ammrf NEWS

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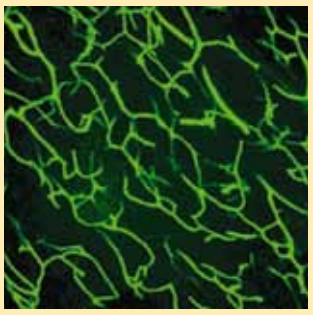
AUSTRALIAN MICROSCOPY & MICROANALYSIS RESEARCH FACILITY



RESEARCH

Dr Gilbert Price from the Centre for Microscopy and Microanalysis, with a reconstructed Diprotodon skeleton at the Queensland Museum. (Photograph: Stewart Gould, The University of Queensland).

Extinct marsupial giant was one-of-a-kind

AMMRF @ UQ

Imagine a wombat standing as tall as a man, nearly as long as a small car, weighing in at over 2 tonnes, with disturbingly long incisors (front teeth), and what you've got is something resembling the Diprotodon, one of Australia's famed but now extinct megafauna. As with all the megafauna, questions remain over the life and demise of the Diprotodon – they are fascinating creatures, but still little understood.

Now research by Dr Gilbert Price at the Centre for Microscopy and Microanalysis (CMM), the University of Queensland, is providing new insights into the nature of these massive marsupials. He completed a comprehensive study of more than 1000 teeth, as well as lower jaw bones, of Diprotodon fossils excavated from different sites in New South Wales, Queensland, South Australia and Victoria.

The work was recently published in the *Zoological Journal of the Linnean Society* (Vol. 153, pp. 369-397, 2008) and is changing established thinking about the existence of distinct Diprotodon species. During the past 170 years, some eight species were defined on the basis of differences in size and skeletal features of individual Diprotodon fossils. However, Dr Price's study has shown that these marked size variations actually fit into just two groups – 'large-form' and 'small-form' – which most likely represent the male and female, respectively, of a single Diprotodon species. This finding is consistent with sexual dimorphism (differences in sizes) between modern male and female marsupials such as today's grey kangaroos. "Just like many modern animals, the difference in size comes down to sex," Dr Price said. "This one is just much more pronounced, with females almost two-thirds the size of the males."

Dr Price works at the University of Queensland's Radiogenic Isotope Facility (RIF), which is part of the CMM. He commenced an Australian Postdoctoral Fellowship, awarded by the Australian Research Council, earlier this year to pursue a project investigating the extinction of Australian megafauna.

This research forms one part of the AMMRF's broader activities in archaeological science or 'archaeometry' in which the application of advanced characterisation techniques helps to answer archaeological questions. For example, Dr Price's research draws heavily on mass spectrometry in the RIF for isotopic analysis. This allows him to determine the ages of megafauna fossils. Dr Judith Field, a senior researcher at the Australian Key Centre for Microscopy and Microanalysis at the University of Sydney, also uses similar techniques in some aspects of her research on megafauna, while her work on ancient starch employs optical microscopy and image analysis. ■

COMMUNITY

'Brilliant Science WA' Garden Party

AMMRF @ UWA

On Sunday 30 March, His Excellency Ken Michael, Governor of Western Australia, invited 50 of the state's key scientists to a garden party in the beautiful grounds of Government House, Perth. The event was part of the 'Brilliant Science WA' initiative, which aims to raise the profile of Western Australian science in corporate business and industry. Among the guests at this prestigious event were Prof. David Sampson, Prof. John Kuo, Dr Martin Saunders and Dr Matt Kilburn of the Centre for Microscopy, Characterisation and Analysis (CMCA) at the University of Western Australia.

The meeting highlighted some of the state's major scientific projects, including a bid to host the Square Kilometre Array radio telescope. Western Australia and southern Africa are the final competitors seeking to host what will be the largest scientific project in history. To support this bid, WA Chief Scientist Prof. Lyn Beazley is promoting the excellence of the state's science.

