Biomolecular Interaction Centre

# *making a difference*

## ANNUAL REPORT 2012–3

UC UNIVERSITY OF CANTERBURY
*Te Whare Wānanga o Waitaha*
CHRISTCHURCH NEW ZEALAND

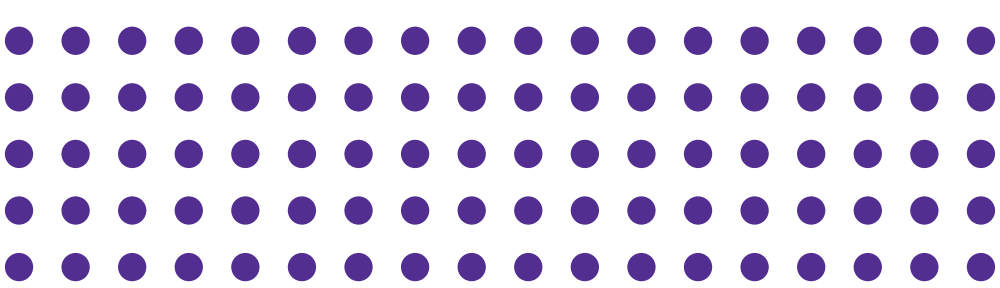
## OUR MISSION

*The Biomolecular Interaction Centre is a multi-disciplinary centre dedicated to the study of molecular interactions critical to biological function.*

*Understanding biomolecular interactions is central to a range of fundamental sciences, new treatments for disease, and a wide range of highly functional products. This gives us a variety of pathways through which we can connect to industry.*

## CONTENT





THIS REPORT COVERS THE PERIOD 1 APRIL 2012–31 OCTOBER 2013

Design and photography by Matt Walters,
School of Biological Sciences, UC

# Director's Report

**PROFESSOR JULIET GERRARD**
***Director, Biomolecular Interaction Centre***

## BIC HAS NOW COME OF AGE.

The Centre was founded in 2007 at the University of Canterbury and includes researchers from the Colleges of Science and Engineering and partners with several New Zealand CRIs, Universities and Callaghan Innovation.

In 2010, BIC received a multi-million dollar investment from the University of Canterbury to become one of two new premier research institutes on campus. There were a few shaky moments along the way, but we are proud of what we have achieved. The support from the University has allowed us to move from an enthusiastic bunch of researchers to a coherent Institute. In 2014, we will enter a new phase in which we have substantially less internal support, and draw the vast majority of our income from external sources. Our annual research income has reached $3 million per annum and continues to grow.

Over the last three years BIC has been working not only on great science and engineering, but also investing energy in fostering key relationships in a rapidly changing funding landscape. This year we have strengthened key strategic relationships with Callaghan Innovation, Fonterra via the Ministry of Primary Industries funded Primary Growth Partnership, a variety of Crown Research Institutes and Universities in NZ and overseas, as well as the NZ CoREs. More on these later in this annual report. This places BIC in a strong position to move forward as an integral part of a resilient, NZ-wide network, with strong connectivity internationally.

BIC has grown to include 8 Principal Investigators and more than 32 Partner, Associate and Affiliated Investigators throughout New Zealand. These investigators are supported by 11 Postdoctoral Fellows and more than 44 Postgraduate students researching biomolecular interactions. The biomolecular flagship projects are now led by some of our emerging investigators: 'Evolving and Engineering Biomolecules' is led by new PI, Rutherford Fellow Anthony Poole, 'Engineering Biotechnology' by new PI, Volker Nock and 'From Interaction to Application' by new Callaghan Innovation Scientist and BIC alumnus, Antonia Miller. We welcome them to the leadership team.

Together BIC supports a dynamic research environment for both staff and students. In the following pages we offer a flavour of our diverse activities and particular successes over the past 18 months.

Juliet Gerrard


BECKMAN
COULTER

# Income

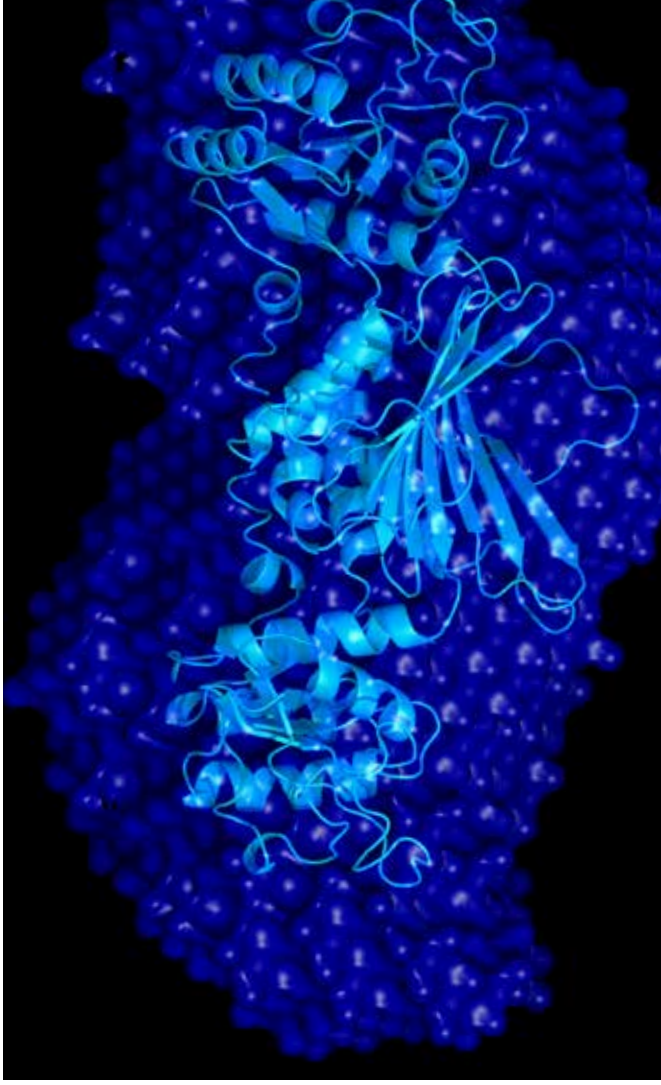
## BIOMOLECULAR INTERACTION CENTRE INCOME (ALL SOURCES)

| | 2012 | 2013* |
|---|---|---|
| UNIVERSITY INSTITUTE SUPPORT | $1,076,575 | $384,551 |
| EXTERNAL REVENUE | $1,468,658 | $2,653,686 |
| TOTAL | $2,545,233 | $3,038,237 |

*FORECAST AS AT 31 OCTOBER 2013

**TOTAL EXTERNAL REVENUE CONTRACTED FROM 2010–TO DATE EXCEEDS $10 MILLION**

# Highlights



## A HAT TRICK OF SMART IDEAS

### THREE SMART IDEA MBIE GRANTS FUNDED IN 2012/3

#### SMART IDEA 1: REVOLUTIONARY INDUSTRIAL PROCESS

In the 2013 round, BIC researchers Professor Conan Fee and Dr Simone Dimartino were awarded a million dollars of Smart Idea funding to look at 3D printed adsorptive media. This is aimed at industrial processes such as improved pharmaceuticals, air quality, lower fuel consumption, new drug delivery devices and potentially better removal of airborne particles, including viruses in improved air filters. Many people have studied more efficient packing geometries by computer modelling but, until now, there has been no way to reproduce those studies in the real world.

#### SMART IDEA 2: NEW DIAGNOSTICS FOR DIABETES

In collaboration with Canterbury Scientific Ltd, BIC researchers Dr Renwick Dobson, Professor Juliet Gerrard and Professor Antony Fairbanks are leading an MBIE-funded research programme ($1 million), focusing on the early detection of people who are at risk to develop diabetic complications. Canterbury Scientific Ltd (CSL) is a Christchurch-based diagnostic company that is exporting a blood protein product to major international diagnostic companies. This product is sold to clinicians as part of the current gold standard blood test. CSL has world class facilities, key product development expertise and a route to international customers. We aim to diversify their product range using in depth knowledge of protein chemistry to design new biomarker products.

#### SMART IDEA 3: PROTEIN NANOTECHNOLOGY FROM FISH WASTE

BIC researchers Dr Madhu Vasudevamurthy and Professor Juliet Gerrard received $1 million for an MBIE funded Smart Idea to use cutting edge nanotechnology to turn fish eye lenses into protein nanofibres with a wide range of applications in bionanotechnology.

The programme builds on exciting preliminary data and has facilitated collaboration with nanotechnology experts from Denmark to develop novel biosensor technology using proteins manufactured in NZ. The BIC group has a unique ability to manufacture protein nanofibres on a large scale which will be hugely helpful in creating new devices to diagnose illnesses, along with many other potential applications.

## WORLD CLASS INFRASTRUCTURE

### LEVERAGING UC INVESTMENTS TO RESEARCH OUR IDEAS

Expanded use of the Australian synchrotron and the BlueFern high performance computing facility, leveraging UC investments in world class infrastructure

BIC researchers continue to make extensive use of the facilities of the Australian Synchrotron. Biomolecular interactions are being examined by determining detailed molecular structures using the two MX beamlines at the synchrotron. In addition solution phase information is being obtained by using the small angle x-ray scattering beamline.

BIC researchers have been very successful in gaining beamline time in a highly competitive allocation system.

In June 2012, BIC hosted the inaugural Australia & New Zealand Small Angle Scattering Workshop, organised by the Australian Synchrotron, which attracted 50 participants from around New Zealand and Australia.

In 2013, BIC and BlueFern cemented their partnership via the establishment of a joint BIC-BlueFern PhD scholarship in computational biology. The first awardee is Sinan Ugur Umu who is using high performance computing to simulate millions of biomolecular interactions as a way to understand how RNA molecules correctly find their targets in the complex environment of the cell.

# NZ-UNIQUE FACILITY

## NEW ANALYTICAL ULTRACENTRIFUGE INTRODUCES CUTTING EDGE TECHNIQUES

Bioinformatic and proteomic approaches are now providing extensive and detailed information about biomolecules in their biological contexts. It is therefore important to develop rigorous ways of probing individual interactions between these biomolecules, their driving forces, and their regulation, since they form the basis of most biological processes. The analytical ultracentrifuge is the perfect tool to examine how biomolecules, such as proteins, DNA, RNA, polysaccharides and lipids, interact, and how we might disrupt such interactions.  Dr Renwick Dobson established the analytical ultracentrifugation centre in May 2013. It is the only centre of its kind in New Zealand and provides access to cutting edge techniques for New Zealand researchers to probe their favourite biomolecules and how they interact. Developments in instrumentation and in data analysis have greatly increased the potential of the approach to deal with other complicated systems, including inorganic crystalline nanoparticles and interaction in cell lysates and food, and to provide information complementary to other techniques, such as SPR.

# INCREASED SCIENTIFIC IMPACT

## OUR IDEAS ARE GETTING NOTICED

High profile publications, including in the prestigious Proceedings of the National Academy of Sciences of the USA and Immunity

BIC researchers, Dr Penel Cross and Professor Emily Parker, are investigating evolutionary events to understand how the activity of enzymes is regulated in a Marsden funded project. By copying nature, they are working towards the creation of tailor-made enzymes that are able to be precisely switched on and off. As part of this research they have uncovered how an enzyme, required by bacteria, is regulated and mimicked this natural example to engineer a ‘designer’ enzyme that is precisely controlled.

This is the first example where parts of different enzymes have been combined in this way to make a functional new enzyme. This novelty is a significant factor in the work being accepted into the US journal Proceedings of the National Academy of Sciences.

Dr Renwick Dobson also hit the big time this year as a co-author on a paper in Immunity (impact factor 21.1) describing how a pseudo kinase, known as MLKL, is involved in triggering necroptosis, the final execution mechanism of the death process.

Dr Anthony Poole was also involved in a high-profile international publication published in Nature detailing the workings of the most complex cells on Earth – algal cells derived by endosymbiotic interactions of four different cells.

# *Flagships*

BIC's diverse research activities have three central foci, our flagship research programmes. These have evolved over the life of the Institute, and are now led by three new BIC investigators, as we nurture new research leaders.

