Lab+Life SCIENTIST

THROUGH THE LOOKING GLASS

THE FUTURE OF MICROBIOLOGY

JUN/JUL 2019
VOL.29 NO.2
ISSN 1000008671

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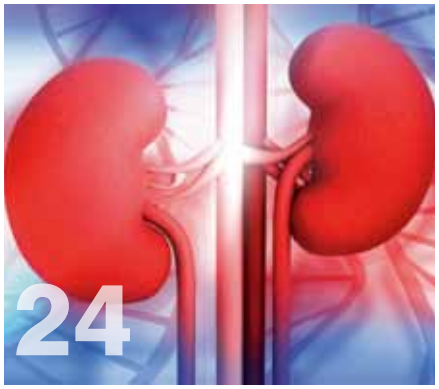

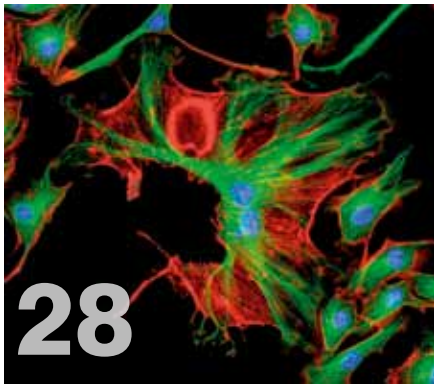

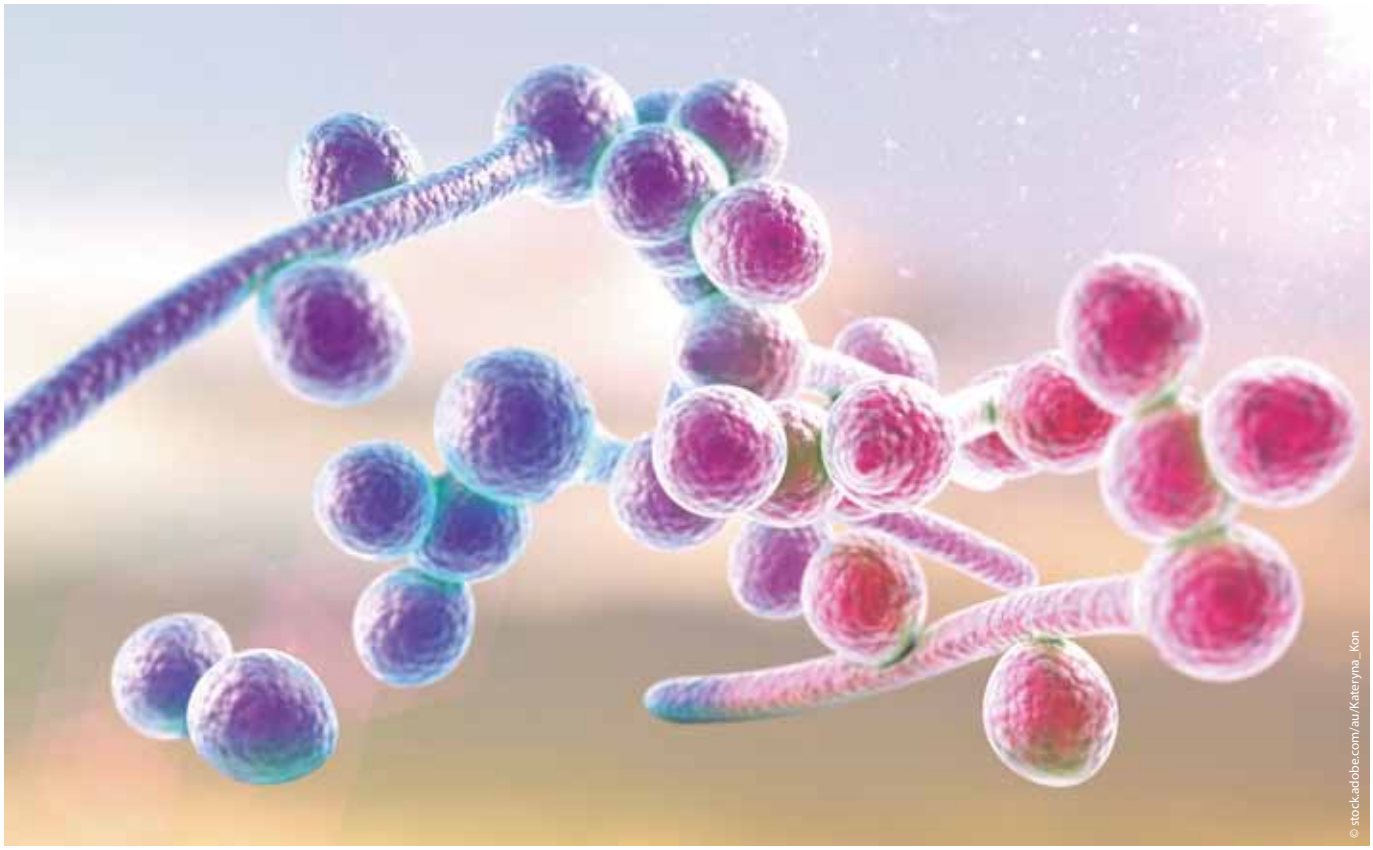

By the time this issue of *Lab+Life Scientist* reaches you, the much-awaited Australian Society of Microbiology 2018 (ASM 2018) Conference may have already started.

The science of microbiology was born in 1674 when Antonie van Leeuwenhoek first observed microorganisms with a simple microscope. Since then, our understanding of the microbial world has improved remarkably.

The lead article in the issue features ASM 2018's Rubbo Orator Professor Paul Young, a renowned virologist and Head of the School of Chemistry & Molecular Biosciences at the University of Queensland. He is the current Chair of the Virology Division of the International Union of Microbiological Societies and a past president of the Australian Society for Microbiology. Young reflects on how, after some unexpected turns in his career, he ended up in the field of virology, but never regretted it. He talks about his rewarding career, challenges and opportunities in the field and also provides insights on some exciting work underway in his laboratory.

The ASM conference features many other eminent scientists from Australia and around the world. The symposia and workshops feature a variety of topics including clinical diagnostics; antimicrobial resistance; vaccine and therapeutic development; public health and one health; tropical, regional and point-of-care medicine; genomics; microbial evolution; marine, wildlife and livestock microbiology; bacterial pathogenesis and regulation; viral pathogenesis; medical mycology; fungal ecology and evolution; as well as communication, education and history.

The other key feature in this issue is clinical trials. The article on page 16 by the CEO of MTPConnect, Sue Macleman, reflects on the state of clinical trials in Australia, the exciting opportunities in the field and how national and collaborative approaches involving all industry stakeholders would further improve Australia's clinical trials environment.

We also provide an update on clinical-stage biotech company Dimerix's plans. With a Phase 2 trial conducted in 2017 yielding promising results, the company is now set to more deeply investigate the therapeutic effects of DMX-200 on chronic kidney disease.

This issue also features a number of other interesting developments, including super-multiplexed fluorescence microscopy; how non-functioning genes play their part in cancer research; a citizen science project led by Macquarie University is seeking a solution to antibiotic resistance in one of the most unlikely places you could imagine — possum poo; and more.

Regards,
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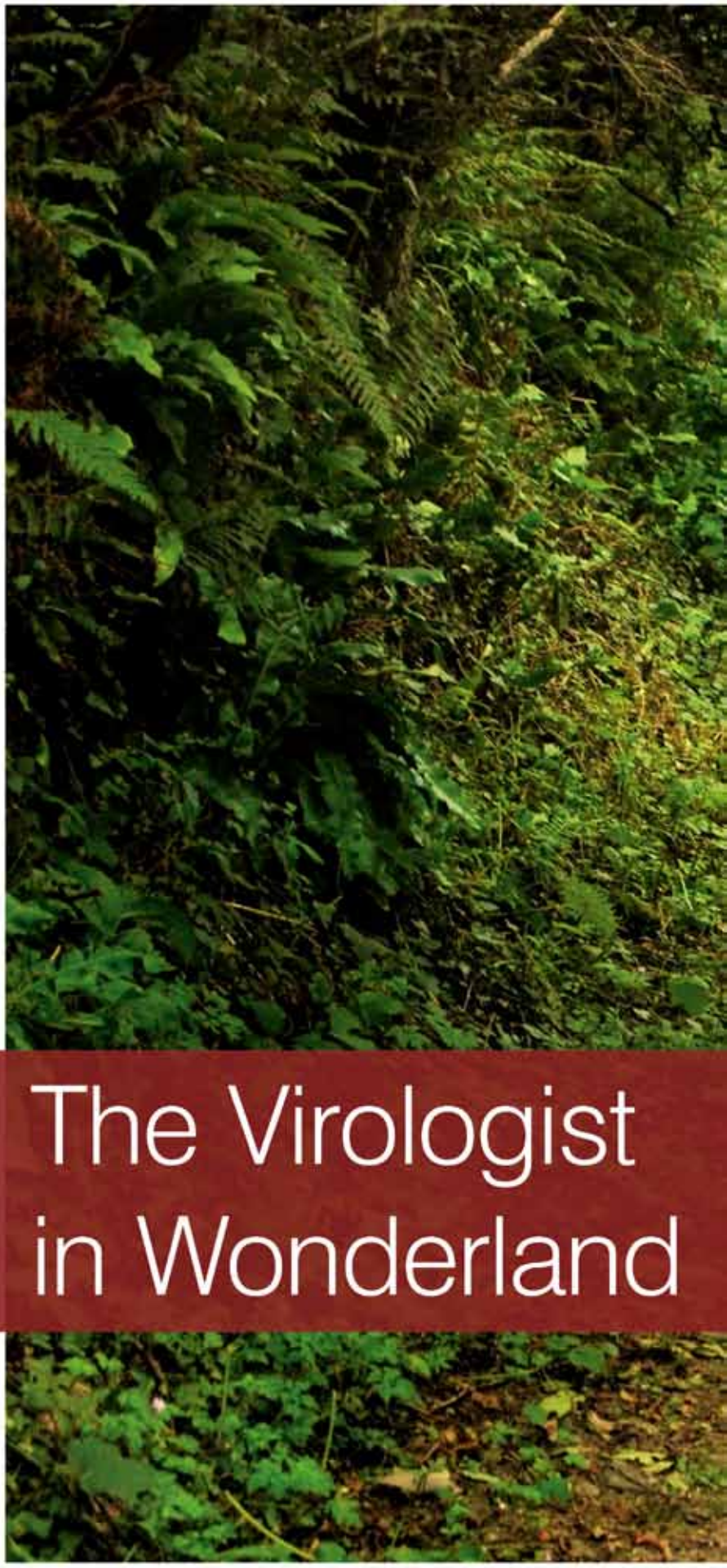
Mansi Gandhi

The Virologist in Wonderland

Paul Young*, Professor of Virology and Head of School of Chemistry and Molecular Biosciences, University of Queensland, takes us down the microbial rabbit hole ahead of the Australian Society of Microbiology 2018 Rubbo Oration 'Virologist in Wonderland'.



Lab+Life Scientist: How did you first become interested in science?

Professor Paul Young: A natural inquisitiveness and wonder about the world that began from as early as I can remember. Much to the frustration of my parents, I was one of those kids who had to take everything apart to find out how it worked — and yes, sometimes things didn't quite go back to the way they were. I had quite a few toys relegated to the dark corners under the house. But that's all part of the discovery process and my ongoing fascination with science. Things don't always go according to plan, but you inevitably learn something from going down the wrong path — such as discovering an even more fascinating one. It has always been a complete mystery to me as to why, with all this prior knowledge of my exploratory tendencies, my parents bought me a chemistry set when I was about 12 years old. Anything could have happened — and it scares me now when I remember the concoctions I experimented with under their house. I converted some spare space into my own 'lab' and even had an old cupboard stocked with chemicals that I had purchased with my pocket money from a chemical supplier — just imagine that happening now. These weekends in my own lab, often as not with my friends as fascinated participants, are my first memories of being hooked with the process of science.

I loved chemistry and biology at school and choosing science at university was a no-brainer. What kept me in science was a number of teachers and mentors who nurtured that fascination and passion throughout my undergraduate and postgraduate years. The passion is still there, as strong as ever, and I now look to my students, colleagues and mentors (you never lose the need for good mentors) to keep the fire stoked.

As part of a dengue vaccine program, we designed a capture ELISA in 1991 as a simple lab tool to measure recombinantly expressed NS1 which we were studying as a candidate vaccine immunogen at the time

LLS: What specifically drew you to virology?

PY: It is a statement of the obvious that your experiences, whether positive or negative, can define your path in life. I entered university with a clear idea of a career in industrial chemistry. It's obvious for someone who set up his own chemistry lab as a young teenager. But first-year chemistry cured me of that. It wasn't the content, but the dry, unimaginative lectures. It is somewhat ironic that chemistry underpins much of what I now do, particularly in drug discovery, and as Head of School of Chemistry and Molecular Biosciences. On the other hand, my lectures in biochemistry and microbiology were absolutely fascinating. This was the mid-70s and the genetic engineering revolution was just beginning — exciting and controversial times given the radical concept of manipulating life's genetic code. In one of my courses, our dynamic lecturer threw out the curriculum and simply took us through the latest papers in *Nature*. I remember one day he bounded into the lecture theatre waving the latest issue of *Nature* (delivered by post, not electronically) shouting out, "You won't believe what they have just been able to do!"

Genetics and bacteriology excited me. I wanted to do honours in the only lab at UQ that was doing experiments in genetic manipulation. I had been accepted, but the previous honours students decided to both stay on for their PhDs and that meant there was no room that year to take new honours students. I was devastated, of course, but after searching around, I found a virus lab at QIMR, in Brisbane, that was working with viruses as tools for evolutionary studies. So, for no better reason than space limitations, my career went down the virus rather than bacteriology path. I have not regretted for one moment that nudge onto a different path than the one I was expecting.

LLS: What's your lab's research focus?

PY: My lab's central interest for over 30 years has been the study of dengue viruses, how they cause severe disease and how we diagnose and control them. The latter has included both vaccine and antiviral drug design strategies. We are fundamentally a virology lab and bring to our work all that entails including underpinning expertise in molecular, cell and structural biology as well as recombinant protein engineering. With that expertise, we have occasionally ventured outside our dengue focus with other long-term projects on respiratory syncytial virus (RSV) and koala retrovirus (KoRV).

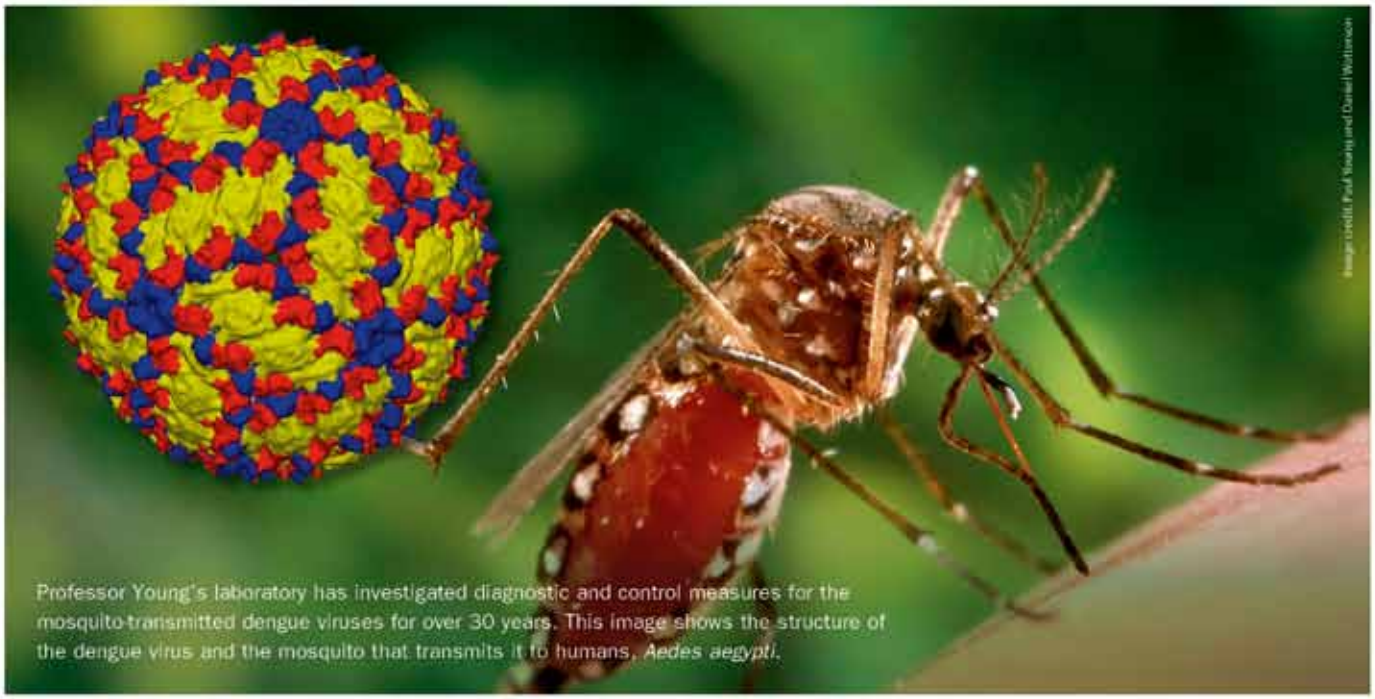
The lab is currently focused on four main areas of investigation — the role of the dengue virus protein NS1 in the pathogenesis of severe dengue disease, in particular in the induction of vascular leak (founded on our observation that NS1 is a TLR4 agonist); a generic subunit vaccine approach to a wide range of enveloped viruses based on our patented strategy for locking viral fusion proteins in their pre-fusion configuration; the delivery of both existing (polio, measles, rubella) and new vaccines to the skin by a micro-needle array patch in collaboration with Vaxxas; and our ongoing study on the impact of the invasion of the koala genome by KoRV.

