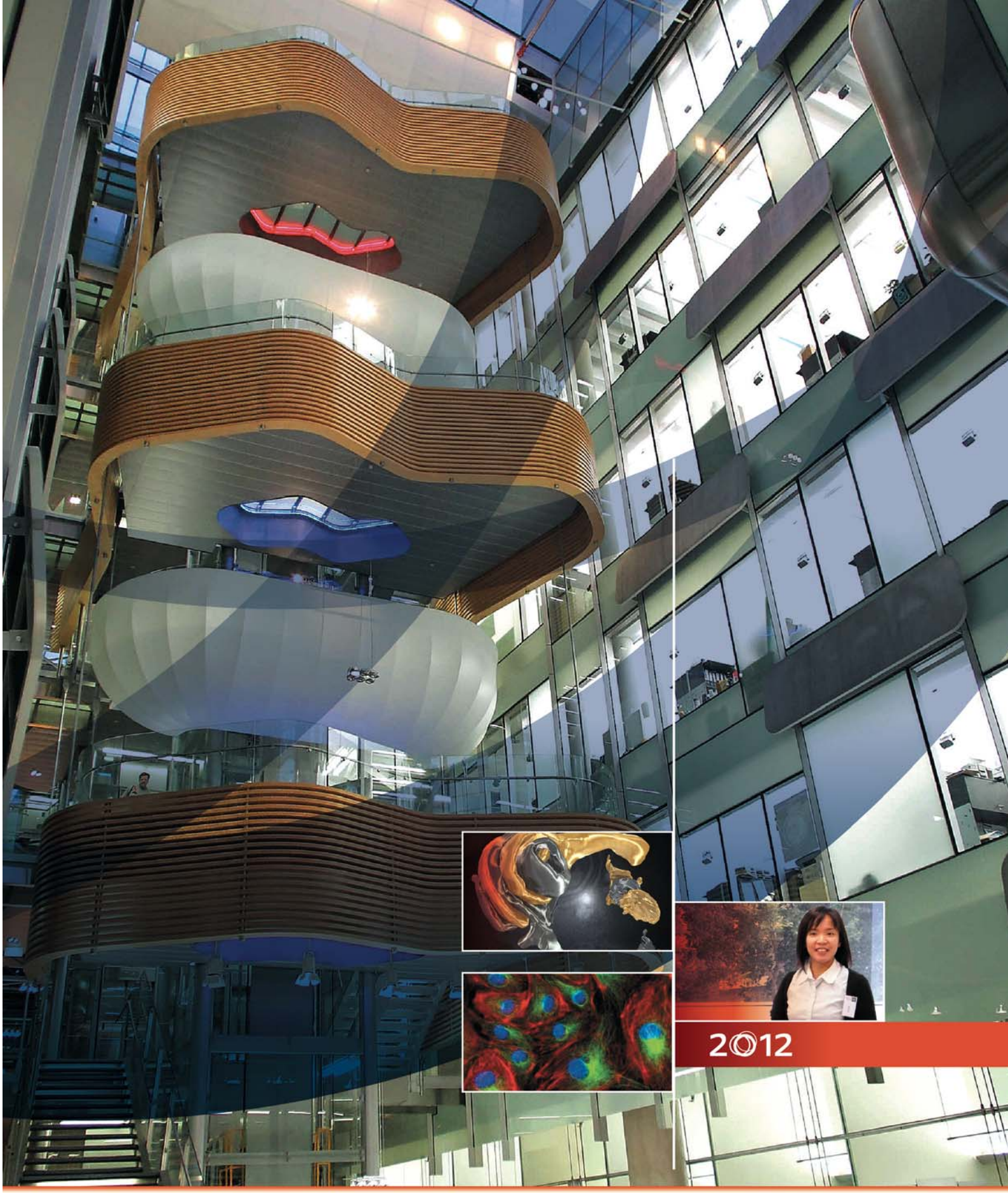

2012

Annual Report

BIO21 MOLECULAR SCIENCE
AND BIOTECHNOLOGY INSTITUTE

www.bio21.unimelb.edu.au

bio21
institute

THE UNIVERSITY OF
MELBOURNE

Introduction

The University of Melbourne's Bio21 Molecular Science and Biotechnology Institute (Bio21 Institute) is a multidisciplinary research facility specialising in medical, agricultural and environmental biotechnology and nanobiotechnology.

Our vision is to improve health and the environment through innovation in biotechnology and industry engagement.

This vision was built on the premise that multidisciplinary ventures between life sciences, physical sciences and engineering disciplines, including the exploitation of 'omics' technologies, was fundamental to translating biological discoveries into biotechnology innovations.

Located in the heart of the Parkville Biomedical Precinct, the Institute accommodates more than 560 research scientists, students, professional staff and industry participants, making it one of the largest biotechnology research centres in Australia.

Our Goals

The goals of the Bio21 Institute are to

- Achieve innovation in the broad area of biotechnology through multidisciplinary research, genomics and strategic alliances/collaborations with academia and industry
- Attract outstanding scientists and technicians
- Establish core platform facilities accessible to diverse scientific and industry communities
- Engage industry and nurture the commercialization of discoveries
- Contribute employable skills and prepare research students and postdoctoral fellows for leadership in industry
- Translate research into community benefits (economic and educational)
- Provide a forum for community engagement and dissemination of information on emerging bioscience and technology issues.

As a flagship facility in the heart of the Parkville Biomedical Precinct, the Bio21 Institute's expertise and state-of-the-art platforms, provide the foundation for collaborative research across the University, Bio21 Cluster organisations and the broader national and international biotechnology community.

Our History

- The Bio21 Institute is built in the grounds of the University of Melbourne's Western Precinct (formerly the Veterinary Precinct) which was established in 1908.
- From the late nineteenth century the site was a livestock market. The heritage-listed remains of the market wall stand by the entrance of the Institute. A horse head sculpture from the market entrance stands at the corner of Story Street and Park Drive.
- In 1930, CSIRO established the Animal Health Research Laboratory on the site.
- In 1996, CSIRO Animal Health moved from Parkville to Geelong. One of the former CSIRO buildings now serves as the Bio21 Institute Business Incubator.
- In 2001, the State Government donated the land in the Western Precinct (previously a Crown Lease to the University of Melbourne) as part of their contribution to the Bio21 Project.
- Building of the Bio21 Institute commenced in May 2002 and the first phase was completed in December 2004.
- The major funding contributors to the construction of the Bio21 Institute building were Atlantic Philanthropies, The University of Melbourne, State Government of Victoria and Commonwealth Government.
- The Bio21 Institute was officially opened in June 2005.

The Bio21 Institute logo with its interlocking rings represents the Institute's strategy – to embrace the partnership between the University, industry and the community.

bio21 institute

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Director's Message

On behalf of the Bio21 Institute members and partners it is a great pleasure to commend to you the Bio21 Institute's 2012 Annual Report that offers a tantalizing glimpse into the breadth and depth of our activities. It has again been an enormously exciting year with significant achievements across our four key elements of world-class interdisciplinary research underpinning biotechnology; cutting-edge platform technologies; education, training and outreach; and industry engagement. Our vision is for the Bio21 Institute to be a world leader in basic and strategic interdisciplinary research and biotechnological innovation that underpins the life sciences sector. This vision, developed in the 2010-2014 Business Plan, continues to be implemented through the "School to Bench to Workplace" concept which embraces and embeds the effective delivery of science education, training and outreach into our basic and translational research objectives.

The inspirational leadership provided by the inter-disciplinary research theme leaders (Structural Biology (Professor Malcolm McConville), Chemical Biology (Associate Professor Spencer Williams), and Nanobiotechnology (Professor Paul Mulvaney) has provided a much needed boost to our research focus and embedding our integrated "whole of Institute" approach. This now informs and drives our recruitment strategy and our investment in infrastructure. As a consequence of the "whole of Institute" approach there has been solid growth in external funding of 21% over 3 years to $38.7M in 2012, of which 26% is category 2-4 funding. There has also been a 19% increase in publications in the past 3 years reflecting the increased outputs and impact from the Institute's research activities. The maturing of key strategic partnerships with industry and academia, in particular with CSIRO, CSL, IBM, VeRSI/VPAC, APCF, DSTO, NICTA and VCCC has been a key step towards increasing income from non-traditional sources and increasing the translation of basic science discoveries. Three exciting new international partnerships in agrifood (with India), infectious diseases (Taiwan) and nanobiotechnology (solar cells with Germany) highlight the international reputation of the Institute's research leaders.

We are delighted to welcome two new outstanding early career research appointments, namely Dr's Kat Holt and Diana Stojanovski, both in the Department of Biochemistry and Molecular Biology, who bring exciting new research programs and collaborations to the Institute from 2013.

We extend our heartiest congratulations to Institute researchers that have been the beneficiaries of numerous prestigious national and international awards that recognise their individual and group's contributions in their designated research fields and also further bolster the reputation of the Institute. Of particular note was the award to Professor Andrew Holmes (Bio21/School of Chemistry and CSIRO) of the Royal Medal from the Royal Society London and the election of Professor Frances Separovic (School of Chemistry) as a Fellow of the Australian Academy of Sciences. Two of our early career researchers, namely Dr's Danny Hatters and Dominic Ng both from the Department of Biochemistry and Molecular Biology, were granted prestigious 4 year ARC Future Fellowships.

Building on our goal of nurturing the brightest young minds, the Bio21 Institute launched two new initiatives in support of early career researchers commencing in 2013. The Wettenhall Establishment Award is a postdoctoral researcher award established in recognition of the outstanding vision of the inaugural Director of the Bio21 Institute, Professor Richard (Dick) EH Wettenhall and his commitment to the career development of young researchers. The Bio21 Institute / CSL Ltd Early Career Researcher Award is a new two year initiative aimed at supporting outstanding early career researchers who are

undertaking fundamental research in the life sciences / biomedical field that has potential biotechnology applications.