LED BY THREE NEW BIC INVESTIGATORS, AS WE NURTURE NEW RESEARCH LEADERS

## EVOLVING AND ENGINEERING BIOMOLECULES

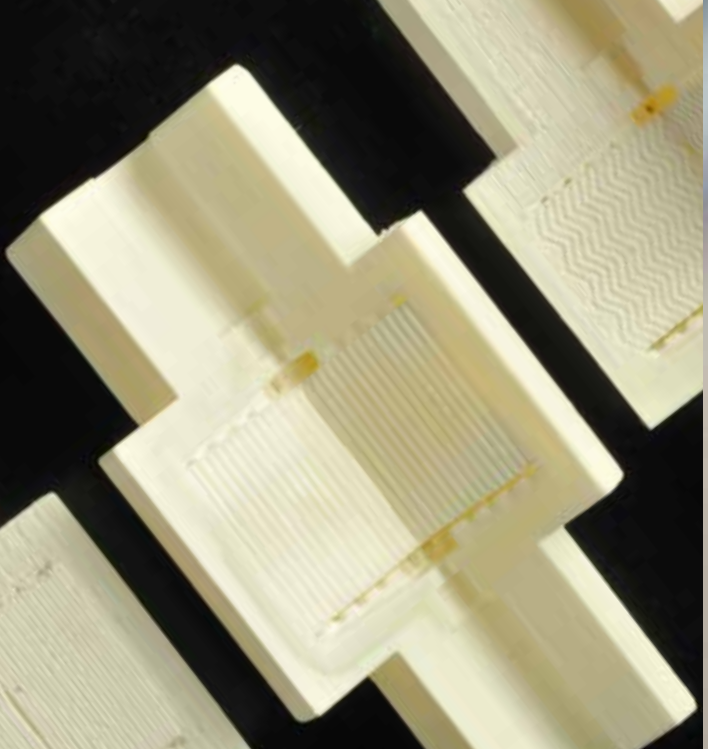
### POOLE, PARKER, DOBSON, GERRARD

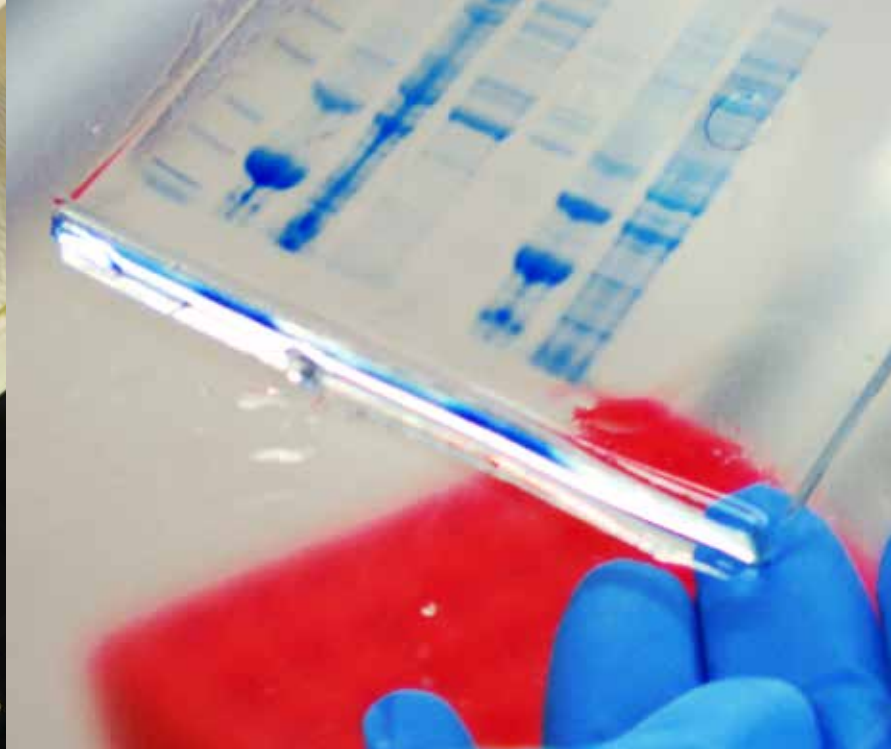
Nothing in biology makes sense except in the light of evolution. We take that adage to heart, and are exploring fundamental questions of how molecules evolve, function and interact. Working closely with our colleagues in the Callaghan Innovation Protein Science and Engineering team, we aim to connect basic research with biotech application.

We are focusing on the following broad areas of activity: Harnessing biomolecular interactions, creating enzymes with novel properties, rewiring cells to produce biomolecules in short supply, utilising long-term evolution experiments to better understand structure, function and evolution, and mining evolutionary diversity for new function.

### FLAGSHIP LEADER - DR ANTHONY POOLE

Ant is a Principal Investigator in the Biomolecular Interaction Centre and a Royal Society of New Zealand Rutherford Discovery Fellow. Prior to returning to New Zealand, he headed a group at Stockholm University in Sweden. Ant's research interests are in molecular evolution and his group use a mix of genomics, bioinformatics and experimental evolution to address fundamental questions on the evolution of molecular systems. His lab is currently using long term evolution experiments in bacteria to study the evolution of translation initiation and deoxyribonucleotide synthesis. His group is also developing tools for generating evolutionary trees from protein structural data.





# ENGINEERING BIOTECHNOLOGY

### DIMARTINO, DOBSON, FAIRBANKS, FEE, GERRARD, NOCK, STAIGER

Advances in bioengineering provide great potential for enhanced device functionalities. We aim to connect basic biotech research with innovative applications driven by engineering technology.

We are focusing on the following broad areas of activity: 3D printed devices for bioseparations, biomolecular interactions on surfaces, biomolecular interactions related to disease, biochemistry on chip and sourcing of advanced materials from nature's pantry.

## FLAGSHIP LEADER - DR VOLKER NOCK

Volker received the Dipl.-Ing. degree in Microsystem Technology from the Institute for Microsystem Technology at the Albert-Ludwigs University of Freiburg, Germany in 2005. He wrote his Diploma thesis on single-use valves and pumps for transdermal drug delivery at the Royal Institute of Technology in Stockholm, Sweden. In 2009 he received the PhD degree in Electrical and Computer Engineering from the University of Canterbury, Christchurch, New Zealand. His PhD dissertation focused on the control and measurement of dissolved oxygen in microfluidic bioreactors.

He was awarded a Post Doctoral Research Fellowship with the MacDiarmid Institute for Advanced Materials and Nanotechnology based at the University of Canterbury in 2009. In 2011 he received a Marsden Post Doctoral Research Fellowship also based at Canterbury. In May 2012 he joined the Department for Electrical and Computer Engineering as a Lecturer.

# FROM INTERACTION TO APPLICATION

### DOBSON, FAIRBANKS, GERRARD, MILLER, MUSCROFT-TAYLOR, PEARCE, STEWARD

Protein interactions are important in an amazing variety of applications, so our basic science finds application in a broad range of fields: drug design, nanotechnology, food science, agritech and diagnostics.

We work closely with the Callaghan Innovation Protein Science and Engineering team, based at BIC, to engage with industry and harness our basic science for economic benefit.

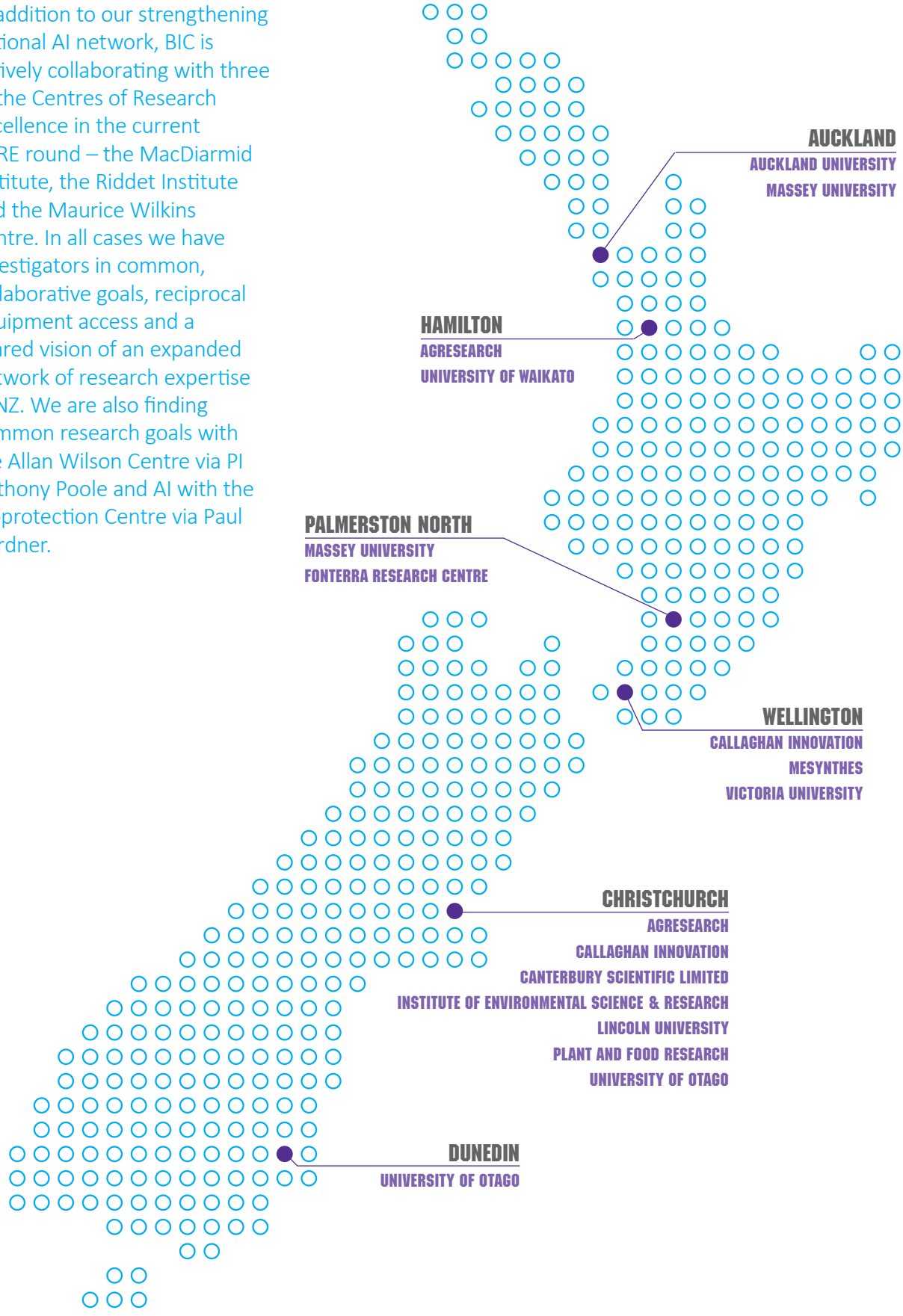
Examples include our involvement with the Fonterra Primary Growth Partnership, our Smart Idea Programme with Canterbury Scientific Limited looking to broaden their product range, and our Smart Idea programmes that seek to commercialise new protein purification methods and find new uses for protein nanostructures.

## FLAGSHIP LEADER – ANTONIA MILLER

Antonia is a Senior Research Scientist in the Callaghan Innovation Protein Science and Engineering Team. Antonia obtained her PhD in biochemistry at the University of Canterbury and undertook international post-doctoral studies in the areas of diabetes and hypertension. During this time Antonia held a prestigious Juvenile Diabetes Research Foundation International Fellowship, was awarded multiple highly competitive research grants as a chief and associate investigator, and published in leading diabetes and hypertension journals. Antonia's work with pre-clinical models of disease led to her interest in industry focused research. Antonia relocated to Canterbury to pursue industry facing research, and has engaged with a series of New Zealand biotechnology firms to address their R&D needs in the biochemistry and cell biology space.

# Our networks

In addition to our strengthening national AI network, BIC is actively collaborating with three of the Centres of Research Excellence in the current CoRE round – the MacDiarmid Institute, the Riddet Institute and the Maurice Wilkins Centre. In all cases we have investigators in common, collaborative goals, reciprocal equipment access and a shared vision of an expanded network of research expertise in NZ. We are also finding common research goals with the Allan Wilson Centre via PI Anthony Poole and AI with the Bioprotection Centre via Paul Gardner.