LLS: Could you share one of your Eureka moments?

PY: As part of a dengue vaccine program, we designed a capture ELISA in 1991 as a simple lab tool to measure recombinantly expressed NS1 which we were studying as a candidate vaccine immunogen at the time. This is an unusual glycoprotein that is secreted from infected cells and the Eureka moment was realising that as a secreted protein it might also be a biomarker of infection in patient blood. We decided to test a bank of patient sera for its presence and were stunned to find very high levels — up to 50 µg/mL — in some serum samples. It took a further 15 years to fully validate NS1 as a viable diagnostic biomarker of early dengue infection and to bring the assay to commercial release, but it is now the foundation for many dengue and other flavivirus rapid assays. Keep an open mind and think outside the usually constrained data box.

LLS: What are you going to talk about at the ASM conference?

PY: It is an honour to have been chosen as the Rubbo Orator this year. I will take the opportunity to reflect on some of my experiences in research and academia and to draw some lessons learned. The



Professor Young's laboratory has investigated diagnostic and control measures for the mosquito-transmitted dengue viruses for over 30 years. This image shows the structure of the dengue virus and the mosquito that transmits it to humans, *Aedes aegypti*.

Virologist in Wonderland title is a reflection of the exciting opportunities I have had as well as some of the unexpected turns that a career in science can often take. I will also spend some time on our recent exciting work with a recombinant protein engineering approach to subunit vaccine design that constrains viral fusion proteins in their more immunogenic, pre-fusion configuration. I will outline our application of this generic vaccine platform technology to rapid response efforts to emerging disease threats as well as to the generation of new influenza vaccines and our progress towards a universal flu vaccine.

LLS: What are some of the biggest challenges in infectious disease research?

PY: The two biggest challenges that we face in infectious disease research today involve effectively addressing the global threats posed by expanding antimicrobial resistance and the regular emergence or re-emergence of new or previously rare diseases. The significant challenge for both lies not only in the fundamental research required to develop new control strategies but the way we translate that research into clinical application.

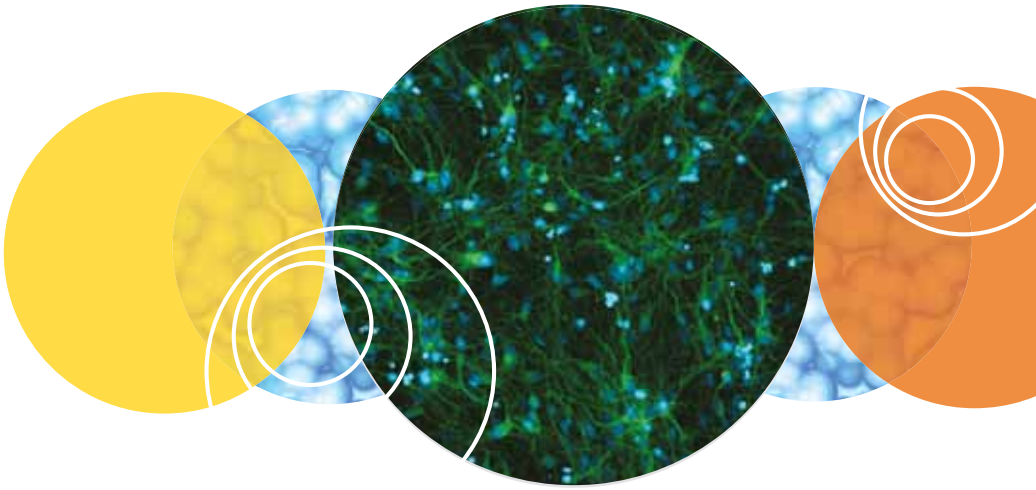
The traditional, costly and time-consuming drug and vaccine development pipeline — normally the sole province of big pharma — as well as the regulatory framework in which they operate both need to reflect the urgency with which these threats have to be met. These are not insignificant challenges but there are new players that include government, philanthropic funders, NGOs and a more willing big pharma sector engaged in helping drive drug and vaccine development further along the pipeline, along with positive moves to new, special-case accelerated pathways to regulatory approval. Preparedness and rapid response have also now become catch phrases for a new approach to emerging disease threats, following the poor 'reactive' response to the Ebola and Zika outbreaks of recent years. The lessons learned have led to a far more effective and coordinated global response to the latest re-emergence of Ebola. While the threats are still there, we should feel encouraged that real action is starting to follow the rhetoric.

LLS: What do you think the future holds for virology research?

PY: Not just the future, but now is a particularly exciting time for a virologist. Like many other fields of science at the moment, we are embracing cross-disciplinary collaboration. Significant developments in underlying technologies such as deep sequencing, mass spectrometry (proteomics, metabolomics, lipidomics, glycomics, etc), structural biology (cryo-EM) to name a few, require a multidisciplinary approach. They are even revolutionising the questions we can ask, let alone the answers we can generate. The sheer quantity of data being generated, big data, offers both opportunities and challenges. A new breed of bioinformaticians is now needed to help us make sense of all this data.

However, the real opportunities I see are in moving further away from our traditional reductionist approach to research to a more systems-based approach. While the reductionist path is still critical to nail down specific biological players, molecular interactions and pathways, we can now ask more complex systems questions and interrogate interacting players without specific prior knowledge. Stunning insights are now coming out of polymicrobial studies where previously unrecognised interactions, synergies and competition between multiple bacteria, viruses and their hosts are in play in the one environment, whether it be the human respiratory tract, termite gut or the ocean's waters. The knowledge gained from these studies will certainly have a significant practical impact. Just around 5–10 years ago it would have been technically challenging, if not impossible, to sequence the entire nucleic acid population of a complex biological sample. Now, with new deep sequencing approaches we can take this capacity into the field. How primitive PCR now looks and how exciting the future. The big opportunities are now in asking the big multisystem questions.

**Professor Paul Young will deliver the Rubbo Oration at The Australian Society for Microbiology Annual Scientific Meeting 2018 to be held from 1–4 July at the Brisbane Convention and Exhibition Centre. Young is the current Chair of the Virology Division of the International Union of Microbiological Societies and a past president of the Australian Society for Microbiology, Australasian Virology Society and the Asia Pacific Society for Medical Virology.*



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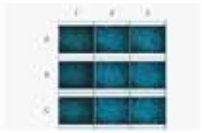

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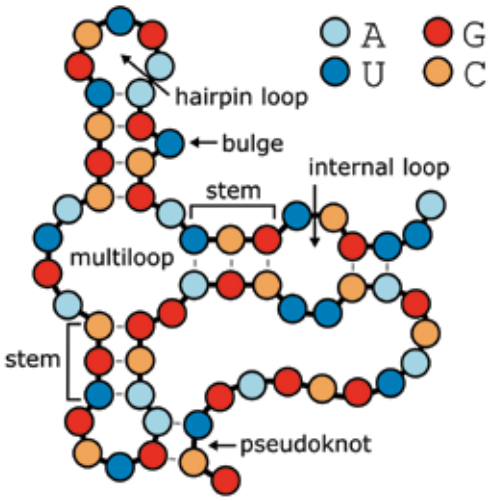


An example of the annotation provided by a new software tool for RNA secondary structure researchers (provided by David Hendrix, OSU College of Science).

A big-data annotation tool, called bpRNA, makes it easier to understand links between disease and mutant RNA. Developed by researchers at the Oregon State University, the program is capable of parsing RNA structures, including complex pseudoknot-containing RNAs, so you end up with an objective, precise, easily interpretable description of all loops, stems and pseudoknots, said corresponding author and Assistant Professor David Hendrix.

"You also get the positions, sequence and flanking base pairs of each structural feature, which enables us to study RNA structure en masse at a large scale." RNA works with DNA, the other nucleic acid — so named because they were first discovered in the cell nuclei of living things — to produce the proteins needed throughout the body. DNA contains a person's hereditary information, and RNA delivers the information's coded instructions to the protein-manufacturing sites within the cells. Many RNA molecules do not encode a protein, and these are known as noncoding RNAs.

"RNA is one of the fundamental, essential molecules for life, and we need to understand RNAs' structure to understand how they function."

DNA has mainly fully base-paired double helices, but RNA is single stranded and can form complicated interactions.

Hendrix said bpRNA, presented in a paper in *Nucleic Acids Research*, features the largest and most detailed database to date of secondary RNA structures. "To be fair it's a meta-database, but our special sauce is the tool to annotate everything," said Hendrix, who is also an assistant professor in the OSU College of Engineering. "Before there was no way of saying where all the structural features were in an automated way. We provide a colour-coded map of where everything is. These annotations will enable us to identify statistical trends that may shed light on RNA structure formation and may open the door for machine learning algorithms to predict secondary RNA structure in ways that haven't been possible."

Researchers have successfully tested the tool on more than 100,000 structures, "many of which are very complex, with lots of complex pseudoknots".

'Non-functioning' genes play their part in cancer research

University of Newcastle scientists have discovered that cancer research does not need to be confined to the 2% of the human genome that makes proteins, revealing new possibilities with genes that were previously thought to be 'non-functioning' in cancer cells. The discovery was made by investigating a special class of genes known as non-coding RNAs (ncRNA), found in the human genome. Led by Professor Xu Dong Zhang, Dr Lei Jin and Dr Rick Thorne, the work could lead to the development of new, more targeted cancer therapies.

The first finding, published in the journal *Nature Cell Biology*, identified a particular ncRNA molecule responsible for protecting the genome and keeping it intact. Named GUARDIN by the scientists, the molecule helps to stabilise a particular protein involved in DNA repair processes.

"We discovered the protective mechanisms of GUARDIN were two-fold," said Professor Zhang, lead investigator on the project. "On one hand, it acts like a sponge to absorb harmful molecules. On the other, it functions like a bridge that brings two proteins together to protect the genome."

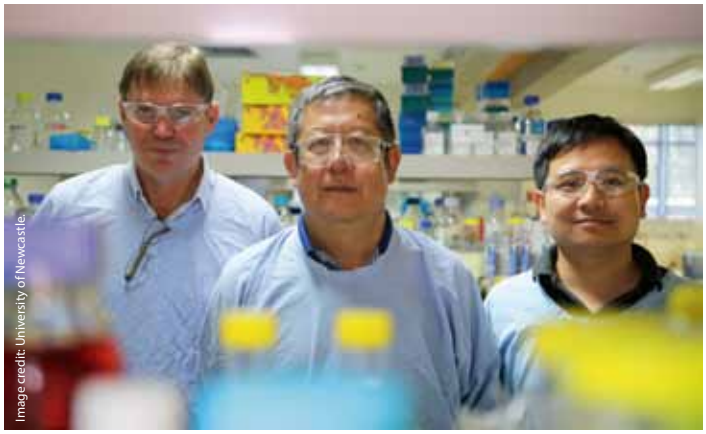
By reducing the presence of GUARDIN in the genome, cancer cells were made more vulnerable to common drug therapies that target DNA. As explained by Dr Jin, "For cells to survive they must maintain the integrity of their genome, their DNA. Many cancer treatments actually work through causing DNA damage and we found that depleting GUARDIN significantly enhanced the death of cancer cells caused by DNA-damaging drugs."

The second finding, published in the *Proceedings of the National Academy of Sciences* earlier this year, investigated an ncRNA that regulates the metabolism of a cell and subsequently how it gets its energy.

"While normal cells use up oxygen for energy, cancer cells use a process called glycolysis to produce energy, which is essential for its survival," said Dr Thorne. "We found that ncRNA IDH1-AS1 accelerated the metabolic activity of cancer cells.

"At face value, glycolysis is not a particularly efficient way for cancer cells to make energy but there are other advantages, for example, producing building blocks that enable cell growth. With many times more non-coding genes than coding genes, the findings have unlocked new avenues for research potential that could lead to a substantial increase of advanced and targeted treatment methods.

"Our findings have shown that ncRNA are functional and play a very important role in the regulation of biological processes, both physiological and pathological," said Professor Zhang. "We have only just touched the surface of how they work in the cell.



Dr Rick Thorne, Professor Xu Dong Zhang and Dr Lei Jin have discovered two new cancer vulnerabilities.

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New lab to advance augmented reality research

CSIRO's Data61 has opened a new facility purpose-built for applied research into novel augmented reality, virtual reality and 3D web technologies — industries set to be worth $143 billion by 2021.

The Immersive Environments Lab, part of CSIRO's $100m research facility in Canberra, will allow researchers to develop new interactive computer graphics and computational imaging services, which will redefine industries including retail, agriculture, manufacturing, health and construction.

CSIRO's Data61 Senior Research Engineer and Experimental Scientist Matt Adcock said AR and VR technology would change the way Australians interact with digital systems at work and at home, such as enabling emergency services to 'beam in' to help administer first aid, to allowing maintenance workers to interact directly with smart buildings, and tapping into vast catalogues of 3D data.

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The lab itself features a fleet of wearable holographic computing devices, spatial cameras, 3D object scanners, haptic (virtual touch) displays, interactive projection mapping stages and motion capture rigs. The CSIRO building which houses the lab contains a cloud-based smart glasses system, developed by Data61, which displays historical and real-time energy usage data overlaid directly on the appliances consuming the energy.

"We've also developed an application for the Powerhouse Museum that uses our multi-user AR techniques," Adcock said.

"A tour guide is able to share a virtual holographic experience with a tour group through smart glasses.

"While the tour guide controls the general narrative, and the holograms appear in exactly the same place to everyone, each individual can investigate specific aspects of the museum objects for themselves.

The Immersive Environments Lab is also collaborating with Australian SMEs which are aiming to be early to market with new AR services, and government partners that are adopting research from the Lab.

Data61 CEO Adrian Turner said the Lab was a unique facility with connections into Data61's deep expertise — in areas such as decision sciences, data sharing and visualisation, collaborative systems, Internet of Things, machine learning, in-situ analytics and robotics — as well as CSIRO's domain expertise in manufacturing and agriculture.

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Partnership to advance composites science

Deakin University and wind energy solutions provider Vestas have teamed up to improve the compressive strength of carbon fibre composite materials for wind turbines.

Derek Buckmaster, Deakin Carbon Nexus Director, said that along with the potential to improve wind turbine performance, the partnership underscored possible expansion of Geelong's composite research and manufacturing footprint and would help Victoria achieve its Renewable Energy Target (VRET).

"The combination of Deakin's research expertise from the world-leading composites research team at Carbon Nexus and Vestas' industry capabilities has the potential to take composite materials research to the next level, delivering real-world outcomes for Victoria."