The CMCA, in addition to being the Western Australian node of the AMMRF, is a State Centre of Excellence for Nano-Characterisation. The invitations were an opportunity to be recognised for the integral role the CMCA plays in the continued development of science. ■

From left: His Excellency Governor Ken Michael, Mrs Michael, Nobel Laureate Professor Barry Marshall, WA Chief Scientist Professor Lyn Beazley, and Professor David Sampson, Director of the Centre for Microscopy, Characterisation and Analysis (CMCA) at the University of Western Australia.

FLAGSHIP INSTRUMENTS

High-sensitivity mass spectrometer to come to Western Australia

The IMS 1280 ion microprobe under construction at the Cameca factory in Paris.

AMMRF @ UWA

The new UWA flagship instrument, the Cameca IMS 1280 ion microprobe, is currently under construction in Paris, as can be seen in the photograph taken inside Cameca's factory. The instrument has a footprint measuring 7x5 m and it weighs more than 7000 kg, largely due to its 3800-kg magnet.

Bearing these large numbers in mind, the Centre for Microscopy, Characterisation and Analysis (CMCA) is currently planning a new laboratory that will include strengthened floors, an anti-vibration platform, and a separate control room with viewing windows. The bulk and weight of the instrument is a major challenge to be dealt with during the installation, and will require the use of an elaborate rail system to distribute the weight across the floors of the corridors during transportation to the new lab.

Once installed and operational, the ion microprobe will provide high-precision isotopic and trace-element analyses of materials, at micron-scale resolution, to help solve fundamental questions in earth, materials and biological sciences. The high spatial resolution and sensitivity of the Cameca 1280 combined with the multi-collector and negative ion capability will provide the opportunity to measure *in situ* stable isotope ratios with a precision previously unattainable. Like the NanoSIMS, previously funded through the NANO-MNRF, the 1280 will be the first in Australia and the Southern Hemisphere. Together, these instruments will provide the complete spectrum of radiogenic and stable-isotope analyses for the geological and biological sciences, making this a unique facility worldwide.

The delivery of this exciting instrument is expected for December 2008. For more information contact Dr Matt Kilburn, phone 08 6488 8068 or email matt.kilburn@uwa.edu.au. ■

Submicron electron-probe microanalysis at the University of New South Wales

AMMRF @ UNSW

UNSW has recently installed a JEOL JXA-8500F Electron Probe Micro Analyzer (EPMA) to enable quantitative elemental analysis of submicron features and elements as light as beryllium (Be). This is one third of the high-resolution scanning electron microscopy (SEM) analysis capability, which is the flagship development at the UNSW node.

This machine has a high-precision sample stage and operates with an 'in-lens' field-emission electron gun, that generates a fine electron beam of high-probe current. The use of a field-emission source for X-ray spectroscopy offers researchers access to accurate chemical information at the sub-micrometre level. It includes four wavelength dispersive X-ray spectrometers (WDS), and a silicon drift detector (SDD) for energy dispersive analysis. The EPMA also operates as a field-emission SEM, collecting images from backscattered or secondary electrons (to 3 nm resolution), to combine high-resolution topographic details with sensitive, spatially resolved elemental information. The advanced capabilities of this state-of-the-art instrument are particularly suited to research in the geosciences, in nanotechnology and in advanced materials.

For more information contact Dr Karen Privat, ph. 02 9385 6468 or email k.privat@unsw.edu.au. ■