This Institute's complex operating environment is able to deliver world-class research outcomes due to the world-class platform technologies (research infrastructure) that provide capability for current research while evolving with the fast pace of technology development. This is largely made possible by the quality of the highly skilled platform staff supported by equally talented administrative and management staff. Through the outstanding leadership provided by Dr Veronica Borrett, General Manager Bio21 Institute the Institute has developed a "sustainable" operating model for technology platforms ensuring their extensive utilisation (>60% external utilization) by the broad researcher community. There were significant upgrades to each of the platforms in 2012 and a highlight was the new super resolution microscope, the OMX Blaze 3D-SIM that will provide unprecedented insights into processes in living cells. Professor Leann Tilley (Department of Biochemistry and Molecular Biology) provided the intellectual leadership for a successful multi-institutional ARC LIEF bid to secure the funding and we were delighted that Professor John Sedat, UC Berkeley, a leader of the consortium that developed the original 3D-SIM super resolution microscope, opened the new facility. The quality of these platforms is recognised by the increased user base and the publication of the research output in the most prestigious international peer reviewed journals (such as *Nature* and *Science*) and the co-authorship of platform staff reflecting their high level of critical intellectual input.

The depth, breadth and impact of our education, training and outreach program is truly amazing and a testament to the incredible skills and unending enthusiasm of our Communications and Public Relations Manager, Ms Helen Varnavas, and is a vital element of the Institute's core activities. Informing the public of the impacts of biotechnology, enthusing and mentoring our future generation of scientists and technologists are all critical strands in our local, national and global engagement and outreach programs. Equally important are the "in-house" activities that build "bridges" both within the Institute and between the Institute and the University and the broader biotechnology sector. In 2012 construction began of a new science sub school, a partnership between the Victorian Government, University of Melbourne, led by the Bio21 Institute and the Melbourne Graduate School of Education and, University High School. A new model of delivering science learning and teaching, the initiative aims to transform the science education experience through a 'school-bench-workplace' concept, which ultimately is an investment in the future growth and sustainability of Australia's science and biotechnology sector.

Industry engagement remains a key objective and driver for the Institute as we strive to translate discoveries into practice. The strategy is multifaceted and includes direct engagement with University of Melbourne Commercial and our industry tenants. The Institute has been highly successful in developing industry engagement (as well as research and consultancy contracts) through strategic relationships with R&D biotechnology/biopharmaceutical companies. A unique feature of the Bio21 Institute is the presence of both SMEs and the multinational CSL group with research capabilities "on-site". These partnerships offer enormous opportunities for collaborative research projects/programs, training opportunities for the postgraduate students of the Institute and mutual sharing of new platform technologies. We also value the contributions of industry scientists who are also appointed as Honorary Institute members; their contributions to teaching, training and outreach activities are highly valued and provide "real world" context to the Institute's activities.

We invite you to share in our enthusiasm of the achievements of Institute members during 2012.

Professor Tony Bacic
Director
Bio21 Molecular Science and Biotechnology Institute

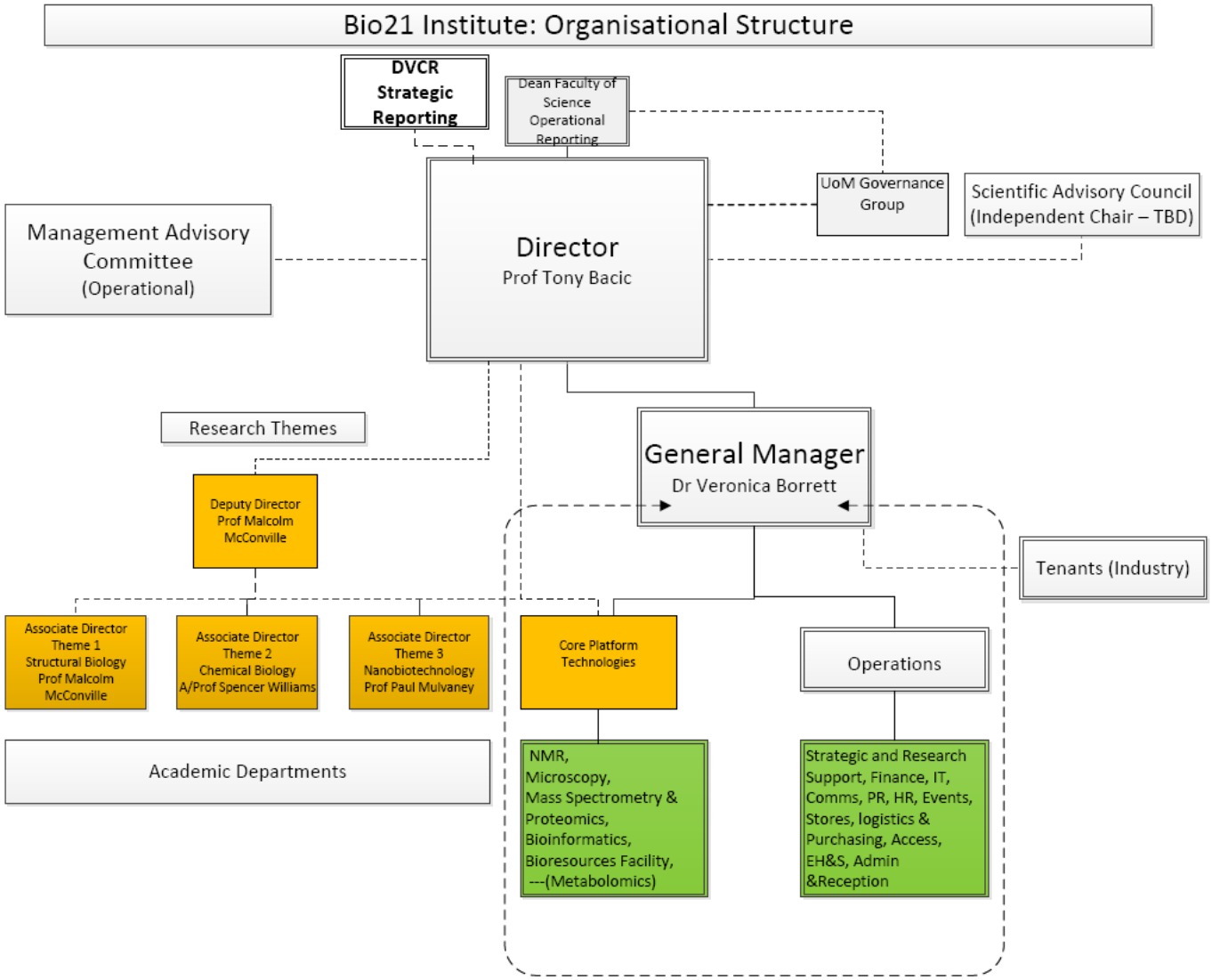
Governance, Structure and Operations

The Bio21 Institute is a multidisciplinary research environment involving a diverse research community, high-end scientific instrumentation and external industry and researcher interactions. To support the operation and management of the Institute, a range of committees representing key stakeholders, areas and functions have been established with membership from across the range of resident groups and affiliated departments.

Committees include:

- Bio21 Institute Governance Group
- Executive Management Group
- Bio21 Institute Management Advisory Committee
- Biological Facility Management Committee
- Stores Facility Management Committee
- Environmental, Health and Safety (EHS) Committee
- Information Technology Management Committee
- Microscopy and Nanotechnology Facility Management Committee
- NMR Facility Strategic Committee
- Mass Spectrometry and Proteomics Facility Management Committee

Underpinning the Bio21 Institute's research and technology capabilities is a portfolio of operational, administrative, maintenance and research support activities. These include management of high end laboratory facilities, common areas, communications, event management and conference facilities, meeting spaces, laboratory services, administration and EHS for more than 560 University researchers plus approximately 80 industry members.



Research Highlights and Achievements

The Bio21 Institute is a world class research and research training Institute built on the performance of our research groups, state of the art research infrastructure and by attracting the best and brightest researchers and research higher degree students.

Anchored by the Institute's three key research themes - Structural Biology, Chemical Biology and Nanobiotechnology – the breadth of our multidisciplinary interactions continue to grow.

Achievements have been in alignment with the strategic vision ranging from increased cross disciplinary collaborations resulting in new research programs and publications, development of our platform technology capability and expertise and an injection of new skills and knowledge from new appointments to the Institute and our affiliated departments.

Structural Biology provides an understanding of the organisation of complex biological systems and molecular processes that underpin normal cellular development and disease. Theme Leader, Professor Malcolm McConville

Chemical Biology uses small molecules and chemical methods and techniques to illuminate and enrich our understanding of biology, human health and disease, and environmental ecosystems. Theme Leader, Associate Professor Spencer Williams

Nanobiotechnology brings together the physical and life sciences with engineering, working at the sub-nano scale, to provide a new level of health, agricultural and environmental research. Theme Leader, Professor Paul Mulvaney

2012 Research Theme Highlights

Structural Biology

- Identified new candidate genes and genetic polymorphisms for climate adaptation in insects using the Drosophila model system.
- Identified a compound which has therapeutic benefit in several models of Parkinson's disease (Journal of Experimental Medicine, 2012)
- Development of a new technique for examining protein aggregates in cells using flow cytometry (Nature Methods, 2012)
- Mapping the carbon metabolism pathways in intracellular and egressed parasite stages of *Toxoplasma Gondii* using metabolomics (Cell Host Microbe, 2012)

Chemical Biology

- Identification of vitamin metabolites as antigens for the immune system to detect pathogens (Nature, 2012, 491, 717)
- Development of copper-64 conjugation methods for antibody labelling (Bioconj. Chem., 2012, 23, 1029)
- New copper-based drugs for treating Parkinson's disease (J. Exp. Med., 2012, 209, 837)
- Defining endomannosidase-based strategies to inhibit host pathways important for viral replication (Proc Natl Acad Sci USA, 2012, 109, 781)
- In 2012, the Bio21 Institute in conjunction with the School of Chemistry coordinated The Australian Workshop for Chemical Biology, engaging almost 90 researchers across Australia to facilitate opportunities for connecting people and activities under this emerging field.

Nanbiotechnology

- A generic new pathway for conjugating nanocrystals for biolabelling applications, published in Angewandte Chemie.
- First nanocrystal biolabelling of calcitonin for imaging bone cancers and tumours.
- Announcement of a nanocrystal detection system for Hendra virus in collaboration with CSIRO Animal Health – featured in Advanced Healthcare Materials.
- First *in vivo* measurements with the Quantum Decoherence Microscope, which appeared in Nature Nanotechnology.
- Ultrasonic spray deposition of active compounds in the "Development of a Novel Treatment to Prevent Vascular Bypass Graft Failure" with Dr Anthony Dear, Monash University.
- Large-scale (A4 size) printed OPV modules for power generation.
- Continuous flow synthesis of nano-particles.

