Lab+Life SCIENTIST

Forensics; mineralogy; monitoring and modifying

Face-to-face with **Philip Kuchel**

Empowering women to stay in science

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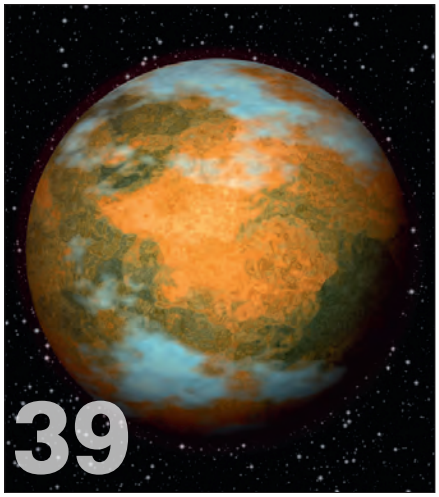

Aspiration isn't what it's cracked up to be

Aspiration is the carrot on the stick for 21st-century workers. We all aspire to the good life filled with rewarding careers, property, travel… We all believe that if we are good enough and work hard enough we can get there.

The truth is we won't. OK, some of us will - but most of us will just mosey along, doing alright but not reaching the heights.

It is aspiration that is motivating the youth of today into unpaid internships which they believe will turn into rewarding careers if they are good enough and work hard enough.

A more and more unlikely outcome is cynical employers exploit their free labour and then simply replace them with another aspiring youth.

In the publishing industry where I work, it is the aspirations of would-be photographers that feed the cost-saving frenzy of the publishers. "We'll put your name on the pictures you supply us for free. This publicity will establish your reputation as a photographer and lead to a full-time job." What full-time jobs? The publishers are making whole photographic departments obsolete and relying on 'free' pictures from aspiring photographers.

Being a member of the baby boomer generation, I started my career thinking life was pretty cruisy. I honestly believed that the women ahead of me had paved the way so that I could have a good career with its potential dictated by my ability and that my gender would not be a liability. I thought a similar, though even more rosy, future would be available for my three daughters. But I was wrong.

The last 50 years of 'women's liberation' have not resulted in a fairer and more equitable society. Women are not equally likely to be CEOs; in fact, they are still a long way behind even getting equal pay. The only real change seems to be that women are now expected to maintain fulfilling careers on top of all the other things they do.

I am blaming aspiration and the myth that we can have it all. Personal aspiration has been one of the causes of the erosion of collective bargaining and the trade union movement.

I look at the talented, educated and inspiring women featured in the article 'Empowering women to stay in science' and desperately hope that the future will be theirs to take and make of what they will. The formation of supportive groups such as Franklin Women is a really positive note in a fairly bleak landscape for professional women. I wish them every success.

Janette Woodhouse

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Susan Williamson

Emeritus Professor Philip Kuchel reflects on the moving spectrum of a distinguished career in biochemical research.

Monitoring moving molecules

Lab+Life Scientist: What drew you to become a biochemist?

Professor Philip Kuchel: The idea that you could explain life processes with biochemistry was, and still is, really fascinating to me - for example, a defect in one enzyme will produce a multisystem disorder in a patient.

I was lucky enough to be admitted into medical school at Adelaide University and by the end of first year I had decided I would pursue medical research in some form; and in second year I took a real liking to biochemistry.

Although there was a lot of memory work in the medical subjects, the challenge served a valuable purpose as it forced me to develop strategies for learning - I basically 'learnt how to learn' in second-year medicine.

I treated a biochemical pathway like some of the word games that involve transformation of a word from one to the next. And I got the bigger picture. I was able to remember structures sufficiently well to get an overview of whole metabolic systems - once you do that it all falls into place.

I took a year off the main course after the third-year examinations and worked with Professor Bill Elliot and Dr George Rogers; I was given the run of the lab.

I had access to sophisticated instruments like the electron microscope, which was a big deal back in those days. I could even run it myself! Here I was, a mere honours student, and they trusted me with expensive instruments.

I think that's one of the things that drew me in - for the first time I had senior people around me who were enthusiastic about what I was discovering.

L+LS: So instead of pursuing medicine you took on a PhD?

PK: By the end of my bachelor of medical science I went into fourth-year medicine, but by that stage I had

It was one thing to have a map of the chemicals in a metabolic pathway, the next thing was to measure how fast they were going and predict the rate of a reaction pathway.

decided I would pursue biomedical science alongside clinical medicine. I enrolled in additional bachelor of science courses in pure maths and computing during the next three years because I wanted to hone my analytical skills. Then I did my residency on the academic medical and surgical units at Royal Adelaide Hospital aiming to see how to combine research and clinical work.