RESEARCH

Nature success for AMMRF researcher

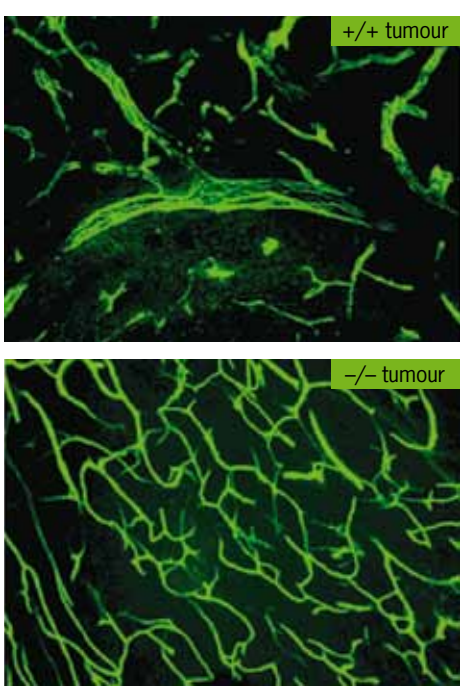
AMMRF @ UWA

Dr Paul Rigby of the UWA's Centre for Microscopy, Characterisation and Analysis (CMCA) and A/Prof. Ruth Ganss and colleagues working at the Western Australian Institute of Medical Research (WAIMR) celebrated the publication of their research in *Nature* last month.

Their article, entitled 'Vascular normalization in Rgs5-deficient tumours promotes immune destruction', describes a new master gene that is responsible for the generation of abnormal blood vessels in and around tumours in mice. These vessels display a 'crazy' architecture compared to normal blood vessels and are also very leaky. The structural arrangement of these abnormal vessels is a critical factor in controlling tumour growth and suppressing immune surveillance; many anti-cancer drugs under development target blood vessel development (angiogenesis).

What the WAIMR and CMCA researchers have shown is that tumours in mice without this gene show a significantly more normal arrangement of vessels, which results in reduced vessel leakiness and improved therapeutic outcomes. The research used thick-sample preparation and confocal-microscopy techniques at the CMCA, that enabled more extensive visualisation and understanding of the arrangement of the tumour vasculature.

This is the first time that a gene has been shown to affect blood-vessel growth and the discovery represents important new knowledge about the way in which tumours grow, and clearly illustrates the importance of such microscopy techniques in biomedical research. ■



Blood vessels in tumours where Rgs5 is expressed (+/+) and where the Rgs5 gene is removed (–/–).

EXECUTIVE DIRECTOR'S COLUMN

Welcome to another edition of AMMRF News, the quarterly newsletter of the Australian Microscopy and Microanalysis Research Facility.

Among its current raft of reviews, the new federal government has asked the National Collaborative Research Infrastructure Strategy (NCRIS) Committee to review the existing NCRIS Roadmap, which underpinned the first round of this infrastructure-funding scheme. The review is to reassess Australia's current infrastructure requirements and any changes that have occurred since 2005. As an NCRIS-funded facility, we were asked to contribute to the consultation process.

Naturally enough, such a review gives one pause for thought about the importance of microscopy and microanalysis for Australian research. Especially, when we consider that the AMMRF represents a $19.2 million federal government investment under the first round of NCRIS and a further contribution of $19.5 million from four state governments and the eight university partners. And this comes on top of years of ongoing support by government and universities for microscopy and microanalysis infrastructure.

So why have these substantial investments been made? The answer is that almost all fields of scientific endeavour and technological advancement depend on understanding, measuring and modifying the structures of all kinds of materials down to the nanometre length scale. Microscopy and microanalysis give us the ability to see and touch objects in this "nano-world".

Even the briefest survey of science will reveal the microscope as a central tool to scientific discovery. Take Robert Hooke's observations of the hidden world in his 1665 book *Micrographia* or the pioneering work of Louis Pasteur and Robert Koch in the late 19th century, which showed that germs are responsible for many diseases.

Today, microscopy and microanalysis are even more crucial. Evolving nanotechnologies – such as quantum computers, quantum dots, quantum photonic devices and molecular electronics – use advanced electron microscopes and scanned probe microscopes as tools for characterisation and, in many cases, fabrication. Likewise, modern microscopy techniques are indispensable tools in understanding the cellular and molecular basis of diseases such as cancer and diabetes.

Microscopy and microanalysis are key tools of discovery for Australian scientists, engineers and clinicians.