Two new group leaders join Bio21 Institute

Dr Kathryn Holt

Research Fellow, Dr Kathryn Holt (pictured left) joined the Department of Biochemistry and Molecular Biology at the Bio21 Institute in December 2012.

Dr Holt's research interests include pathogen genomics and bioinformatics, in particular genomic epidemiology which focuses on the study of pathogen populations and metagenomics which is the study of bacterial communities. Using next generation sequencing (NGS) technologies to sequence and compare the genomics of hundreds of closely related isolates of the same pathogen, the overall aim is to study populations of bacteria that contribute to disease in Australia and developing countries including *Salmonella typhi (*typhoid) and *Shingella sonnei* (dysentery).

Dr Holt obtained a double degree BA/BSc at the University of Western Australia majoring in biochemistry, applied statistics and philosophy. She completed a PhD in molecular biology at the Wellcome Trust Sanger Institute and the University of Cambridge focusing on pathogen genomic sequencing.

In 2009 she returned to Australia to take up an NHMRC Postdoctoral Fellowship in the Department of Microbiology and Immunology, University of Melbourne, prior to joining the Department of Biochemistry and Molecular Biology as a research group leader.

Successful in being awarded four NHMRC Project grants, Dr Holt's research brings exciting opportunities that enhance existing collaborations and also develop new cross disciplinary links including connections with the Victorian Life Sciences Computational Initiative.

Dr Diana Stojanovksi

Dr Diana Stojanovski (pictured left), was recruited to join the Department of Biochemistry and Molecular Biology at the Bio21 Institute commencing in January 2013 as the Biochemistry Fund Fellow.

Dr Stojanovski's research interests are in the area of mitochondrial biogenesis and disease. Often recognised as a power house generating energy within the cell, mitochondria are a key contributor in promoting cellular health and disease. Some of the diseases associated with mitochondrial dysfunction include cancer, Alzheimer's and Parkinson's diseases.

Her research is firstly focussed on understanding the machineries and mechanism that drive protein import and assembly in mitochondria, and secondly, unravelling the link between defects in mitochondrial protein import and assembly and human disease.

Dr Stojanovski obtained her BSc (Hons) and PhD in the Department of Biochemistry at La Trobe University. In 2006 she commenced post-doctoral work in the laboratory of Professor Nikolaus Pfanner, a world-leader in mitochondrial protein import at the University of Freiburg in Germany. Her time in Germany was supported by a prestigious Alexander von Humboldt Fellowship. In 2009 she returned to the Department of Biochemistry at La Trobe University and as an ARC Australian post-doctoral fellow established her independent research group dealing with mitochondrial protein trafficking.

3D motion of common cold virus offers hope for improved drugs using Australia's fastest supercomputer

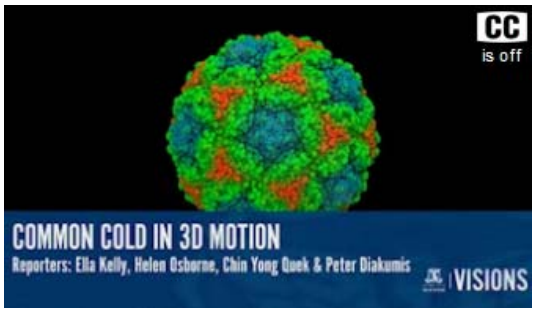
A team led by Professor Michael Parker (Bio21 Honorary Professorial Fellow) from St Vincent's Institute of Medical Research and University of Melbourne's Dr Mike Kuiper (UoM/VLSCI) in collaboration with Dr John Wagner and Dr Matthew Downton from the IBM Collaboratory, have simulated in 3D, the motion of the complete human rhinovirus, the most frequent cause of the common cold, on Australia's fastest supercomputer, paving the way for new drug development.

Rhinovirus infection is linked to about 70 per cent of all asthma exacerbations with more than 50 per cent of these patients requiring hospitalisation. Furthermore, over 35 per cent of patients with acute chronic obstructive pulmonary disease (COPD) are hospitalised each year due to respiratory viruses including rhinovirus.

A new antiviral drug to treat rhinovirus infections is being developed by Melbourne company Biota Holdings Ltd, targeted for those with these existing conditions where the common cold is a serious threat to their health and could prove fatal.

Published work with Biota shows that the drug binds to the shell that surrounds the virus, called the capsid. But that work doesn't explain in precise detail how the drug and other similar acting compounds work.

Professor Parker and his team are working on the IBM Blue Gene/Q at the University of Melbourne with computational biologists from IBM and the Victorian Life Sciences Computation Initiative (VLSCI).



Pictured: University of Melbourne Visions episode: http://visions.unimelb.edu.au/episode/148

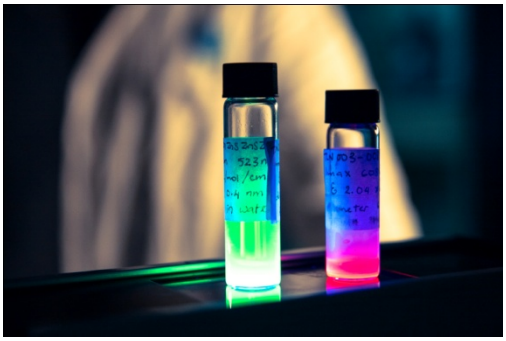
In November 2012, the team's rhinovirus modelling work was recognized with the award of an International Data Corporation (IDC) High Performance Computing (HPC) Innovation Excellence Award. Presented at the SC12 supercomputer industry conference in Salt Lake City, Utah, the HPC Innovation Excellence Award recognizes noteworthy achievements by users of HPC technologies.

A 'quantum' step towards on-the-spot Hendra virus detection

A collaboration between CSIRO scientists and Bio21 Institute researcher Professor Paul Mulvaney, has developed a new method which could pave the way for a portable Hendra virus biosensor.

In a paper published in the journal of Advanced Healthcare Materials, scientists detailed the outcome of the study designed to find a faster, simpler way to detect the virus which could greatly enhance the success rate of any biosecurity counter measure

Hendra virus was discovered in 1994 following an outbreak of illness in a large racing stable in the Brisbane suburb of Hendra.



Pictured: Bottles of quantum dots used to detect Hendra. Photo: CSIRO

Current detection methods are mainly lab-based and require samples to be shipped to state or national testing labs. CSIRO's tests have shown that this new method can deliver a positive or negative test result, under lab conditions, within 30 minutes.

The team tested three new detection methods and found that by using quantum dots - to increase the sensitivity of current analytics methods (assays) - they were able to simplify the detection process to the point where the creation of a portable sensor is now possible.

The method uses a similar principle as a current lab technology, known as Luminex, but the combination of quantum dots and magnetic nano-particles allows the same process to be carried out on a much smaller scale.

The study is a proof-of-concept of the possibility to implement this method in a portable Hendra virus sensor that could be used at the point of care. The most exciting aspect to this technology is it could be used to detect any other virus by simply targeting the virus with the corresponding antibody.

Tracking proteins behaving badly provides insights for treatments of brain diseases

A novel technique that tracks diseased proteins behaving badly by forming clusters in brain diseases such as Huntington's and Alzheimer's has been developed by Dr Danny Hatters (pictured left) and his research team in collaboration with researchers at Monash University.

Published in Nature Methods, the technique was the first of its kind to rapidly identify and track the location of diseased proteins inside cells which could provide insights into improved treatments for brain diseases and others such as cancer.

Using a flow cytometer the team were able to track the protein clusters in cells at a rate of 1000s per minute. In addition, cells with clustered proteins can be recovered for further study - neither of which had been possible before.

By being able to identify locations of diseased proteins in cells enables drugs to be developed to target different stages of disease development.

Enzyme structure opens the door to HIV and Hepatitis C treatment

More than 180 million people worldwide are infected by deadly viruses such as HIV and Hepatitis C.

Developing new drugs to help combat these diseases is now a step closer due to research led by the Bio21 Institute's Associate Professor Spencer Williams in collaboration with Professor Gideon Davis from the University of York, United Kingdom.

The international collaborators have focused on understanding how a group of human viruses, including HIV and Hepatitis C, hijack human enzymes to replicate and cause disease.

Using synchrotron radiation, Bio21 researchers have determined the 3D structure of the enzyme endo-mannosidase, and have developed the most potent inhibitors yet described. Endo-mannosidase is an enzyme involved in building the viral coat, and this work provides a new strategy to stop viruses from hijacking human enzymes and block viral coat assembly.

By enhancing our understanding of how the viruses use our enzymes, and through developing inhibitors that block the pathway, we are fast-tracking the development of novel medicines to fight infectious disease.

The study was published in the international journal, Proceedings of the National Academy of Sciences (PNAS).

HPV vaccine shows dramatic decrease in HPV prevalence

Researchers at the Royal Women's Hospital (The Women's) found the human papillomavirus (HPV) prevalence in women aged 18-24 years has seen a dramatic decrease of 77 per cent in the HPV types targeted by the vaccine.

The study published in the Journal of Infectious Diseases compared rates of HPV in family planning clinics in Victoria, New South Wales and Western Australia to a pre-vaccine study conducted prior to 2007.

Associate Professor Sepehr Tabrizi at the Women's and lead author of the study, said the paper funded by the National Health and Medical Research Council (NHMRC) and the Anti-Cancer Council showed a remarkable decrease in vaccine preventable HPV prevalence in just four years after implementation of the Australia wide vaccination program.

The research further confirms the effectiveness of the HPV vaccine and complements previously published studies that demonstrated lower high grade lesions in younger women, as well as reduction of genital warts amongst the vaccine eligible age group.

A continuation of this study will be looking at the effectiveness of the vaccine in protecting against HPV types not in the vaccine formulation due to be completed in early 2013.