Carbon fibre composites are critical material to the further improvement of wind turbine blades, due to their unmatched strength-to-weight ratio, enabling the manufacture of longer blades which improve efficiency and lower cost. The uptake of carbon fibre composites has been one of the main drivers behind the increased turbine efficiency and competitiveness of wind power in recent years. Turbine blades are now the largest single use for carbon fibre, accounting for over 40% of global production.

Vestas Asia Pacific President Clive Turton noted the importance of the Victorian Government's renewable energy targets and auction strategy to the local renewable energy industry. "Improved composite material will bring revolutionary benefit to renewable industry locally and globally. By improving efficiency and driving down the cost of wind turbines, we are providing Victoria, Australia and the world with clean and more affordable energy," Turton said.

"Breakthroughs in composite materials will benefit the wind industry, and may deliver significant commercial outcomes in other industries."

Dr Adrian Gill, global lead specialist for blade structure and material at Vestas, said, "With carbon fibre composite innovations, we can increase the performance of turbine blades. Stronger carbon fibre will allow us to reduce the required amount of carbon fibre used in the blade, so the blade will be lighter and cheaper. This makes renewable energy cleaner and more affordable, and supports the development of Australia's growing wind energy sector.

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Rapid, non-invasive tool for Zika detection

Researchers from Australia, Brazil and the US have developed a fast and effective tool to detect Zika virus.

The findings by researchers from the University of Queensland, with colleagues from Brazil and the US, have been published in *Science Advances*.

The researchers claim that near-infrared spectroscopy (NIRS) is 18 times faster and 110 times cheaper than the current detection method.

Dr Maggy Sikulu-Lord from the Queensland Alliance for Agriculture and Food Innovation said, "We can quickly identify mosquitoes that are infected with Zika virus so public health authorities can treat affected areas before disease spreads to humans.

"It only involves shining a beam of light onto mosquitoes and using that information to determine if the mosquito is infected."

Zika is a mosquito-borne virus that can cause abnormalities in unborn babies and is linked to the rare paralysing condition called Guillain-Barre Syndrome (GBS).

Dr Sikulu-Lord hopes the World Health Organisation will use NIRS in countries where Zika is endemic.

"We hope public health authorities can use it to predict future disease outbreaks and save lives by treating mosquito populations in time."

She said the technology had potential to detect a number of diseases.

"We hope to have results for detecting dengue and malaria in mosquitoes in the next few months.

"We don't think it will eradicate diseases but it will give us the ability to detect diseases quickly so that we can stop disease outbreaks."

So far, NIRS technology has been shown to have a 94 to 99% accuracy rate in identifying infected mosquitoes under laboratory conditions in Brazil.

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The team, which includes researchers Dr Rafael de Freitas and his team (Fiocrus, Rio de Janeiro), Dr John Beier (University of Miami) and Dr Floyd Dowell (USDA), is testing the accuracy of the technique under field conditions in Rio de Janeiro.

This work is supported by the Combating Zika and Future Threats Grand Challenge. Grand Challenges Canada's Stars for Global Health, funded by the Government of Canada, provided funding for pilot data collection. The work was supported by the United States Agency for International Development (USAID).

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Microbiome research to aid malnourished children

Science and technology company Merck has announced a collaboration with Washington University in St. Louis that could lead to the optimising of nutritional supplements to restore a healthy gut microbiome.

The two-year collaboration will employ Merck's CRISPR genome-editing technology in research studies by Dr Jeffrey Gordon of Washington University School of Medicine. The research aims to determine the differences between gut bacterial communities in healthy and malnourished children, and to identify what features of healthy intestinal bacteria are critical for supporting healthy growth. From there, nutritional approaches to restore a normal microbiome can be developed and optimised, as nutritional interventions to date have failed to solve the problem.

"Development of the gut microbiome is disrupted in severely malnourished children, leaving them with immature communities compared with healthy children," said Udit Batra, CEO of Life Science at Merck. "Our collaboration with the leading expert in the study of the human microbiome, Dr Jeffrey Gordon, will focus on how to repair and reconstitute a normal microbiome in malnourished children. Using our foundational genome-editing technology, we will continue to form collaborations with the global scientific community to explore how to develop exciting new treatments for many diseases."

Merck, together with Dr Gordon's group, will use its CRISPR genome scissors in this collaboration to modify the sequence of DNA in microbes cultured from human gut microbiome samples. The results will help the researchers obtain essential information about the microbes' functions and nutritional needs.

"Our shared goal is to apply gene-editing technology to further understand the mechanisms by which beneficial human gut microbes promote healthy growth in children," said Dr Gordon. "By marrying this technology with our preclinical models, we can decipher how gut microbes become established in the developing gut, what nutrients are necessary to sustain those microbes and how gut microbial communities influence muscle and bone growth, maturation of our immune systems and metabolic health.

"Results obtained from this collaboration should aid our ongoing efforts to devise new, safe and culturally acceptable ways to repair the developing gut communities in malnourished children or children at risk of malnutrition. This knowledge will facilitate development of new types of microbiota-directed foods, composed of naturally occurring ingredients, that increase the representation and beneficial functions of naturally occurring bacterial strains in the immature gut communities of these children."

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Sue MacLeman, Chief Executive Officer, MTPConnect

Transforming trials

Through public-private collaborations

British naval surgeon James Lind had no idea his 18th-century attempts to cure scurvy would lead the way for some of Australia's great medical research success stories.

International Clinical Trials Day, held in May, commemorates Lind's trials into the causes of scurvy and recognises that clinical trials are central to discovering and proving the efficacy of new treatments. But we've come a long way since 1747.

Today, Australia is a world-leading clinical trials destination and the sector has developed significantly in recent years, with changes in structure and growth in clinical trials activity levels. Approximately 1360 new clinical trials were commenced in Australia in 2015 and this figure has been growing at around 5% per year since 2010, outpacing that of the US, UK and even the overall global average growth rate.

The clinical trial sector is estimated to have contributed approximately $1.1 billion in 2015 to the Australian economy as direct expenditure or investment, and industry sponsors are estimated to contribute $930 million in funding for clinical trials in Australia each year. The vast majority of this is in the form of foreign investment flowing into the country from multinational medical device, biotechnology and pharmaceutical trial sponsors. Considering this, the breadth of Australia's clinical trials sector — level of economic activity and both the economic and health value derived from the conduct of trials — is substantial. Historic volumes suggest that Australia is still experiencing growth in the total number of trials conducted. But international competition for clinical trials is intensifying.

With other countries and populous regions like Asia striving to improve their clinical competitiveness, the question remains whether Australia can hold its dominant position. In a globally competitive marketplace, we need to not only defend our specific areas of strength, but work towards more sustainable competitive advantages. This can only be achieved through national and collaborative approaches, engaging all sector stakeholders — governments, sponsors, clinical investigators, health system managers and industry — and we're already seeing this in action.

Trial recruitment — developing a national and global solution

Historically, Australia has faced challenges in patient recruitment and economics. Our geographically dispersed and comparatively small patient base creates difficulty in recruiting sufficient patients for trials that require large patient numbers. However, in more recent years, Australia has been increasingly competing with East Asia, Eastern Europe and South America in the conduct of trials, with those countries offering lower design complexity, lower requirement in equipment and procedures and larger participant volumes. The number of participants per trial site in Australia is generally lower than these direct competitor countries, which means the opportunity for growth in the number of clinical trials will be more challenging.

Combined with the general lack of effectiveness in referrals between sites and other healthcare entities, clinical trial costing remains complex and variable. Due to Australia's well-structured health system, a number of diseases are routinely managed in the primary care settings (GPs) and these facilities lack recruitment data linkages to local clinical sites, which in Australia are predominately located in major hospitals. These factors impact the economics of the clinical trial site, as the set-up cost is a fixed cost that can only be spread across a limited number of patients.

These barriers call for a national planning of clinical trials programs — and there's an opportunity for Australia to combine its reputation for patient diversity and high quality, with the development of new technologies and innovation. We've seen this in the success of ClinTrial Refer — a new smartphone and web-based platform that

connects doctors and patients to recruiting trials across research networks. The integrated app is supporting over 19 current derivative pilot apps, links to the wide network of Australia New Zealand Clinical Trials Registry and enables doctors to be linked with patients for current trials in less than one minute. The initiative received funding from MTPConnect's Project Fund Program.

Since the campaign was launched in 2013 in New South Wales and Canberra, ClinTrial Refer has been associated with over 60% increase in trials recruitment and has received overwhelming support from Australian pharmaceutical companies participating in the initiative that expressed the need for national approach.

Improving Australia's attractiveness

Despite the shift to Asia and emerging markets, there are opportunities for Australia to increase the number of medicine clinical trials being undertaken locally. Australia can differentiate itself as a high-skilled, cost-effective and efficient clinical trial destination; by targeting international and local medical device, biotechnology and pharmaceutical companies that are seeking certainty around cost and time, world-class infrastructure, access to an ethnically diverse patient base and good clinicians, to ensure better data tracking and quality assurances.

Australia is globally competitive in trials in complex or rapidly changing disease areas, and performs better relative to advanced health system markets in oncology, infectious diseases, musculoskeletal, nephrology and ophthalmology trials. These trials require high-quality data and treatment environments, and high levels of key opinion leader involvement, particularly in early stages. Australia's Phase 1 specialised service providers — CMAX, Linear Clinical Research and sites such as Prince of Wales, Nucleus Network — are highly regarded in terms of their quality and speed of delivery, supported by streamlined processes and private ethics committees through Bellberry. This has attracted inbound investment and activity specifically from small and medium-sized entities in the Asia Pacific region.

A collaborative network of clinical trial units extends across Australia, and all states are courting international pharmaceutical companies, urging them to bring their early-stage trials to Australia. The Clinical Trials: Impact & Quality (CT:IQ) project is an example of this — a new national initiative that promotes a whole-sector approach to improve the quality, efficiency and impact of clinical trials in Australia. The initiative, funded by MTPConnect, brings together multiple stakeholders including Bellberry, Australian Clinical Trials Alliance (ACTA), the National Health and Medical Research Clinical Trials Centre (NHMRC CTC) and The George Institute.

> By building on areas of strength and pursuing further structural improvement with a national focus, Australia could realise a considerable increase in annual expenditure by the sector.

Supporting future growth

It's exciting to see the work already being undertaken by the public and private sector participants, and the calls for greater collaboration between the sectors to improve Australia's clinical trials environment, with a view to improving health outcomes and increasing international investment in Australia.

The 2018–19 Budget has active reforms for the sector and demonstrates the Australian Government's understanding of the value clinical trials and research, and how it supports better health outcomes for Australia. The government has delivered investment of $2.4 billion in growing Australia's research science capability, and an additional $1.9 billion in Australia's national research infrastructure over 12 years to ensure that we have the tools to develop and commercialise first-to-market products. As part of a National Health and Medical Industry Growth Plan, $248 million will be provided to expand the successful rare cancers, rare diseases and unmet-need clinical trials program. A 'national clinical trials front door' will also be established to better coordinate the Australian clinical trials sector.

A critical and welcome announcement for the sector relates to the reforms of the Research and Development Tax Incentive (RDTI) — these reforms that will encourage additional investment in R&D and ensure RDTI's long-term sustainability. The exclusion of clinical trials from the $4 million annual cap on RDTI cash refunds illustrates the known value of clinical trials for both economic and health outcomes. The impact for R&D intensive companies is also recognised with an intensity component and increased cap to $150 million, and these measures are expected to increase R&D activity in Australia. MTPConnect is working with the Australian Government and sector on the rollout of these measures.

To date, MTPConnect has funded 34 national and industry-led, dollar-for-dollar matched projects, with over 200 consortium members — of which four projects focus on facilities to produce products at low volumes for clinical trials, four projects to assist patient recruitment for clinical trials and one project focused on upskilling graduates with trials-specific workforce skills.

By building on areas of strength and pursuing further structural improvement with a national focus, Australia could realise a considerable increase in annual expenditure by the sector. If Australia can maintain its trial growth rate, it could surpass $2 billion of annual expenditure in the next 10 years and create more than 6000 new high-skilled jobs in a sustainable sector, driving broader health and economic outcomes, and ultimately providing patients with early access to new and potentially life-saving treatments.

All this, because James Lind decided to experiment with oranges and lemons.

Human cytokine screening panel

The Bio-Plex Pro Human Cytokine Screening Panel 48-plex is a ready-to-use, 96-well kit that delivers analytical performance and data integrity across 48 well-characterised assays that are multiplexed in a single well.

The panel contains 48 cytokine and chemokine signalling molecules studied within complex extracellular events and an array of signalling pathways that trigger heart diseases, Alzheimer's disease, autoimmunity, infectious disease, inflammation, cancer and neurodegeneration. The panel consists of adaptive immunity cytokines IL-2, IL-3 IL-4, IL-5, IL-7, IL-9, IL-13, IL15 and GM-CSF; pro-inflammatory cytokines IL-1α, IL-1β, IL-1ra, IL-6, IL-10, 17, IL-18, IFN-γ, IFN-α2 and TNF-α; and anti-inflammatory cytokines IL-10, IL-12 (p40) and IL-12 (p70).

The panel has been developed to provide a broad dynamic range to ensure both endogenous and disease-state samples fall within the quantitative range of the assay for all analytes with a higher level of sensitivity for analyte detection with optimised reagents. Compatible with all xMAP platforms (Bio-Plex 200, Bio-Plex 3D and MAPGIX Instruments), the panel enables users to broadly screen critical targets of interest in a single well, conserving sample, saving time and minimising sources of human error.

Bio-Rad Laboratories Pty Ltd
www.bio-rad.com

Microfluidic platform

BioFlux is a microfluidic platform analysis system with the ability to simultaneously grow up to 96 biofilms under controlled shear conditions. The product features quick and easy set-up with no messy pumps or tubing.

Bacteria and fungi organised into biofilms are highly refractive to known antibiotics and biocides. To develop biofilm solutions, screening technologies must be designed to grow biofilms under conditions that represent an in vivo or in situ community, while maintaining the ability to add and observe the effects of compounds.

BioFlux offers a comprehensive solution for running both fundamental biology assays as well as antimicrobial compound screens. Representative applications include biofilm growth, mutant screens, antibacterial or antifungal screening, host-pathogen interactions and adhesion strength.

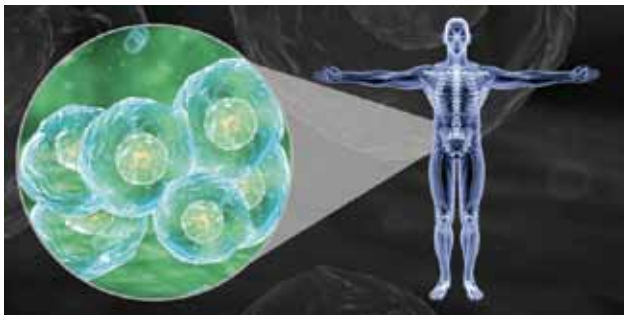
The system is proficient in controlled media flow for up to 21 days, reducing media consumption and the use of stains and drug compounds. With two-inlet designs, scientists can perform, for example, multiple parallel bacterial chemotaxis experiments and competitive biofilm development assays. With the ability to control temperature, gas content and nutrient delivery, users can even grow anaerobic biofilms, as the system controls shear forces to quantify bacterial adhesion.

Bio-Strategy Pty Ltd
www.bio-strategy.com

Cancer cell lines

GeneCopoeia offers premade cancer cell lines carrying diverse gene mutations commonly seen in tumour biomarkers, including EGFR, KRAS and BRAF in the MAPK pathway.

The mutant cells are engineered based on the HCT116 cancer cell line, in which mutations are integrated either homozygously or heterozygously using CRISPR technology. They can be used to enhance our understanding of cancer biology and the development of cancer therapies, either as cell line models for the study of metabolic and signalling pathways or as in vitro models for drug screening and toxicity studies.



The cell lines feature puromycin resistance for easy growth and maintenance. Mutations are available in both homozygous and heterozygous forms. Premade cell lines are available for next-day shipping; a custom cell line service is also available.