## AGRESEARCH

Jolon Dyer, Lincoln

Ali Hodgkinson, Ruakura

## CALLAGHAN INNOVATION

Richard Furneaux, Lower Hutt

Peter Tyler, Lower Hutt

Antonia Miller, Christchurch

Andrew Muscroft-Taylor, Christchurch

Phillip Rendle, Lower Hutt

Michael Steward, Christchurch

## CANTERBURY SCIENTIFIC LIMITED

Maurice Owen

## INSTITUTE OF ENVIRONMENTAL SCIENCE & RESEARCH (ESR)

Brent Gilpin

## FONTERRA RESEARCH CENTRE

Skelte Anema

## LINCOLN UNIVERSITY

Jim Morton

## MASSEY UNIVERSITY

Jane Allison, Auckland

Austen Ganley, Auckland

Geoff Jameson, Palmerston North

Bill Williams, Palmerston North

## MENSYNTHES

Barney May

## PLANT AND FOOD

Nigel Larsen

## UNIVERSITY OF AUCKLAND

Shaun Lott

Alok Mitra

Chris Squire

Jadranka Travas-Sejdic

David Williams

## UNIVERSITY OF OTAGO

Stephen Brennan

Monica Gerth

Wayne Patrick

Tim Woodfield, Christchurch

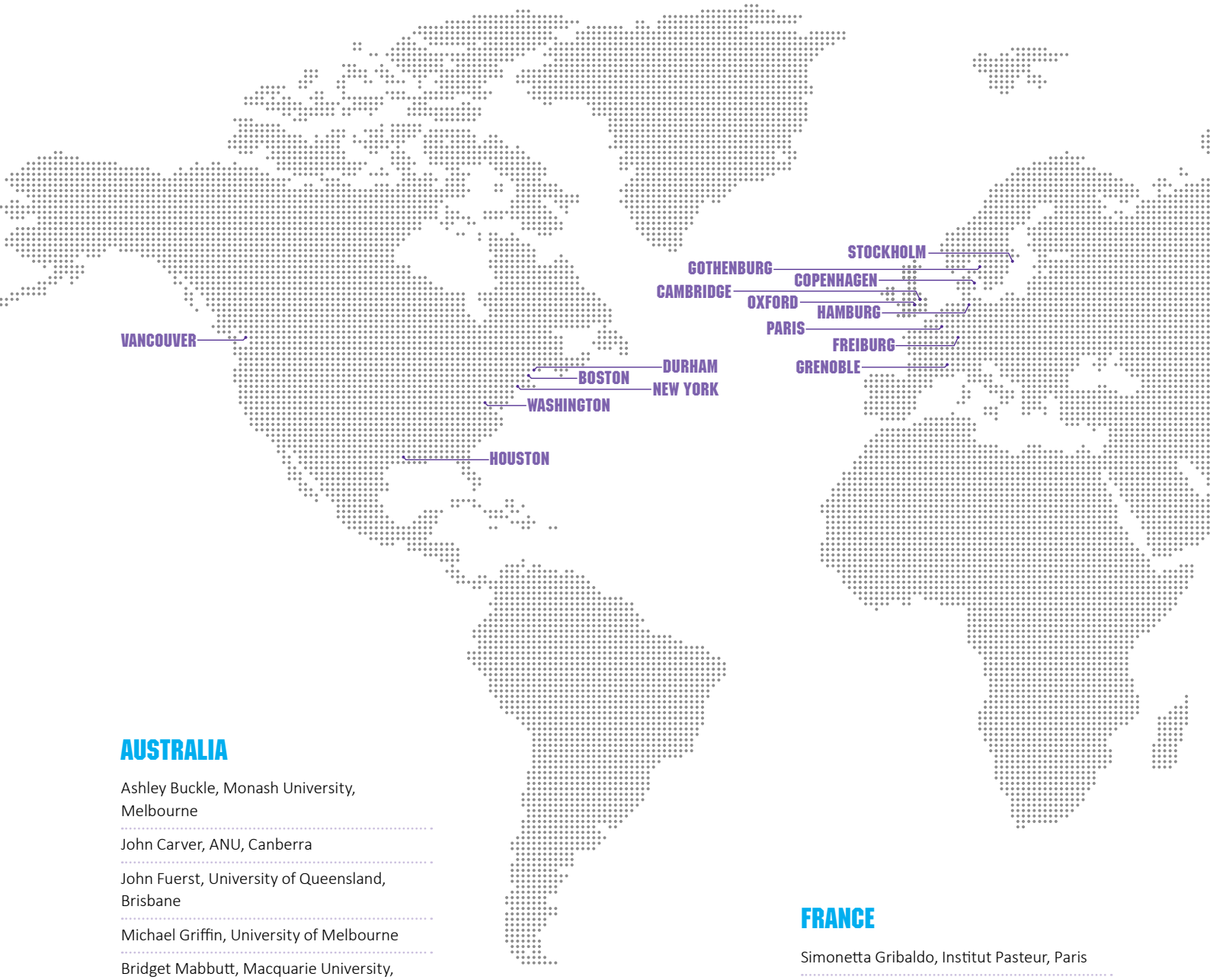
## UNIVERSITY OF WAIKATO

Vic Arcus

## VICTORIA UNIVERSITY

Petrik Galvosas

Kate McGrath




## AUSTRALIA

Ashley Buckle, Monash University, Melbourne

John Carver, ANU, Canberra

John Fuerst, University of Queensland, Brisbane

Michael Griffin, University of Melbourne

Bridget Mabbutt, Macquarie University, Sydney

Joel Mackay, University of Sydney, Sydney

James Murphy, Walter and Eliza Hall Institute, Melbourne

Matt Perugini, La Trobe University, Melbourne

## CANADA

Karen Cheung, University of British Columbia, Vancouver

## CHINA

Wenhui Wang, Tsinghua University, Beijing

## DENMARK

Eske Willerslev, Copenhagen University, Copenhagen

## ENGLAND

Sean Devenish, University of Cambridge, Cambridge

Carol Robinson, University of Oxford, Oxford

Graham Richards, University of Oxford, Oxford

Colin Kleanthous, University of Oxford, Oxford

## FRANCE

Simonetta Gribaldo, Institut Pasteur, Paris

Claude Verdier, University Joseph Fourier, Grenoble

## GERMANY

Haydyn Mertens, EMBL, Hamburg

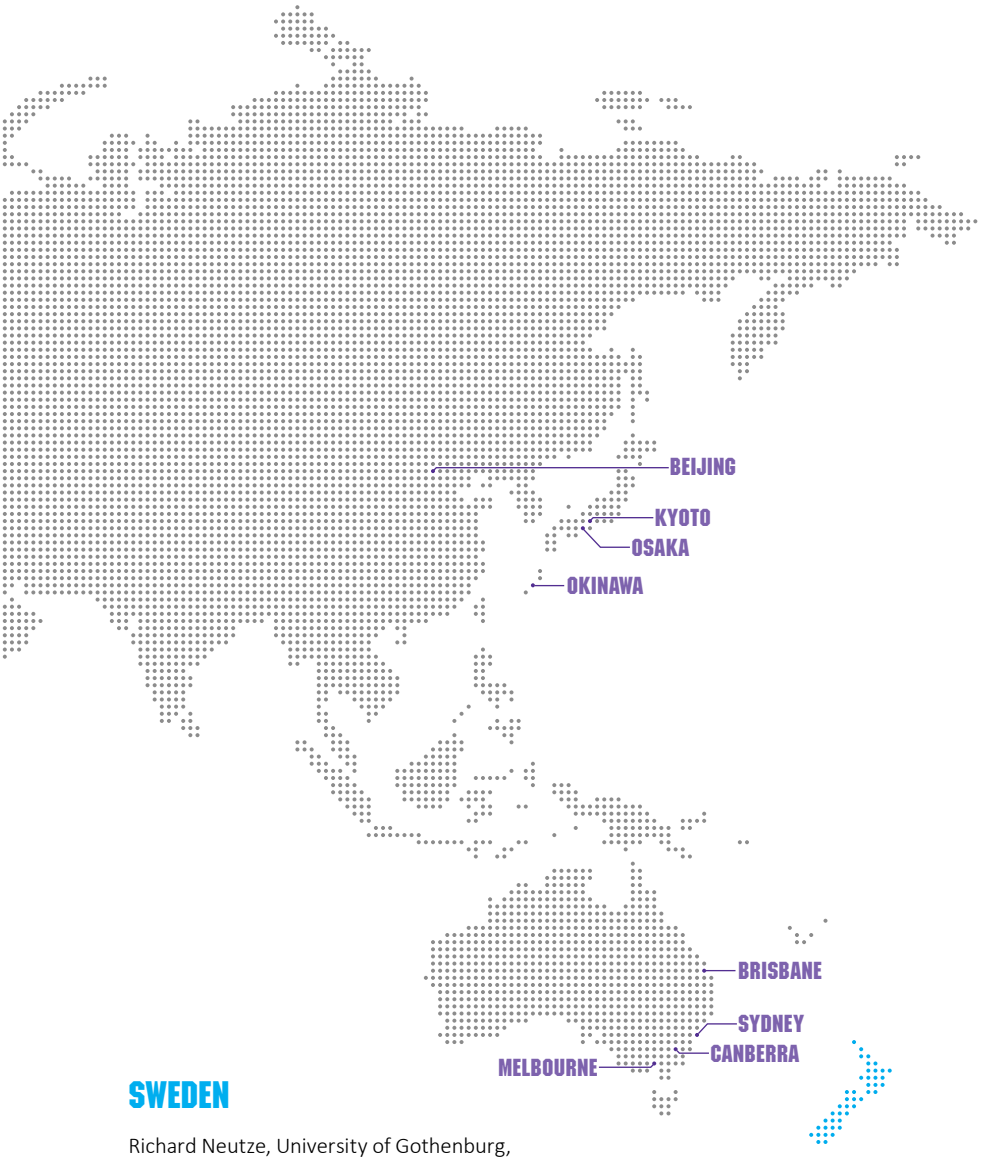
Gerald Urban, University of Freiburg, Freiburg

## JAPAN

Eiji Morita, Osaka University, Osaka

Jun Ogawa, Kyoto University, Kyoto

Robert Sinclair, Okinawa Institute of Science & Technology, Okinawa




## SWEDEN

Richard Neutze, University of Gothenburg, Gothenburg

Britt-Marie Sjöberg, Stockholm University, Stockholm

## UNITED STATES OF AMERICA

Tim Cooper, University of Houston, Houston

Laura Domigan, Tufts University, Boston

Andre Hudson, Rochester Institute, New York

Thomas Laue, University of New Hampshire, Durham

George Lorimer, University of Maryland, Washington

Charlene Mello, University of Massachusetts, Boston

Vern Schramm, Einstein, New York

Our researchers increasingly collaborate with major international groups from all over the world. This is reflected in a growing number of collaborative grants and publications.

# Industry collaborations

## CALLAGHAN INNOVATION

### CALLAGHAN INNOVATION HAS COLOCATED 5 SCIENTISTS WITHIN BIC

In 2012, as part of the New Zealand Government's efforts to assist the rebuild and growth of Canterbury businesses, the Callaghan Innovation Protein Science and Engineering Group was established and co-located within BIC. In addition to this, Callaghan Innovation has bought out 50% of Professor Juliet Gerrard's time to be an Industry and Outreach Fellow, and provided support for her research team at Gracefield. To support the BIC/Callaghan Innovation relationship, they also employed our BIC Institute Manager, Susie Meade on a half-time contract to be an account manager, aligned with their protein science and engineering team. Callaghan Innovation has also committed to eight UC postgraduate scholarships. We are actively pursuing the opportunities that the co-location brings in terms of our industry linkages and new avenues of funding to support projects.

Callaghan Innovation aims to accelerate the commercialisation of innovation by New Zealand firms through a variety of approaches. The Protein Science and Engineering Team assists in the biotechnology space by either adding value to existing products, which many companies see as crucial in a competitive international market, or, exploring new opportunities based on existing company product portfolios and strategic R&D goals and expansion plans.

Callaghan Innovation has identified that universities can play a key role in realising the goal of growing the high value manufacturing sector in Canterbury, New Zealand's second largest manufacturing sector. The Protein Science and Engineering Team, headed by Dr Andrew Muscroft-Taylor, is delighted to be co-located at the University of Canterbury, given its world class facilities and the potential to further develop our relationship with academics. Embedding within the University is assisting in creating strong alliances between the University, Industry and Callaghan Innovation. Projects involving all three are already underway between BIC (Dr Renwick Dobson, Dr Grant Pearce), Callaghan Innovation and a variety of Christchurch businesses.

Four research scientists have been appointed to the team with a broad range skills to meet industry needs: Dr Michael Steward (antibody technologies, molecular biology, protein biochemistry), Dr Antonia Miller (cell biology, protein biochemistry, physiology), Dr James Strong (fermentation, bioprocess engineering), and Mr Dion Thompson (protein biochemistry, enzymology). The team leader, Andrew Muscroft-Taylor, has expertise in protein biochemistry and synthetic organic chemistry.

EMBEDDING WITHIN THE UNIVERSITY ASSISTS IN CREATING STRONG ALLIANCES BETWEEN THE UNIVERSITY, INDUSTRY AND CALLAGHAN INNOVATION

CONSIDERABLE EFFORT HAS BEEN INVESTED IN NEGOTIATING A PLACE FOR BIC AND UC IN THE PGP PROGRAMME

# PRIMARY GROWTH PARTNERSHIP WITH FONTERRA

## BUILDING AN ONGOING RELATIONSHIP BETWEEN BIC AND FONTERRA

Building on an existing relationship with Fonterra via an MSI contract, considerable effort has been invested in negotiating a place for BIC and UC in the PGP Programme. We now have in place a PhD student and postdoctoral fellow, working on the control of protein interactions in dairy food.

The PGP is a Ministry of Primary Industry (MPI) funded programming. The programme is driving the future market success of the primary industries through long-term innovation programmes that are jointly funded by government and industry. A key goal is to encourage more private investment in research and development in New Zealand.

Dairy is New Zealand's most significant industry. Innovation throughout the dairy value chain is therefore essential to anchoring not only the position of New Zealand dairy, but the whole New Zealand economy.

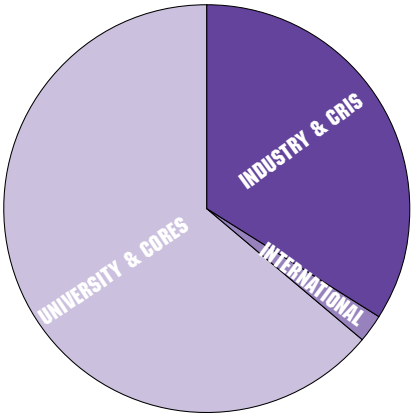
Fonterra is co-leading a PGP programme aimed at creating new products, increasing on-farm productivity, reducing environmental impacts, and improving agricultural education. The programme, entitled "Transforming the Dairy Value Chain", is aimed at transforming the dairy value chain through investment in building capability and knowledge. Fonterra is investing in this scientific capability and leading work to create new premium dairy offerings, including products with specific health and wellness benefits.

# Our growing capability

## THE CENTRE HAS A GROWING TEAM OF POSTGRADUATE SCHOLARSHIPS WITH CRI AND INDUSTRY PARTNERS

**44** POSTGRADUATE STUDENTS

### POSTGRADUATE FUNDING PARTNERS

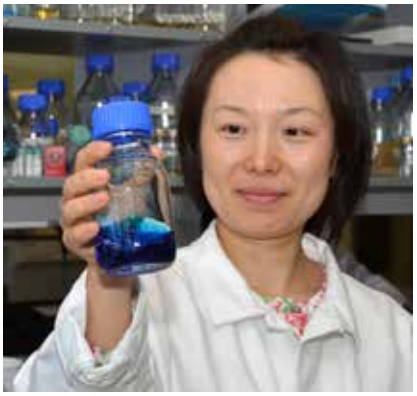



## SARAH KESSANS

### EVOLUTION OF A METABOLIC REGULATORY ENZYME

Sarah received her PhD in Molecular and Cellular Biology from Arizona State University in 2011. Her dissertation was focused on developing a plant-based HIV vaccine component, and included an initial structural analysis of the membrane proximal region of HIV gp41.

She is currently working with Dr Renwick Dobson and PhD student Katherine Donovan, on the evolution of the metabolic regulatory enzyme, pyruvate kinase, in E. coli. They are seeking to elucidate mechanisms by which the pyruvate kinase mutations in Richard Lenski's E. coli evolution experiments gave rise to increased fitness of the bacteria. The team hopes to uncover these answers by evaluating the structures, dynamics, and protein-protein interactions of the wildtype enzyme and mutants generated from the evolution experiments.



## XIAOLI SUN

### CONTROLLED MANIPULATION OF FOOD PROTEINS

Xiaoli is a PhD student and she is working on the PGP project, 'Enhanced Protein Functionalities', which is sponsored by the New Zealand Primary Growth Partnership programme with Fonterra. This project is focus on understanding how molecular interactions with and between food proteins can be manipulated in a controlled way.

Xiaoli received her BSc degree at the University of Heilongjiang August First Land at China in Food Science, and MSc degree at Massey University in Food Technology. Her Masters project focused on investigating the astringency mechanism of whey protein in acidic conditions, in a project was sponsored by Fonterra and Technology for Industry Fellowships (TIF). Xiaoli had 3 years working experience in New Zealand dairy industry, which provides technical support to dairy product development.