A big turning point was when I made the choice to enrol in a PhD in physical biochemistry with Professor Laurie Nichol and Dr Peter Jeffrey in the JCSMR at the Australian National University (ANU). Amongst other things the work introduced me to computer modelling of enzyme kinetics using new numerical methods of solving otherwise intractable differential equations.

That was a higher order development for me - it was one thing to have a map of the chemicals in a metabolic pathway, the next thing was to measure how fast they were going and predict the rate of a reaction pathway.

I was sharing a lab with postdoc Dr Dave Roberts, who arrived from Belfast and had been commissioned by Cambridge University Press to write a textbook on enzyme kinetics. He asked me to refine some of the mathematical derivations in it - that was quite a buzz for me as a PhD student.

We developed a computer model of the human urea cycle that could predict the time course of metabolic events. Dave used the Univac 1108 mainframe computer at ANU and it took over the whole core memory of 128 K to simulate 10 minutes of metabolism in 10 minutes!

We were making incredible assumptions about the distribution of the enzymes inside the cell, but what we calculated were metabolite concentrations that matched pretty well with what was reported in the clinical biochemical literature.

We could actually predict the levels of the metabolites that would arise when one of the enzymes was defective.

That was when I realised that by doing physical chemistry you could predict a clinical outcome. That was really exciting.

L+LS: Did you consolidate your career as a research academic at the University of Sydney?

PK: Yes, most definitely! The University of Sydney was looking for someone to foster links between biochemistry and the Faculty of Medicine - biochemistry remains in the Faculty of Science to this day, but a lot of the inspiration for what we do in research, and what we teach, comes from medicine.

I was fortunate to have excellent funding right form the start of my career. I had two 5-year NHMRC project grants in succession. The first one I received was in the early 1980s and that really set me up.

I moved to the University of Sydney in 1980 and helped reshape the Biochemistry Department, working very closely with Professor Gerry Wake until the end of 1999 when he retired. Up until 1995 we alternated chairmanship of the department in 2-year stints. That suited both of us really well as we had periods of respite without losing touch with administrative and academic events that were important to the research and educational success of the department. We had the same view on research and teaching - teaching was to be research inspired, not just storytelling, and it was to be problem-solving.

I recall Gerry saying to me, "If your research is going well you can handle anything else (such as administration and teaching)"; that was also my view.

Having continuity, in infrastructure and the people around you, and a sense of security in your job is important for a research career.

Another important person throughout my career was Dr Bob Chapman, whom I had employed with my first grant at the University of Sydney. We worked together almost our whole careers.

Bob could make the NMR spectrometers 'sing'. He could operate them for hours on end; consequently, the research students were great beneficiaries of his ever-presence and wealth of experience. He was a no-nonsense individual, so if you could get an idea or interpretation of some NMR data past Bob you had done well. This was excellent training for the students.

L+LS: How has access to infrastructure dictated your research choices?

PK: This has been vital in our particular line of research.

When we finally mustered enough money to buy our own NMR spectrometer, I decided on a wide-bore

instrument with a view to adding extra magnetic coils inside it so we could measure molecular diffusion. I was not sure where this would lead, but I knew that the diffusion coefficient of a molecule is a fundamental property that could reflect how it takes to encounter an enzyme that operates on it.

Furthermore, how neat would it be to measure how fast molecules move around inside cells!

This was linked to our curiosity about the timescale of events in living systems - how long does it take for a molecule to move from one side of a cell to the other? Surely that transit time determines in a very fundamental way why cells are the size they are.

Ours was the first super-conducting magnet in the world with magnetic-field-gradient coils in it. We could measure diffusion of small molecules in red blood cells and, perhaps more interestingly, we measured the rate of diffusion of haemoglobin in red blood cells. That became a benchmark experiment for us.

We had reasoned that if we developed the technology to a point where we could measure how fast haemoglobin was moving around inside the cell then that would open up a raft of other experiments based on measuring diffusion. And, indeed, it turned out that way. Magnetic field gradients have become a central part of modern NMR spectroscopy, and pulse sequence development.

L+LS: How do you think NMR compares to other methods for measuring the chemical basis of life?

