traditional widefield fluorescence signals from membrane molecules are dwarfed by the cytoplasmic fluorescence background, TIRF microscopy is widely used to distinguish biological processes that occur at cell surfaces from those that occur within the cytoplasm. Such processes include adhesion of cells to surfaces, cellular secretion processes, and binding of proteins at receptors on cell surfaces.

For further information see, for example, D. Axelrod (2003) "Total internal reflection fluorescence microscopy in cell biology", Methods in Enzymology, 361: 1–33. ■



Lung cancer cell tagged with a fluorescent protein. Left: traditional wide-field image. Right: TIRF image of the same cell without the cytoplasmic fluorescence. Scale bar is 10 µm. Image: Katarzyna Grzes, The University of Sydney.

BUSINESS & MARKETING

AMMRF supports AMAS X and APCET

These two exciting conferences coming up early in 2009 are both being supported by the AMMRF.

The Australian Microbeam Analysis Society's tenth biennial symposium (AMAS X) has been organised by Adelaide Microscopy, with pre-symposium workshops arranged to review and discuss the state of the art in analytical microscopy and microanalysis. These workshops will be held at Adelaide Microscopy, Flinders University, the University of South Australia and Forensic Science SA. The symposium will be held for the first time in Adelaide, and will take place from 11 to 13 February 2009. It aims to provide a forum where participants can discuss microanalysis and imaging, with emphasis on practical solutions and applications. The deadline for registration and abstract submission is 31 December, so please register and submit your abstract early to facilitate program planning and to be sure of your spot.

Staff from the Institute of Molecular Bioscience at the University of Queensland are helping to organise the Asia-Pacific Congress on Electron Tomography (APCET) to be held in Brisbane from 31 January to 4 February 2009. It will bring together world leaders in the field of electron tomography of molecules and cells, and will foster the exchange of ideas and technical information among biologists, biophysicists, computer scientists, mathematicians, materials scientists and electron-optical instrumentation specialists in an open interdisciplinary environment.

Both meetings provide very relevant programs with invited speakers, and promise to be extremely stimulating for all who attend. ■

Fresh off the press: AMMRF Profile 2008

It has been an exciting year for the AMMRF. The facility is fully operational, six Linked Laboratories have come on board, and the investment in world-class instruments and expert staff is yielding results. Much of this research has significant practical goals and contributes to important national issues such as improved healthcare and environmental sustainability. The *AMMRF 2008 Profile* highlights some of this research undertaken by the facility's user community.

For a copy of the Profile please contact:
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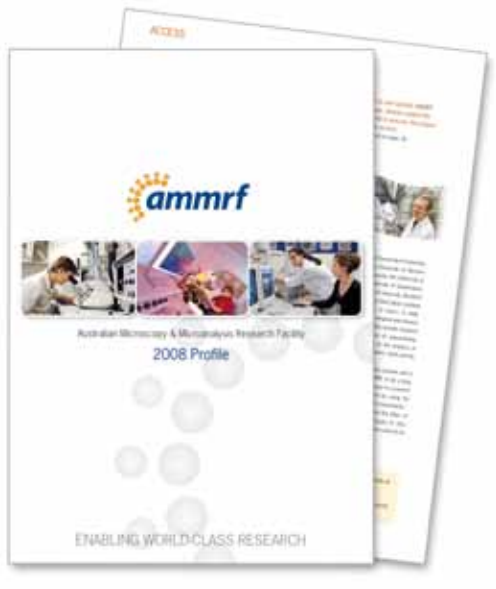


AMMRF at ComBio2008

ComBio, as the name suggests, is a combined conference that brings together life scientists from the various societies at one big biennial meeting. In September this year, it was held in Canberra with over 850 delegates in attendance. The AMMRF had a table display with leaflets and banners (and some very popular jelly babies).

There was a lot of interest in the capabilities we have to offer – especially in microCT, cell sorting and flow cytometry, and live animal imaging. The AMMRF Travel and Access Program (TAP) was also very well received when people found out that it would enable them to access any node with the facilities they need. At the end of the meeting, a lot of scientists went home much more aware that we could really add value to their research projects, and many enquiries have since been followed up. ■

STAFF NEWS

Australian National University

Geoff Hunter, technical officer at the ANU's Electron Microscopy Unit, died unexpectedly from a heart attack while competing in a fun run on 14 September. He was aged only 28. Geoff joined the EMU in April 2005, and his skills in electronics proved essential in maintaining the unit's microscopes. Geoff wasn't afraid to take on additional responsibilities and acted as the ANU representative on the e-research committee of the AMMRF. He will be remembered as cheerful and always helpful, and he is greatly missed. Our sympathy goes to Geoff's wife Kerryn, son Zachary and daughter Lily. ■