## ERIC RICHARDS

### UNDERSTANDING BIOACTIVE PROTEINS IN KIWIFRUIT

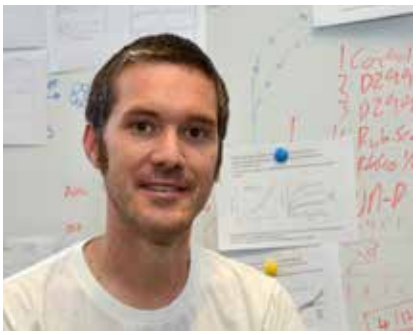
As part of a collaborative project between BIC, Callaghan Innovation and Anagenix, a New Zealand biotechnology company, Eric Richards is carrying out a Masters research project looking at some of the bioactive protein compounds in kiwifruit. Kiwifruit contain natural proteases, which may help in improving digestive health. The aim of this research is to investigate the natural variation in enzyme activity and to look at ways in which enzyme activity can be maintained during processing and storage. Eric says "The project has also given me knowledge into how biotechnology companies can help bridge the gap between research and the public. This experience will allow me to be better prepared when I have the opportunity to contribute to other biotechnology companies in the future."

**11** POSTDOCTORAL FELLOWS

## OUR EARLY CAREER SCIENTISTS ARE INTEGRAL IN MENTORING THE POSTGRADUATE COMMUNITY

# *Our people*

## PRINCIPAL INVESTIGATORS



### PROFESSOR JULIET GERRARD

Director
Principal Investigator, BIC

### PROFESSOR EMILY PARKER

Deputy Director
Principal Investigator, BIC

### PROFESSOR CONAN FEE

Principal Investigator, BIC

### DR VOLKER NOCK

Principal Investigator, BIC
Flagship Leader

### DR RENWICK DOBSON

Principal Investigator, BIC

### DR GRANT PEARCE

Principal Investigator, BIC

### DR ANTHONY POOLE

Principal Investigator, BIC
Flagship Leader

### ADJUNCT PROFESSOR WILLIAM SWALLOW

Principal Investigator, BIC

## ADVISORY BOARD

Professor Edward Baker, Chair

Dr Richard Furneaux, Deputy Chair

Professor Peter Hunter

Professor Anton Middelberg (Until July 2012)

Professor David Beebe (From August 2013)

## MANAGEMENT STAFF

Dr Susie Meade

Dr Jonathan Love (July 2012- May 2013)

## TECHNICAL STAFF

Ms Rayleen Fredericks

Mrs Jackie Healy

Dr Marie Squire (now Chemistry)

## ASSOCIATE INVESTIGATORS

Dr David Ackerley, School of Biological Sciences, Victoria University

Dr Jane Allison, Centre for Theoretical Chemistry and Physics, Massey University

Prof Vic Arcus, Department of Biological Sciences, University of Waikato

Prof Mark Billinghurst, HITLAB, UC

Dr David Collings, School of Biological Sciences, UC

Dr Deb Crittenden, Chemistry Department, UC

Dr Simone Dimartino, Chemical and Process Engineering, UC

Prof Antony Fairbanks, Chemistry Department, UC

Dr Paul Gardner, School of Biological Sciences, UC

Assoc Prof Pete Gostomski, Chemical & Process Engineering, UC

Assoc Prof Richard Hartshorn, Chemistry Department, UC

Prof Geoff Jameson, Institute of Fundamental Sciences, Massey University

Dr Shaun Lott, School of Biological Sciences, University of Auckland

Dr Aaron Marshall, Chemical & Process Engineering, UC

Assoc Prof Ken Morison, Chemical & Process Engineering, UC

Dr Antonia Miller, Protein Science and Engineering Team, Callaghan Innovation

Dr Andrew Muscroft-Taylor, Protein Science and Engineering Team, Callaghan Innovation

Dr Wayne Patrick, Department of Biochemistry ,Otago University

Prof Ian Shaw, Chemistry Department, UC

Dr Mark Staiger, Mechanical Engineering Department, UC

Dr Michael Steward, Protein Science and Engineering Team, Callaghan Innovation

Dr Arvind Varsani, School of Biological Sciences, UC

Dr Gabriel Visnovsky, Chemical & Process Engineering, UC

Dr Tim Woodfield, Department of Orthopaedic Surgery and Musculoskeletal Medicine, University of Otago

## AFFILIATED INVESTIGATORS

Assoc Prof Lindsey Conner, School of Sciences and Physical Education, UC

Assoc Prof Rosemary du Plessis, School of Social and Political Sciences, UC

## PARTNER INVESTIGATORS

Prof Stephen Brennan, University of Otago

Dr Jolon Dyer, AgResearch

Dr Brent Gilpin, Institute of Environmental Science & Research

Dr Nigel Larsen, Plant and Food Research

Assoc Prof Jim Morton, Lincoln University

Dr Phillip Rendle, Callaghan Innovation

## BIC ADJUNCTS

### ADJUNCT PROFESSOR

Professor Stephen Brennan, University of Otago

Professor Geoff Jameson, Massey University

Professor Carol Robinson, Oxford University

### ADJUNCT ASSOCIATE PROFESSOR

Dr Jolon Dyer, AgResearch Ltd

Dr Nigel Larsen, Plant & Food Research Ltd

Associate Professor Jim Morton, Lincoln University

### ADJUNCT SENIOR FELLOW

Dr Brent Gilpin, Environmental Science & Research

Dr Antonia Miller, Callaghan Innovation

Dr Andrew Muscroft-Taylor, Callaghan Innovation

Dr Phillip Rendle, Callaghan Innovation

Dr Michael Steward, Callaghan Innovation

### ADJUNCT FELLOW

Dr Leonardo Negron, Callaghan Innovation

Dr Rachel Williamson, Australian Synchrotron

## POSTDOCTORAL FELLOWS AND RESEARCH STAFF

Dr Justine Cottam, Associated with Professor Juliet Gerrard's group

Dr Penel Cross, Associated with Professor Emily Parker's group

Dr Simone Dimartino, Associated with Professor Conan Fee's group (until July 2013)

Dr Wanting Jiao, Associated with Professor Emily Parker's group

Dr Müge Kasanmascheff, Associated with Dr Renwick Dobson's group

Dr Sarah Kessans, Associated with Dr Renwick Dobson's group

Dr Moritz Lasse, Associated with Dr Renwick Dobson's group

Dr Ali Reza Nazmi, Associated with Professor Emily Parker's group

Dr Luigi Sasso, Associated with Professor Juliet Gerrard's group

Dr Hironori Suzuki, Associated with Dr Renwick Dobson's group

Dr Céline Valéry, Associated with Professor Juliet Gerrard's group

Dr Madhu Vasudevamurthy, Senior Research & Commercialisation Fellow

## POSTGRADUATE STUDENTS

Helen Ashmead - Juliet Gerrard, in partnership with Callaghan Innovation, PhD

Nicola Blackmore – Emily Parker, in partnership with the Maurice Wilkins Centre, PhD

Shradha Chandrasekaran – Conan Fee, PhD

Tyler Clarke – Emily Parker, MSc

Tammie Cookson – Emily Parker, in partnership with the Maurice Wilkins Centre, PhD

Jennifer Crowther - Renwick Dobson, in partnership with AgResearch, PhD

Katherine Donovan – Renwick Dobson, PhD

Emma Dorsey – Renwick Dobson, MSc

Hisham Eldai – Paul Gardner, PhD

Letitia Gilmour – Renwick Dobson, in association with Canterbury Scientific Ltd, MSc

Logan Heyes – Emily Parker, PhD

Michael Hunter – Emily Parker, PhD

Amanda Inglis – Emily Parker, in partnership with ESR, MSc

Dmitri Joseph – Emily Parker, in partnership with the Maurice Wilkins Centre, PhD

Manmeet Kaur - Juliet Gerrard, in partnership with MBIE, PhD

Jeremy Keown – Grant Pearce, PhD.

Sam Kim - Juliet Gerrard, in partnership with Callaghan Innovation, PhD.

Eric Lang – Emily Parker, in partnership with the BlueFern, PhD.

Wenting Liu – Anthony Poole, PhD

Emma Livingstone – Emily Parker, MSc

Deepti Mahapatra – Juliet Gerrard, in partnership with AgResearch, PhD

Anton Mather – Simone Dimartino, MSc

Gerd Mittelstädt – Emily Parker, PhD

Gert-Jan Moggré – Emily Parker, in partnership with Callaghan Innovation, PhD

Suhas Nawada – Conan Fee, in partnership with CAPE, PhD

Angela Newton – Juliet Gerrard, in partnership with Fonterra, PhD

Rachel North – Renwick Dobson, PhD

Thomas Orban – Renwick Dobson, in partnership with MBIE and Canterbury Scientific Ltd, PhD

Mohamad Othman – Emily Parker, MSc

Rishi Pandey - Celine Valéry & Juliet Gerrard, in partnership with AgResearch, PhD

Amy Phillips - Juliet Gerrard, in partnership with MacDiarmid, PhD

Prasanna Ponnumallayan – Conan Fee, PhD

Nivaskumar Ramaswarmy – Grant Pearce, PhD

Arvind Ravichandran – Renwick Dobson, PhD

Eric Richards - Grant Pearce, in partnership with Callaghan Innovation and Anagenix, MSc

Kannan Subramanian – Conan Fee, in partnership with the Wakefield Institute, PhD

Xiaoli Sun - Juliet Gerrard, in partnership with Fonterra, PhD

Ryu Toyama – Emily Parker, MSc

Sinan Umu - Anthony Poole & Paul Gardner, in partnership with BlueFern, PhD

Akshita Wason, Juliet Gerrard, in partnership with MacDiarmid, PhD

Alicia Lai Sook Wei - Anthony Poole, PhD

Michael Weusten – Emily Parker, PhD

Sarah Wilson-Coutts - Emily Parker, in partnership with Callaghan innovation, PhD

Amy Yewdall – Juliet Gerrard, in partnership with US ARO, PhD

## GRADUATED OR COMPLETED DEGREE REQUIREMENTS

Timothy Allison, PhD, Emily Parker, Substrate specificity and mutational studies of KDO8PS

Penelope Cross, PhD, Emily Parker, Unravelling the evolution of allosteric regulation I 3-3-deoxy-D-arabino-heptulosonate 7-phosphate synthase

Jennifer Crowther, BSc Honours, Renwick Dobson, The structural characterisation of diaminopimelate decarboxylase (LysA)

Laura Domigan, PhD, Juliet Gerrard, New nanomaterials: Amyloid fibrils from waste proteins

Frances Huisman, PhD, Emily Parker, Studies into the allosteric regulation of IPMS

Moritz Lasse, PhD, Juliet Gerrard, structure and nutritional value of processed proteins in food

Jacob Littlejohn, MSc, Juliet Gerrard, Peroxiredoxins as self-assembling nanostructures

Ben Plummer, ME, Conan Fee

Jared Raynes, PhD, Juliet Gerrard, Immobilising enzymes on protein nanotubes for biotechnology purposes

Sebastian Reichau, PhD, Emily Parker, Inhibition and regulation of *Mycobacterium tuberculosis* 3-deoxy-D-arabino-heptulosonate 7-phosphate synthase

Elena Sugrue, BSc Honours, Renwick Dobson, Investigation into the role of a dynamic domain in pyruvate kinase

David Tran, PhD, Emily Parker, Investigating the substrate specificity of 3-deoxy-D-arabino-heptulosonate 7-phosphate (DAH7P) synthase

Charunya Nanayakkara, BSc Honours, Grant Pearce, Studies of DHDPR from *Arabidopsis thaliana*

Balaji Somasundaram, PhD, Conan Fee, A surface plasmon resonance assay to determine the effect of influenza neuraminidase mutations on its affinity with antiviral drugs?

## HIGHLIGHT

Professor Juliet Gerard was made a Fellow of the Royal Society of New Zealand. She was also appointed as Chair of the Marsden Council and made a Director of Plant and Food Research.

# Outputs

**100 REFEREED JOURNAL ARTICLES AND BOOK CHAPTERS, 26 CONFERENCE POSTERS AND GIVEN 40 PRESENTATIONS**

Scientific Publications and Other Research Outputs - 1 April 2012 – 31 October 2013

## BOOK CHAPTERS AND JOURNAL ARTICLES


Allison, T.M., Cochrane, F.C., Jameson, G.B., Parker, E.J. (2013) Examining the role of intersubunit contacts in catalysis by 3-deoxy-D-manno-octulosonate 8-phosphate synthase. Biochemistry, 52: 4676-4686.

Anderson, J., Horn, B.J., Gilpin, B.J. (2012) The Prevalence and Genetic Diversity of *Campylobacter* spp. in Domestic 'Backyard' Poultry in Canterbury, New Zealand. Zoonoses and Public Health, 59: 52-60.

Atkinson, S.C., Dogovski, C., Downton, M.T., Pearce, F.G., Reboul, C.F., Buckle, A.M., Gerrard, J.A., Dobson, R.C.J., Wagner, J., Perugini, M.A. (2012) Crystal, solution and *in silico* structural studies of dihydrodipicolinate synthase from the common grapevine. PLoS ONE, 7: e38318.

Atkinson, S.C., Dogovski, C., Downton, M.T., Dzabotar, P.E., Dobson, R.C.J., Gerrard, J.A., Perugini, M.A. (2013). Structural, kinetic and computational investigation of Vitis vinifera DHDPS reveals new insight into the mechanism of lysine-mediated allosteric inhibition. Plant Molecular Biology, 81: 431-446.

Blackmore, N.J., Reichau, S., Jiao, W., Hutton, R.D., Baker, E.N., Jameson, G.B., Parker, E.J. (2013) Three sites and you are out: Ternary synergistic allostery controls aromatic amino acid biosynthesis in *Mycobacterium tuberculosis*. Journal of Molecular Biology, 425: 1582-1592.

Boughton, B.A., Dobson, R.C.J., Hutton, C.A. (2012) The crystal structure of dihydrodipicolinate synthase from *Escherichia coli* with bound pyruvate and succinic acid semialdehyde: Unambiguous resolution of the stereochemistry of the condensation product. Proteins, 80: 2117-2122.

Brindefalk, B., Dessailly, B.H., Yeats, C., Orengo, C., Werner, F., Poole, A.M. (2013) Evolutionary history of the TBP-domain superfamily. Nucleic Acids Research, 41: 2832-2845.