I hope you enjoy this edition of AMMRF News. Please do take the time to contact your local AMMRF node to find out how this national facility can help you answer your research questions. ■

Regards,
Simon Ringer, Executive Director & CEO

COMMUNITY

‘Building the Community’ Sydney 2008

The theme of the 2nd AMMRF Strategic Planning Workshop, held on 14 and 15 May in Sydney, was ‘Building the Community’, reflecting the current stage of the AMMRF: deep into its first year of operation, growing in staff numbers, commissioning new flagship instruments, and supporting researchers around Australia.

The annual planning workshop provides a forum for AMMRF staff to meet, plan and network. This year’s workshop had 115 participants, well up from the 78 that participated in last year’s first workshop.

The two core aims for each workshop are, firstly, strategic planning and, secondly, team building among the nodes. The key strategic planning goals for this workshop were to identify AMMRF capability and to form ‘expert groups’ around instrumentation and techniques. Two of the four sessions were dedicated to these goals. A break-out session provided an opportunity for the specialist groups to form, set expectations, and consider how groups will add value to the experience of researchers accessing the AMMRF’s facilities. Another session was spent identifying how the diverse capabilities of the AMMRF can answer pressing scientific questions to best support Australia’s research priorities.

A major focus of the formal team building was to integrate a large number of new staff into the wider facility community. This was done through a session where groups built optical microscopes from plastic lenses and office supplies, as well as through the workshop dinner.

After two busy and enjoyable days, the Planning Workshop had certainly achieved what it set out to do – to build the AMMRF community. ■

New initiative supports nanotechnology R&D

Australian nanotechnology efforts received a boost with the announcement that Australia’s national facilities for nanoscale fabrication and characterisation are to work together closely for the benefit of all researchers.

The AMMRF and Australian National Fabrication Facility Ltd (ANFF) signed a memorandum of understanding at the 2008 International Conference on Nanoscience and Nanotechnology (ICONN08) in Melbourne. Collaboration between the facilities will be principally in the areas of facility management and operation and business development, with a view to achieving best practice in all areas of operation.

“This partnership will capture the obvious synergies between nanoscale fabrication and characterisation capabilities to enhance the overall national research capability by linking NCRIS investments,” said Prof. Simon Ringer, Executive Director of the AMMRF.

“Nanotechnology will underpin advances right across healthcare, primary industries and manufacturing sectors,” said Dr Bob Frater AO, Chair of ANFF Ltd. “These facilities provide researchers with the essential infrastructure to generate leading-edge research outcomes and competitive advantage for Australia.”

The ANFF provides researchers and industry with access to advanced fabrication facilities, enabling processing of hard and soft materials for use in sensors, medical devices, nanophotonics and nanoelectronics. ■

LAB NEWS

EMU Golden Jubilee Commemorative Symposium

AMMRF @ USYD

In 2008, the University of Sydney’s Electron Microscope Unit (EMU) is celebrating 50 years of research, service and training in the field of microscopy and microanalysis. To mark this special milestone, the unit will be hosting the 3-day Commemorative Symposium ‘*Small Matters: Microscopy and Microanalysis*’ from 3-5 December 2008. The event will also include the official Golden Jubilee Luncheon in the Great Hall of the University of Sydney on 4 December.

The interdisciplinary symposium will focus on microscopy and microanalysis, presenting a combination of contemporary research areas, from technical developments in microscopy to the application of microscopy in fields as diverse as advanced materials, cancer research, tissue engineering and archeology.

The unit is looking forward to welcoming national and international speakers to collaborate with like-minded experts and to engage with the microscopists of the future.

The exciting program will have plenary lectures by Dr Thomas Kelly (Imago Scientific Instruments) and Prof. Wolfgang Baumeister (Max-Planck-Institute for Biochemistry), and the list of international speakers includes eminent names like David Williams, David Cockayne, Paul Midgley, Manfred Rühle, Mike Loretto and Hans Tanke, to name just a few. Detailed information about the symposium and the golden jubilee can be found at www.emu.usyd.edu.au.