United Bioresearch Products Pty Ltd
www.unitedbioresearch.com.au

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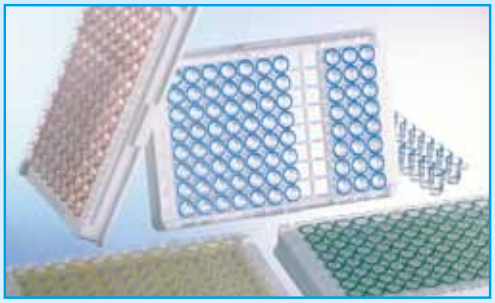
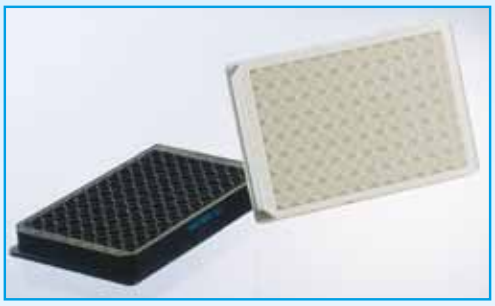
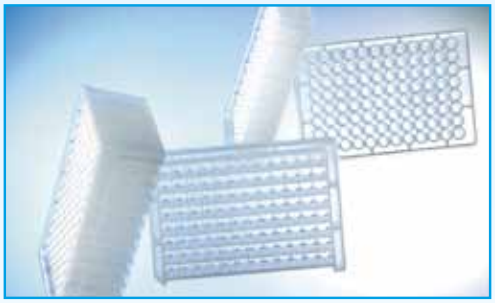


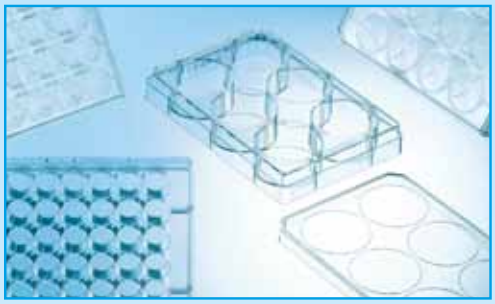
ELISA / Immunology



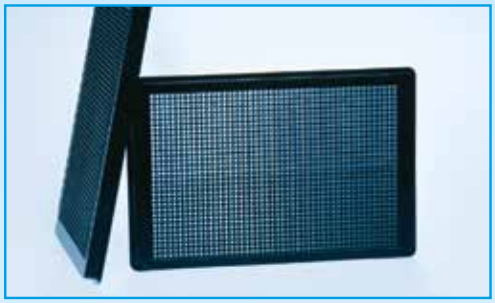
Fluorescence / Luminescence



Sample Storage

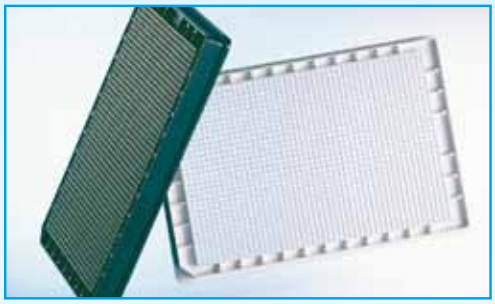


Cell Culture



1536 Well Plates

Protein Crystallisation



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Growth promotion testing kit

Microbiologics, a supplier of ready-to-use QC microorganisms for clinical, pharmaceutical, food, water and educational applications, has added ***Escherichia coli*** ATCC 8739 to its EZ-Accu Shot product. This is in addition to five other USP compendial strains for growth promotion testing: ***Aspergillus brasiliensis*** derived from ATCC 16404; ***Bacillus subtilis*** subsp. ***spizizenii*** derived from ATCC 6633; ***Candida albicans*** derived from ATCC 10231; ***Pseudomonas aeruginosa*** derived from ATCC 9027; and ***Staphylococcus aureus*** subsp. ***aureus*** derived from ATCC 6538.

The EZ-Accu Shot Select kit contains one instant-dissolve pellet of each of the six strains and six vials of hydration fluid. Each pellet delivers 10–100 CFU per inoculum (0.1 mL) with no serial dilutions and provides 8 h of stability after rehydration for added flexibility to perform tests. The kit includes 10 tests for each microorganism.

EZ-Accu Shot Select strains are just three passages from the reference culture to meet Pharmacopeia standards.

Cell Biosciences Pty Ltd
www.cellbiosciences.com.au

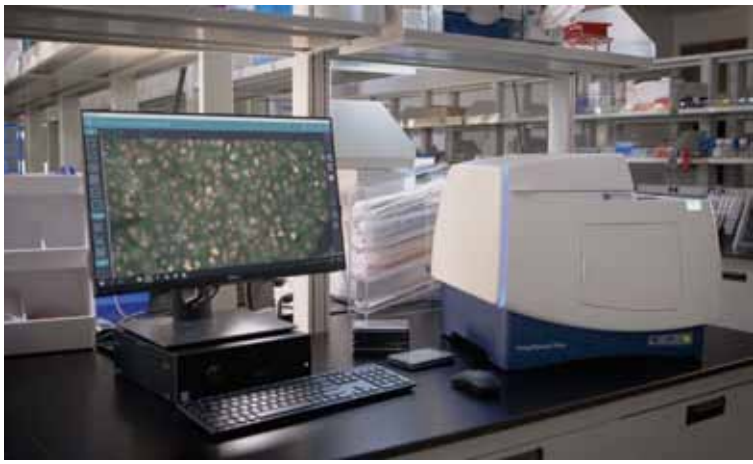
Intermediate inverted research microscope

The Eclipse Ts2R is an intermediate inverted research microscope from Nikon that provides a wide variety of observation methods and many enhanced functionalities.

Observation methods available include Phase Contrast, DIC, Hoffman Modulation Contrast and Emboss Contrast. Thick samples such as cancer cells, oocytes and embryos, which are difficult to observe with conventional phase contrast methods, can be easily observed with Emboss Contrast, which provides high-contrast, pseudo three-dimensional images without the need for optical components.

The product incorporates high-performance optical accessories common to the standard inverted research microscope Eclipse Ti to produce high-quality images. It also showcases intuitive controls, LED illumination and accessories like the contrast shield, designed for improved workflow and functionality. The compact design is intended to not only save valuable laboratory space but also to improve ergonomics.

Coherent Scientific Pty Ltd
www.coherent.com.au



Automated cell imaging system

The ImageXpress Pico Automated Cell Imaging System is more than a digital microscope, combining imaging and powerful analysis for individual labs that need easy automated imaging solutions.

After a simple step-by-step set-up, images are automatically acquired and analysed while users can work on other tasks. The CellReporterXpress software offers features that simplify user experience while generating data-rich results. Outputs can be viewed in many formats, including heat maps, scatter plots and videos.

The product captures images automatically in brightfield, colorimetric, fluorescence and live-cell modes. Users can analyse data easily with preconfigured analysis protocols. Data can also be exported and shared with built-in sharing and remote access capabilities.

The complete and integrated solution offers seamless tiling and stitching to image, analyse and display large regions of wells or slides. Other benefits include: large field of view (FOV); a bright, stable, long-lasting light source; slide overview mode; a wide magnification range; label-free imaging; a small footprint; and fluorophore flexibility.

Bio-Strategy Pty Ltd
www.bio-strategy.com

Dissolvable microcarriers

For cell therapy and other applications, traditional microcarriers are not always sufficient. Difficulty separating precious cells from traditional microcarriers may result in lower yields of healthy cells in the final product.

Corning Dissolvable Microcarriers are designed to simplify cell harvest, separation and concentration processes. They arrive pre-sterilised and pre-coated with the user's selected surface coating of either denatured collagen or Synthemax to enhance cell attachment.

The microcarriers are easily dissolved with a solution of EDTA and pectinase within 10–20 min, without the need for microcarrier separation. They offer a cell separation that is said to be faster, gentler and more convenient than that of standard commercially available microcarriers.

The dissolvable microcarriers are suitable for those who need to produce large cell quantities for cell therapy and vaccine production.

Corning Singapore Holdings
www.corning.com/lifesciencs

Medical supplies and equipment

Point of Care Diagnostics' new website, pocdscientific.com.au, enables hospitals, laboratories and researchers to order critical equipment, chemicals and pathology supplies more easily.

The website features a range of scientific products including everyday lab consumables — such as those for histological work — to larger capital equipment items, such as centrifuges, heaters, incubators and fume hoods.

Also available are liquid-handling items, such as aspirators and pipettes, as well as a comprehensive range of chemicals, stains, reagents and solutions, which can also be ordered online.

Customers can log in, manage orders and oversee their accounts. Purchases can be made with credit/debit cards or invoiced.

Point of Care Diagnostics
www.pocd.com.au

Upright fluorescence and brightfield microscope system

TissueFAXS PLUS from TissueGnostics is an upright fluorescence and brightfield microscope system for the scanning and analysis of slides, cytospins, smears and tissue microarrays. It enables the user to quantify and quantitatively analyse any protein or other substance which can be marked with immunofluorescent or immunohistochemical markers.

The product is based on a fully motorised and automated upright microscope and equipped with two cameras (for immunofluoresence and immunohistochemistry); an 8-slide stage controllable in the three axes (an optional robot stack loader can be added); and the TissueGnostics software packages TissueFAXS (microscope control and Tissue Stitching), TissueQuest and HistoQuest, controlled and driven by computer workstation with two large TFT flat screens.

The system offers an autofocus fully tuneable for sensitivity and speed and precision up to 100x objective. The partial reacquisition mode allows for portions digitised slide representation where sharpness or colour rendition is not as good as expected, without the need to repeat the entire experiment.

The product can be equipped with supplementary components for contrast microscopy methods such as differential interference contrast (DIC) microscopy in brightfield. It can scan 10 channels in epifluorescence and supports all Zeiss objective classes with M24 thread.

The TissueFAXS PLUS system can be upgraded for spinning disc confocality or high-speed epifluorescence scanning.

tissuefaxs-plus.

SciTech Pty Ltd
www.scitech.com.au

Flow cytometer and flow cytometry antibodies

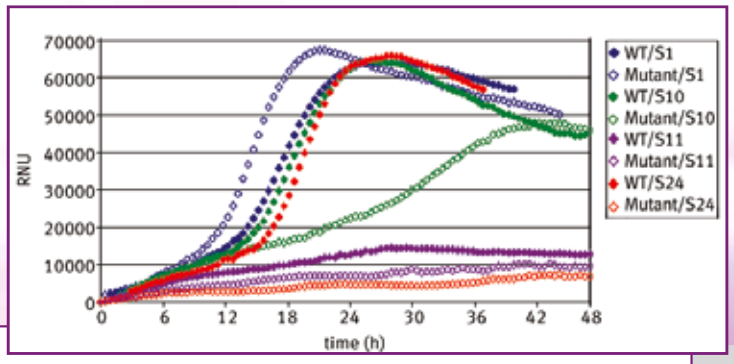
Bio-Rad Laboratories' ZE5 Cell Analyzer was designed based on user feedback and developed in collaboration with Propel Labs. The result is a flow cytometer that gives users the flexibility to run up to 30-parameter experiments and the convenience of an integrated universal sample loader that accommodates any sample tube or plate format.

The sample delivery system ensures quick processing and minimal sample loss, allowing users to re-use sample for downstream experiments. The ZE5 and Everest Software is easy to learn and use. The ZE5 Cell Analyzer's fast electronics and short laser transit time enable run speeds of up to 100,000 events per second with no loss of data, suitable for analysing rare cell events.

Bio-Rad also has over 2500 validated flow cytometry antibodies for human, mouse and rat species.

Bio-Rad Laboratories Pty Ltd
www.bio-rad.com

Bright Solutions for Microbiologists



Traditional methods of conducting microbial growth assays can be a difficult and time consuming. BMG LABTECH's microplate readers allow for high-throughput automated measurements of microbial growth, providing researchers with the possibility of long term microbial growth assays with minimal user interaction.

The flexibility to pre-program and vary temperature, and the various shaking methods and speeds available, can assist with supporting consistent environmental conditions and a homogenous sample. BMG LABTECH's newly developed gas-ramping function of the Atmospheric Control Unit (ACU) in the Omega Series and CLARIOstar allow precise, pre-programmed changes to atmospheric conditions throughout the growth cycle. These features can allow growth of fastidious microbes with specific atmospheric requirements and also can potentially mimic conditions found in the host.

The recently patented LVF monochromators, available in the CLARIOstar, also provide significantly higher sensitivity and flexibility for detecting growth. Automated reading and recording, and the ability to conduct multiple assays simultaneously also offer considerable time saving advantages to researchers.

Growth assays on BMG LABTECH's microplate readers are just the beginning, with a vast range of other applications available. BMG LABTECH plate readers can be equipped with the capacity to read with up to seven different detection modes and many of BMG LABTECH's microplate readers have received certification from reagent companies for their outstanding performance.

Contact BMG LABTECH for further information on how BMG LABTECH microplate readers can support your research, minimise operational time, improve performance and save costs.

For more details or enquries:
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Email sales@bmglabtech.com.au
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BMG LABTECH

The Microplate Reader Company

Lauren Davis

Kidney disease trial
shows two drugs are better than one

Clinical-stage biotech company Dimerix is on a mission to treat chronic kidney disease and, with the help of lead therapeutic candidate DMX-200, it just might succeed. With a Phase 2 trial conducted in 2017 yielding promising results, the company is now set to more deeply investigate the therapeutic effects of DMX-200 on a hugely underserved disease.

Kidney Health Australia states that around one in 10 Australians aged 18 years and over has indicators of chronic kidney disease (CKD), such as reduced kidney function and proteinuria — the presence of the protein albumin in the urine. People with CKD have a two- to three-fold greater risk of cardiac death than those without it, according to the organisation, and those requiring blood dialysis cost the Australian healthcare system a whopping $100,000 per annum per patient.

The good news is that, when managed with effective treatment, deterioration in kidney function can be reduced by as much as 50%. The bad news is that the current treatment option is decades old, and does not actually reverse the disease — it merely slows its progression.

"At the moment, the treatment option for all kidney diseases generally is to lower the blood pressure of the patient, and that serves to take the pressure off the kidney, the kidney being a filter," Dimerix CEO Kathy Harrison told *Lab+Life Scientist*. "If you in effect turn the hose down, turn the pressure down, then it stops the pressure on those filters and damaging those filters, which reduces the amount of protein leakage through the kidney.

"But it doesn't reverse the disease, and in fact patients still generally progress in some forms of the disease, such as the rare disease FSGS [focal segmental glomerulosclerosis]. In the case of a disease like FSGS, patients can progress to complete kidney failure and therefore dialysis within 1–2 years, if they have the severe form of the disease, and kidney transplant is unsuccessful 40% of the time, in that they have the transplant, put a healthy kidney in, and the disease recurs. So there's no good treatment options at all for FSGS.

"Things like diabetic kidney disease [DKD], they're slower progressing, but eventually the patient's kidneys will deteriorate and they will end up on dialysis. So it's a massively underserved condition — the treatments that are used have been used for decades."

So what makes DMX-200 so promising? As explained by Harrison, it all started when Dimerix used its Receptor-Heteromer Investigation Technology (Receptor-HIT) assay platform to identify a pair of receptors that function in a joint manner (interact) when ligands, small molecule drugs, peptides or antibodies bind to them.

"We know that the angiotensin receptor and the chemokine 2 receptor — which are the receptors that are important in DMX-200 — actually interact with each other from what we've seen in the assay with Receptor-HIT," Harrison said. "When they interact together, they transactivate each other, so they actually turn each other on to have this additional signalling which occurs when they're operating as a unit. What we find then, if you try to use an antagonist or a blocker to stop one of the receptors operating — for example, you use an angiotensin receptor blocker to try to turn the angiotensin receptor off — it actually won't turn off unless you block the chemokine 2 receptor."

The signals sent out by these receptors typically cause inflammation, which is a major contributor to the progression of chronic kidney disease. To solve this problem, Dimerix added a safe anti-inflammatory drug, propagermanium, to the standard of care treatment, irbesartan — an angiotensin receptor blocker that lowers blood pressure. Together, the two drugs work

synergistically to block the signals of both angiotensin and chemokine 2 — with impressive results.

"We saw that when you just blocked one [receptor] or the other, you saw some reduction in protein in the urine," Harrison said. "But when you had them together, you saw a much bigger reduction, and similar things in the pathology of the kidney as well."