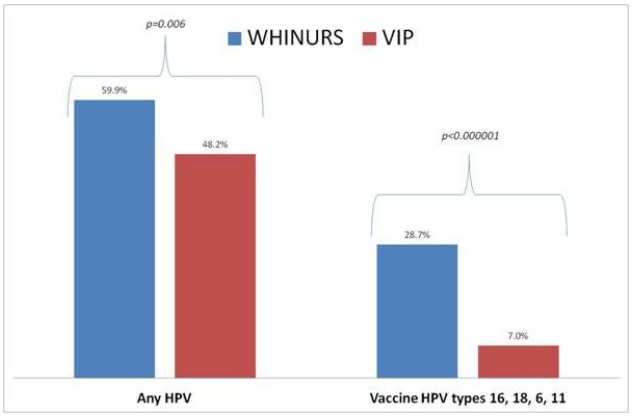


Figure 1. Differences in HPV genoprevalence between pre-(WHINURS) and post-vaccine (VIP) population. Tabrizi et al. 2012. J Infect Dis. 206:1645–51

Scientists use frogs to battle superbugs

Professor Frances Separovic in collaboration with Australian Nuclear Science and Technology Organisation (ANSTO) scientists Dr Anton Le Brun and Dr Michael James, have been searching of ways to fight antibiotic-resistant bacteria by analysing synthetic anti-microbial skin secretions of Australian Green-Eyed and Growling Grass frogs. The two species were selected because peptides secreted from their skin form a defence to a broad spectrum of bacteria, including *Staphylococcus aureous* (such as the infamous "Golden Staph".)

Commonly known as superbugs, antibiotic-resistant bacteria can pose significant risks to human health. Data on the MyHospitals website shows in Australian hospitals there are around 7,000 *Staphylococcus aureus* bacteraemia infections alone each year.

The cutting-edge research underway at ANSTO, has scientists using neutrons from OPAL, Australia's only nuclear reactor, to analyse how and why the peptides from the frog skin secretions work, and how they are efficient at killing bacterial cells and establishing whether (and how) these antimicrobial peptides are selective for bacterial cells.

With the increase in antibiotic resistance, peptides (small proteins) that destroy cell membranes are being considered as therapeutics. However, there is a need for peptides that preferentially destroy bacterial membranes.

By understanding their 3D structure and mechanism of action at the molecular level, they may be able to increase their antibiotic potency and specificity.

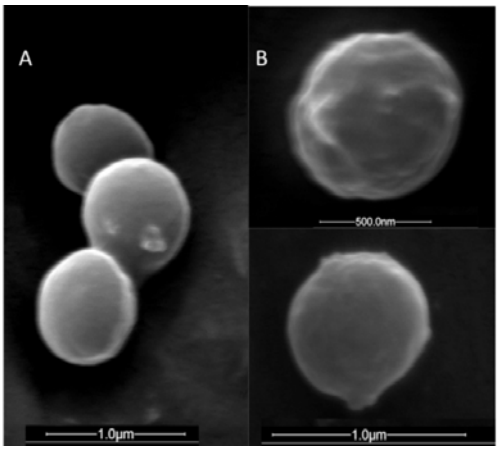


Figure 1: Scanning Electron Microscope images of S. aureus at mid-log phase. (A) Untreated bacteria have a typical spherical shape with smooth surface. (B) After incubation with antimicrobial peptide, bacteria show surface alterations.

Mad Cow blood test now on the horizon

A simple blood test for Creutzfeldt-Jakob Disease (CJD) and Mad Cow disease is a step closer, following a breakthrough by scientists Dr Shayne Bellingham and Professor Andrew Hill.

Using newly available genetic sequencing the scientists discovered cells infected with prions (the infectious agent responsible for these diseases) release particles which contain easily recognized 'signature genes'.

These particles travel in the blood stream, making a diagnostic blood test a possibility potentially providing a way to screen people who have spent time in the UK, who currently face restrictions on their ability to donate blood.

With a simple blood test nurses could deem a prospective donor's blood as healthy, with the potential to significantly boost critical blood stocks.

Mad Cow disease was linked to the deaths of nearly 200 people in the United Kingdom who consumed meat from infected animals in the late 1980s.

Since 2000, the Australia Red Cross Blood Service has not accepted blood from anybody who lived in the UK for more than six months between 1980 and 1996, or who received a blood transfusion in the UK after 1980.

The research was published in Oxford University Press Nucleic Acids Research journal.

The exciting breakthrough might also help detect other human neurodegenerative diseases, such as Alzheimer's and Parkinson's without being invasive.

The research was undertaken at the University of Melbourne, with funding from the National Health and Medical Research Council and the Australian Research Council.

Pictured: Exosomes imaged using Cryo-Electron Microscopy (Imaged at the Advanced Microscopy Unit, Bio21 Institute).

Reducing the need for pesticides: Bilateral international research explores crop productivity

The new collaborative research project titled 'Crop Plants Which Remove Their Own Major Biotic Constraints' aims to produce plants that control pests (biotic constraints) themselves, without the need for pesticides.

Funded by the Australia-India Strategic Research Fund and Grand Challenges program (2012) the international collaboration is led by the University of Melbourne and International Centre for Genetic Engineering and Biotechnology in India. Australia will provide $3.0 million to fund the Australian arm of the research and the Government of India will support the participation by Indian teams in these joint projects.

India is the world's largest grower and consumer of cauliflower and cabbage (6 million tonnes a year of cauliflower alone) and cauliflower is a major dietary source for a billion people. About a third of the national crop is lost to insect pests despite about 25 per cent of the total costs of producing the crop being spent on buying and applying insecticides.

For Australia, one of the world's major canola growers and exporters, insect control in canola is a key element in the costs of production, but insect attacks are sporadic and unpredictable, so this technology can remove the need for costly monitoring and control of the key pests and reduce the environmental footprint of the crop.
Dr Charles Robin from the Department of Genetics at the Bio21 Institute and colleagues at Melbourne's School of Land and Environment, will use a novel approach to provide commercially important crop plants with the ability to suppress vital genes in aphids as well as providing control caterpillar pests using environmentally sensitive proteins expressed in the crop plants. The work will focus on developing insect resistant plants for cabbage, cauliflower in India and canola in Australia.

Multidisciplinary approach leads to successful funding linking international partner

Professor Malcolm McConville in collaboration with Dr Aaron Jex from the Faculty of Veterinary Sciences was successful in receiving more than $777,000 (2012-2017) for their ARC Linkage Grant "Harnessing the 'omics revolution to investigate drug response and resistance mechanisms in *Giardia duodenalis*".

Working with partner organisation, Yourgene Biosciences Co Ltd in Taiwan, this international research project will harness cutting-edge technologies to explore how Giardia, a major global cause of diarrhoeal illness in humans, responds to and becomes resistant to key anti-giardial drugs, providing valuable information for drug preservation and development.

International funding supports collaborative solar R&D project

VICOSC researchers Dr Wallace Wong and Dr David Jones were awarded $500,000 as part of an overall $1.2 million awarded by the Australian Solar Institute Australia-Germany Collaborative Solar R&D fund for their project "Enhancing efficiencies in printed solar cells by controlling morphology development".

Working with German collaborators from partner organisations Light Technology Institute at Karlsruhe Institute of Technology and Laboratory for Electron Microscopy at Karlsruhe Institute of Technology, the project aims to improve the efficiency, reproducibility and performance consistency of flexible, low-cost organic solar cells by controlling the molecular alignment of the active organic components in the cell.

The team will develop interface modification methods to direct molecular organisation in thin printed films. The resulting organic films will be analysed using advanced electron microscopy and X-ray diffraction techniques.

Interdisciplinary seed funding

The University of Melbourne's commitment to tackling society's big picture issues is the aim of the Interdisciplinary (ID) Seed Funding Scheme. The scheme continued in 2012 with Bio21 Institute taking the lead in facilitating the overall 'biotechnology' theme.

Seven projects were awarded in 2011 by the Bio21 Institute and the University's Melbourne Research Office (MRO) for commencement in 2012.

Grants funded from the MRO

- Hatters, Hannan, Petrou ($50K): Building an "Aggreomics" paradigm for neurodegenerative disease
- Mulhern, Williams, Parker ($50K): Understanding the mechanism of action of a new type II diabetes drug.
- Cheng, Graham, Tuck, Nandurkar ($50K): Self-Reporting Fluorescent Chemosensor Peptide Substrates as Molecular Sensors of Src Kinase Activity in Platelets – Development of a Sensitive and Reliable Assay of Platelet Function

Funded by Bio21 Institute

- Gleeson, Dower ($50K): Intracellular trafficking and function of the membrane receptor FcRn which prolongs the serum half-life of novel therapeutic proteins.
- Williams, Pera, Savage ($30K): New molecular regulators of stem cells in the central nervous system – an interdisciplinary approach
- Morfa, Rijs, Khairallah, da Silva ($30K): Nanoparticle Films for Catalytic Capture and Reuse of Carbon Dioxide.
- Hill, Gras , Scheerlinck ($50K): Measuring milk quality through miRNA profiling of milk derived exosomes and microvesicles; a role for dietary miRNA?

Grant part-funded by Bio21 Institute with equal contribution from Melbourne Materials Institute (MMI)

- Tran, Hocking, O'Connor ($40K): Developing Nanocomposites for Soft Tissue Regeneration.

ID Seed Grants for 2013

The 2012 round of projects similarly provided a range in research applications with collaborations from Melbourne's Research Institutes, multiple academic and hospital departments and research institutes.

Funded from MRO ($40K) with top up funding from Bio21 Institute ($10K):

- Albright, A (Chemistry) with White, J (Bio21/Chemistry), Ackermann, U (Austin Health) and Howell, D (Florey): 'Development, synthesis, *in vitro* and *in vivo* evaluation of novel radiotracers for PET imaging of ischemic Stroke'.

- O'Hair, R (Bio21/Chemistry), Ziogas, J, Wright, C and Cranswick, N (Pharmacology), Walker, D,Tordesillas, A (Maths) and Small, M (Maths and Stats): 'Small Needles, Big Haystacks, and a Smart Comb: Integrating Network Theory and Mass Spectrometry to Improve Pharmaceutical Development'.

Funded from the Bio21 Institute

- Gooley, P (Bio21/Biochemistry), Scott, D and Bathgate, R (Florey Neuroscience): 'Engineering stabilised, split G protein-coupled receptors for nuclear magnetic resonance spectroscopy based structural analysis' ($50K)

- Tull, D (MA/Bio21), Williams, S (Bio21/Chemistry), Meikle, P and Barlow, C (MA/Baker IDI): 'The development of combinatorial lipid libraries' ($50K)

- Hutton, C (Chemistry/Bio21), Cottram, J (Chemistry), Barnham, K (Bio21/Neuroscience): "Towards a diagnostic agent for Alzheimer's disease; detection of neurotoxic amyloid peptides' ($30K)

Awards and Recognition

Professor Andrew Holmes awarded a Royal Medal from the Royal Society London

Each year, three Royal Medals, also known as the Queen's Medals, are awarded by The Royal Society London, for the most important contributions in the physical, biological and applied or interdisciplinary sciences.