Busby, J.N., Landsberg, M.J., Simpson, R.M., Jones, S.A., Hankamer, B., Hurst, M.R.H., Lott, J.S. (2012) Structural analysis of Chi1 chitinase from Yen-Tc: The multisubunit insecticidal ABC toxin complex of *Yersinia entomophaga*. Journal of Molecular Biology, 415: 359-371.

Castell, A., Short, F.L., Evans, G.L., Cookson, T.V.M., Bulloch, E.M.M., Joseph, D.D.A., Lee, C.E., Parker, E.J., Baker, E. N., Lott, J. S. (2013) Substrate capture mechanism of *Mycobacterium tuberculosis* anthranilate phosphoribosyltransferase provides a mode for inhibition. Biochemistry, 52: 1776-1787.

Chandrasekaran, N.N., Dimartino, S., Fee, C.J. (2013) Study of the adsorption of proteins on stainless steel surfaces using QCM-D. Chemical Engineering Research & Design, 91: 1674-1683.

Chen, H., Jiao, W., Jones, M.A., Coxon, J.M., Morton, J.D., Bickerstaffe, R., Pehere, A.D., Zvarec, O., Abell, A.D. (2012) New tripeptide-based macrocyclic calpain inhibitors formed by N-alkylation of histidine. Chemistry & Biodiversity, 9: 2473-2484.

Chi, G., Manos-Turvey, A., O'Connor, P.D., Johnston, J.M., Evans, G.L., Baker, E.N., Payne, R.J., Lott, J.S., Bulloch, E.M.M. (2012) Implications of binding mode and active site flexibility for inhibitor potency against the salicylate synthase from *Mycobacterium tuberculosis*. Biochemistry, 51: 4868–4879.

Clerens, S., Plowman, J.E., Dyer, J.M. (2012) Food Proteomics: Mapping modifications for proteomic applications in biology. In J.L. Heazlewood (Ed.), Proteomic Applications in Biology, 1-32. New York, InTech.

Cross, P.J., Allison, T.M., Dobson, R.C.J., Jameson, G.B., Parker, E.J. (2013) Engineering allosteric control to an unregulated enzyme by transfer of a regulatory domain. Proceedings of the National Academy of Sciences USA, 110: 2111-2116.

Cross, P.J., Parker, E.J. (2013). Allosteric inhibitor specificity of *Thermotoga maritima* 3-deoxy-D-arabino heptulosonate 7-phosphate synthase. FEBS Letters, 587: 3063-3068.

Cross, P.J., Allison, T.M., Pietersma, A.L., Wilson-Coutts, S. J., Parker, E.J. (2013). *Neisseria meningitidis* expresses a single 3-deoxy-D-arabino heptulosonate 7-phosphate synthase that is inhibited primarily by phenylalanine. Protein Science, 22: 1087-1099.

Curtis, B.A., Tanifuji, G., Burki, F., Gruber, A., Irimia, M., Maruyama, S., Arias, M.C., Ball, S.G., Gile, G.H., Hirakawa, Y., Hopkins, J.F., Kuo, A., Rensing, S.A., Schmutz, J.,

Symeonidi, A., Elias, M., Eveleigh, R.J.M., Herman, E.K., Klute, M.J., Nakayama, T., Oborník, M., Reyes-Prieto, A., Armbrust, E.V., Aves, S.J., Beiko, R.G., Coutinho, P., Dacks, J.B., Durnford, D.G., Fast, N.M., Green, B.R., Grisdale, C.J., Hempel, F., Henrissat, B., Höppner, M.P., Ishida, K-I., Kim, E., Kořený, L., Kroth, P.G., Liu, Y., Malik, S-B., Maier, U.G., McRose, D., Mock, T., Neilson, J.A., Onodera, N.T., Poole, A.M., Pritham, E.J., Richards, T.A., Rocap, G., Roy, S.W., Sarai, C., Schaack, S., Shirato, S., Slamovits, C.H., Spencer, D.F., Suzuki, S., Worden, A.Z., Zauner, S., Barry, K., Bell, C., Bharti, A.K., Crow, J.A., Grimwood, J., Kramer, R., Lindquist, E., Lucas, S., Salamov, A., McFadden, G.I., Lane, C.E., Keeling, P.J., Gray, M.W., Grigoriev, I.V., Archibald, J.M. (2012) Algal nuclear genomes reveal evolutionary mosaicism and the fate of nucleomorphs. Nature, 492: 59-65.

Damodaran, V.B., Fee, C.J., Popat, K.C. (2012) Modeling of PEG grafting and prediction of interfacial force profile using X-ray photoelectron spectroscopy. Surface and Interface Analysis, 44: 144-149.

Dayaram, A., Opong, A., Jäschke, A., Hadfield, J., Baschiera, M., Dobson, R.C.J., Offei, S.K., Shepherd, D.N., Martin, D.P., Varsani, A. (2012) Molecular characterisation of a novel cassava associated circular ssDNA virus. Virus Research, 166: 130-135.

De Bruyn, A., Villemot, J., Lefeuvre, P., Villar, E., Hoareau, M., Harimalala, M., Abdoul-Karime, A.L., Abdou-Chakour, C., Reynaud, B., Harkins, G.W., Varsani, A., Martin, D.P., Lett, J-M. (2012) East African cassava mosaic-like viruses from Africa to Indian ocean islands: Molecular diversity, evolutionary history and geographical dissemination of a bipartite begomovirus. BioMedical Central Evolutionary Biology, 12: 228.

Dimartino, S., Lir, I., Haber, M., Azhari, R. (2013) Characterization of biomimetic adhesives from the red algae *Gracilaria conferta* for biomedical applications. In R. Santos, N. Aldred, S. Gorb, P. Flammang (Ed.), Biological and Biomimetic Adhesives, Challenges and Opportunities, pp117-131, RSC Publishing, Cambridge.

Domigan, L., Andersen, K.B., Sasso, L., Dimaki, M., Svendsen, W.E., Gerrard, J.A., Castillo-Leon, J. (2013) Dielectrophoretic manipulation and solubility of protein nanofibrils formed from crude crystallins. Electrophoresis. 34: 1105-1112.

Dyer, J., Solazzo, C. (2012) Evaluating the degradation of silk fabrics and silk-based biomaterials. In P. Aramwit (Ed.), Silk: Production, Properties and Uses, pp 117-134, Nova Science Publishers, New York.

Ecroyd, H., Garvey, M., Thorn, D.C., Gerrard, J.A., Carver, J.A. (2013) Amyloid fibrils from readily available sources: Milk casein and lens crystallin proteins, In Gerrard, J.A. (ed.), Protein Nanotechnology: Protocols, Instrumentation and Applications, 2nd Edition, pp 103-118, Humana Press, Springer, New York.

Fee, C.J., Damodaran, V.B. (2012) Production of PEGylated proteins. In G. Subramanian (Ed.), Handbook of Biopharmaceutical Production Technology: pp 199-222, Wiley-VCH, Chichester.

Fee, C.J. (2013) Label-free, real-time interaction and adsorption, Analysis 1: Surface plasmon resonance, In J. A. Gerrard (Ed.), Protein Nanotechnology: Protocols, Instrumentation and Applications, 2nd Edition. pp 371, Methods in Molecular Biology Series volume 996, Humana Press, Springer, New York.

Fee, C.J. (2013) Label-free, real-time Interaction and adsorption. Analysis 2: Quartz crystal microbalance, In J. A.Gerrard (Ed.), 2013: Protein Nanotechnology: Protocols, Instrumentation and Applications, 2nd Edition. pp 371, Methods in Molecular Biology Series volume 996, Humana Press, Springer, New York.

Finn, R.D., Gardner, P.P., Bateman, A. (2012) Making your database available through Wikipedia: The pros and cons. Nucleic Acids Research, 40: D9-D12.

Gardner, P.P. (2012) Three years of RNA Families. RNA Biology, 9: 2-3.

Garvey, M., Meehan, S., Gras, S.L., Schirra, H.J., Craik, D.J., Van der Weerden, N.L., Anderson, M.A., Gerrard J.A., Carver, J.A. (2013) A radish seed antifungal peptide with a high amyloid fibril-forming propensity. Biochim Biophys Acta, Proteins and Proteomics, 1834:1615-1623.

Garvey, M., Vasudevamurthy, M., Rao, S.P., Ecroyd, H., Gerrard, J.A., Carver, J.A. (2013) Preparation, processing and applications of protein nanofibres. In A. Dufresne, S. Thomas and L.A. Pothan (Ed.), Biopolymer nanocomposites: Processing, properties and applications, pp 599-612. Wiley & Sons Inc., New Jersey.

Gerrard, J.A. 2013: Protein Nanotechnology: Protocols, Instrumentation and Applications, 2nd Edition. pp371. Methods in Molecular Biology Series volume 996, Humana Press, Springer, New York.

Gerrard, J.A. (2013) Protein nanotechnology: What Is It? In Gerrard, J.A. (Ed.), Chapter 1 pp 1-18, Protein Nanotechnology: Protocols, Instrumentation and Applications, 2nd Edition. pp 371. Methods in Molecular Biology Series volume 996, Humana Press, Springer, New York.

Gerrard, J.A., Cottam, J.R. (2012) Protein cross-linking in food: Structure, applications, implications for health and food safety. In B.K. Simpson (Ed.), Food Biochemistry and Food Processing (2nd ed.), pp 207-222, Wiley-Blackwell, New York.

Gerrard, J.A., Lasse, M., Cottam, J., Healy, J.P., Fayle, S.E., Rasiah, I., Brown, P.K., Bin Yasir, S.M., Sutton, K.H., Larsen, N.G. (2012) Aspects of physical and chemical alterations to proteins during food processing - some implications for nutrition. British Journal of Nutrition, 108: S288-S297.

Gerth, M.L., Nigon, L.V., Patrick, W.M. (2012) Characterization of the indole-3-glycerol phosphate synthase from *Pseudomonas aeruginosa* PAO1. The Protein Journal, 31: 359-365.

Gobeaux, F., Fay, N., Tarabout, C., Mériadec, C., Meneau, F., Ligeti, M., Buisson, D-A., Cintrat, J-C., Minh Huy Nguyen, K., Perrin, L., Valéry, C., Artzner, F., Paternostre, M. (2012) Structural role of counterions adsorbed on self-assembled peptide nanotubes. Journal of the American Chemical Society, 134: 723-733.

Griffin, M.D.W., Billakanti, J.M., Wason, A., Keller, S., Mertens, H.D.T., Atkinson, S.C., Dobson, R.C.J., Perugini, M.A., Gerrard, J.A., Pearce, F.G. (2012) Characterisation of the first enzymes committed to lysine biosynthesis in *Arabidopsis thaliana*. PLoS ONE, 7: e40318.

Griffin, M.D.W., Gerrard, J.A. (2012) The relationship between oligomeric state and protein function. In J.M. Matthews (Ed.), Protein dimerisation and oligomerization in biology, pp 74-90, Springer, New York.

Gross, A.J., Nock, V., Polson, M.I.J., Alkaisi, M.M., Downard, A.J. (2013) Surface patterning using two-phase laminar flow and *in situ* formation of aryldiazonium salts. Angewandte Chemie, 52: 10261–10264.

Grosvenor, A.J., Morton, J.D., Dyer, J.M. (2012) Determination and validation for

markers of heat-induced damage in keratins. American Journal of Analytical Chemistry, 3: 431-436.

Hadfield, J., Thomas, J.E., Schwinghamer, M.W., Kraberger, S., Stainton, D., Dayaram, A., Parry, J.N., Pande, P., Martin, D.P., Varsani, A. (2012) Molecular characterisation of dicot-infecting mastreviruses from Australia. Virus Research, 166: 13-22.

Healy, J.P., Wong, K., Sawyer, E.B., Roux, C., Domigan, L.J., Gras, S.L., Sunde, M., Larsen, N.G., Gerrard, J.A., Vasudevamurthy, M. (2012) Polymorphism and higher order structures of protein nanofibers from crude mixtures of fish lens crystallins: Toward useful materials, Biopolymers. 97: 595-606.

Herritsch, A., Abdul Rahim, E., Fee, C. J., Morison, K.R., Gostomski P.A. (2013) An interactive virtual tour of a milk powder plant. Chemical Engineering Education, 47: 107-121.

Hettiarachchi, C.A., Melton, L.D., Gerrard, J.A., Loveday, S.M. (2012) Formation of β-lactoglobulin nanofibrils by microwave heating gives a peptide composition different from conventional heating. Biomacromolecule, 13: 2868-2880.

Hobbs, J. K., Jiao, W., Easter, A. D., Parker, E. J., Schipper, L. A., Arcus, V. A. (2013) The change in heat capacity for enzyme catalysis determines the temperature dependence of enzyme catalysed rates. American Chemical Society Chemical Biology, 8: 2388–2393.

Hoeppner, M.P., Gardner, P.P., Poole, A.M. (2012) Comparative analysis of RNA families reveals distinct repertoires for each domain of life. PLoS Computational Biology, 8: e1002752.

Hoeppner, M.P., Poole, A.M. (2012) Comparative genomics of eukaryotic small nucleolar RNAs reveals deep evolutionary ancestry amidst ongoing Intragenomic mobility. BMC Evolutionary Biology, 12: 183-202.

Huber, T., Bickerton, S., Müssig, J., Pang, S., Staiger, M.P. (2012) Solvent infusion processing of all-cellulose composite materials. Carbohydrate Polymers, 90: 730-733.

Huber, T., Müssig, J., Curnow, O., Pang, S., Bickerton, S., Staiger, M.P. (2012) A critical review of all-cellulose composites. Journal of Materials Science, 47: 1171-1186.

Huber, T., Pang, S., Staiger, M.P. (2012) All-cellulose composite laminates. Composites: Part A: Applied Science and Manufacturing, 43: 1738-1745.

Huisman, F. H. A., Squire, C. J., Parker, E. J. (2013) Amino-acid substitutions at the domain interface affect substrate and allosteric inhibitor binding in α-isopropylmalate synthase from *Mycobacterium tuberculosis*. Biochemical and Biophysical Research Communication, 433: 249-254.