Harrison said DMX-200 is particularly effective because patients with kidney disease are already taking an angiotensin receptor blocker, so they are able to take propagermanium as an adjunct therapy rather than something with its own agenda.

"It's also important because we are able to keep the patients on that angiotensin receptor blocker, which is really important for managing their blood pressure. It's a very safe treatment, adding to what they're already taking but having this synergistic effect because of the way that we understand the two receptors operating in the cell."

Dimerix is not the only company currently investigating chronic kidney disease, but Harrison believes it has some advantages over its competitors. She noted, "One of those competitors, what they do is they switch the patient off their angiotensin receptor blocker to put them onto their drug. So we believe ours is a much safer way of operating."

Another company is taking an approach more closely aligned with Dimerix's, but utilising a chemical antigen instead. Harrison said, "The compound we're using, propagermanium, is registered in Japan for treatment of chronic hepatitis B. So it's been used in a chronic setting for a couple of decades, so we know that it's very safe… Whereas for people bringing in a chemical antigen that doesn't have that history of use, obviously there's always a higher risk that something else might happen that you're not expecting."

Last year Dimerix completed a Phase 2a 'all comers' clinical trial, where DMX-200 was studied in patients with a group of diseases in the broad category of CKD. In addition to meeting the primary safety endpoint across the study, a subgroup with DKD showed a clinically and statistically significant efficacy response, reducing proteinuria by more than 50% in 25% of patients. In fact, following completion of dosing, a number of patients applied to remain on DMX-200 under the Therapeutic Goods Administration's (TGA) Special Access Scheme.

Dimerix had already planned to undertake a Phase 2a trial for patients with FSGS, for which the company has received Orphan Drug designation (ODD) in the US. But the data in patients with DKD was also sufficiently compelling to support a follow-up trial in a larger patient group. The company thus announced two trials — one covering DKD and another covering FSGS.

The upcoming FSGS Phase 2a trial is set to study the effects of DMX-200 in around 10 patients, with endpoints including safety and efficacy (proteinuria reduction). The DKD Phase 2b trial will meanwhile study the effects of DMX-200 in around 40 patients, with the primary endpoint being a change in 24-hour albumin creatinine ratio (ACR) based on identified patient responses in the 2017 study. Both the DKD and FSGS trials will commence at the same time and be run across the same 10 or so sites across Australia, using the same principal investigators and same vendors — a measure that will enable the company to conduct both trials without seeking any additional funding.

"What happened was, we raised through a shareholder placement around $3 million, which closed in January," said Harrison. "And then with our oversubscribed placement, which we were expecting to raise $2.5 million, we actually raised $4.5 million. So that means that the total raised was $7.5 million, instead of the $5.5 million that we were expecting, and the $5.5 million was what we were planning to use to progress the FSGS study all the way through to being Phase 3-ready, through the next set of trials and all the processes that go with that.

"Because we raised the extra money, we felt that we could now also do the diabetic kidney disease study at the same time. So we've looked pretty carefully about how we're doing this, and producing synergies by having the same sites. We believe we'll be able to get through these studies on that funding."

A randomised, double blind, placebo-controlled crossover design was selected as the most appropriate format for both trials — meaning that every patient will receive irbesartan for at least three months prior to and throughout the trial, and will receive DMX-200 or a placebo at different periods of the study. By receiving DMX-200 and placebo in an order that is both randomised and blind to patient and investigators, safety and efficacy data can be collected for every patient on each trial. This also enables each patient to act as their own control, mitigating the impact of variability in disease behaviour from patient to patient.

"We have selected the most robust method of ensuring accurate detection of an efficacy signal for both our FSGS and DKD trials," said Associate Professor David Packham, Chief Medical Officer at Dimerix. "As every patient will receive both study drug and placebo with a six-week washout period between treatments, we will be able to assess individual patient responses and avoid confounding factors due to differences in the natural history of the diseases under study between patients. Further, the fact that all participants who complete the trial are certain of having received trial drug for one of two treatment periods will make this much more attractive to patient participation and recruitment."

Dimerix plans to be recruiting for both studies in Q3 2018, with preliminary data expected for the DKD study in Q3 2019 and for FSGS in Q4 2019. From there, according to Harrison, it could be just a few years until DMX-200 makes its way to market.

"For FSGS, because of the orphan indication, assuming that we went into a pivotal Phase 3, we believe, based on our discussions with the FDA, that a Phase 3 could potentially have an accelerated approval if everything went well within 12 months of starting the study," she said. "So I guess you're looking at not that many years down the track.

"Diabetic kidney disease is obviously a much larger indication, a much more complex pathway. What we would hope is that this trial would help solidify the results that we had in the Phase 2a trial, and get some more strength around those, and out-license that."

Same-day test for *Legionella*

Legionella bacteria are of public health significance due to their ability to cause potentially fatal respiratory tract infections. If ***Legionella*** reaches significant numbers in cooling towers, showers or taps, it is possible for the bacterium to be transmitted to people via small droplets.

Traditional methods to screen for ***Legionella*** are labour-intensive and time-consuming, taking up to 10 days to return a result. Veriflow ***Legionella*** from Invisible Sentinel is a molecular detection method that returns results in around 4 h.

Based on the company's DNA Signature Capturing Technology, Veriflow ***Legionella*** will detect 10 cfu/mL in water and environmental samples, without the need for filtration and with only basic sample prep. The test requires little equipment, making the technology accessible to all laboratories.

The assay has undergone CDC ELITE proficiency testing and was able to correctly identify ***Legionella*** in all samples, in addition to being able to distinguish between viable and non-viable organisms. The ability to detect ***Legionella*** in such a short time should allow for earlier intervention, which may assist in preventing outbreaks.

The product is available in Australia from Australasian Medical and Scientific Limited.

Australasian Medical & Scientific Ltd
www.amsl.com.au

Laboratory freezer with Profi controller

The LIEBHERR Laboratory Freezer with Profi controller is German engineered with high-quality materials, and equipped with advanced functions for the safe and secure storage of the user's valuable samples and reagents.

Samples and reagents can be optimally stored between -10°C to -35°C, and the high-tech Profi electronic controller allows temperatures to be set to 1/10°C accuracy for precise temperature control. Temperature stability and consistency is assured by the dynamic (forced-air) cooling system working in conjunction with the highly efficient compressor, thick insulation and eco-friendly and energy-efficient refrigerant (R 290).

Using a hot gas defrost system, the laboratory freezer is designed to defrost less often and faster (in just 8 min) without compromising the integrity of samples and reagents. Visual and audible alarms warn users of undesirable temperature deviations, and an integrated data memory records the last 30 alarm events and one week's worth of temperature profiles.

The freezer is equipped with a keypad lock to prevent temperature and alarm settings being changed without a passcode, and is fitted with locks to prevent unauthorised access. Temperature and alarm data can be transferred to a building management system via RS 485 interface and alarms can be forwarded to an email, phone, etc via volt-free contact for extra security.

Andi-Co Australia
liebherrprofessional.com.au

Automated TER measurement

The cellZscopeE, from NanoAnalytics, measures the TER and the capacitance of cell layers under physiological conditions. It is suitable for entry-level systems for computer-controlled TER (transepithelial/-endothelial resistance) measurements. TER of the cell layers under investigation is determined in real time and long-term measurements over days and weeks can also be carried out.

The good performance, instrument operations and easy maintenance make the product suitable for controlling the confluence of cell layers as well as for studying the influence of substances on the barrier function. It sweeps over a wide frequency range instead of simply measuring at a few frequency points. This provides unambiguous detection of cell layer properties.

The product is compatible with a variety of standard cell culture inserts from different manufacturers; the cell module can be loaded with six inserts simultaneously. Three versions of the electrodes are available, tailored for use with small (24-well), mid-sized (12-well) or large (6-well) inserts, respectively. Different well sizes can be combined within one cell module. The time resolution per well is 1 datapoint/h.

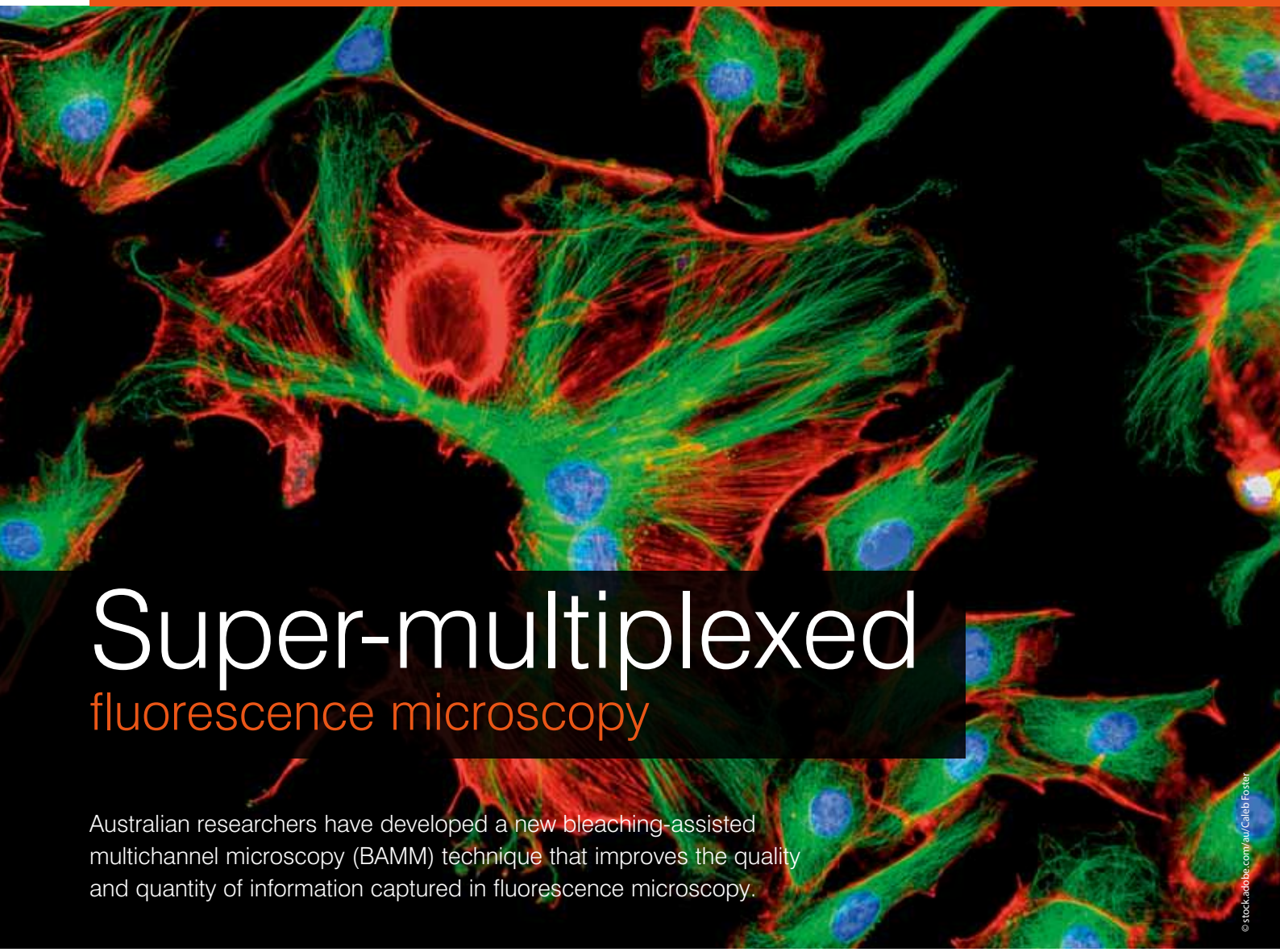
SciTech Pty Ltd
www.scitech.com.au

Meropenem-vaborbactam panel

BD has introduced the ability to execute in vitro rapid identification (ID) and antimicrobial susceptibility testing (AST) for meropenem-vaborbactam in its latest panel for the BD Phoenix Automated Microbiology System, which detects resistance in Enterobacteriaceae, Non-Enterobacteriaceae and most gram-positive bacteria isolates from pure culture belonging to the genera ***Staphylococcus***, ***Enterococcus*** and ***Streptococcus***.

The BD Phoenix offers clinical microbiology laboratories the ability to rapidly test antimicrobial resistances or susceptibilities. The company's rapid results for ID and AST are powered through an oxidation-reduction indicator with turbidity measurement for growth detection, as well as full on-panel antimicrobial concentrations and the BDXpert system for data analysis.

BD
www.bd.com



Super-multiplexed
fluorescence microscopy

Australian researchers have developed a new bleaching-assisted multichannel microscopy (BAMM) technique that improves the quality and quantity of information captured in fluorescence microscopy.

Developed by researchers at the Australian Research Council's Centre of Excellence for Nanoscale BioPhotonics (CNBP), the technique is expected to help researchers gain biological insights into the intricate processes taking place within living cells. This includes the interplay between proteins and molecules which have the potential to impact a wide range of health areas from fertility, to pain, to heart disease and more.

The new technique takes a current long-standing weakness of fluorescence microscopy — photobleaching — and turns it into a strength that improves imaging output by up to three times, with no additional hardware required.

"Fluorescence microscopy is one of the most widely used techniques in biology. This is where light-emitting molecules called fluorophores are bound to extremely small cellular targets such as proteins, genetic material or other biomolecules of interest," said Dr Antony Orth, CNBP Research Fellow at RMIT University and lead author of the research paper.

"When the fluorophore is excited by light from the microscope, it reacts by emitting a specific colour signature. Seeing that colour signature under the microscope helps us view, track and understand the cellular target that the fluorophore has been bound to."

Dr Orth said that you can attach different coloured fluorophores to different cell targets, all in the one sample, to maximise the data and imaging information that is received.

This traditional approach to fluorescence microscopy is versatile, but there is a major limitation: the visible (or colour) spectrum, where most fluorophores operate, can get crowded. In an ideal experiment, each target should be chosen to have a distinct colour emission, but this becomes increasingly difficult to arrange as the number of targets increases.

"The visible colour spectrum spans a range of 400 nm to 700 nm and only about 200 nm of this range is available for fluorescence colour emission," said Dr Orth.

"A typical fluorophore emits over a 50 nm range of the colour spectrum. Dividing 200 nm of the visible spectrum into 50 nm segments means that the colours of the fluorescent emitters begin to blend together when you attempt to squeeze in more than four colours.

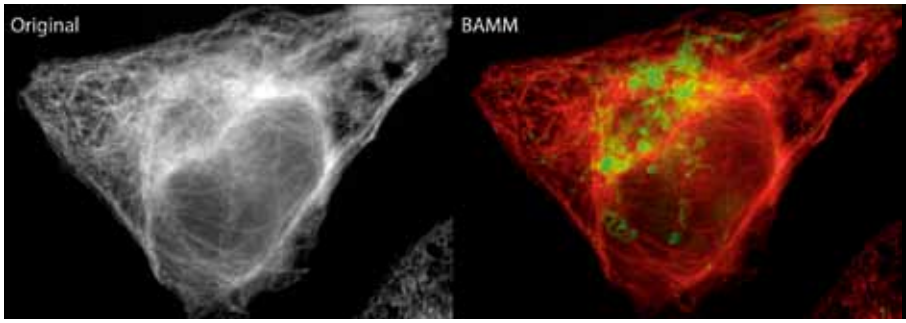
"This is generally limiting researchers to four or fewer fluorescent targets in a sample," said Dr Orth.

"Typically, most experiments are even less ambitious, incorporating only two or three targets. The heart of the problem is that only one property of the fluorophore — its colour — is being used for identification."

To help overcome this limitation, Dr Orth and his co-researchers developed BAMM to increase their imaging output.

"Instead of using colour to differentiate between fluorophores, we use the fourth dimension of time and exploit a phenomenon called photobleaching — the dimming of a collection of fluorophores or pigments under repeated exposure to light," said Dr Orth.

"Because each type of fluorophore photobleaches at a different rate, we can differentiate between



This figure shows the information-rich cellular images made possible by using the BAMM technique. The 'Original' image shows cells containing multiple fluorescent targets, all having similar colours. This results in a monochrome image. With BAMM, photobleaching rates are colour coded red, green and blue for visualisation, so that each fluorescently labelled structure can be identified even though the fluorophore's native colour information was never used.

fluorophores without using any colour information. We use the rate of photobleaching as the identifier.