In 2012, internationally recognised chemist, Professor Andrew Holmes was awarded a Royal Medal. The award recognises his contributions at the interface of the materials and biological sciences that will lead to outcomes that will benefit society. He also played a pioneering role in the field of applied organic electronic materials.

The award also recognises the area of organic electronic materials and the collaborative work with cell biologists. The work in polymer chemistry, is an area that can lead to a diverse range of applications from the development of more energy efficient products to the greater understanding of biological processes.

Professor Holmes is a University of Melbourne Laureate Professor of Chemistry at the Bio21 Institute, a CSIRO Fellow and a Distinguished Research Fellow at Imperial College London.

In the late 1980's he established a collaboration with University of Cambridge physicists that in 1990 led to the discovery of light emitting polymers. Professor Holmes led the Chemistry team in that collaboration for 14 years. These polymers have applications in solid state (LED) lighting, flat panel displays, transistors and solar cells.

Professor Holmes returned to Melbourne in 2004 as an ARC Federation and Inaugural VESKI Fellow joining the Bio21 Institute and School of Chemistry.

At the Bio21 Institute, Professor Holmes leads the Victorian Organic Solar Cells Consortium involving the University of Melbourne, CSIRO, Monash University and industry partners. The Consortium is working towards delivering efficient flexible printed solar cells for low cost applications in electricity generation and benefits from a strong collaboration with the Imperial College Doctoral Training Centre in Plastic Electronics.

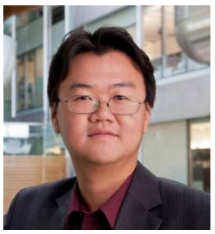
The Royal Medal Image: Royal Society website http://royalsociety.org

Pictured: Professor Andrew Holmes is presented the Royal Medal by Professor Dame Jean Thomas, Vice-President of the Royal Society London, on the Anniversary Day on 30 Nov 2012. (Photo: The Royal Society London, Tracey Croggon.)

Biophysicist appointed Fellow of the AAS

Biophysicist, Professor Frances Separovic was admitted as a Fellow of the Australian Academy of Science. Professor Separovic is the first female chemist to be elected. She was also elected a 2012 Fellow of the International Society for Magnetic Resonance for her leading role in NMR studies of membrane structure and biophysics, mostly using solid-state NMR.

Two new ARC Future Fellowships awarded



Biochemistry and Molecular Biology Department researchers, Dr Danny Hatters (left) and Dr Dominic Ng (right) were awarded Australian Research Council Future Fellowships – a prestigious 4-year career research award.

Parasitology research excellence award

Professor Malcolm McConville was awarded the Bancroft-Mackerras Medal for Excellence by the Australian Society for Parasitology. The medal is awarded in recognition of outstanding contributions of its members to the Science of Parasitology. *Pictured: President of the Society, Denise Doolan, presents the award to Professor McConville.*

Victorian Young Tall Poppy Award

One of the major Victorian Young Tall Poppy Awards was presented to Dr Paul Umina from the Dept of Zoology and Bio21 Institute in recognition for his work on sustainable protection of crops from insects. Paul's research is enabling farmers to achieve a balance between profitability and environmental sustainability by developing new ways to combat insect pests and improve crop yields without harming the environment. The Young Tall Poppy Science Awards aim to recognise early career researchers who have achieved significant research outcomes and have demonstrated their passion to engage with the community in science. The Bio21 Institute is a proud supporter of the program hosting the event in 2012. *Picture: Dr Paul Umina (right) with University of Melbourne Deputy Vice Chancellor Research, Professor James McCluskey. Photo: AIPS.*

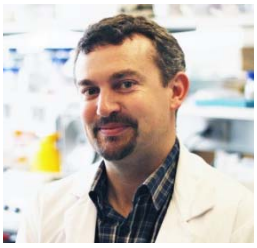
Professor Michael Parker FAOBMB Award

Professor Michael Parker (left), Honorary Professorial Fellow Bio21 Institute/ Biochemistry and Molecular Biology, was awarded the 2012 Federation of Asian and Oceanian Biochemists and Molecular Biologists Award (FAOBMB) for Research Excellence. Awarded annually to a distinguished biochemist or molecular biologist, based on work carried out predominantly within the FAOBMB region, the award for research excellence reflects excellence of scientific contributions to the field and sustained research productivity. Professor Parker will be presented with his award at the 2013 FAOBMB Meeting.

Dairy Industry Australia R&D Awards

Chemical and Biomolecular Engineering's Dr Sally Gras and her research team including Research Fellow Dr Lydia Ong received two out of five 2012 Dairy Industry Australia Ltd Awards. The awards were presented honouring the role of people and teams in producing R&D and creating value in the Australian dairy industry and helping to understand the structure of curd during cheese making. Dr Gras and her team were awarded the 'Most Engaged Research Group – Curd Microstructure Team' and Dr Ong was awarded 'Most Outstanding Post-doctoral Fellow '. *Pictured: Dr Sally Gras being awarded the certificate by Mr Chris Line, member of the Board of Directors, DIAL. (Photo: DIAL).*

Molecular Biologist awarded Churchill Fellowship



Molecular biologist, Dr Stuart Ralph, was awarded the Dorothea Sandars Churchill Fellowship for his work on parasitic diseases. His particular interest is the cause of severe malaria, *Plasmodium falciparum* and therapies for combating this disease. As part of his Fellowship Stuart travelled to India, visiting Delhi, Lucknow and Pune to meet parasite biologists, medicinal chemists and computational scientists. With the burden of disease-causing parasites particularly high in developing countries, and not enough funding put into developing much needed treatments, there is a need to search for potential targets for chemotherapeutic treatments. The Churchill Trust was established in 1965 to honour the memory of Sir Winston Churchill by awarding overseas research fellowships known as 'Churchill Fellowships'. (*Photo: Hirunda Kanaharaarachchi.*)

Enabling Platform Technologies

New Super Resolution Microscopy Capability at Bio21 Institute

Australian researchers are pioneering the application of new super resolution microscopy techniques, with the help of the new OMX Blaze 3D-SIM microscope, to studies of important human pathogens such as the malaria parasite, as well as to understanding cancer and neurodegenerative diseases.

Collaborators from Department of Biochemistry and Molecular Biology, Bio21 Institute at The University of Melbourne, Monash and La Trobe Universities and the Walter and Eliza Hall Institute (with co-funding from an ARC LIEF grant) came together to bring one of the first OMX-BLAZE 3D SIM instruments in the world to the Bio21 Institute.

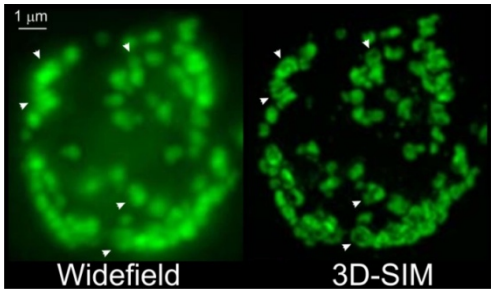
Officially opened in July by Professor John Sedat, a leader of the consortium that developed the original 3D-SIM super resolution microscope, the new $1 million OMX BLAZE provides researchers from across Victoria and nationally, the opportunity to delve deep into live cells.

Cell biologists now have the capability to perform 3D-structured illumination microscopy on live cells which means improved resolution providing new avenues for investigation.

The new OMX BLAZE achieves an 8-fold increase in volume resolution allowing researchers to see inside very small organisms such as bacteria and malaria parasites and inside the organelles of mammalian cells.

Pictured: The new equipment was officially opened by Professor Sedat with a ribbon cutting ceremony, declaring the new OMX Blaze Microscope officially open for business. Pictured from left to right: Prof Tony Bacic, Prof Leann Tilley, Dr Eric Hanssen, Prof John Sedat, Dr Paul McMillan and Professor Paul Gleeson. Photo: H Varnavas, Bio21 Institute.

Biochemist Professor Leann Tilley is a key user of the new capability which will enhance her research in tackling the malaria parasite.



Professor Leann Tilley's lab has pioneered the application of 3D-SIM to studies of the malaria parasite, *Plasmodium falciparum*. 3D-SIM has been used to reveal novel sub-compartments of the Maurer's clefts to follow the genesis and organisation the inner membrane complex or merozoites and to determine the molecular basis of the banana shape of gametocytes.

The new OMX Blaze is located within the Bio21 Institute's Advanced Microscopy Facility which is part of an expanded network of facilities including areas such as the Department of Anatomy and Neuroscience overall supporting the broader whole-of-University approach to key research infrastructure under MCRIC.

Pictured above: OMX Blaze, 3D structured illumination microscope. This super resolution microscope permits imaging below the diffraction limit with resolutions typically of 90-130 nm in x,y and 250-350 nm in z
It is equipped with

- *6 lasers: 405, 445, 488, 514, 568, 642nm*
- *3 CMOS cameras (imaging up to 4 colours)*
- *Live cell system*

Electron Microscopy

The Bio21 Institute Electron Microscopy (EM) Facility provides high quality facilities for physical sciences, life sciences and engineering applications.

The Institute's EM Facility is a key participant in the broader University of Melbourne Advanced Microscopy Facility - bringing together multiple disciplines ranging from biochemistry to botany, microbiology to anatomy and cell biology, physics, engineering and nanotechnology. With multiple nodes across University departments, Melbourne's Advanced Microscopy Facility is a well-established suite of state of the art electron and optical microscopes located across multiple nodes catering to the spectrum of scientists from academia, industry and government. For example around 80% of the usage of the Bio21-based EM Facility is by researchers outside the Institute.

The Electron Microscopes:

- Tecnai F30 Transmission electron microscope – a key Australian high-resolution cryo-electron microscope for structural investigation of biological molecules. The cryo TEM is equipped with an anti-contaminator and cold stage which allows imaging of quick frozen samples as well as tomography in either room temperature or cryo conditions.