The EMU incorporates the Australian Key Centre for Microscopy and Microanalysis, which is headquarters of the AMMRF and a node of the ARC Centre of Excellent for Design in Light Metals. ■

RMIT University links with the AMMRF

AMMRF Linked Laboratory

RMIT’s Microscopy and Microanalysis Facility (RMMF) has become a Linked Laboratory of the AMMRF. A Linked Laboratory partnership is a strategy of the AMMRF to create access pathways to specialised laboratories around the nation for researchers from all disciplines of physical and biological sciences, engineering and medical research.

RMMF provides high-quality electron microscopy and microanalysis facilities for research and teaching throughout RMIT. Key facilities include three TEMs, three SEMs, an environmental SEM, and a scanning auger microscope with X-ray gun for X-ray photoelectron spectroscopy. Also included are three light-scattering spectrometers for particle sizing.

In addition to opening up the facilities to researchers around the country, staff and students from RMIT are excited about the prospect of having streamlined access to the vast array of facilities throughout the nodes of the AMMRF. ■

From left: Mrs Rosie Hicks, CEO of ANFF; Dr Bob Frater AO, Chair of ANFF; Dr Greg Smith, Chair of the AMMRF Board; and Dr Miles Apperley, AMMRF General Manager.

AMMRF at ICONN08

The AMMRF was well represented at ICONN08 in February – a conference attended by many current and potential users. A combined display booth for the AMMRF and the ANFF exhibited capabilities in characterisation and in fabrication.

Researchers from several of the AMMRF nodes also presented their work and A/Prof. Joe Shapter, from the SARF node, participated in the conference’s highly successful schools program. ■

STAFF NEWS

South Australian Regional Facility (SARF)

The SARF node recently appointed **Dr Chris Gibson** as Laboratory Manager. Dr Gibson is responsible for the scanning probe microscope laboratories at Flinders University Nanotechnology, which offers access to atomic force microscopes, confocal and confocal Raman techniques. Dr Gibson previously worked at a number of universities, including Cambridge, Leeds and Birmingham, where he applied scanning-probe techniques to topics such as the structure of natural aquatic colloids and the formation of humic thin films, the use of carbon nanotubes to enhance AFM resolution, high-resolution imaging of proteins and viruses, and the corrosion of wool fibres. ■

The University of Sydney

Dr Willie Geerts joined the AMMRF in April as Senior Microscopist, Advanced TEM Specialist. He is responsible for the node's TEM area, and particularly for introducing and implementing 3-D transmission (cryo) electron tomography. Dr Geerts has BSc, MSc and PhD degrees in diverse areas of biomedical science from universities in the Netherlands. After his studies, Dr Geerts worked in a bio-molecular lab of the University of Utrecht, then as a postdoctoral fellow in the Department of Electron Microscopy at the University of Utrecht in 2000, and became a principal investigator on 3-D electron tomography in 2006. ■

The University of New South Wales

Dr Amy Pui Ching Wo recently joined the UNSW node as a research associate to provide technical and analytical support to AMMRF users working with electron microscopes, and to conduct her own research with electron microscopy. Dr Wo is a mechanical engineering graduate, and obtained a PhD in materials science from the University of Hong Kong, where, afterwards, she worked as research associate and part-time assistant professor. Amy has expertise in atomic force microscopy (AFM) and various electron microscopy techniques (SEM, FIB and TEM). Her research interests include nano-indentation and nano-scratch testing of high-temperature alloys. ■

The University of Western Australia

Dr John Cliff joined the NanoSIMS team at the Centre for Microscopy, Characterisation and Analysis. Dr Cliff has extensive knowledge of SIMS instrumentation and techniques from a wide range of applications. His graduate and postgraduate studies at Oregon State University involved analysing soil biology with ToF-SIMS. His previous experiences include applying SIMS to nuclear forensics at the Pacific Northwest National Laboratory and the International Atomic Energy Agency in Vienna. John is currently learning the 'personality' of the NanoSIMS flagship and is looking forward to getting his hands on the soon-to-arrive Cameca IMS 1280 ion microprobe. ■

IN BRIEF

The SARF node at **Flinders University** has recently acquired a WITec Alpha 300 RS, which combines confocal Raman microscopy, with atomic force microscopy (AFM) and near-field scanning optical microscopy (NSOM). The Alpha 300 RS represents a new generation of Raman-imaging systems, focusing on high-resolution and high-speed spectrum and image acquisition. Now chemical information acquired by confocal Raman microscopy can be directly linked to the high spatial and topographical resolution of AFM and the below-diffraction-limit imaging of NSOM.