"When paired with traditional colour information, this added dimension of photobleaching enables scientists to use 2–3 times more types of fluorescent molecules, all in one sample. This lets us extract far more information from a single investigation.

"Researchers will be able to design more informative tests — for example, highlighting five targets when only two were previously practical. They will no longer have to avoid using two fluorophores with the same colour, since a difference in photostability alone is enough to distinguish between the two targets," he said.

Traditionally, the phenomenon of photobleaching (or fading) has been detrimental to the fluorescent microscopy process. This is where high-intensity and ongoing illumination from the microscope permanently destroys a fluorophore's ability to fluoresce so that imaging of the cell target becomes impossible.

"BAMM transforms photobleaching from a long-standing weakness of fluorescence microscopy into a significant strength to allow increased identification of cellular targets," said Dr Orth.

"BAMM doesn't require any additional hardware, it's comparatively simple to do and doesn't require any specialised sample preparation. It's an extremely exciting new approach which has the potential to benefit all fluorescence microscopy users and their exploratory science," he said.

Researchers formally involved with the BAMM project were affiliated with CNBP (RMIT University and the University of Adelaide) and Thermo Fisher Scientific.

Findings have been published in the journal *Biomedical Optics Express*.

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*Dr Enrique Neumann**

The hidden costs of NGS

The $100 genome era is said to be upon us. But is it really?

The cost analysis of DNA sequencing indicates that this landmark is finally within reach, but the reality is that most next-generation sequencing (NGS) labs are still spending significantly more than that.

As NGS technologies continue to evolve, the costs associated with sequencing, analysis and data storage continue, making this powerful technology ever more affordable and widely accessible. However, unless you are aware of some of the extra and less obvious expenses associated with NGS, your lab could be losing money unnecessarily, without even realising it. While there's a lot of talk about having reached the $1000 genome mark, and even getting to as low as $100 per genome, the supporting data (such as that published by NHGRI1) is often based on direct 'production' costs associated with sequencing and initial data processing. To be fair, this is openly disclosed and sensible for cost-of-goods estimates, but not so useful if you are looking to optimise the whole process of NGS to make it truly practical and cost-efficient for your lab.

There have been some informative articles about the 'real cost of NGS', but for the most part these focus on everything from sequencing onwards, and gloss over the upstream steps of sample and library preparation. Unfortunately, that is a major oversight, because the process of NGS starts long before you press 'go' on your sequencer. The good news is that many of these expenses can be reduced and controlled easily, if you know where to look. Here are some things that could be costing you more than you think:

Sample tracking

In a high-volume NGS lab, it is easy to misplace or mix up samples, necessitating recollection or repeat testing. In some cases, replacing samples may not even be an option, or a mix-up may go undetected. Occasional errors like these may not seem that big initially but over time hunting down lost samples and re-running tests is a drain on resources and can add significant costs. In addition to the direct costs, there is also the incalculable impact of client and patient dissatisfaction. Worse still are the consequences of a poor medical decision due to lack of information or an erroneous result stemming from an undetected error. What price would you put on your lab's reputation? To keep such mistakes to a minimum, it takes reliable and integrated measures for end-to-end traceability at every step of NGS, from sample collection right through to reporting.

Nucleic acid extraction

The 'massively parallel' high-throughput nature of NGS has inevitably highlighted upstream bottlenecks in sample preparation, particularly nucleic acid extraction. Conventional methods for DNA and RNA isolation are generally low-throughput and very labour-intensive. In addition to decreasing productivity, manual extraction approaches create unnecessary opportunities for inaccuracy and human error, and that ultimately translates into wasted time, reagents and resources. Once extracted, nucleic acids need to be accurately quantified for subsequent titration. At this stage, you can lower the price per sample significantly by working with the smallest

volumes possible, which is typically achieved by using robotics and higher density plates.

Library preparation

If you have large numbers of samples to process, library preparation can actually cost more than the sequencing itself. With many steps involved for amplification, pooling, normalisation, etc, there are numerous opportunities for waste and error. It is critical that reagents, samples and controls are added in the right amounts, to the right wells, at the right time. Since the volumes involved are very small, on the order of microlitres or even lower, it is easy to accidentally skip a sample or add something twice. At best, such mistakes can mean that the process needs to be repeated. At worst, errors such as index cross-contamination can go undetected and lead to erroneous results, with serious consequences — especially in the clinic.

PCR for library preparation and quantitation

It is worth paying special attention to PCR workflows that are integral to library preparation and quantitation. Cross-contamination of samples and amplicons during PCR can be a major issue that is hard to detect. The nature of PCR is such that small errors are readily amplified and can end up skewing your library. This can be particularly problematic when the aim is to assess rare variants (eg, in examining tumor heterogeneity). Library prep for RNA sequencing is particularly vulnerable to PCR-induced distortions, and that adds unnecessary cost to what is already a relatively expensive process. When PCR is used for quantitation, everything is typically done in triplicate, multiplying the total number of pipetting steps and different samples you have to deal with, and increasing chances of error. Seemingly small PCR errors are far from insignificant when it comes to cost control. It is difficult to estimate the frequency and the eventual cost of these sorts of mistakes, since many of them may go undetected. It's better to introduce measures to avoid such errors in the first place.

Understanding the real cost of NGS

This list is far from exhaustive, but hopefully the point is clear — it is definitely worth scrutinising the NGS process from start to finish, especially the steps upstream of sequencing, and ruthlessly eliminate unnecessary manual steps and sources of error. Investing in quality automation can go a long way in addressing all of the above issues. At the same time, it can free up skilled staff for more important (and interesting) work. Of course, the solutions required will vary, depending on specific applications and methodologies.

References: Wetterstrand KA. DNA Sequencing Costs: Data from the NHGRI Genome Sequencing Program (GSP) Available at: www.genome.gov/sequencingcostsdata. Accessed [16 Mar 2018].

Tecan Australia
www.tecan.com.au

**Dr Enrique Neumann is Product and Application Manager, Genomics, at Tecan, Switzerland. He studied Biology at the University of Santiago de Compostela, Spain. During his PhD at the University of Edinburgh, he focused on the molecular processes in plant cells. He joined Tecan in 2015 and focuses on the development and support of genomic applications for Tecan's liquid handling platforms.*

Microfluidic-based nanoparticle manufacturing platform

While nanoparticles, composed of polymers or lipids, can be used to deliver pharmaceutical drugs, they are traditionally made by extrusion or sonication — which can be labour-intensive and prone to batch-to-batch variations. To make the transition from bench to clinic, nanoparticle manufacturing methods need to be both reproducible and scalable.

The NanoAssemblr platform from Precision NanoSystems offers microfluidic-based technologies to introduce formulation opportunities that, in addition to being scalable, provide extensive control over the size optimisation and manufacturing process. There is a choice of three systems to accelerate nanomedicine development.

The NanoAssemblr Spark offers drug screening and disease target identification via cell transfection. It manufactures 25–250 μL per run.

The NanoAssemblr Benchtop is suitable for rapid nanomedicine candidate development. It manufactures 1–15 mL per run.

The NanoAssemblr Blaze is suitable for larger preclinical testing of nanomedicines and early chemistry, manufacturing and controls investigation. It manufactures 10–1000 mL per run.

Applications and types of formulations include: protein delivery and screening; nucleic acid delivery and screening; nanoparticle design; targeted drug delivery; lipid nanoparticles; liposomes; and polymeric nanoparticles.

ATA Scientific Pty Ltd
www.atascientific.com.au

Bacterial and viral antigens

The Native Antigen Company is an expert in the production of bacterial and viral antigens, specialising in the development and manufacture of native and recombinant viral and bacterial antigens.

The company's antigens are used by pharmaceutical and IVD manufacturers in vaccine research and serology where proper folding and glycosylation are vital. As well as offering antigens from a rapidly expanding portfolio, the company undertakes bespoke product development and custom manufacture using its mammalian cell protein expression system.

The company provides natively produced, high-purity antigens and toxins presented in a variety of formats, including: glycerol, frozen, lyophilised and as cell lysates. The available bacterial antigens include *Bordetella pertussis*, *Chlamydia*, *Clostridium difficile*, *Mycoplasma*, *Neisseria gonorrhoeae* and *Vibrio cholerae*.

The company produces viral antigens from a range of established and emerging viral diseases which include: chikungunya virus, Crimean-Congo haemorrhagic fever virus, Ebola virus, EBV, HIV, influenza virus, Lassa Fever virus, Mayaro virus, Oropouche virus, Parvovirus, respiratory syncytial virus, Vaccinia virus, Japanese encephalitis virus, tick-borne encephalitis virus, Usutu virus, Zika virus, adenovirus, astrovirus, CMV, dengue virus, HSV, West Nile virus and yellow fever virus.

BioNovus Life Sciences
www.bionovuslifesciences.com.au

Aseptic milk sampling system

TruDraw is a single-use aseptic sampling system for liquid dairy products developed by QualiTru. It includes a disposable blue cap, a sterile 59 mL container and an attached sterile needle to draw a sample in, protecting against the risk of external contamination.

Aseptic sampling is of utmost importance in the dairy industry, where the income that farmers receive is directly linked to their products' purity. Yet sampling is typically conducted by collecting raw milk from the top of a milk tanker with dippers, which is prone to contamination from the environment or dirty dippers.

TruDraw can be used for secure sample tracking of an individual container, which works with TruStream fittings and ports. Used in conjunction with QualiTru's TruStream sanitary sampling ports, it can be drawn from the side or rear of a trailer, without having to climb on top of a tanker.

The system's Single Samplers collect samples from QualiTru's 12- and 7-channel sampling septa and provide a chain of custody process from sample collection to laboratory testing. Users simply twist the blue cap into alignment with the vial's tab and hinge, then press down on the blue cap until it pierces through the vial's lid.

After removing the needle's safety cover, TruDraw is inserted into the sampling septum and product is drawn into the container. Once filled, the certified sampling person removes and discards the blue cap, with the sample aseptically sealed until the tamper-evident label is broken at the testing facility.

Key Diagnostics Pty Ltd
www.keydiagnostics.com.au

LiveCyte: Every cell tells a story

The Challenges of Live Cell Imaging

The biggest challenge for many live cell researchers is to characterise individual cells without impacting their behaviour through the act of monitoring them. Whilst the use of fluorescent labels allows both cells and cellular functions to be visualised, the levels of illumination needed to excite the fluorophores can alter innate properties of cells, with the associated cytotoxicity limiting the scope, duration and integrity of any experiment. Hence, the emergence of label-free techniques, which exploit the inherent contrast of cellular components to create images, that allows cells to be tracked and monitored over longer periods of time. However, for many such techniques, constraints caused by low levels of contrast preclude the automated segmentation of individual cells and by association the capability to differentiate them based on subtle differences in their morphology and motion.

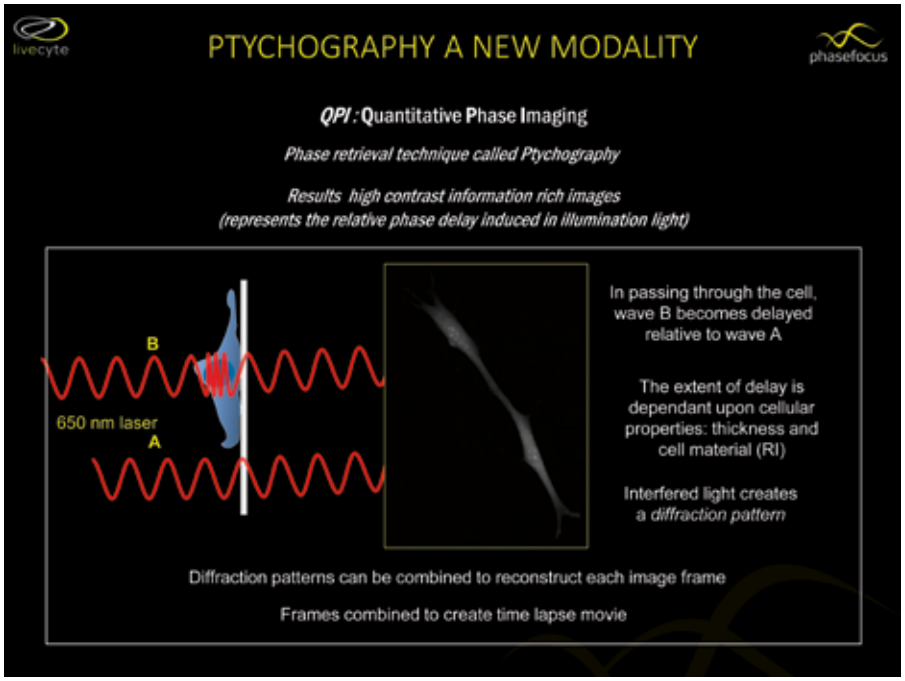
The LiveCyte™ imaging & cell analysis system from Phasefocus addresses these limitations by employing Ptychographic Quantitative phase imaging (QPI). This technology leverages phase shift information to generate high contrast cell images under low levels of light intensity, allowing individual cells to be identified and tracked for prolonged periods without the need for perturbing labels. This ability to image under a more natural environment with reduced risk of phototoxicity not only supports the use of sensitive cell types such as primary and stem cells, but also enables viable cells to be recovered for subsequent experimentation or downstream analysis, giving it broad spectrum appeal and for clinical applications in particular.

QPI: Making every cell count

The ability to segment and follow individual cells is paramount for accurate quantification of cell behaviour and differentiates LiveCyte from other commercially available live cell imaging systems.

Ptychography is a computational technique, and unlike optical methods where intensity variations make it difficult to extract quantitative data, the full extent of phase shift can be calculated and subsequently translated into high contrast, artefact free images. Furthermore, the technology employed in LiveCyte delivers a continuous field of view with no loss of resolution permitting even highly motile cells to be tracked during time-lapse imaging, ensuring no cells are "lost".

It is the fidelity and quantitative nature of the images which enables the direct measurement of cell parameters, allowing specific morphological and dynamic characteristics of the cells to be measured. As a result, researchers not only gain a true record of cell count for the population as a whole but have the added capability to define and quantify distinct sub-populations within complex heterogeneous cultures, achieving a more realistic narrative of cell behaviour.



Automated, multi-parametric analysis

Superior time-lapse imaging is critical in its own right, but in order to ascertain the precise impact of environmental conditions, it is the data analysis that is the crux of every experiment. LiveCyte's Cell Analysis Toolbox™ (CAT) contains automated tracking software that monitors changes in individual cells, through multiple cell divisions eliminating the need for manual tracking, achieving a seamless integration of image acquisition and analysis.

Each experiment automatically yields a plethora of metrics, providing information on phenotypic parameters such as cell thickness, volume, dry mass in addition to kinetic behaviour characterised by factors including cell speed, displacement and meandering index.

With the capability to compare response to different treatment or environmental conditions at both population and single cell level within a single experiment, laboratory workflows can be effectively streamlined, making the best use of limited resources.

In the current economic climate, as researchers face ongoing cost pressures and demands for productivity improvements, LiveCyte represents a rapid and cost-effective means of gaining deeper insights into biological processes, associated with a wide range of disease conditions with positive implications for drug discovery and development of personalised medicine.

ATA Scientific is pleased to be the local distributor for the LiveCyte Cell Imaging and Analysis system developed by UK-based company Phasefocus™.

Reference: Kasprowicz, R., Suman, R., O'Toole, P. Characterising live cell behaviour: Traditional label-free and quantitative phase imaging approaches. *J. Biochem. & Cell Bio.* 84 (2017) 89-95.

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Low-voltage TEMs for cell biology

Electron microscopy allows for the study of the activities, functions, properties and organisation of cells, providing a deep understanding of organisation and function within cells. In cell biology, the high-contrast imaging provided by a low-voltage electron microscope (LVEM) is a major advantage.

Although there are instances where staining is desirable for diagnostic purposes, generally it is not advantageous to stain samples in order to generate adequate detailed contrast. Delong's LVEM microscopes still allow for staining as an option, yet high-contrast results are acquired from samples in their inherent, natural state. And while electron microscopy is traditionally a demanding technique to learn, the simplicity of the LVEM5 and LVEM25, combined with the elimination of the staining step, makes it accessible to many researchers.