South Australian Regional Facility

The AMMRF would like to say farewell to **Dr Peter Self** – senior microscopist and deputy director of Adelaide Microscopy at the University of Adelaide. He had spent several years at CSIRO Soils, and at the Ian Wark Research Institute at the University of South Australia, before joining Adelaide Microscopy in 2001. A physicist specialising in high-resolution transmission electron microscopy (TEM), scanning electron microscopy (SEM) and X-ray microanalysis, Peter can turn his hand to just about any kind of microscopy or technique. With the priceless gift of being able to explain complex concepts in a simple way, Peter helped many of Adelaide Microscopy's users (and staff!) to a better understanding of their science. We wish Peter all the best in the future and thank him for his outstanding contribution to Adelaide Microscopy's success. ■

The University of New South Wales

The UNSW node of the AMMRF is proud to announce that **Dong Ming Zheng** has been awarded the prestigious 'Staff Award for Excellence in Innovation' by the University of New South Wales. The Award was presented to Dong Ming for his extraordinary accomplishment in developing the AC Lab System online booking system, created to manage the use of Electron Microscope Unit and other UNSW Analytical Centre facilities. Dong Ming was chosen from among many other commendable nominations in this category, from various departments and units of UNSW. The innovations in the AC Lab System are the transparent method for registration, training, certification, booking, usage data collection and billing. ■

COMMUNITY

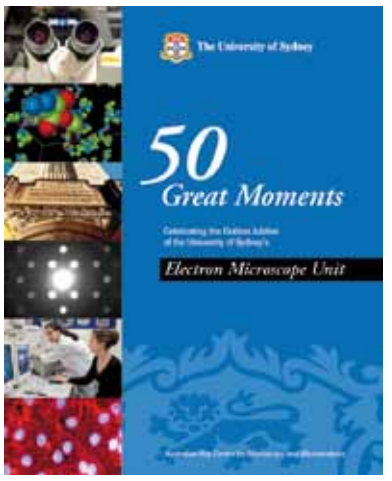
Celebrating Australia's first centralised electron microscopy facility

AMMRF @ USYD

Have you ever wondered why Australia, with its relatively small population, has such a strong capability in electron microscopy and other forms of advanced microscopy and microanalysis? An examination of the history of microscopy down-under brings to light several contributing factors, one of which was the creation of centralised microscopy facilities in many Australian universities during the last 50 years.

The first such centralised facility for electron microscopy was the Electron Microscope Unit (EMU) at the University of Sydney, which was established in 1958 to meet the microscopy needs of researchers from around the campus and elsewhere, irrespective of their affiliation or discipline. It was a bold and potentially risky departure from the widespread model of department-based microscopes that had predominated globally during the previous two decades. However, the EMU quickly showed the merits and value of a centralised service for provision of high-end microscopes and training in electron microscopy. Before long, other universities began following Sydney's lead, and centralised (electron) microscopy labs soon sprang up around the country.

To celebrate 50 years of providing microscopy services and training, and doing research in microscopy, the EMU has just launched a history book covering its achievements, instruments, people and science. The book, *50 Great Moments – Celebrating the Golden Jubilee of the University of Sydney's Electron Microscope Unit*, is available through Sydney University Press (www.sup.usyd.edu.au). ■



Education award for microscopy teaching at UQ

Dr Bronwen Cribb receiving the award from Prof. Paul Greenfield, AO, Vice-Chancellor of the University of Queensland.

AMMRF @ UQ

The Centre for Microscopy and Microanalysis at the University of Queensland has been presented the 2008 Award for the Enhancement of Student Learning for postgraduate education. This is in recognition of the module-based teaching approach overseen by Dr Bronwen Cribb. Selection criteria involved the distinctiveness, coherence and clarity of purpose of the program; its influence on student learning and engagement; breadth of impact; and concern for equity and diversity.

The module-based program offered by the Centre is recognised for its unique and valuable contribution to educating researchers capable of undertaking complex research projects with state-of-the-art microscopy and microanalysis technology. The innovative aspect of this teaching program is the application of a process that allows individual choice and the development of specialist skills in a multi-client environment. Trainers are highly skilled and well versed in different cultural approaches and language issues. Students are able to integrate their own learning styles within the program, which not only focuses on language, but also on visual, auditory and kinaesthetic learning approaches as well. ■

OUT OF THE FRAME

On a wheel and a prayer

AMMRF @ USYD

Peter Hines from the AMMRF team at the University of Sydney heads off again to the Apple Isle in February next year to contest the National Penny Farthing Championships. This will be Peter's fourth time at the event, held in the picturesque Tasmanian village of Evandale. The weekend involves a series of circuit races, a heritage parade, and on the Sunday there is a 20-mile road race to the National Trust property, Clarendon House.

The distinctive big wheel of the penny farthing evolved during the dawn of bicycle design as a way to make a faster machine. It was only with the advent of a decent chain that the rear wheel could be driven (and geared up), giving rise to the modern 'safety' bicycle. "It's a wonderful feeling riding so high", says Peter, on a machine he describes as "simple to ride, but very unforgiving". Success in the four-lap championship race demands "good legs, a good bike and the ability to leave your brain at the starting line". Peter's favourite event of the weekend is the biathlon (run-ride-run) because unlike himself, "most cyclists hate to run".

The Evandale Village Fair and Penny races are on February 21, 2008. The event is "highly recommended for spectators but even better if you are involved".

We all wish Peter the best of luck in next year's event. ■

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