Ireland, R.D., Brennan, S.O., Gerrard, J.A., Walmsley, T.A., George, P.M., King, R.I. (2012) A mass-spectroscopic method for measuring des-Leu albumin - A novel marker for chronic pancreatitis. Clinical Biochemistry, 45: 1664-1668.

Jiao, W., Parker, E.J. (2012) Using a combination of computational and experimental techniques to understand the molecular basis for protein allostery. In C. Christov and T. Karabencheva (Ed.), Advances in Protein Chemistry and Structural Biology Volume 87: Structural and Mechanistic Enzymology - Bringing Together Experiments and Computing, pp 391-413, Elsevier, Oxford.

Johari, S., Nock, V., Alkaisi, M.M., Wang, W. (2013) On-chip analysis of *C. elegans* muscular forces and locomotion patterns in microstructured environments. Lab on a Chip, 13: 1699–1707.

Joseph, D.D.A., Jiao, W. & Parker, E.J. (2013) Arg314 is essential for catalysis by N-acetyl neuraminic acid synthase from *Neisseria meningitidis*, Biochemistry, 52: 2609-2619.

Julian, L., Lorenzo, A., Chenuet, J-P., Bonzon, M., Marchal, C., Vignon, L., Collings, D.A., Walters, M., Jackson, B., Varsani, A. (2012) Evidence of multiple introductions of beak and feather disease virus into the Pacific Islands of Nouvelle-Calédonie (New Caledonia). Journal of General Virology, 93: 2466-2472.

Keown, J.K, Griffin, M.D.W, Mertens, H.D.T, Pearce, F.G. (2013) Small oligomers of ribulose-bisphosphate carboxylase/ oxygenase (rubisco) activase are required for biological activity, Journal of Biological Chemistry, 288: 206074-20615.

Koulman, A., Lee, T.V., Fraser, K., Johnson, L., Arcus, V, Lott, J.S., Rasmussen, S., Lane, G. (2012) Identification of extracellular siderophores and a related peptide from the endophytic fungus *Epichloë festucae* in culture and endophyte-infected Lolium perenne. Phytochemistry, 75: 128-139.

Kraberger, S., Thomas, J.E., Geering, A.D.W., Dayaram, A., Stainton, D., Hadfield, J., Walters, M., Parmenter, K.S., van Brunschot, S., Collings, D.A., Martin, D.P., Varsani, A. (2012) Australian monocot-infecting mastrevirus diversity rivals that in Africa. Virus Research, 169: 127- 136.

Lassé, M., Gerrard, J.A., Pearce, F.G. (2012) Aggregation and fibrillogenesis of proteins not associated with disease: A few case studies. In J.R. Harris (Ed.), Protein Aggregation and Fibrillogenesis in Cerebral and Systemic Amyloid Disease, pp 253-270, Springer, Dordrecht, New York.

Lundin, D., Poole, A.M., Sjöberg, B-M., Högbom, M. (2012) Use of structural phylogenetic networks for classification of the ferritin-like superfamily. Journal of Biological Chemistry, 287: 20565- 20575.

Manos-Turvey, A., Cergol, K.M., Salam, N.K., Bulloch, E.M.M., Chi, G., Pang, A., Britton, W.J., West, N.P., Baker, E.N., Lott, J.S., Payne, R.J. (2012) Synthesis and evaluation of M. tuberculosis salicylate synthase (MbtI) inhibitors designed to probe plasticity in the active site. Organic and Biomolecular Chemistry, 10: 9223-9236.

Massaro, M., Ortiz-Catedral, L., Julian, L., Galbraith, J.A., Kurenbach, B., Kearvell, J., Kemp, K., van Hal, J., Elkington, E., Taylor, G., Greene, T., van de Wetering, J., van de Wetering, M., Pryde, M., Dilks, P., Heber, S., Steeves, T.E., Walters, M., Shaw, S., Potter, J., Farrant, M., Brunton, D.H., Hauber, M., Jackson, B., Bell, P., Moorhouse, R., McInnes, K., Varsani, A. (2012) Molecular characterisation of beak and feather disease virus (BFDV) in New Zealand and its implications for managing an infectious disease. Archives of Virology, 157: 1651-1663.

McGroty, S.E., Pattaniyil, D.T., Patin, D., Blanot ,D., Ravichandran, A.C., Suzuki, H., Dobson, R.C., Savka, M.A., Hudson, A.O. (2013) Biochemical characterization of UDP-N-acetylmuramoyl-L-alanyl-D-glutamate: meso-2,6-diaminopimelate ligase (MurE) from *Verrucomicrobium spinosum* DSM 4136(T.). PLoS One, 8: e66458.

McKenzie, J.L., Robson, J., Berney, M., Smith, T.C., Ruthe, A., Gardner, P.P., Arcus, V.L., Cook, G.M. (2012) A VapBC Toxin-antitoxin module is a post-transcriptional regulator of metabolic flux in Mycobacteria. Journal of Bacteriology, 194: 2189-2204.

Mercadante, D., Melton, L.D., Norris, G.E.,

Loo, T.S., Williams, M.A.K., Dobson, R.C.J., Jameson, G.B. (2012) Bovine ß-Lactoglobulin is dimeric under imitative physiological conditions: Dissociation equilibrium and rate constants over the pH range of 2.5-7.5. Biophysical Journal, 103: 303-312.

Mittelstadt, G., Negron, L., Schofield, L.R., Marsh, K., Parker, E.J. (2013). Biochemical and structural characterisation of dehydroquinate synthase from the New Zealand kiwifruit *Actinidia chinensis*. Archives of Biochemistry and Biophysics, 537: 185-191.

Monjane, A.L., Pande, D., Lakay, F., Shepherd, D.N., van der Walt, R., Lefeurve, P., Lett, J-M., Varsani, A., Rybicki, E.P., Martin, D.P. (2012) Adaptive evolution by recombination is not associated with increased mutation rates in Maize streak virus. BioMedical Central Evolutionary Biology, 12: 252.

Murphy, J.M., Czabotar, P.E., Hildebrand, J.M., Lucet, I.S., Zhang, J.G., Alvarez-Diaz, S., Lewis, R., Lalaoui, N., Metcalf, D., Webb, A.I., Young, S.N., Varghese, L.N., Tannahill, G.M., Hatchell, E.C., Majewski, I.J., Okamoto, T., Dobson, R.C., Hilton, D.J., Babon, J.J, Nicola, N.A., Strasser, A., Silke, J., Alexander, W.S. (2013) The pseudokinase M.L.K.L. mediates necroptosis via a molecular switch mechanism. Immunity, 39: 443-453.

Murray, L.M., Nock, V., Alkaisi, M.M., Lee, J.J.M., Woodfield, T.B.F. (2012) Fabrication of polymeric substrates with micro- and nanoscale topography bioimprinted at progressive cell morphologies. Journal of Vacuum Science and Technology B: Microelectronics and Nanometer Structures: Processing, Measurement, and Phenomena, 30: 06F902.

Nachar, V.R., Savka, F.C., McGroty, S.E., Donovan, K.A., North, R.A., Dobson, R.C.J., Buckley, L.J., Hudson, A.O. (2012) Genomic and biochemical analysis of the diaminopimelate and lysine biosynthesis pathway in *Verrucomicrobium spinosum*: Identification and partial characterization of L,L-diaminopimelate aminotransferase and UDP-N-acetylmuramoylalanyl-D-glutamyl-2,6-meso-diaminopimelate ligase. Frontiers in Evolutionary and Genomic Microbiology, 3: 183.

Newton, A.E., Fairbanks, A.J., Golding, M., Andrewes, P., Gerrard, J.A. (2012) The role of the Maillard reaction in the formation of flavour compounds in dairy products - not only a deleterious reaction but also a rich source of flavour compounds. Food and Function, 3: 1231- 1241.

Nguyen, T., Waterman, J., Staiger, M.P., Woodfield, T. (2012) Controlling in vitro corrosion rate of pure Mg with rough surface texture via biomimetic coating systems. Corrosion Engineering, Science and Technology, 47: 358-364.

Nguyen, T.L., Blanquet, A., Staiger, M.P., Dias, G.J., Woodfield, T.B.F. (2012) On the role of surface roughness in the corrosion of pure magnesium *in vitro*. Journal of Biomedical Materials Research Part B: Applied Biomaterial, 100B: 1310-1318.

Nock, V., Blaikie, R.J. and Alkaisi, M.M. (2013) Optical oxygen sensors for micro- and nanofluidic devices. In K. Iniewski (Ed.), Smart Sensors for Industrial Applications (1st ed.), pp 131-152, CRC Press, Boca Raton.

Nurfaizey, A.H., Stanger, J., Tucker, N., Buunk, N., Wallace, A., Staiger, M.P. (2012) Manipulation of electrospun fibres in flight: The principle of superposition of electric fields as a control method. Journal of Materials Science, 47: 1156-1163.

Pande, D., Kraberger, S., Lefeurve, P., Lett, J-M., Shepherd, D.N., Varsani, A., Martin, D.P. (2012) A novel maize-infecting mastrevirus from La Réunion Island. Archives of Virology, 157: 1617-1621.

Péréfarres, F., De Bruyn, F.A., Kraberger, S., Hoareau, M., Barjon, F., Lefeuvre, P., Pellegrin, F., Caplong, P., Varsani, A., Lett, J-M. (2012) Occurrence of the Israel strain of Tomato yellow leaf curl virus in New Caledonia and Loyalty Islands. New Disease Reports, 25: 6.

Piasecki, T., Kurenbach, B., Chrząstek, K., Kraberger, S., Martin, D.P., Varsani, A. (2012) Molecular characterisation of an avihepadnavirus isolated from *Psittacula krameri* (Ring-necked parrot). Archives of Virology, 157: 585-590.

Poole, A.M., Kobayashi, T., Ganley, A.R.D., (2012) A positive role for yeast extrachromosomal rDNA circles? BioEssays, 34: 725-729.

Poole, A.M., Stouffer, D.B., Tylianakis, J.M. (2012) Ecosystomics: Ecology by sequencer. Trends in Ecology & Evolution, 27: 309-310.

Randunu, K.M., Dimartino, S., Marcus, R.K. (2012) Hydrodynamic evaluation of polypropylene capillary-channeled fibers as a stationary phase in high performance liquid chromatography. Journal of Separations Science, 35: 3270-3280.

Rao, S.P., Meade, S.J., Healy, J.P., Sutton, K.H., Larsen, N.G., Staiger, M.P., Gerrard, J.A. (2012) Amyloid fibrils as functionalizable components of nanocomposite materials. Biotechnology Progress, 28: 248-256.

Raynes, J.K., Gerrard, J.A. (2013) Amyloid Fibrils as Bionanomaterials. In Rehm, B.H.A. (ed.)Bionanotechnology: Biological Self-assembly and its Applications, pp 85-106, Horizon Scientific Press, Caister Academic Press, Norfolk, UK.

Reboul, C.F., Porebski, B.T., Griffin, M.D.W., Dobson, R.C.J., Perugini, M.A., Gerrard, J.A., Buckle, A.M. (2012) Structural and dynamic requirements for optimal activity of the essential bacterial enzyme dihydrodipicolinate synthase. PLoS Computational Biology, 8: e1002537.

Reichau, S., Parker, E. (2013) Active site plasticity of a critical enzyme from *Mycobacterium tuberculosis*. Royal Society of Chemistry Advances, 3: 3209-3212.

Rosario, K., Dayaram, A., Marinov, M., Ware, J., Kraberger, S., Stainton, D., Breitbart, M., Varsani, A. (2012) Diverse circular ssDNA viruses discovered in dragonflies (Odonata: Epiprocta). Journal of General Virology, 93: 2668-2681.

Saufi, S.M., Fee, C.J. (2013) Mixed matrix membrane chromatography based on hydrophobic interaction for whey protein fractionation. Journal of Membrane Science, 444: 157-163.

Scott, B., Young, C.A., Saikia, S., McMillan, L.K., Monahan, B.J., Koulman, A., Astin, J., Eaton, C.J., Tapper, B.A., Parker, E.J., Jamieson, G.B. (2013). Deletion and gene expression analyses define the Paxilline biosynthetic gene cluster in *Penicillium paxilli*. Toxins, 5: 1422-1446.

Sellier, M., Nock, V., Gaubert, C. , Verdier, C. (2013) Droplet actuation induced by coalescence: Experimental evidences and phenomenological modeling. The European Physical Journal Special Topics, 219: 131-141.

Solazzo, C., Dyer, J.M., Clerens, S., Deb-Choudhury, S., Wyeth, P. (2012) Proteomic profiling of the photo-oxidation of silk fibroin: Implications for historic tin-weighted silk. Photochemistry and Photobiology, 8: 1217-1226.

Staiger, M.P. (2012) Guest Editor's Editorial: Preface to the special section on Materials

Science in New Zealand. Journal of Materials Science, 47: 1101-1102.

Stainton, D., Kraberger, S., Walters, M., Wiltshire, E.J., Rosario, K., Halafihi, M., Lolohea, S., Katoa, I., Faitua, T.H., Aholelei, W., Taufa, L., Thomas, J.E, Collings, D.A., Martin, D.P., Varsani, A. (2012) Evidence of inter-component recombination, intra-component recombination and reassortment in Banana bunchy top virus. Journal of General Virology, 93: 1103-1119.

Thum, C., Cookson, A.L., Otter, D.E., McNabb, W.C., Hodgkinson, A.J., Dyer, J., Roy, N.C. (2012) Can nutritional modulation of maternal intestinal microbiota influence the development of the infant gastrointestinal tract? Journal of Nutrition, 142: 1921-1928.

Thureborn, P., Lundin, D., Plathan, J., Poole, A.M, Sjöberg, B-M., Sjöling, S. (2013) A metagenomics transect into the deepest point of the Baltic Sea reveals clear stratification of microbial functional capacities. PLoS One, 8: e74983.

Valery, C., Pandey, R., Gerrard, J.A. (2013). Protein β-interfaces as a generic source of native peptide tectons. Chemical Communications, 49: 2825-2827.

Waterman, J., Birbilis, N., Dias, G.J., Woodfield, T.B.F., Staiger, M.P. (2012) Improving *in vitro* corrosion resistance of biomimetic calcium phosphate coatings for Mg substrates using calcium hydroxide layer. Corrosion Engineering, Science and Technology, 47: 340-345.