- Tecnai F20 Transmission electron microscope. High-resolution TEM for materials science applications with HAADF (STEM) detector and EDAX system.

- FEI Quanta scanning electron microscope (ESEM) An Environmental Scanning Electron Microscope fitted with Peltier cold stage operating from -25 to +40^{o}C.

- FEI Nova dual beam, focussed ion beam system. The Nova Combined SEM and gallium ion beam instrument is equipped with EDAX, Pt-deposition system and micromanipulator. Suitable for device cross-sectioning, TEM sample preparation, nanofabrication and 3D reconstruction using the Slice and View system. It is equipped with a Kleindiek NanoWorkstation with for micromanipulation, electrical measurements, tension measurements and nanoforging

The optical microscopes:

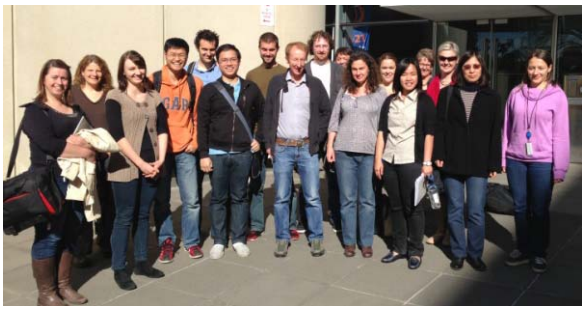
- Confocal Leica SP5 with resonance scanner for fast live imaging
- OMX Blaze structured illumination microscope for super resolution microscopy with resolution up to 115 nm. Equipped with 3 cameras, 6 lasers and temperature controlled stage.

The Sample preparation equipment:

- A manual and an automated plunge freezers for macromolecule solutions
- A Leica EMPACT2 High Pressure freezer for rapid freezing of specimen under vitreous conditions
- A Leica AFS1 for manual freeze substitution of frozen samples
- A Leica AFS2 with robot loading for fully automated freeze substitution and embedding of frozen samples
- A Reichert-Jung UCE and Leica UC7 ultramicrotomes for room temperature section of ultra-thin sections
- A Leica UC7/FC7 cryo ultra microtome for sectioning of frozen samples.

Highlights for 2012

Organized in conjunction with the RMIT EM unit, more than 80 scientists attended the Electron Tomography Forum. Topics ranging from tomography of biological and material samples were presented by speakers across Victoria's EM community. A four day hands on workshop followed for 12 participants with experts from Bio21, RMIT University and Monash University, CSIRO and University of Queensland *(Pictured below workshop participants Photo: E Hanssen).*



New instrumentation installed:

- A Leica EMPACT2 High Pressure freezer for rapid freezing of specimen under vitreous conditions
- A leica AFS2 with robot loading for fully automated freeze substitution and embedding of frozen samples
- A Leica UC7/FC7 cryo ultra microtome for sectioning of frozen samples.
- A Kleindiek NanoWorkstation on the Nova dual beam
- OMX blaze super resolution microscope.

Mass Spectrometry and Proteomics Facility

The Bio21 Institute's Mass Spectrometry and Proteomics Facility (MSPF) is an open access research laboratory providing access to instrumentation that is either unavailable or unaffordable to the general biotechnology community. With five mass spectrometers and three HPLC systems primarily setup for protein and small molecule research, this forms the basis of the mass spectrometry and proteomics platform at Bio21 Institute.

The facility offers mass analysis of small molecules to large proteins, as well as proteomics for the analysis of individual proteins up to high throughput of complex tissue samples using spot picking and digestion robots, and bioinformatics analysis.

Instruments include:

- ABSciex 5600 Mass Spectrometer
- ABSciex 5500 Mass Spectrometer
- Thermo OrbiTRAP ELITE ETD Mass Spectrometer
- Bruker MALDI-TOF Mass Spectrometer
- 2 x Agilent LC-esi-TOF Mass Spectrometers

Pictured: Agilent 1100 HCT ion trap Protein digests.

Highlights for 2012

New Technologies: The addition of a Thermo OrbiTRAP ELITE ETD mass spectrometer has added to our capacity for high end proteomic analysis of proteins and peptides. In particular this instrument allows us to directly work with intact proteins where previously we could only work with peptide fragments.

Additional Users: The facility has more than 200 users that have booked time and been taught how to run their own experiments using the mass spectrometers in the MSPF. More importantly the user base includes users from not only The University of Melbourne but also every other Victorian university, WEHI, Peter MacCallum, St Vincents Institute, MHRI, MCRI, and multiple Industry groups.

Specialist expertise: Dr Ching-Seng Ang joined the Mass Spectrometry and Proteomics Facility in 2012 as one of our in-house technical specialists.

Pictured: Agilent 6220 LC/esiTOFAccurate mass of chemicals and proteins.

Nuclear Magnetic Resonance (NMR)

NMR spectroscopy determines the structures of molecules ranging from small chemicals to macromolecular proteins and nucleic acids. It is particularly useful for the analysis of proteins that cannot be crystallised, and for investigating interactions between proteins, biological membranes and ligands, including potential new drugs.

The Bio21 Institute facility houses eight NMR spectrometers ranging from 300 to 800 MHz, making it the largest high field facility in Australia.

Instruments include:

- 300 MHz NMR – Varian system for solid-state spectroscopy
- 400 MHZ NMR – Agilent 400MR with a one Probe
- 500 MHz NMR – Agilent DD2 system equipped with autosampler and a broadband probe
- 500 MHz NMR – Bruker Avance System equipped with TXI cryoprobe
- 600 MHz NMR – Bruker Avance III with TCI cryoprobe
- 600 MHZ NMR – Varian VNMRS system for solid-state spectroscopy
- 600 MHz NMR - Varian INOVA equipped with a broadband probe
- 800 MHz NMR – Bruker Avance II with TCI cryoprobe and autosampler

Key applications include:

- Superior ligand screening using cryogenic probes
- Methods development including protein (macromolecular) structure elucidation (solution, solids)
- Screening for novel drug leads
- Range of nuclei including 1H, 13C, 15N, and 31P and low gamma nuclei
- Metabolomics
- Methods for examining peptides in biomembranes

Highlight for 2012:

In 2012, the Institute's NMR capability was further enhanced with upgrades to the Varian 500 MHz and 600 MHz spectrometers.

In addition a new 400 system with associated robot was installed as a result of a successful ARC LIEF grant totalling $1.23 million between The University of Melbourne, Bio21 Institute in collaboration with RMIT University. The collaborative project is focusing on advanced characterisation of materials by NMR.

The new technology will support a broad range of research possibilities for development of advanced materials for medical, industrial and environmental applications.

NMR Forum: More than 70 scientists from academia, industry and government bodies attended the 2012 Applications of NMR Spectroscopy Forum at the Bio21 Institute. The event showcased the breadth of NMR applications with key speakers and a series of case studies by NMR specialists from multiple Universities including and Institutes in Victoria and other states. This was followed by a series of case studies by postgraduate students.

Specialist expertise: Dr Shenggen Yao has joined the NMR Facility as one of our in-house technical specialists.

Education, Training and Development

With a large community of early career researchers and students at the Bio21 Institute, our focus is to facilitate programs that aid in their training and career development. This includes partnership opportunities.

A range of programs continued in 2012 supporting Honours, Masters, Postgraduate students and Postdoctoral researcher levels. Programs range from the Bio21 Institute Postgraduate Travel Award Scheme through to supporting member driven initiatives such as the Bio21 Institute Research Symposium led by the Research Assistant and Postdoctoral Research Fellow Association also known as RAPD.

Support, both financial and advisory, help strengthen our internal community by providing our next generation of researchers with valuable experience and skills relevant in today's biotechnology sector.

Bio21 Institute Postdoctoral Fellowship Scheme – Two new initiatives supporting early career researchers

In 2012, the Bio21 Institute launched two new initiatives in support of early career researchers commencing in 2013.

The Wettenhall Establishment Award is a postdoctoral researcher award established in recognition of the outstanding vision of the inaugural Director of the Bio21 Institute, Professor Richard (Dick) EH Wettenhall and his commitment to the career development of young researchers.

The Bio21 Institute / CSL Ltd Early Career Researcher Award is a new two year initiative aimed at supporting outstanding early career researchers who are undertaking fundamental research in the life sciences / biomedical field that has potential biotechnology applications.

Bio21 Postgraduate Student Travel Awards

The Bio21 Institute encourages postgraduate students to broaden their experience and education. To support these programs, travel awards are intended to contribute towards students interested in attending a cross-disciplinary conference, visit laboratories to learn techniques or to enhance industry collaborations and outcomes. In 2012, the institute awarded 15 student travel awards.

Bio21 STRAPA PhD scholarships awarded

Two PhD students, Andrew Brown (Biochemistry and Molecular Biology) and Stephanie Bellmaine (Chemistry), were awarded Bio21 Institute Strategic Australian Postgraduate Awards (STRAPA). The scholarships are awarded to PhD students to support their research conducted at the Bio21 Institute.

Andrew Brown's project "The role of plasmacytoid dendritic cells in resistance to bacterial infection" builds upon a novel finding that plasmacytoid dendritic cells can confer resistance to the causative agent of Legionnaire's Disease, *L. pneumophila*, and aims to discover the mechanisms used by this poorly understood cell type in combating infections.

Stephanie Bellmaine's project "New molecular regulators of stem cells in the central nervous system" aims to identify compounds that can influence neuronal stem cell development. Specifically, how newly identified compounds and related species affect neural stem cells, and will identify new compounds that have improved actions on stem cells.

Bio21 RAPD and student associations

The Bio21 Institute's Research Assistant and Postdoctoral Research Fellows (RAPD) and Postgraduate members are a dynamic group driving a significant number of institute-wide programs that support learning and development.

Embracing the multidisciplinary approach, a cross section of our member representatives, connect with the aim of fostering networks and potential collaborations.

Pictured Left to Right: Dr Lou Fabri (CSL), Dr Henry Butt (Bioscreen) and Dr Guglielmo Gottoli (Newman College) participated as panelists in the 2012 RAPD organized Professional Development Series discussing the topic 'Outside Academia'. RAPD Member, Dr Marco Sani (far right) facilitated the session. Photo: H Varnavas Bio21 Institute.