The versatile LVEM5 electron microscope operates with four distinct imaging modes: TEM, SEM, STEM and ED. This provides for comprehensive imaging and finer study. The more powerful LVEM25 is built on the same platform as the LVEM5 and offers the same benefits, together with higher beam energy. The LVEM25 has the added benefit of being able to work with conventionally prepared thin sectioned materials. This provides images without the side effects often encountered such as staining artefacts or the sample crashing out by chemical reaction with heavy metals.

The LVEM microscopes provide high-quality imaging, making them suitable for pathology as well as other life science applications.

Scientex Pty Ltd
www.scientex.com.au

LIMS mobile platform

Lims1 OmniMobile is a platform to enable Lims1 mobile applications, providing laboratories with off-site solutions to streamline workflow processes. The product features multiplatform compatibility (Android, Windows Phone, iPhone); on-site data entry; both online and offline operation; and GPS location/geotagging. It is also camera enabled.

The screen layout is designed to make the product simple and easy to use, regardless of external conditions. Information pertaining to inspection point can be quickly located and data can be held on the device temporarily if there is no network connection. Once a network is present, the data will be forwarded to the database automatically.

Images of potential issues requiring expert opinion can be captured quickly in the field. Images and data loaded in the field will appear in the database immediately. Responses or requests for further data can be responded to without any delay while the technician is still in the field.

Furthermore, the mobile application is part of the larger Lims1 system. All information captured within the mobile application goes directly to the main Lims1 system.

Users can now automate their entire laboratory workflow, accessing the lab on the go, record information at the sampling site and increase productivity in the lab. For labs already beginning the process of going paperless, Lims1 OmniMobile is designed to improve traceability and regulatory compliance.

LTech Australia Pty Ltd
www.lims1.com

Pressure-compensated control valves

Mass Flow ONLINE has released the FLOW-CONTROL series, designed by Bronkhorst for precise control of constant flow rates in low-flow gas and liquid applications.

The control valves do not require any electrical power source, since the desired flow rate is manually set via the needle valve. Any upstream or discharge pressure variations are automatically compensated by a built-in membrane operated valve to ensure a steady, constant flow. With their thought-out design and construction, the valve models are designed to ensure a pressure sensitivity smaller than 0.5–1% Rd/bar.

The manually operated, pressure-compensated control valve series is available in four different models to control flow capacities in a range from 0.02 l_n/min up to 50 l_n/min (N_2-equivalent) and three up to 1800 mL/min for water. While process connections are optionally available, the inline valve assemblies are equipped with G 1/4″ BSPP female in- and outlet ports.

Anri Instruments & Controls Pty Ltd
www.anri.com.au

Bead mill homogeniser

The Bead Ruptor Elite, a bead mill homogeniser featuring an integrated touchscreen user interface, is suitable for the extraction of DNA, RNA, proteins and small molecules from even tough samples. Serving as an updated version of Omni International's Bead Ruptor, the Elite is claimed to be the most powerful and advanced bead mill homogeniser available today.

The product showcases an innovative touchscreen dashboard that allows users to easily monitor and control homogenisation preferences. The touchscreen is customisable with programmable protocol settings for speed and processing energy, time, number of runs and dwell (or pause) between cycles.

The 8 GB memory allows users to designate and store over 100 protocol settings with customised titles for maximum repeatability. The user interface features a usage tutorial and a 'quick-run' feature for fast and simple processes.

Specifically designed for laboratories that require high-throughput sample disruption, the product's optimised tube motion, with speeds up to 8 m/s, results in rapid and efficient sample disruption. The versatile unit is compatible with a wide range of accessories, including an array of interchangeable tube carriages capable of processing sample volumes from 250 μL to 50 mL.

Designed with safety in mind, the device is equipped with a sealed processing chamber, lid safety interlock and a convenient front-loading design for ease of use. An optional Omni Cryo cooling unit is available for heat-sensitive samples.

Capella Science
www.capellascience.com.au

Sequencing system

The iSeq 100 Sequencing System is a small and accessible sequencer from Illumina. Designed for simplicity, it allows labs of all sizes to sequence DNA and RNA at the push of a button. It leverages complementary metal-oxide-semiconductor (CMOS) technology and sequencing by synthesis (SBS) chemistry, enabling virtually any lab to acquire powerful next-generation sequencing (NGS) technology.

The system allows users to work across a range of applications within several areas of interest, including cancer research and microbiology, whether they are new to next-generation sequencing, sending samples out or they already have an Illumina system in the lab. It is suitable for small whole-genome sequencing (eg, bacteria, viruses, plasmids), targeted sequencing of a set of genes or gene regions, gene expression analysis or 16S metagenomics.

The product enables users to prepare libraries for a range of targeted applications, including microbial sequencing and targeted resequencing. A run on the system can be commenced in less than 5 min, with sequencing complete in 17.5 h for a 2 x 150 bp run.

Users can monitor and analyse sequencing runs using the on-instrument software and touch-screen interface.

Illumina Australia Pty Ltd
www.illumina.com

High-resolution scientific CMOS camera

The 4 MP Prime BSI Scientific CMOS (sCMOS) camera from Photometrics offers 95% quantum efficiency (QE), making it suitable for low-light imaging techniques such as TIRF, radiometric imaging, cell motility and light sheet microscopy. Users can maximise their ability to detect faint fluorescence with a low read noise of 1.3e- as well as capture highly dynamic events with high temporal resolution and fast frame rates of 43.5 fps @ 16-bit/63 fps @ 11-bit.

The Prime BSI camera delivers a balance between high-resolution imaging and sensitivity, with an optimised pixel design and 95% quantum efficiency to maximise signal detection. The 4 MP camera with 6.5 μm pixels captures highly detailed images with good quality while acquiring data at high frame rates. This ensures that all data is collected and no event goes undetected.

Prime BSI delivers a 100% pixel fill factor and does not rely on micro-lensing technology to increase detection. This is said to result in a 30% increase in sensitivity over previous sCMOS cameras. The balance in performance makes the product a versatile imaging camera for live-cell imaging with high sensitivity, high resolution, large field of view, high frame rates and large dynamic range.

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AACB AIMS

2018 Combined Scientific Meeting

The Australasian Association of Clinical Biochemists and the Australian Institute of Medical Scientists will be holding the AACB AIMS 2018 Combined Scientific Meeting at the International Convention Centre (ICC) Sydney from 3–5 September 2018.

The meeting combines the AACB 56th Annual Scientific Conference and the AIMS 47th National Scientific Meeting. The theme for the conference is 'Diagnosis to Cure', with related topics to be explored over the course of three days. The first day is 'metabolism day' — topics to be covered include inborn metabolic syndromes and the gene and enzyme therapies. Carolyn Sue, Kevin Carpenter, Michael Tchan, Ian Cateson and Tina Yen will provide insights into some of these conditions. The David Curnow Lecture and Saal Foley Lecture will also be held on this day.

On day two, the focus will be on cancer. This includes molecular diagnosis and classification, immunotherapies and drug treatments. Dr Ken Dutton-Regester from QIMR, the recipient of the 2017 Queensland Young Tall Poppy Science Awards, will talk about melanoma genetics and biology. This year will also feature the David Rothfield Memorial Oration, an honorary lectureship that is jointly sponsored by the RCPA, AACB, RCPAQAP and NATA and alternates each year between the RCPA Pathology Update and the AACB Annual Scientific Meeting. The oration will be presented by Professor Andy Hoofnagle from Washington University, who will talk about proteomics.

The second day will be concluded by Dr Roger Reddel, who will introduce Procan, a new database that Australian researchers are setting up that will feed the information gathered through analysing the proteins of 70,000 cancer samples. This will be made available worldwide and is expected to become the reference for recommending the best-known treatments for patients.

The last day will focus on chronic diseases such as diabetes, kidney disease, auto-immune conditions and bleeding disorders. These diseases are a huge burden on the health system and speakers will cover topics such as monitoring response to treatments in chronic leukaemia, organ transplant surgeries and biomedical ethics.

Other highlights include: industry exhibition, submitted oral papers and posters, networking functions, industry symposia, meet-the-experts breakfast sessions and the gala dinner.

Karl Fischer titrator

Metrohm has expanded the OMNIS titration platform enabling users to perform volumetric Karl Fischer titrations. The OMNIS Karl Fischer Titrator addresses the needs of users, offering ease of use and protection from solvents and reagents with a whole range of innovative features.

With the OMNIS Karl Fischer Titrator, the complete analysis is performed in a closed system. From filling the titration cell with solvent to adding the reagent and disposing of the sample after the titration, there is no exposure of the user to liquids at any point.

Karl Fischer titration with OMNIS is easy: users do not even have to start the titration, as this is done automatically by OMNIS. After the introduction of the sample, users may therefore simply walk away and only return to start the next analysis — at a single mouse click.

If higher sample throughput is required, users may determine water content in up to 50 samples completely unattended on the OMNIS Sample Robot. There is no reason to worry about ambient moisture negatively affecting sample integrity as samples are waiting to be analysed: OMNIS Dis-Cover keeps samples protected with air- and dust-proof lids, which are automatically removed from the sample beakers before the analysis and put on again immediately after.

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Spectrometer accessory

An accessory compatible with Thermo Scientific FTIR spectrometers is designed to enable art conservationists to easily perform spectral analysis to verify the authenticity of paintings, sculptures, textiles and other large artwork.

The Thermo Scientific ConservatIR FTIR external reflection accessory lets users analyse objects that do not fit inside the sample compartment of Thermo Scientific benchtop Nicolet FTIR spectrometers. The external accessory directs an infrared beam to an optomechanical arm that articulates in a range of motion from -5 to 95 degrees, enabling art authenticators to measure samples in multiple orientations. As an additional benefit, users can measure samples in two modes: specular/diffuse reflection, for non-contact analysis, or attenuated total reflection (ATR), using an optional diamond ATR sampling interface.

An integrated video camera on the accessory enables users to magnify the sample image to facilitate high confidence in the measurement location. Once data is generated using the ConservatIR accessory, users can analyse it with Thermo Scientific OMNIC software, designed to provide ease of data collection and analysis in one platform. The accessory is also designed to enable spectral analysis of other large objects, including automotive parts, toys, fixtures and castings.

Thermo Fisher Scientific
www.thermofisher.com.au

Near-infrared fluorescence imaging system

The LIGHTVISION near-infrared fluorescence imaging system is designed to support breast cancer treatment through the visualisation of lymph vessels and blood vessels based on the detection of near-infrared fluorescent light emitted from indocyanine green (ICG). It creates real-time contrast images of lymph vessels below tissue surfaces by administering ICG through the lymph vessels, exposing the corresponding tissue to excitation light and then detecting and visualising the slight emission of near-infrared light from the ICG.

By visualising the lymph vessels during surgery, the surgeon can perform procedures while monitoring the position of lymph vessels being excised, eg, on a monitor screen. This is useful for identifying the position of sentinel lymph nodes, which are important for diagnosing the metastasis status of cancer cells during breast cancer surgery.

Furthermore, by visualising the ICG administered through blood veins, the blood flow can also be confirmed during surgery by performing intraoperative angiography. This is useful for evaluating blood flow through flaps and anastomotic vessels during breast reconstructive surgery.

The device is equipped with high-definition sensors, producing high-quality, real-time images on a single monitor, for surgeons to proceed with surgery. It also supports image acquisition in a bright field of view, without the need to switch off room lighting.

The ability to display three images simultaneously means that a visible light image, a near-infrared fluorescence image and a combined visible light image with superimposed near-infrared fluorescence image can all be displayed simultaneously, in real time, on the same screen. This means that all three images can be assessed and compared with ease. To identify the position of lymph nodes, lymph vessels and blood vessels in visible and near-infrared fluorescence images, areas of fluorescence can be displayed as either green or blue, providing clear visible separation from surrounding tissue.

The camera arm can be extended to a length of about 180 cm, providing optimal positioning during procedures, while the main unit is easily controlled via a simple and detachable control console. Good image quality is assured via automatic focusing, automatic light exposure adjustment and automatic white balance adjustment, while the images can be zoomed to a magnification of up to 10 times.

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Dr Susan E. Sharp - Kaiser Permanente
Dr Anja Spang - Royal Netherlands Inst. for Sea Research
A/Prof. Victor J. Torres - New York University
Prof. Fitnat H. Yildiz - University of California

Public Lecture

Prof. Nicholas Graves - AusHSI

Stay for the sand, surf & sunshine

SA Water scientists use DNA in

Tassie tiger search

Scientists at SA Water's AWQC laboratories have integrated high-throughput DNA sequencing technology to their water quality analysis services and have been applying it to searches for shy platypus, and the presumed-extinct thylacine.

A business unit of 2018 Australian Digital Utility of the Year SA Water, AWQC provides specialist water and sewerage expertise including sampling, analysis, advice and research to other Australian and international water companies.

Two new pieces of equipment in the AWQC laboratories, the ION Chef and the ION S5, create DNA chips and unique barcodes for organisms found in water samples, to provide detailed and reliable information.

Talking about the technology he will showcase at the Ozwater'18 conference in Brisbane, AWQC Manager of Life Sciences Dr Thorsten Mosisch said similar technology is used by hospitals across the country for cancer and genetics research.

"Our scientists are the first to apply it in the water industry and now with a simple one-litre sample they can determine exactly what organisms, including vertebrates, native fish and bacteria have been in contact with that water sample," he said.

"DNA sequencing reduces the time required to perform the analysis of water samples for organisms present and provides far greater accuracy than traditional methods.

"Importantly, the benefits can be realised without the need for any traditional microscopy, culture techniques or complex and time-consuming field sampling.

"This molecular-based analytical technique has significant implications for public health, research, conservation efforts, and optimising processes and conditions within water and wastewater treatment plants."

DNA extraction, purification, fragmentation and amplification are performed using the ion torrent ION Chef.

The amplified fragments tether to a small bead, which sits in one of millions of wells on a semiconducting chip, which is placed in the ION GeneStudio S5 to read the DNA using Next-Generation Sequencing (NGS) methods.

The fragments are then pieced together to generate complete sequences for each organism detected in a sample and compared against reference sequences in curated databases, allowing organisms such as livestock, native fish, humans and bacteria that have been in contact with the water to be identified.

The equipment is frequently helping detect good bacteria in samples from SA Water's wastewater treatment plants, to enhance the treatment of sewage before it is recycled for irrigation or released back to the environment.

SA Water is a corporation owned by the people of South Australia, and provides 1.6 million customers with water services. The corporation invests $300 million a year in sustaining and enhancing its state-wide network, to ensure it continues to play an integral role in the state's social and economic development.

"Another particularly satisfying moment came when we were able to identify that foreign matter found in a bore had the bacterial composition of biofilm, rather than seepage from a nearby wastewater polishing lagoon, with the findings streamlining preparation of a business case to replace the bore."

Dr Mosisch acknowledged it's the search for mystery animals that has captured the AWQC team's imagination.

"Platypus are thought to have been extinct on mainland South Australia since the 1970s, but last year there were several 'sightings' in the Sturt Gorge Recreation Park in the Adelaide Hills," he said.

"We took 22 water samples from the sighting locations and other typical habitats, and found a range of animal DNA including koala, rabbit, dog, deer, several fish and bird families, and even human. Sadly, there was no platypus on this occasion."

But it was scat rather than water which was examined in the AWQC's other big animal investigation.

"There are a number of people actively searching for evidence of the thylacine, or Tasmanian tiger, and we were asked to determine if some scat samples could be from one of the animals, to prove one was currently or recently alive."

To complete the testing, AWQC accessed two independent thylacine DNA samples from accredited national online gene bank the National Centre for Biotechnology Information, which is supplied by museums, accredited universities and research organisations from peer-reviewed literature, and is traceable and curated.

"We detected the DNA of vertebrates such as fox, wallaby, wombat, possum and kangaroo from the scats, meaning these animals either produced the scat or were potentially eaten and then digested by the host animal.

"However, analysis of three scat samples from three separate locations, which were each tested several times, consistently found no presence of thylacine DNA."

Dr Mosisch said this might just mean the thylacine hunters need to keep looking.