This sensitive setup allows for the non-destructive imaging of chemical properties without specialised sample preparation. Moreover, the inherent depth resolution of the confocal microscope allows imaging of the interior of transparent samples without microtome sectioning or the use of freeze fracture. ■

In March, **Queensland University of Technology** (QUT) officially launched its Linked Laboratory relationship with the AMMRF. The Analytical Electron Microscopy Facility of QUT is now part of the nationwide grid of microscopy and microanalysis. During the launch, Prof. John Bell, Director of the Linked Laboratory and Assistant Dean Research for the Faculty of Built Environment and Engineering, expressed his delight at having ease of access to the AMMRF and at making QUT's instruments accessible to the Australian research community. ■

The SARF node at the **Ian Wark Research Institute (University of South Australia)** can now offer researchers access to a Kratos Axis Ultra DLD X-ray Photoelectron Spectrometer (XPS). This instrument quantitatively characterises the surfaces of materials.

One of three X-ray sources irradiates the sample and creates characteristic photoelectrons that provide chemical information about the sample. The combination of monochromated X-rays and a magnetic immersion lens gives high-intensity, high-resolution spectra for sensitive analysis of surface composition.

A delay-line detector allows chemical imaging and small-spot selected area analysis to be performed from areas as small as 15 µm in diameter. The sample stage is equipped for cooling and heating from –196 to 400°C, and the addition of an ion gun allows *in situ* sample cleaning and depth profiling. ■

RESEARCH

Fellowship goes to Western Australian node

AMMRF @ UWA

Dr David Wacey from the University of Oxford has been awarded a prestigious UWA Postdoctoral Research Fellowship to investigate early-life and astrobiology. David will work at the Centre for Microscopy, Characterisation and Analysis (CMCA), using the flagship instruments the Cameca NanoSIMS 50 and the soon-to-arrive Cameca IMS 1280 ion microprobe.

Western Australia is the ideal place to study early life: it is home to some of the world's oldest rocks, has fieldwork locations on the doorstep* and has access to state-of-the-art analytical instrumentation at CMCA. One of the unique attributes of secondary-ion mass spectroscopy (SIMS) is the ability to measure isotopic ratios, which may be indicative of biological processes, *in situ*. David will use this technique to analyse 3.5-billion-year-old rocks from the Pilbara region, meteorites, and perhaps someday Mars return samples.

UWA awards only three such fellowships per year, and David's appointment received strong support from the Australian Academy of Science's Mawson Medalist, Professor Peter Cawood, from UWA's School of Earth and Geographical Sciences. ■

**The Western Australian definition of 'doorstep' is anywhere within a 2000-km radius.*

OUT OF THE FRAME

Angus Netting braves the elements

AMMRF @ SARF

After attending the ACMM20 conference in Perth in February, Adelaide Microscopy's Angus Netting entered the 2008 Rottnest Channel Swim. This 19.5-km, open-water race begins at Perth's beautiful Cottesloe Beach and ends at Thompson Bay, Rottnest Island.

Angus joined some 2100 competitors in the ocean at sunrise on 19 February for his second attempt at the marathon swim; the first attempt was aborted in 2007 due to bad weather. During the race, friends in Adelaide kept up a stream of text messages to Angus's support boat to track his progress. Angus passed the halfway mark an hour under the cut-off time, but then the swell turned against him so that he arrived at the 15-km-buoy five minutes late and was disqualified.

Nevertheless, Angus – sporting a great swimmers-cap tan from nearly 9 hours in the water – was pleased with his effort. And so are his colleagues: well done, Angus! ■

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