A range of initiatives supported by the Institute were led by our RAPD and student groups during 2012 including the annual Bio21 Institute RAPD Research Symposium and a four part Professional Development Series tailored to the RA and postdoctoral / early career researcher level. Topics included 'Coping with Workload', 'Managing Contracts, Contacts and Opportunities', 'Building up a track record' and 'From postdoc to group leader'.

Pictured: Audience at the 2012 Bio21 Institute Research Symposium organized by the RAPD Association. Photo: H Varnavas Bio21 Institute.

Careers in Biotech Forum

The Bio21 Institute's postgraduate student members were active in facilitating networks and interactions across their member groups and collectively.

The 2012 Science Careers Event 'A day in the life of...." organised by Bio21 Institute and postgraduate representatives included nine speakers from a range of careers in science, business and industry providing insight into their career paths current roles and some of their experiences.

The opportunity to welcome back to the Institute former members was one of the highlights of the event.

Pictured: Careers Event speakers from a range of industries shared their insight during a panel session. Photo: H Varnavas Bio21 Institute.

The range of careers profiled included bioinformatics through to medical writing, motion graphics consultant to business development manager. This was aligned with the breadth of fields represented including academia, industry, science communication/animation, business development, IP law, recruitment and government.

More than 120 researchers, postdoctoral fellows and students attended the event from the Bio21 Institute, broader University of Melbourne and a range of research institutes across Melbourne.

Engagement, Outreach and Events

A key objective of the Bio21 Institute is to engage with secondary school students, teachers and the general public to inspire and inform them about scientific discovery, impacts of biotechnological innovation and related matters. This involves a range of events, activities and programs using a range of channels. We also contribute within the community including opportunities to support student conferences and public forums which are aligned with the Institute's objectives. Some of the activities Bio21 supported in 2012 included:

- ICT for Life Sciences – Graeme Clark Oration
- Materials for Life Sciences conference
- Melbourne Protein Group Postdoctoral Conference
- Australian Science and Medical Research Student Conference
- Victorian Young Tall Poppy Awards

TechNyou Outreach Program extended

Since 2010, the Bio21 Institute has been managing the Australian Government's TechNyou Outreach Program and in 2012, it was extended to June 2013. An initiative of the Australian Government's Department of Innovation, Industry, Science, Research and Tertiary Education (DIISRTE) the program aims to inform and engage the Australian public on emerging technologies such as bio- and nanotechnologies. TechNyou's alignment with the Bio21 Institute's ongoing commitment to engagement provided opportunity for community groups, students, teachers and the general public to engage in a range of activities including visits, tours, presentations, field days and teacher conferences.

Innovating for Victoria's Health

Pictured above: The exhibition at Queen's Hall. Photo courtesy The Bio21 Cluster; photo by Cameron Wells.

Showcasing the strength and value of the health and medical research sector in Victoria, an exhibition was held in the Queen's Hall at the Victorian Parliament House from 22-24 May. Hosted by the Bio21 Cluster, the expo was supported by the Minister for Innovation, The Hon Louise Asher MP, and aimed to showcase to our parliamentarians the significant capability and impact of Victorian biomedical research. More than 70 organisations came together for this event, providing a diverse set of examples addressing the expo themes of the "economic benefit to Victoria", the impact on health and medical research on "saving and improving lives" and showcasing "Victoria on the world stage". As a flagship biotechnology research centre, the Bio21 Institute was an active participant to this important sector event.

'School to Bench to Workplace' - Bio21 Science sub-school project

Inspiring the next generation of scientists will be the focus of an innovative education initiative – the Bio21 science sub school to be located at the University of Melbourne Western Precinct. The science sub school is a partnership between the Victorian Government, the University of Melbourne, led by the Bio21 Institute and the Melbourne Graduate School of Education and, University High School. Two hundred Year 11 and 12 students will have access to state of the art facilities at the new sub school and will gain exposure to an environment that fosters interest in science which ultimately helps keep Victoria competitive in the scientific world by increasing the number and quality of people in science.

In 2012, construction commenced for the new Science Sub-school with an expected completion in early 2014.

A new model of delivering science learning and teaching, the initiative aims to transform the science education experience through a 'school-bench-workplace' concept, which ultimately is an investment in the future growth and sustainability of Australia's science and biotechnology sector.

The science sub school will also provide outstanding professional development opportunities for science teachers. Scientists from the University will pass on leading edge techniques to the teachers, enabling them to take knowledge of the latest developments back to their classrooms.

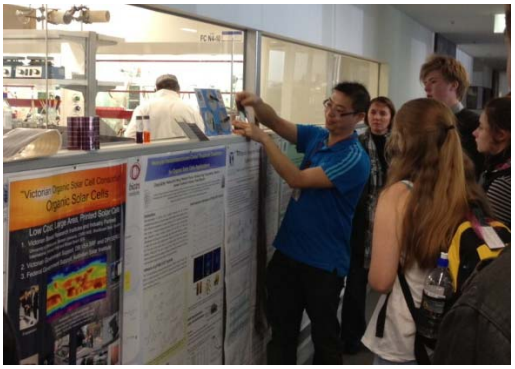
Pictured above: Architect's drawings of the Sub-School by architects Clarke Hopkins Clarke.

Science Discovery Expo @ Bio21

More than 120 Year 9 and 10 students from schools across Melbourne experienced the Bio21 Science Expo which included interactive displays and discussion. From extracting DNA to discussing views on the latest science and technology, students had the opportunity to meet some of our talented scientists and to hear about and see some of the exciting and diverse research undertaken at Bio21 ranging from health and medical research to environment and nanotechnology.

The 'Science Discovery Day' aimed to inspire students to pursue a career in science and all students had the opportunity to get hands on with a range of interactive displays including growing crystals, insects under the microscope, solar cells, DNA extraction and an art and science experience.

Science Discovery Tour visits Bio21



A group of University of Melbourne students in their 1st, 2nd and 3rd year Bachelor of Science and Bachelor of Biomedicine studies visited the Bio21 Institute as part of the University's Science Discovery Tours – a program held during semester break for students interested in finding out more about the research centres and programs within the Parkville Precinct.
Pictured (above): Dr Wallace Wong from the Victorian Organic Solar Cells Consortium presents to students as part of the Science Discovery Tour. Photo: H Varnavas Bio21 Institute.

Outreach with Australian Nanotech Network Young Scientist Ambassador

As part of her role as Australian Nanotech Network Young Scientist Ambassador, Postgraduate student Ms Julia Baldauf has been visiting schools across Victoria. Engaging students with hands-on activities such as a spring that remembers its shape, magic sand and seeing different colours of nanocrystals, Julia hopes to inspire students about nanotechnology and science more broadly. *Pictured: Julia Baldauf in the classroom.*

Science engagement via the small screen

Bio21 Institute's Professor Andrew Hill featured in an episode of the Channel 10 Children's Show 'Scope' where he talked about the use of ultracentrifuges. The show allows opportunity to engage with a younger audience explaining science and science concepts in a simple and fun way. It also provides a great opportunity for researchers to practice their science communication skills.
Pictured: Andrew Hill image from Channel 10 Scope TV episode website www.ten.com.au.

Free Radical Engagement

In 2012, as part of their community engagement programs, the ARC Centre for Excellence for Free Radical Chemistry and Biotechnology's was successful in receiving an Inspiring Australia Grant for an outreach program 'Insight Radical'. 'Insight Radical' aims to create dialogue in the broader community about free radicals and their impact, both positive and negative, on health, materials, and the environment. Led by the COE's Community Awareness Program Manager, Renee Beale, activities will include: working with artists and holding public art exhibitions in Melbourne, Sydney and London; presenting science art workshops and programs.

International VIPs and Delegations

The Bio21 Institute's international standing has established us as a key destination to visit for many international visitors and delegations. In 2012, the Bio21 Institute continued to host a range of VIPs and delegations from here and abroad including GSK Delegation; Austrade; Indian Department of Science and Technology; Vice Minister from Ministry of Science and Technology China.

We were also pleased to a special Humboldt Foundation event to celebrate the opportunities for German/Australian linkages. A special seminar by Professor Helmut Schwarz, President of the Alexander von Humboldt Foundation "Promoting Excellence, Building Trust: the Humboldt Foundation and the Australian-German Research Partnership". The event welcomed the German Consul Dr Anne-Marie Schleich and eight former Humboldt Research Fellows.

Pictured L-R: Institute Director Professor Tony Bacic, Dr Schleich German Consul General, Professor Rob Saint Dean of Science, Professor Schwarz and Professor Richard O'Hair, Chemistry/Bio21 Institute. Photo: H Varnavas, Bio21 Institute.

The Bio21 Institute was pleased to welcome the Vice Minister of the Ministry of Science and Technology (MOST), PR China. Vice Minister, Madam Chen, accompanied by a delegation of six MOST representatives were specifically interested in finding out more about the Bio21 Institute's multidisciplinary approach and the establishment of our research centre. Researchers from the Bio21 Institute presented on the range of collaborative research projects and partnerships currently underway with researchers and organisations in China ranging from insect pest control, climate change, waterway pollution and protein aggregation which occurs in diseases. *Pictured L-R: MOST Vice Minister, Madam Chen and Professor Tony Bacic Director, Bio21 Institute. Photo: H Varnavas, Bio21 Institute.*

International Student Visits

The Bio21 Institute hosted a number of student visits and programs during 2012. These included the annual visit by Nanjing Agricultural University (NAU) PhD students. NAU and the University have a long standing relationship with a formal Memorandum of Agreement in place linking the Melbourne School of Land and Environments and the Bio21 Institute. Over two days students were engaged with a program of presentations, tours and site visits.

The Bio21 Institute welcomed back Professor Sang-Ki Rhee from Korea's Soon Chun Hyang University. Professor Rhee and his colleagues have led a student group visit to Australia as part of an education field trip. The 2012 group included 19 undergraduate students. This annual visit is part of the Bio21 Institute's MOU with the organisation to foster mutual interactions between the two organisations.

Pictured: A visit to the NMR Cave, Professor Sang-Ki Rhee, far right, with some of his students Photo: H Varnavas, Bio21 Institute.

Conferences, events and seminars

In 2012, the Bio21 Institute hosted more than 40 major events and conferences and 130 research and industry seminars including 12 international speakers. These include institute organized events, regular discipline seminar series, PhD completion seminars, key University events and external events. Some of the key events and conferences held in 2012 included the Nossal Institute for Global Health Conference; the Victorian Young Tall Poppy awards; the Australian Chemical Biology Workshop; Flow Cytometry Conference; MALDI Imaging Symposium; Fetal Medicine Symposium and the Australian Society for Medical Research Student Conference.