Lauren Davis

Tackling antibiotic resistance, one piece of possum poo at a time

Antibiotic resistance is the phrase on everyone's lips these days, with scientists searching far and wide for solutions to this growing problem. Now, a citizen science project led by Macquarie University is seeking answers in one of the most unlikely places you could imagine — possum poo.

As explained by Dr Koa Webster, Project Coordinator on the 'Scoop a Poop' project, evidence of antibiotic resistance has been found in gut and faecal bacteria from numerous wildlife species in both terrestrial and marine environments — so it's not just an issue that affects humans.

"Resistance doesn't exist in isolation in human-associated bacteria, but rather there are connections between humans, agricultural and domestic animals, and wildlife — which means that we need to consider all three groups when we study antibiotic resistance," she said.

"Possums are common throughout Australia, particularly in urban areas. They are an ideal species to look at to see how prevalent antibiotic resistance is in the bacteria hosted by Australian wildlife. In addition, their poo is easy to identify."

Scoop a Poop was the brainchild of Associate Professor Michelle Power, who had an ongoing research interest in antibiotic-resistant bacteria and their presence in wildlife. According to Dr Webster, Associate Professor Power conceived Scoop a Poop "as a way to investigate antibiotic resistance in a common wildlife species, and also as a science outreach program to teach school students about antibiotic resistance".

After obtaining a $402,000 Citizen Science Grant from Inspiring Australia in May 2017, it was time for Associate Professor Power and her colleagues to commence their investigation into antibiotic resistance in native animals — an investigation that would not be possible without the assistance of students from participating schools, their parents and Youth at the Zoo.

"Because the project investigates the occurrence of antibiotic resistance genes in wildlife populations, we want samples from as broad a geographical area as possible," Dr Webster explained. "We could go on multiple field trips to gather our own samples, but we would never be able to get the broad range that can be covered by citizen scientists.

"In addition, involving citizen scientists give us an opportunity to provide a science outreach lesson to the schools and community groups involved in the project. We can educate about the risks of antibiotic resistance, how it is affecting our wildlife and what members of the public can do to help reduce the development of resistance in the community."

It certainly helps that the collection kits are easy to use, comprising gloves, a jar, a swab (only for older students and adults) and an instruction card. Then, it's a simple matter of locating some possum poo,

Newington College students at Macquarie University.

putting on the gloves and scooping a few pellets into the jar using the lid's built-in scoop.

"You [then] open the swab packet and stick the swab into one of the poo pellets, then place the swab in its special tube," Dr Webster said. Barcodes are provided to stick on to the jar and the swab tube, while a sample information card helps users record the date and location of the collection.

The project will also soon be supported by a new app, free to download from the App Store and Google Play, which allows participants to log their collection location using their phone's GPS — the information will then be sent straight to the project database. Users will also be able to view a map of collection locations as they are verified; a feature known as 'Scatlas'.

Once the samples have been picked up from participants' schools and take back to the lab, Associate Professor Power's undergraduate students log the sample ID and collection information. Dr Webster said, "If the kit includes a swab, we freeze the media from the swab tube at -80°C for later culturing. The scat samples are kept in a cool room until we have enough samples to run a DNA extraction protocol.

"For DNA extraction, we use a FastPrep machine (to lyse the cells) and a specialist faecal DNA extraction kit. Once we have enough samples to run an analysis, we run a series of PCR reactions, followed by gel electrophoresis and visualisation on a gel imaging machine (GelDoc).

"Our PCRs test for Class 1 integrons, which are a type of mobile DNA that are associated with antibiotic resistance. Not all resistance is controlled by Class 1 integrons, but this is the specific mechanism that we are interested in for this project."

Now one year into the project, Dr Webster can reveal that, according to the preliminary results, ~25% of the possum samples tested so far have been positive for Class 1 integrons. "In future, we will be doing further PCRs and gene sequencing to identify the particular antibiotics that the genes carried on the integrons confer resistance to," she said.

"The prevalence of ~25% is a high proportion compared to our previous studies in other wildlife species, and it will be interesting to see if we see similar results across the whole Sydney basin and in more rural and regional areas."

Although the project is currently aimed towards school and community groups, members of the public can pick up collection kits of their own at special events such as the upcoming Macquarie University Open Day on 18 August. You can also follow the project on Facebook and Twitter, or get involved by emailing Dr Webster at fse.scoopapoop@mq.edu.au.

"The project has started in Sydney but we are expanding to regional NSW shortly and then to at least two other states over the course of the project," Dr Webster said. "Ideally, we would like to get samples from across Australia!"

The Scoop a Poop display table.

Robot speeds up NZ uni's research efforts

Victoria University of Wellington, New Zealand, has installed an automated liquid handling system to probe the atomic structure of proteins.

The TTP Labtech mosquito liquid handling solution, installed by AXT, will accelerate research by facilitating automatic preparation of hundreds of samples.

The mosquito is particularly suitable for protein crystallographers as it combines speed, accuracy and high-precision pipetting, all in a user-friendly package. In addition, the positive displacement pipette technology ensures repeatable liquid dispensing down to the nanolitre level that maximises the usability of valuable reagents. Combining this with single-use disposable pipette tips prevents potential cross-contamination, ensuring the purity and accuracy of each and every formulation prepared.

The automated and high-throughput nature of the mosquito liquid handling system will allow researchers to prepare vast numbers of samples required for accurate screening experiments. These numbers are typically in the hundreds, if not the thousands, and are necessary to help identify the optimal conditions for preparing the best crystals. Use of the mosquito accelerates this process, bringing it down from days or even months.

"The mosquito has become a valuable instrument in our research workflow," said Professor Emily Parker from the Ferrier Research Institute at the Victoria University of Wellington. "Important biological processes are mediated by proteins. Studying protein structures helps us to understand how proteins function. This understanding will help us to control and engineer desired proteins that can be used as treatments to address critical global problems."

Researchers at the Ferrier Research Institute, Victoria University of Wellington, with their TTP Labtech mosquito system.

Richard Trett, managing director at AXT, said, "Research into protein-based therapeutics is on the increase, as they are more easily assimilated into the body's own defence system. We are pleased that we can offer systems like the mosquito and other screening technologies that will help develop the next generation of biopharmaceuticals to teams like Professor Parker's, with a view to minimising the impacts of diseases and ailments that affect our society."

The mosquito from TTP Labtech is part of AXT's protein-based product portfolio that also includes X-ray-based protein crystallography systems from Rigaku Oxford Diffraction and protein characterisation tools from Unchained Labs.

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- **Paula Cannon**, University of Southern California, *USA*
- **Ellen Lumpkin**, Columbia University, *New York, USA*
- **Christof Niehrs**, Institute of Molecular Biology Mainz (IMB), *Germany*
- **Anna Philpott**, University of Cambridge, *Cambridgeshire, UK*
- **Elizabeth Robertson**, University of Oxford, *Oxford, UK*
- **Randy Schekman**, University of California, *Berkeley, USA*
- **Keiko Torii**, University of Washington, *Washington, USA*
- **Michael Udvardi**, Noble Research Institute, *Oklahoma, USA*
- **Tobias Walther**, Harvard Medical School, *Boston, USA*
- **Valerie Weaver**, University of California, *San Francisco, USA*
- **Nieng Yan**, Princeton University, *New Jersey, USA*

Provisional Conference Streams:

- Plant Biology
- Developmental, Stem Cell and Regenerative Biology
- Immunology, Infection, Host
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- Cell Biology and Signalling
- Biochemistry and Metabolism
- Emerging Technologies
- Education

The conference is the combined meetings of the ASBMB, ASPS, ANZSCDB, NZSPB and NZSBMB with the International Society of Differentiation (ISD) partnering with the ANZSCDB.

- Australian Society for Biochemistry and Molecular Biology
- Australian Society of Plant Scientists
- Australia and New Zealand Society for Cell and Developmental Biology
- International Society of Differentiation
- New Zealand Society of Plant Biologists
- New Zealand Society for Biochemistry and Molecular Biology

Further Information

Conference Chair:
Liz Harry
Liz.Harry@uts.edu.au

Registration/ Exhibition:
Sally Jay
combio@asbmb.org.au

Late Poster Submission Deadline:

Friday, 10 August 2018

Onsite Poster Submission Deadline:

Tuesday, 18 September 2018

www.combio.org.au/combio2018

FOLLOW US ON

Kate L. Seib, Chair of the local organising committee for ASM2018, Brisbane

Australian Society For Microbiology 2018

The Australian Society for Microbiology would like to invite you to Queensland for its Annual Scientific Meeting and Trade Exhibition. This year, the meeting will be held in Queensland's capital city, Brisbane, from 1–4 July.

ASM2018 will be held at the Brisbane Convention and Entertainment Centre (BCEC) at South Bank, just a few steps from the beautiful Brisbane River and a few minutes from the vibrant city centre. The venue is in close proximity to a host of good restaurants, museums including the Queensland Art Gallery-Gallery of Modern Art (QAGOMA), the Queensland Museum and Sciencentre, and the Queensland Performing Arts Centre (QPAC), shops and weekend markets. For those who may want to explore further, there are beautiful beaches only an hour to the north (Sunshine Coast) or south (Gold Coast) and other tourist attractions nearby (eg, Dream World, Sea World, Australia Zoo).

The meeting will feature eminent scientists from Australia and around the world, covering a range of topics related to microbiology. The symposia and workshops will cover a variety of topics including clinical diagnostics; antimicrobial resistance; vaccine and therapeutic development; public health and one health; tropical, regional and point-of-care medicine; genomics; microbial evolution; marine, wildlife and livestock microbiology; bacterial pathogenesis and regulation; viral pathogenesis; medical mycology; fungal ecology and evolution; as well as communication, education and history.

ASM2018 will commence on Sunday with the Annual Public Lecture. This year's opening speaker is Nicholas Graves, Professor of Health Economics at the Institute of Biomedical and Health Innovation, School of Public Health, Queensland University of Technology (QUT). Professor Graves is currently the Academic Director for The Australian Centre for Health Services Innovation (AusHSI) and the Centre of Research Excellence in Reducing Healthcare Associated Infections (CRE-RHAI) QUT. His applied research brings economics to the study of health care.

The Bazeley Oration will be presented by Professor Dennis Burton on Sunday. The Bazeley Oration is fully supported by the Commonwealth Serum Laboratories (CSL) to recognise significant achievements in the field of vaccines. Professor Burton is Chairman of the Department of Immunology and Microbial Science, The Scripps Research Institute, La Jolla, USA. His research is focused on infectious disease, in particular the interplay of antibodies and highly mutable viruses, notably HIV.

The annual Rubbo Oration will be held on Tuesday evening, and recognises outstanding contribution to the field of microbiology. This year, the awardee is Paul Young, Professor of Virology and Head of the School of Chemistry & Molecular Biosciences at the University of Queensland. Professor Young has dedicated much of his working life to understanding the molecular basis of dengue virus induced pathogenesis, as well as developing improved diagnostics, therapeutics and vaccine control strategies for the flaviviruses, dengue, West Nile and Zika viruses.

The event will feature several plenary speakers, including Professor Michael Jennings (Institute for Glycomics Griffith University, Australia — bacterial pathogenesis and glycobiology), Professor Karl Kuchler (Medical University, Vienna — fungal infection biology and antifungal resistance), Dr Susan Sharp (Kaiser Permanente, Portland — clinical microbiology and diagnostics), Dr Anja Spang (Royal Netherlands Institute for Sea Research — archaea in oceanic environments), Associate Professor Victor Torres (New York University School of Medicine — Staphylococci toxins and host interactions) and Professor Fitnat Yildiz (University of California, Santa Cruz — biofilms and signal transduction).

The symposia invited speakers and proffered papers, the posters and the Special Interest Group, and specific discipline meetings will provide attendees with an opportunity to learn and interact with industry colleagues. The meeting will conclude on Wednesday with a comprehensive workshop program delivering content pertinent to genomics, clinical serology and molecular biology, culture media and Eukaryotic microbes.

The 2018 Australasian Mycological Society (AMS) Scientific meeting will be held on Wednesday, 4 July in conjunction with ASM (at the BCEC) and on Thursday, 5 July (AMS only, at the University of Queensland). Professor Rytas Vilgalys (Duke University, USA) is the plenary speaker for Thursday.

EduCon 2018 will commence immediately after the conclusion of the main ASM Annual Scientific Meeting. To be held on Wednesday, 4 July (2.30–5.30 pm) and Thursday, 5 July (8.30 am–4.00 pm), the event will focus on contemporary and exciting ways to engage students and teach microbiology at all levels. It is open to educators in any field, not just microbiology.

The social program has been developed with the objective of facilitating networking and interactions. The Sunday night Welcome Reception and Poster & Trade Session, and the Monday night Poster & Trade Session will both be held in the BCEC Plaza Auditorium Foyer. The Tuesday night Rubbo celebration will be held in the BCEC Sky Room that overlooks South Bank and the Brisbane wheel. All three evenings will provide a great opportunity to catch up with old friends and colleagues, and to develop new relationships within the industry, while also having fun.

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25th International Conference on Chemistry Education (ICCE 2018)
July 10–14, Sydney
ICCE 2018 is jointly organised by the Chemistry Education Group at the University of Sydney, the Royal Australian Chemical Institute supported by the wider Australian chemistry education community. ICCE 2018 will also be a forum where Australian and international chemistry educators can build connections between research and practice to provide richer student learning experiences. The overarching theme of the conference, inspired by one of Sydney's most famous icons, is 'Bridging the Gap'.
https://iupac.org/event/25th-international-conference-chemistry-education-icce-2018/

1st World Congress on Nutrition & Food Sciences
July 09–10, Sydney
http://www.nutritionalconference.com/

8th World Congress on Plant Science & Genomics
July 09–10, Sydney
http://plantgenomics.plantscienceconferences.com/

15th Asia-Pacific Pharma Congress
July 16–18, Melbourne
http://asiapacificpharmaconference.blogspot.com.au/

International Symposium on Relations between Homogeneous and Heterogeneous Catalysis
July 22–25, Sydney
http://www.ishhc18.com/

Human Genetics Society of Australasia 42nd Annual Scientific Meeting 2018
August 4–7, Sydney
https://www.hgsa.org.au/about/42nd-annual-scientific-meeting

National Science Week
August 11–19, Australia-wide
www.scienceweek.net.au/

9th Vacuum and Surface Science Conference of Asia and Australia
August 13–16, Sydney
http://www.ansto.gov.au/Events/9thVacuumandSurfaceScienceConferenceofAsiaandAustralia/index.htm

Colorectal Cancer Conference
August 16–17, Melbourne
http://www.colorectalcancerconference.org

2018 ARCS Annual Conference
August 21–23, Sydney
https://www.arcs.com.au

International Society for Clinical Biostatistics and Australian Statistical Conference 2018
August 26–30, Melbourne
http://iscbasc2018.com/

SAFETYconnect 2018
August 29–30, Brisbane
www.safety-connect.com.au/

GeneMappers2018
August 29–31, Brisbane
http://www.qimrberghofer.edu.au/genemappers18/

AusAg & Foodtech Summit 2018
September 3–4, Melbourne
http://agfoodtech.com.au/

ASCIA 2018 conference
September 4–8, Canberra
http://www.ascia2018.com/

16th International Congress of Therapeutic Drug Monitoring & Clinical Toxicology 2018
September 16–19, Brisbane
https://iatdmct2018.org/

ComBio2018
September 23–26, Sydney
http://www.combio.org.au/combio2018/

3rd Joint conference of the Asia-Pacific EPR/ESR Society and the International EPR (ESR) Society (IES) Symposium
September 24–28, Brisbane
http://www.apes-ies2018.org/

Melbourne International Joint Breast Congress (MIBC)
October 11–13, Melbourne
http://melbournebreast2018.org/

Neutrons and Food 5
October 16–19, Sydney
http://www.ansto.gov.au/Events/Neutronsandfoodconference2018/index.htm

2018 Cutaneous Biology Meeting
October 29–November 1, North Stradbroke Island
http://cutaneousbiology2018.org/

AusBiotech 2018
October 31–November 2, Brisbane
https://www.ausbiotech.org/events/event/AusBiotech-2018

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Printed and bound by
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Print Post Approved PP100008671

ISSN No. 2203-773X

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