Widmann, J., Stombaugh, J., McDonald, D., Chocholousova, J., Gardner, P., Iyer, M.K., Liu, Z., Lozupone, C.A., Quinn, J., Smit, S., Wikman, S., Zaneveld, J.R., Knight, R. (2012) RNASTAR: An RNA structural alignment repository that provides insight into the evolution of natural and artificial RNAs. RNA, 18: 1319-1327.

Xiong, X., Xu, Z., Yang, Z., Liu, Y., Wang, D., Dong, M., Parker, E.J., Zhu, W. (2013) Key targets and relevant inhibitors for the drug discovery of tuberculosis. Current Drug Targets, 14: 676-699.

Yoshida, A., Chitcholtan, K., Evans, J.J., Nock, V., Beasley, S.W. (2012) *In vitro* tissue engineering of smooth muscle sheets with peristalsis using a murine induced pluripotent stem cell line. Journal of Pediatric Surgery, 47: 329-335.

## CONFERENCE POSTERS AND PAPERS

Chandrasekaran, N., Dimartino, S., Fee, C.J., Adsorption of proteins on stainless steel surfaces. Chemeca2012, Wellington, New Zealand: 23-26 September 2012.

Cross, P.J., Parker, E.J., Tailor-made ACT domains - Controlling ligand specificity and sensitivity. 38th Lorne Conference on Protein Structure and Function, Lorne, Australia: 10-14 February 2013.

Cross, P.J., Parker, E.J., Tailor-made ACT domains - Controlling ligand specificity and sensitivity. E3 Satellite, Queenstown Molecular Biology Meetings, Queenstown, New Zealand: 25-26 August 2013.

Erhardt, J., Nock, V., Kieninger, J., Urban, G.A., Non-invasive characterization of dissolved oxygen dynamics in water-in-oil droplet microfluidics – Towards 3d micro tumor spheroids for high throughput cancer drug screening. The 17th International Conference on Miniaturized Systems for Chemistry and Life Sciences, Freiburg, Germany: 27-30 October 2013.

Evelyn, E., Marshall, A.T., Gostomski, P., Ethanol oxidation in a microbial fuel cell (MFC) utilising various mediators and potential integration of a MFC into an anaerobic biofiltration system. Chemeca2012, Wellington, New Zealand: 23-26 September 2012.

Fee, C., Plummer, B., New approaches to food fractionation by chromatography: Adapting high-cost techniques to the production of moderate-value products. 14th International Symposium on Preparative and Industrial Chromatography and Allied Techniques, Brussels, Belgium: 30 September-3 October 2012.

Gilmour, L.H., Pattinson, N., Owen, M., Yandle, T., Fee, C., Dobson, R., The redox switch that could make all the difference., Queenstown Molecular Biology Meeting, Queenstown, New Zealand: 26-28 August 2013.

Herritsch, A., Abdul Rahim, E.E., Morison, K., Duenser, A., Young, B., Fee, C., Winchester, J., Gostomski, P., Discoveries from students' interactions with an immersive learning application. Chemeca2012, Wellington, New Zealand: 23-26 September 2012.

Johari, S., Nock, V., Alkaisi, M.M., Wang, W., Elastomeric pillar arrays for integrated measurement of *C. elegans* locomotion forces. 16th International Conference on Miniaturized Systems for Chemistry and Life Sciences (MicroTAS), Okinawa, Japan: 28 October-1 November 2012. In Proceedings of the Sixteenth International Conference on Miniaturized Systems for Chemistry and Life Sciences, 455-457.

Keown, J.R., Griffin, M.D.W., Mertens, H.D.T., Pearce, F.G.., Solution structures of Rubisco activase. 37th Protein Structure and Function Conference, 5-9 February 2013.

Murray, L.M., Lee, J.J.M., Nock, V., Woodfield, T.B.F., Alkaisi, M.M., Polymeric Substrates with Bioimprinted Micro- and Nanoscale Topography for Regulation of Chondrocyte Re-Differentiation. 56th International Conference on Electron, Ion and Photon Beam Technology and Nanofabrication, Waikoloa, USA: 29 May-1 June 2012.

Nazmi, A.R., Dobson, R., Parker, E., Exploring the quaternary structure of *Pyrococcus furiosus* DAH7PS.37th Protein Structure and Function Conference, Lorne, Australia: 5-9 February 2012.

Nazmi, A.R., Othman, M., Parker, E.J., Insights into allosteric regulation of a bi-functional DAH7PS enzyme from *Bacillus stearothermophilus*. Annual Symposium of the Protein Society, Boston, USA: 20-23 July 2013.

Nock, V., Murray, L.M., Dennis, C., Evans, J.J., Alkaisi, M.M., Effect of micro-patterned polystyrene substrates on myoblast morphology. 6th International Conference on Advanced Materials and Nanotechnology, Auckland, New Zealand: 11-15 February 2013.

Phillips, A.J., Lott, J.S., Gerrard, J.A., Characterising AhpE: A self-assembling tuberculosis protein. 37th Lorne Conference on Protein Structure and Function, Lorne, Australia: 5-9 February 2012.

Phillips, A.J., Lott, J.S., Gerrard, J.A., Peroxiredoxins: Self-assembling protein scaffolds. Queenstown Molecular Biology Conference, Queenstown, New Zealand: 27-29 August 2012.

Phillips, A.J., Valéry, C., Radjainia, M., Mitra, A., Lott, S.J., Gerrard, J.A., Peroxiredoxins: Towards engineering self-assembling scaffolds from protein nano-donuts. Protein Engineering: New Approaches and Applications, University of Chester, UK: 10-12 April 2013. (Awarded First Prize)

Phillips, A.J., Valéry, C., Radjainia, M., Mitra, A., Lott, S.J., Gerrard, J.A., Responsive nanoscaffolds from protein systems. Sixth National Conference on Advanced Materials and Nanotechnology, Auckland, New Zealand: 11-15 February 2013.

Ponnumallayan, P., Fee, C.J., Molecular self-assembly: Development of a novel switchable filtration membrane using self-assembling peptides. Chemeca 2013, Brisbane, Australia: 29 September–2 October 2013.

Reichau, S., Jiao, W., Walker, S.R., Hutton R.D., Parker, E.J., Tackling Tuberculosis by combining mechanism- and modelling-based inhibitor design. Maurice Wilkins Centre Symposium on tuberculosis drug discovery and immunology, Auckland, New Zealand: 17 May 2012.

Reichau, S., Parker, E.J., Does Length Matter? Exploring active site plasticity of a key enzyme from *Mycobacterium tuberculosis*. Queenstown Molecular Biology Meeting, Queenstown, New Zealand: 27-29 August 2012. (Student Poster Prize)

Saufi, S.M., Fee, C.J., Preparation of multiple interaction membrane chromatography using mixed matrix membrane preparation concept. Euromembrane, London, UK: 23-27 September 2012.

Somasundaram B., Fee C.J., Fredericks R., Hall R., Fairbanks A., Watson A., Surface plasmon resonance assay to identify potential drug resistant influenza neuraminidase mutations. Chemeca, Brisbane, Australia: 29 September–2 October 2013.

Subramanian K., Fee C.J., A new surface plasmon resonance assay for measuring insulin receptor-insulin interactions in real time. 38th Lorne Conference on Protein Structure and Function, Lorne, Australia, 10-14 February 2013.

Wason, A., Lsm proteins as scaffolds in bionanotechnology. Queenstown Molecular Biology Meeting, Queenstown, New Zealand: 27-29 August 2012. Wason, A., Lsm proteins as Scaffolds in Nanotechnology Sixth International Conference on Advanced Materials and Nanotechnology, Auckland, New Zealand: 10-15 February 2013.

Yewdall, A., Manipulating the quaternary structure of peroxiredoxins. Queenstown Molecular Biology Meeting, Queenstown, New Zealand: 26-28 August 2013. (Awarded Second Prize in the Redox Poster Session)

## ORAL PRESENTATIONS

Abdul Rahim, E. E., Duenser, A., Billinghurst, M., Herritsch, A., Unsworth, K., McKinnon, A., Gostomski, P., A Desktop Virtual Reality Application for Chemical and Process Engineering Education. OzCHI, Melbourne, Australia: 26-30 November 2012.

Boi, C., Dimartino, S., Sarti, G.C., Scale up of membrane affinity chromatography processes. Affinity, Vienna, Austria: 26-29 June 2013.

Chandrasekaran, N., Dimartino, S. , Fee, C.J., Adsorption of proteins on stainless steel surfaces. Chemeca 2012, Wellington, New Zealand: 23-26 September 2012.

Chandrasekaran, N., Dimartino, S., Fee, C.J., Comparative study of dairy protein-associated water and its adsorption effects on stainless steel surfaces by fluorescent labelling and QCM-D. NZCCME Conference, Auckland, New Zealand: 25-26 November 2013.

Dimartino, S., Chandrasekaran, N., Fee, C.J., Study of the adsorption of proteins on stainless steel surfaces using QCM-D. Australia, New Zealand and the Pacific Workshop on Biofouling Management for Sustainable Shipping, Melbourne, Australia: 5-9 May 2013.

Dimartino, S., Momich, D., Schadock-Hewitt, A.J., Marcus, R.K., Fee, C.J., Chromatographic properties of capillary-channelled polymer fibres for the purification of large biomolecules. Recovery of Biological Products XV, Stowe, USA: 29 July-2 August 2012.

Dimartino, S. Savory, D., McQuillan, A.J., In situ IR bioadhesion studies of *Durvillaea antarctica* – sperm, egg, and zygote. Australia, New Zealand and the Pacific Workshop on Biofouling Management for Sustainable Shipping, Melbourne, Australia: 5-9 May 2013.

Dimartino, S., Savory, D., Petrone, L., McQuillan, A.J., ATR-FTIR and microscopic study of the attachment of zygotes from Fucoid seaweeds. Biological Adhesives: From Biology to Biomimetics, Cluj Napoca, Romania: 9-11 April 2013.

Damodaran, V.B., Fee, C.J., Solid-phase protein PEGylation through molecular tethering, ACS Annual Meeting: Chemistry of Energy and Food, New Orleans, USA: 7-11 April 2013.

Fee, C.J., New approaches to food fractionation by chromatography: Adapting high-cost techniques to the production of moderate-value products. 14th International Symposium on Preparative and Industrial Chromatography and Allied Techniques, Brussels: 30 September–3 October 2012. (Keynote Address)

Fee, C.J., Dimartino, S., Nawada, S., Printed Chromatography Media. PREP 2013 Symposium, Boston, USA: 14-17 July 2013.

Gerrard, J.A., Amyloid fibrils as useful nanomaterials? MacDiarmid Emerging Scientists Association, Christchurch, New Zealand: 27 November 2012.

Gerrard, J.A., Protein nanodoughnuts: Towards responsive materials. Sixth International Conference on Advanced Materials and Nanotechnology, Auckland, New Zealand: 10-15 February 2013.

Gerrard, J.A., Protein nano-doughnuts as self-assembling structures: Towards designed molecular machines. Queenstown Research Week, Queenstown, New Zealand: 27-29 August 2012.

Gerrard, J.A., Protein nanotechnology. Morgo Conference, Queenstown, New Zealand: 6-7 September 2012.

Gerrard, J.A., Protein nano-doughnuts as self-assembling structures: Towards responsive materials. Victoria University of Wellington, Wellington, New Zealand: July 2013.

Gerrard, J.A., Fun with doughnuts. School of Biological Sciences, University of Canterbury, Christchurch, New Zealand: 16 May 2013.

Kasanmascheff, M., Unraveling the unknown central atom in nitrogenase. School of Biological Sciences, University of Canterbury, Christchurch, New Zealand: 14 March 2013.

Kessans, S., Biochemical and immunological characterization of plant-produced HIV-1 Gag/dgp41 enveloped virus-like particles, School of Biological Sciences, University of Canterbury, Christchurch, New Zealand: 4 April 2013.

Nock, V., Gross, A.J., Polson, M.I.J., Alkaisi, M.M., Downard, A.J., Single and multiphase laminar flow patterning of aryldiazonium salt solutions inside microchannels. 3rd Australia & New Zealand Micro/Nanofluidics and Bionano Symposium, Wellington, New Zealand: 12-13 April 2012.

Nock, V., Muller, Y., Sellier, M., Verdier, C., Mixing droplets by coalescence induced self-propulsion. 6th International Conference on Advanced Materials and Nanotechnology, Auckland, New Zealand: 11-15 February 2013.

Parker, E.J., Inhibitors of key metabolic enzymes as drug lead. Sino-NZ Drug Discovery Symposium at the Shanghai Institute of Materia Medica, Shanghai, China: 26 April 2012.

Parker, E.J., Evolving enzymes: Mechanism, inhibition and unusual allostery. Purdue University, USA: 18 June 2012

Parker, E.J., Evolving enzymes: Mechanism, inhibition and unusual allostery. New York University, USA: 15 June 2012.

Parker, E.J., Evolving enzymes: Mechanism, inhibition and unusual allostery. Albert Einstein College of Medicine, USA: 21 June 2012.

Parker, E.J., SAXS and protein allostery. ANZSAS Workshop, Christchurch, New Zealand: 28-29 June 2012.

Parker, E.J., Allosteric regulation of enzymes: Contrasting mechanisms, evolution and conformational mobility University of Cambridge, UK: 27 July 2012.

Parker, E.J., Probing allosteric sites of essential bacterial enzymes: Potential targets for drug design. Drug Discovery Meeting, Queenstown Research Week. 27 August 2012.

Parker, E.J., Divergent mechanisms for the allosteric control of the shikimate pathway. ComBio 2012, Adelaide, Australia: 24 September 2012.

Parker, E.J., Turning enzymes on and off: Regulation and inhibition of biosynthetic aldolases. Research School of Chemistry, Australian National University, Australia: 18 November 2012.

Parker, E.J., Turning enzymes on and off: Dynamic protein allostery. Lorne Conference on Protein Structure and Function. Lorne, Australia. 12 February 2013.