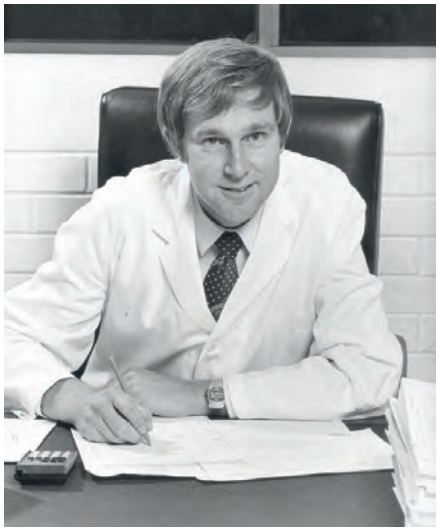
PK: That is a leading question! So I will be somewhat 'tongue in cheek' and suggest that in the quantitative (measurement) sciences 'there is spectroscopy and there are other things - like gas chromatography and mass spectrometry'. And 'in spectroscopy there is NMR spectroscopy and there are the rest!' With respect to scope and adaptability to novel contexts across all of science, NMR 'has it in spades'!

I think the reason for this is that chemistry is all about the electrons around atomic nuclei. The electrons are the basis for connecting other atoms to build up molecules. The electron cloud around each atomic nucleus influences its local magnetic field so when you change chemistry you change the electron cloud and you change the NMR resonance (absorption) frequency.

NMR is exceedingly sensitive to what happens to that electron cloud and no other spectroscopy comes near it with respect to versatility. It is the method of choice for studying chemical events in heterogeneous systems, which is, after all, what cell-biology is all about.

L+LS: What are some of your career highlights?

PK: I went to Oxford in 1975, and in 1976-77 a group of four of us carried out the first proton NMR



Philip Kuchel in his office at Sydney University in 1981.

experiments to successfully follow metabolism, non-invasively, in whole cells (red blood cells) - that was really magic.

The air was abuzz in 1975 with experiments using phosphorous-31 NMR spectroscopy on intact rat muscle. Everyone believed it would be impossible to use proton NMR to record signals from metabolites in cells because of the utter dominance of the water signal in spectra from biological samples. But the so-called, spin-echo pulse sequence fortuitously enabled us to do this.

Basically, we excited the nuclei of the water molecules with a radiofrequency pulse and then waited a while - as chance would have it, the relaxation time for the water signal was short relative to that of other small mobile molecules, and so by waiting a while we could get the signal from the small molecules. It was remarkable that it worked.

The first NMR spectrometer with a superconducting magnet to be installed in a university was the Bruker 270 megahertz instrument at Oxford, and that was the one we used.

We followed the conversion of glucose to lactic acid in suspensions of human red blood cells - all without smashing the cells up.

Prior to doing those experiments I had met Sir Hans Krebs, the discoverer of the urea cycle and the Krebs cycle.

I had discussed our urea cycle computer model and amongst the things he said about it (apart from declaring he knew little about computers!) was something like: "Ahh, but you don't know what the enzymes are behaving like inside the cell; it won't be like the inside of a test-tube!"

We were showing that NMR spectroscopy could be used to measure enzymatic reactions inside cells, and then Sir Hans took great interest in our work. This was another buzz for a boy from the colonies!

The use of the spin-echo pulse sequence for studying metabolism in whole cells was a really important development. It turned out to be a career-forming experiment for me.

L+LS: Have you made a significant biomedical discovery in your research?

PK: There are a few examples of this from my group - being the first to report phospholipase D in human red blood cells provides a good example.

It happened like this...

When I left Oxford at the end of 1978 I took a job at the new medical school at Newcastle University where I set out to combine clinical work, teaching and research, as well as trying to maintain cutting-edge research - I've never worked so hard in my life!

Professor Geoff Kellerman, my 'boss' at the time, generously organised with Dr Alan Jones, the director of the new National NMR centre at ANU, to allocate me some time on the new 270 megahertz NMR spectrometer. I flew down to Canberra about once a month and Alan and I worked like mad all weekend. An organic chemist by profession, he rapidly became fascinated by the fact that we could study metabolic processes in cells with this instrument. This was an instrument that was really the preserve of organic chemists!

On the strength of reading a *New England Journal of Medicine* article, which described choline levels being much higher than normal in the red blood cells of patients with bipolar disorder, we began investigating these cells.

Through a clinical biochemist in Newcastle I obtained some blood from patients who were taking lithium carbonate as their main treatment for bipolar disorder. And sure enough the first proton spin-echo NMR spectra showed big choline peaks. In a very facile way we could measure choline concentration in whole red blood cells. We rapidly published a paper on this finding.