Many researchers actively participate in organising and hosting international events on-shore, which increases Victoria's reputation and representation ensuring we maintain our position on the world stage. In 2012, Bio21 Institute based chemist Professor Mark Rizzacasa co-organised the 19th International Conference on Organic Synthesis (ICOS) held at the Melbourne Convention Centre. The event drew together more than 550 leading organic chemists and students from thirty-three different countries.

APPENDICES

2012 Research & Management Profile Summary

Resident Departments and Research group leaders

Faculty of Medicine, Dentistry and Health Sciences

Biochemistry and Molecular Biology
Associate Professor Marie Bogoyevitch
Associate Professor Heung-Chin Cheng
Professor Paul Gleeson
Associate Professor Paul Gooley
Dr Danny Hatters
Professor Andrew Hill
Dr Kathryn Holt
Associate Professor Geoff Howlett
Professor Malcolm McConville
Dr Terry Mulhern
Dr Stuart Ralph
Dr Diana Stojanovski (relocates January 2013)
Professor Leann Tilley
Professor Ian van Driel
Professor Jose Villadangos (joint Microbiology)

Dental Science
Professor Eric Reynolds

Obstetrics and Gynaecology
Professor Suzanne Garland (with Women's Hospital)

Pathology
Professor Roberto Cappai

Pharmacology
Professor Kevin Barnham

Faculty of Science

Botany
Professor Tony Bacic

Chemistry
Dr Paul Donnelly
Professor Andrew Holmes (joint Bio21 Institute & CSIRO)
Dr Craig Hutton
Professor Paul Mulvaney
Professor Richard O'Hair
Professor Mark Rizzacasa
Professor Carl Schiesser
Professor Frances Separovic
Professor Tony Wedd (Honorary Professorial Fellow)
Associate Professor Jonathan White
Associate Professor Spencer Williams
Associate Professor Uta Wille

Genetics
Professor Philip Batterham
Dr Charles Robin

Zoology
Professor Ary Hoffmann (joint Genetics)

Melbourne School of Engineering

Chemical and Biomolecular Engineering
Dr Sally Gras

Profiles of our research group leaders and their research interests, are available in the Bio21 Institute website www.bio21.unimelb.edu.au

Affiliated departments and Institutes

University of Melbourne departments and institutes participate in Bio21 Institute programs and research collaborations. Affiliations include:

Anatomy and Cell Biology
Botany
Centre for Animal Biotechnology (Vet Science)
Centre for Nanoscience and Nanotechnology (Chemical and Biomolecular Engineering)
Chemistry (main campus research groups)
Chemical and Biomolecular Engineering
Genetics (main campus research groups)
Medicine
Microbiology and Immunology
Pathology (main campus research groups)
Physics
Surgery
Veterinary Science
Zoology (main campus research groups)

Melbourne Materials Institute
Melbourne Energy Institute
Melbourne Neuroscience Institute

Key Centres and Programs

The Bio21 Institute accommodates a number of research centres and programs including:

ARC Centre of Excellence in Plant Cell Walls
ARC Centre of Excellence Free Radical Chemistry and Biotechnology
ARC Centre of Excellence Coherent X-ray Crystallography
NHMRC Program for Pathogen Research
NHMRC Program for Neurodegeneration Diseases

Oral Health Co-operative Research Centre
Victorian Organic Solar Cell Consortium
Victorian Centre for Aquatic Pollution Identification and Management
Women's Centre for Infectious Diseases – Royal Women's Hospital

Platform Technologies

Electron Microscopy (part of Advanced Microscopy Facility)
Dr Eric Hanssen
Dr Sergey Rubanov
Mr Roger Curtain

Nuclear Magnetic Resonance
Dr David Keizer
Dr Hamish Grant
Dr Shenggen Yao

Mass Spectrometry and Proteomics
Dr Nick Williamson
Mr Paul O'Donnell
Mr John Karas
Dr David Perkins (with VPAC)
Dr Ching Seng Ang

Bioresources Research Facility
Mr Max Walker
Ms Shiralee Whitehead
Mr Carlos Chahine
Ms Shasta Brown
Ms Tabatha Lovelace
Ms Lan Ta
Ms Samantha Zahra

NCRIS Metabolomics Australia (with School of Botany)
Professor Tony Bacic
Professor Malcolm McConville
Dr Uta Roessner (Botany)
Dr Dedreja Tull (Bio21 Institute)
Dr Vladimir Likic (Bioinformatics)
Dr Saravanan Dayalan
Dr Amsha Nahid
Mr David De Souza
Dr Thusitha Rupasinghe
Mr James Pyke
Ms Sheena Sahani
Mr Jairus Bowne
Mr Sean O'Callaghan
Ms Alysha deLivera
Dr Claudio Silva
Ms Mala Jayamanne
Mrs Komal Kanojia

Management, Administration and Operations

Professor Tony Bacic
Dr Veronica Borrett
Mr Michael Blake
Mr Chris Bunney
Ms Denea Conlan
Mr Sam Eshtiaghi
Ms Annetta Jensen
Dr David Keizer
Mr Hirunda Kanaharaarachchi (joint Biochemistry)
Mr Thu Nguyen
Mr Christian Rantzau
Mr Peter Riak
Mr Vladimir Tikhomandritskiy (joint Biochemistry)
Mr Zlatan Trifunovic
Ms Helen Varnavas
Mr Manuel Zacharias

Honorary Members

Professorial Fellows
Professor REH (Dick) Wettenhall
Professor Michael Parker (joint Biochemistry)
Professor Steven Dower (CSL)
Professor Carol Robinson (joint Chemistry)
Principal Fellows
Dr Nick Birbilis (Monash University)
Dr Vic Ilag (Patrys Ltd)
Professor Darren Kelly (St Vincent's / School of Medicine)
Dr Eugene Maraskovsky (CSL)
Associate Professor Peter Meikle (Baker Institute)
Dr Andrew Nash (CSL)
Dr Martin Pearse (CSL)
Honorary Senior Fellows
Dr Henry Butt (Bioscreen)
Dr Suzanne Fiel (St Vincent's Institute)
Dr Mark Hinds (Walter and Eliza Hall Institute)
Honorary Fellows
Dr Luke Miles (St Vincent's Institute)
Dr Jack Parsons (Prana Biotechnology)
Dr Fabio Turatti (Sienna Cancer Diagnostics)
Dr Scott Watkins (CSIRO)
In addition, senior research staff with CSL hold Honorary Appointments.

Industry members

Bioscreen
CSL Limited Research and Development Group
Prana Biotechnology
Sienna Cancer Diagnostics
Tecniplast
TechNyou

Major Individual Awards, Prizes and Fellowships

Professor Andrew Holmes awarded a Royal Medal from The Royal Society London

Professor Frances Separovic elected Fellow of the Australian Academy of Science

Professor Malcolm McConville awarded the Bancroft-Mackerras Medal for Excellence by the Australian Society for Parasitology

Dr Danny Hatters awarded ARC Future Fellowship

Dr Dominic Ng awarded ARC Future Fellowship

Dr Stuart Ralph has been awarded the Dorothea Sandars Churchill Fellowship for his work on parasitic diseases.

Dr Michael Griffin awarded CR Roper Fellowship (Faculty of Medicine, Dentistry and Health Sciences, University of Melbourne)

Dr David Keizer awarded Faculty of Science Dean's Award for Environment, Health and Safety

Dr Veronica Borrett awarded the University of Melbourne's Bronwyn Jane Adams Award

Bio21 Institute/CSL Ltd Early Career Researcher Awarded to Dr Justine Mintern (commencing 2013)

Bio21 Institute REH Wettenhall Early Career Researcher Awarded to Dr Darren Creek (commencing 2013)

Dr Sally Gras and team awarded Dairy Industry Australia Ltd 2012 Award for Most Engaged Research Group – Curd Microstructure Team

Dr Lydia Ong, awarded Dairy Industry Australia Ltd 2012 Award for Most Outstanding Post-doctoral Fellow

Dr Emma Petrie awarded a Melbourne Research Fellowship (Career Interruptions)

Cheryl Chia and Helena Safavi-Hemami awarded ASBMB Fellowships

Research Facts and Figures

- Total grants income > $38.5 million
- Research Higher Degree students in 2012 >240
- More than 500 Publications - 19% increase from 2009
- Research group leaders – 36
- Independently funded research fellows – 34%
- More than 40 major conferences and events and 130 research and industry seminars hosted in 2012

New major funding success

- 'Crop Plants Which Remove Their Own Major Biotic Constraints' : Funded by the Australia-India Strategic Research Fund and Grand Challenges program (2012). An international collaboration led by The University of Melbourne and International Centre for Genetic Engineering and Biotechnology in India. Australia will provide $3.0 million to fund the Australian arm of the research and the Government of India will support the participation by Indian teams in these joint projects.

New grants and funding

- ARC Discovery Grants – 6
- NH&MRC Project Grants -13
- NH&MRC Large Project Grants - 2
- ARC Large Infrastructure & Equipment Funding – 3
- University of Melbourne Interdisciplinary Seed Funding Grants 2012 (for 2013 with Bio21 Institute contribution) – 5
- Bio21 Institute Postgraduate Student Travel Awards – 15 awarded during 2012
- Bio21 Institute/CSL Ltd Early Career Researcher Award - 1
- Bio21 Institute REH Wettenhall Early Career Researcher Award - 1
- Strategic Australian Postgraduate Awards (STRAPA)-PhD scholarships - 2

Memberships

- Ausbiotech
- BioMelbourne Network
- Bio21 Australia Ltd (Bio21 Cluster)
- Victorian Platforms Technology Network
- ANZAAS - The Australian & New Zealand Association for the Advancement of Science
- Victorian Microscopy Network
- ANZMAGnet

The Bio21 Institute 2012 Annual Report has been produced by Bio21 Institute Communications and published by the Bio21 Institute Director's Office.

The Bio21 Institute 2012 Annual Report is available as a downloadable PDF document on the Bio21 Institute website. The website also provides further information including: Profiles of Bio21 Institute based Researchers and key Centres and Programs located at the Bio21 Institute.

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