Parker, E.J., Aldolase mechanism, inhibition and allostery. RACI Biomolecular Division Conference, Blue Mountains, Australia: 11-14 July 2013.

Pearce, F.G., Solution structures of Rubisco and Rubisco Activase., ANZSAS Workshop, Christchurch, New Zealand: 28-29 June 2012.

Phillips, A.J., Valéry, C., Radjainia, M., Mitra, A., Lott, S.J., Gerrard, J.A., Peroxiredoxins: Towards engineering self-assembling scaffolds from protein nano-donuts. Protein Engineering: New Approaches and Applications, University of Chester, UK: 10-12 April 2013.

Phillips, A.J., Valéry, C., Radjainia, M., Mitra, A., Lott, S.J., Gerrard, J.A., Responsive nanoscaffolds from protein systems. Sixth National Conference on Advanced Materials and Nanotechnology, Auckland, New Zealand: 11-15 February 2013.

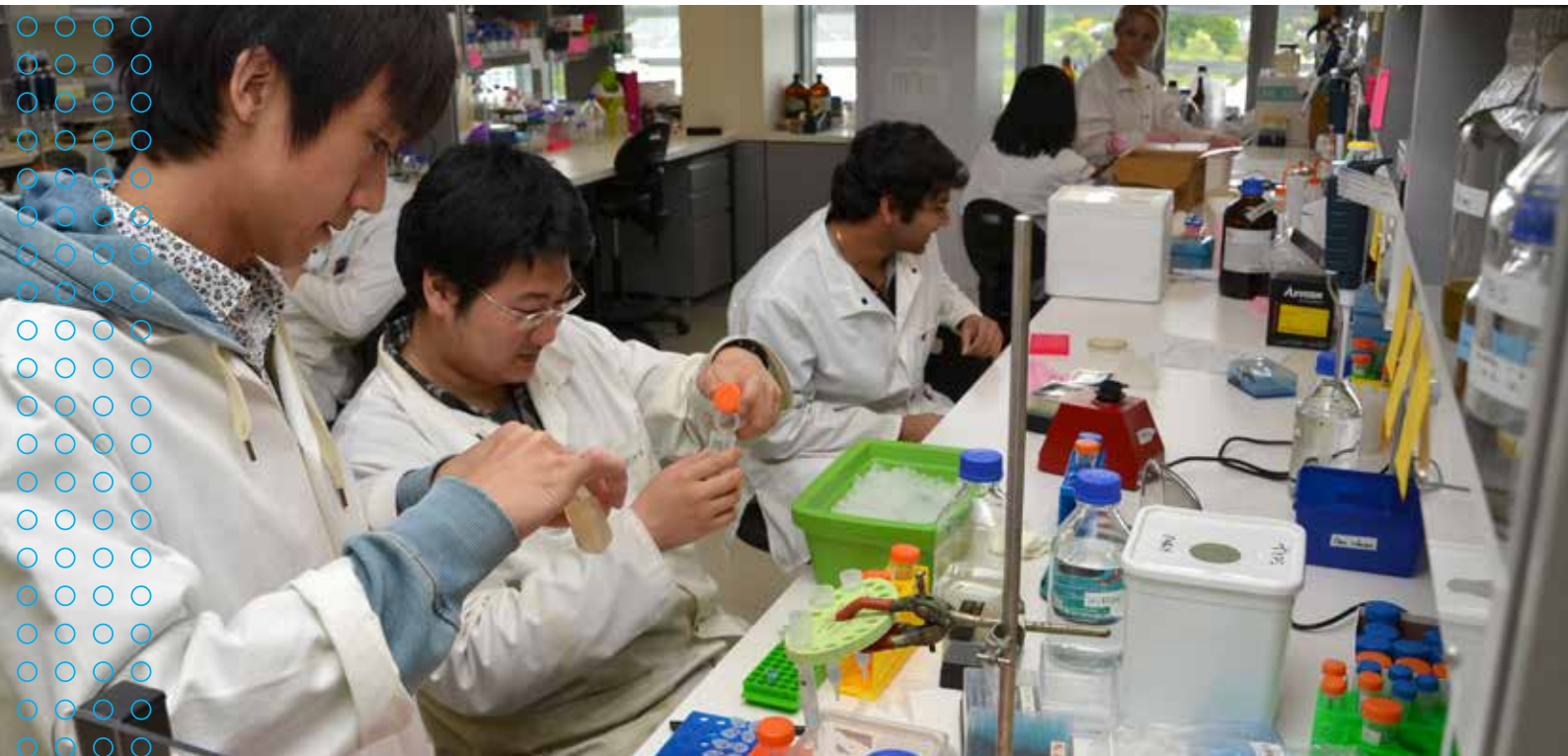
Reichau, S., Flanagan, J., Parker, E.J., Discovery of new allosteric ligands by virtual screening. Molecular Modelling – Discovery through Biomolecular Simulation, Queenstown, New Zealand: 30 August-1 September 2012.

Reichau, S., Parker, E.J., Synthesis and evaluation of inhibitors targeting a crucial enzyme in *Mycobacterium tuberculosis*. 19th International Conference on Organic Synthesis, Melbourne, Australia: 2-4 July 2012.

Saufi S.M., Fee C.J., Preparation of multiple interaction membrane chromatography using a mixed matrix membrane concept. Euromembrane 2012, Westminster, London, 23-27 September 2012.

Sasso, L., Conducting polymer microelectrodes as dopamine sensors from cell populations. School of Biological Sciences, University of Canterbury, Christchurch, New Zealand: 20 June 2013.

Valéry, C., Self-assembling peptides: Exploring native sources for *de novo* sequence design. School of Biological Sciences, University of Canterbury, Christchurch, New Zealand: 8 November 2012.



# Grants received

External research income has grown significantly during the life of the Institute, and we are much less dependent on support from the University to meet our research goals.

Simone Dimartino, Biological adhesives: From biology to biomimetics, Royal Society of New Zealand, $5,000

Simone Dimartino, Conan Fee, Don Clucas, Three dimensional printed adsorptive media, MBIE, $995,299

Renwick Dobson, Biophysical properties of goat beta-lactoglobulin, AgResearch, $10,000

Renwick Dobson, Diagnostic markers for diabetic complications, Canterbury Scientific Ltd, $28,000.

Renwick Dobson, Growing up milks, AgResearch, $184,860

Renwick Dobson, Mapping the evolution of a key glycolytic enzyme, Marsden Fast-start, $266,956

Renwick Dobson, National Centre for Analytical Ultracentrifugation – Probing biomolecular-interactions of medical relevance, Lottery Health, $90,000

Renwick Dobson, Not different, just better: The adaptive evolution of an enzyme, US Department of Defense, $397,591

Renwick Dobson, Juliet Gerrard, Antony Fairbanks, Diagnostic markers for diabetic complications, MBIE, $995,628

Renwick Dobson, Hironori Suzuki, Structural and Biochemical Studies of ATG1 Complex, Postdoctoral Fellowship and Scientist Exchange Fellowship Programs in Japan 2012-2013, Royal Society of New Zealand, $164,000

Antony Fairbanks, Doctoral scholarship grant, IRL, $105,000

Conan Fee, SPR studies of insulin receptors and type II diabetes related to gastric by-pass surgery, Prometheus Capital Ltd, $15,000

Sally Gaw, Accumulation of micropollutants in Te Whaka-raupo/Lyttelton Harbour, Brian Mason Scientific and Technical Trust, $4,771

Sally Gaw, Fate and behaviour of wastewater PCP's in constructed wetlands and on-site land application systems, NIWA, $30,000

Sally Gaw, Impacts of using earthquake demolition materials as seafill on trace metal concentrations in seawater biota, Brian Mason Scientific and Technical Trust, $15,133

Paul Gardner, Bioinformatic approaches to functionally characterise RNAs, Rutherford Discovery Fellowship, $800,000

Juliet Gerrard, Enhanced protein functionalities, PGP, $567,300

Juliet Gerrard, IRL doctoral scholarship grant, IRL, $191,000

Juliet Gerrard, IRL Industry and Outreach Fellowship, IRL, $475,002

Juliet Gerrard, Nutritional vitality: Dairy biopolymer for fat replacer, Fonterra, $594,495

Juliet Gerrard, Red Meat Combifoods, AgResearch, $96,720

Juliet Gerrard, Self assembling peptides as tools to probe the quaternary assembly of proteins, AgResearch, $76,500

Juliet Gerrard, The Riddet Institute Contract for Research Services, Riddet Institute, $414,295

Juliet Gerrard, Antony Fairbanks, Nutritional Vitality: Dairy emulsion catalysis, Fonterra, $140,860

Juliet Gerrard, Celine Valéry, Peter Steel, Proteins as supramolecular building blocks for responsive materials and nanodevices, United States Department of Defense, $417,246

Richard Hartshorn, High strength protein biomaterials through photo-induced crosslinking, AgResearch, $51,150

Wanting Jiao, Emily Parker, New drugs for lung infections in cystic fibrosis, CMRF, $82,872

Wanting Jiao, Emily Parker, Novel strategies for antibiotic design: Targeting histidine biosynthesis in pathogens, Lottery Health, $85,500

Emily Parker, Controlling the partitioning between the hydrolysis and transglycosylation reactions, Industrial Research Ltd, $54,000

Emily Parker, Identifying novel inhibitors of a crucial biosynthetic enzyme from Mycobacterium tuberculosis, Maurice Wilkins Centre, $9,960

Emily Parker, Investigating in inhibition of adenosine triphosphate phosphoribosyltranferase: A potential target for antimicrobial drug design, IRL, $50,000

Emily Parker, Next generation enzymes for chemical transformations, Callaghan Innovation, $98,875

Emily Parker, Next-generation enzymes for commercial applications, Subcontract from Waikato University for MBIE smart idea, $223,642

Emily Parker, Retracing the evolution of enzyme regulation: Understanding the molecular mix-and-match that gives rise to sophisticated control of metabolism, Marsden, $639,130

Emily Parker, Grant Pearce, Renwick Dobson, Juliet Gerrard, Conan Fee, Richard Furneaux, Macromolecular crystallization to probe biomolecular interactions of medical importance, Lottery Health, $100,000

Grant Pearce, Characterisation of enzymes important as nutraceutical additives, IRL, $35,000

Grant Pearce, Why is the most abundant enzyme in the world lacking specificity? Marsden Fast-start, $266,667

Anthony Poole, How does complexity emerge in cellular systems? Rutherford Discovery Fellowship, $800,001

Céline Valéry, Juliet Gerrard, Nano-doughnuts by biological antioxidant proteins, Dumont D'urville NZ, $18,000

Madhu Vasudevamurthy, Juliet Gerrard, Jackie Healy, Susie Meade, Protein nanofibres based biosensors and chromatography beads, MBIE, $973,669

# Grants disbursed

One of BIC's aims is to promote excellent, high-impact, interdisciplinary and collaborative research outputs related to biomolecular interactions, in particular protein interactions. BIC awards seed and flexible project grants to encourage and grow research that supports our vision.

Seed and flexible grants support BIC Investigators with new interdisciplinary initiatives developing novel areas of research and therefore must involve the development of new areas of collaborative research, rather than established programmes. Projects selected are likely to seed further investigations and applications to grant-funding bodies.

In 2012 and 2013, we awarded BIC grants of $57,000 and $94,250 respectively.

## 2012

Dave Collings, Seed Grant, The biochemical basis behind microtubule stability in *Ornithogalum*, $5,000

Renwick Dobson, Seed Grant, Protein purification: Maintenance of a hybrid AKTA on the 6th floor of SBS, $5,000

Antony Fairbanks, Seed Grant, *In vivo* testing of synthetic amilyn analogues, $5,000

Conan Fee, Flexible Grant, Control of membrane transport by self-assembling peptides, $4,000

Conan Fee, Seed Grant, Magnetically stabilized fluidized bed (MSFB) chromatography, $5,000

Richard Hartshorn, Flexible Grant, New approaches to stable haemoglobin controls, $1,500

Ali Reza Nazmi & Emily Parker, Flexible Grant, Establishing a new system to study protein complexes at the BIC, $2,500

Matilda Newton, Wayne Patrick & Emily Parker, Flexible Grant, Characterisation of the *Pseudomonas aeruginosa* Shikimate Kinase: A Potential Drug Target, $4,000

Volker Nock, Seed Grant, $5,000

Emily Parker, Seed Grant, Allostery and mechanism in histidine biosynthesis, $5,000

Grant Pearce, Seed Grant, Mass spectrometry studies of Rubisco activase, $5,000

Arvind Varsani, Seed Grant, Geminate vs icoshedral, $5,000

Tim Woodfield, Seed Grant, Investigating the role of surface topography and bioactive peptide modification of biomaterial substrates on cell function in 3D? $5,000

## 2013

Penel Cross & Emily Parker, Flexible Grant, Mechanism of allosteric regulation of mammalian phenylalanine hydroxylase, $4,700

Simone Dimartino, Flexible Grant, Scale up of capillary channelled polymer stationary phases for affinity purification of biomolecules, $5,000

Renwick Dobson, Seed Grant, Understanding the modular packaging and assembly events in the bacterial nano-compartments, $10,000

Conan Fee, Seed Grant, Self-assembling molecule membranes and 3D printed porous media, $10,000

Paul Gardner & Ant Poole, Flexible Grant, How does selection distinguish between 'good' & 'bad' RNA-RNA interactions? $14,550

Volker Nock, Seed Grant, High-throughput microfluidic screening of bacterial chemotaxis, $10,000

Emily Parker, Seed Grant, Exploring the fundamental influences of protein allostery, $10,000

Grant Pearce, Seed Grant, Determining the binding constants of Rubisco activase, $10,000

Ant Poole, Seed Grant, Quantifying the effect of RNA polymerase slippage on protein expression, $5,000

Mark Staiger, Flexible Grant, Tissue engineering using marine collagen and regenerated cellulose, $3,000

Arvind Varsani, Flexible Grant, Towards understanding the process of viral emergence, $12,000

**TO ENCOURAGE AND GROW RESEARCH THAT SUPPORTS OUR VISION**