But what was the explanation for the high levels of choline? This demanded an explanation!

Radioactive choline transport into red blood cells had been measured by others; and a choline transporter was known to exist, but no-one knew why. It suddenly made sense that this natural process occurred as part of the membrane-turnover in red blood cells and the main reason for the choline transporter was to let the choline out of the cells. But lithium inhibits the choline transporter and, in turn, the choline efflux from the red cells causing it to accumulate.

Thus we discovered that phospholipase D catalyses the removal of the choline head-group from lecithin if lecithin flips to the inside face of the plasma

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membrane - lecithin normally resides on the outside face of cells. So the choline released inside the cells exits via the choline transporter. All the disparate facts now made sense!

Others have since independently (re)discovered phospholipase D. But our studies led to the hypothesis that lithium may be working in the brain by causing an accumulation of choline that in turn caused elevation of acetylcholine, a neurotransmitter - but the story is not this simple and the mode of action of lithium in bipolar disorder is still not properly understood.

L+LS: Is there an unanswered research question from your career?

PK: Yes, there are many, but a Holy Grail for me is: we don't know where half of the ATP turnover that occurs in red blood cells goes! And if that's true for red blood cells, what is it like for other cells in the body, for example, a neuron?

We think we know what the energy requirements are for pumping sodium and potassium ions to maintain membrane potential in a nerve cell, but we must be paying for the shape of the dendrites, dendrite turnover, the trafficking of vesicles within the nerve cell etc, etc.

The balance sheet for energy turnover in cells is not understood.

L+LS: Did your research influence what you taught students at university?

PK: Most definitely!

When I arrived at the University of Sydney in 1980, Dr Greg Ralston and I set about implementing research-led education at least into our third-year classes.

Greg was also interested in new ways of teaching; and we concocted the idea of having 'Option' courses where about one-third of the third-year teaching would involve small-group lectures and work groups on topics relevant to each individual academic staff member's research program. I delivered an Option course on 'NMR in Biochemistry' and taught students for several years about applications of NMR, exploring ways of studying reactions in living cells, how fast molecules were exchanging across cell membranes, etc.

We were attracting some of the very best chemistry students to careers in biochemistry, and in the 1980s and 1990s, some very gifted students came my way via chemistry.

Part of the attraction for students was the novelty of NMR in biological applications - it was dynamic and hence very exciting. The technique had reached a stage in its development where one could obtain really fundamental information with relatively simple experiments on cells.

At the Prime Minister's prize night in 2005 with from left: Peter Colman (WEHI, Melbourne), Barry Marshall (WA, recently announced Nobel Prize in Medicine), Philip Kuchel, Peter Schofield (Director Neuroscience Australia).

That nexus between chemistry and biochemistry has been broken to a large extent, with the demise of 'strong' prerequisites in our undergraduate degrees.

L+LS: What do you think of the current environment for academic staff in the tertiary education system?

PK: There are many more research institutes and specialist research centres than in 1980 when I began my research in Sydney. To maintain a workable balance between teaching, research and organisation is the perennial challenge of an academic. I think academic staff are being put under incredible pressure today. The administration in our universities appears to be becoming top-heavy and very expensive.

I think the recruiting policy for academic staff is flawed. It is demoralising for extant staff who have, in general, worked hard in a department to learn that someone has been brought in from outside (drawing two or three times the average salary) with little or no consultation with the staff. These decisions are often made higher up for reasons of improving research or, less often, educational 'metrics'.

We must continue emphasising problem-solving as a central aspect of university education. This is being done in many practical classes, but it should be 'research led' with specialist courses given by research experts.

L+LS: Can you talk about your time as director of the Singapore Bioimaging Consortium?

PK: This was an unexpected adventure that presented itself at a late stage in my academic career.

In 2009, I was asked to apply for the position as executive director of the Singapore Bioimaging Consortium (SBIC). This was a consortium of scientists dedicated to recording images of animal models of human diseases and how these might change under the influence of various drugs and treatments. I was appointed as incoming executive director in 2010.

I was placed on leave without pay from the university because I had a PhD student still working there - PhD student number 26 as it turns out.

The consortium had been established by Professor Sir George Radda, who had indicated his intention to step down as director at the end of 2010. But he ended up staying on in the SBIC.

The move to such a position in a country like Singapore would be a big change for anybody. The bureaucracy in Singapore is 'top-down' and much less democratic than here. I also thought the issue of career development for postdocs needed attention. I tried to implement discussion groups and create a more congenial working environment, but this was difficult to achieve because of a lack of positive feedback on changes that a few senior colleagues and I tried to make.

I had been awarded a 5-year contract but I left after two years and returned to the University of Sydney in 2012. I did not see a way clear to making substantial changes in the research culture of the SBIC and being able to direct my own research projects in the remaining years of my contract to justify fighting on. There were still so many projects and so much unfinished business on my research 'to-do list' that returning home was the obvious choice.

Having said that, I'm glad that I went there because it was an incredible watershed for me and led me into dynamic nuclear polarisation that we don't have time to talk about now!

So, I was appointed Emeritus Professor by the Senate of the University. I secured an ARC Project Grant, which enabled the appointment of a terrific postdoc, and on the strength of that I have a lab and my old office back. So it worked out remarkably well.

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Spider venom can prevent pain, too

In news which may cause arachnophobes around the world to breathe a collective sigh of relief, researchers have discovered that spider venom contains compounds which have the potential to block pain. Their study, published in the *British Journal of Pharmacology*, shows particular promise for the 15% of adults worldwide who suffer from persistent pain.

Chronic pain treatment in the USA alone is estimated to cost around $600 billion a year - greater than the combined economic cost of cancer, diabetes and stroke. Furthermore, the study authors noted that current analgesics have "limited efficacy and dose-limiting side effects".

Led by Professor Glenn King from The University of Queensland's (UQ) Institute for Molecular Bioscience (IMB), the research team sought a method to block the voltage-gated sodium channel Nav1.7, which plays a key role in pain transmission. Professor King explained, "Previous research shows indifference to pain among people who lack Nav1.7 channels due to a naturally occurring genetic mutation - so blocking these channels has the potential of turning off pain in people with normal pain pathways."

The team turned their search towards spiders, many of which kill their prey with venoms that contain hundreds or even thousands of mini proteins called peptides. Professor King stated, "We have nine sodium channels in our bodies and our challenge is to find peptides that can distinguish between these channels and target only Nav1.7 - something current pain relief drugs can't do but spider venom peptides most likely can."

The team developed a high-throughput fluorescent-based assay that allowed them to rapidly analyse a huge number of venom peptides in order to search for those with the potential to block Nav1.7 channels. Venoms from over 200 species of spider were screened, revealing that 40% of the venoms contained at least one compound that blocked the channels - more than any other natural source, according to Professor King.

The team discovered seven promising peptides in tarantula venoms, one of which had "the right structure, stability and potency to form the basis of a future painkiller", said Professor King. He added that the team's next step is to "continue exploring the clinical potential of these peptides - and the ones we are still yet to find".

Replacing leaky heart valves in situ

In a first-in-humans trial, Sydney surgeons have successfully replaced leaking valves in two human hearts while they were still beating.

Usually when heart valves are repaired, bypass surgery is performed to stop a patient's heart, allowing surgeons to repair valves. In this procedure, surgeons implanted artificial valves inside the patients while their hearts continued to beat.

The procedure is much less invasive and better tolerated by patients, especially those who are unwell.

The two patients had mitral valve regurgitation or mitral insufficiency, a common condition where the mitral valve between the left ventricle and left atrium does not close properly and allows blood to flow backward in the heart. When severe, mitral insufficiency can cause heart failure and arrhythmias.

Developed by a US medical devices company, the artificial mitral valve is currently in a first-in-human clinical trial being conducted in Australia.

The early feasibility trial is being conducted here due to the expertise of Australian cardiac surgical teams and our expeditious regulatory system.

The trial commenced at St Vincent's Hospital in Sydney with the first patient operated on in late November last year. After six weeks without complications, doctors performed the procedure on another patient in February 2015.

The artificial valve is shaped like a flower. It is made from the heart tissue of a pig, which is sewn into a metal cage and tethered to the apex of the heart with string to hold it in place. It is also easily removed.

The trial will commence at other Australian sites including the Prince Charles Hospital in Brisbane and Flinders Medical Centre in Adelaide.

Australian CRO Mobius Medical is managing the trial and also acts as local sponsor for the US medical devices company.

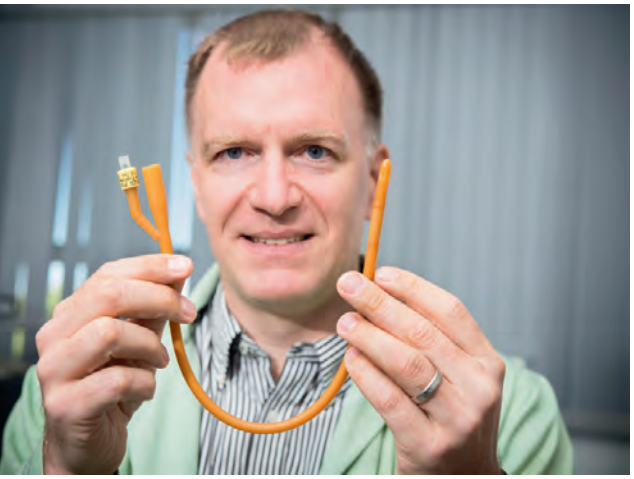
Bacteria-resistant catheters to reduce infection

Flinders University researchers are undertaking a project to reduce urinary tract infections associated with the use of catheters during hospital stays.

Lecturer and researcher Dr Ingo Koeper explained that high rates of infection in patients are "not surprising really, because as soon as you insert foreign material into the body, bacteria will grow". Current medical practice is to regularly change catheters in an effort to prevent infection; however, this is uncomfortable for patients and expensive for the health system.

Dr Koeper and his team have proposed an alternative that will be both simpler and more effective - coating the catheter with a non-toxic bacteria-resistant chemical compound. The project came about after Dr Koeper learnt a colleague in the water desalination field was using a similar technique on desalination membranes.

"We are using a similar polymer and a similar method," he said, "and early laboratory results have been promising, suggesting that we can cut bacterial growth by 95%."



Now, said Dr Koeper, the team needs to determine that the product they are using to coat the catheter is safe for human use. The team is working closely with urology doctors and nurses based at the Repatriation General Hospital, where they are analysing the data of urology patients and interviewing medical staff about current catheter practice.

With the help of a $30,000 grant from The Repat Foundation, the researchers plan to develop a suitable chemical compound and hold comprehensive clinical trials to ensure its safety and efficacy. Dr Koeper said the team is "hoping that within five years we may have a new bacteria-resistant catheter on the market".

Automated mineralogy system installed at NSW mine

Scientific equipment supplier AXT has announced the installation of a TESCAN TIMA automated mineralogy system at Northparkes Mines, a copper and gold mine located in Central West NSW. This marks the first mine site installation of an automated SEM-based minerals analysis system in Australia.

The TESCAN Integrated Mineral Analyzer (TIMA) uses a scanning electron microscope (SEM) with a highly integrated energy dispersive X-ray analysis (EDX) system to perform full spectrum analyses at very fast speeds. This enables fully automated data collection, resulting in fast and reliable results. The product is able to characterise mineral abundance, size by size liberation, mineral association and grain size automatically on multiple samples.

The system will add high-resolution, automated mineralogy capabilities for advanced characterisation of process plant and geological samples to Northparkes' on-site assay and metallurgical laboratory offerings. The automated data will be utilised in both a process plant and ore characterisation sense.

"This installation is a major advance as it takes the technology from the laboratory to the mine site," said TESCAN TIMA Business Development Manager Paul Gottlieb. "The TIMA data can be analysed much more rapidly, resulting in faster fine-tuning of plant performance and increased productivity."

In terms of production control and optimisation, the information from the product will be integrated with plant control variables to allow troubleshooting and optimisation of concentrator performance, resulting in improved production efficiency. Data will be used to support metallurgical optimisation projects, identify opportunities for improvement and justify plant changes. The instrument will also be used to support mining operations including resource model validation and optimisation.

"The benefits expected from the TIMA will apply to all areas of our business, including exploration, underground development and production, ore process control and marketing - all linking together to achieve our goal of greater efficiency," said Northparkes Mines Manager Ore Processing Department Roslyn Dalton. "In particular, the TIMA will be a good fit for our existing metallurgical applications. The TIMA offering is developing and expanding and we are excited to be a part of that, including having user input into future software development."

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Novotech awarded CRO Best Practice Award

Sydney-based contract research organisation (CRO) Novotech has been awarded the CRO Best Practice Award for the third time in recent years by Frost & Sullivan.

Established in 1996, Novotech has grown to become Australia's largest independent CRO. The company provides clinical development services across all clinical trial phases and therapeutic areas, and has been actively involved in hundreds of drug development programs for US and EU registration.

Lynda Shelly, executive director, clinical operations at Novotech, accepting the award from Mark Dougan, Frost & Sullivan Australia's managing director.

Frost & Sullivan's Sanjeev Kumar said Novotech has "proven its excellence in the Australia and Asia-Pacific market" by delivering services and information that meet or exceed the standards of customers, doctors, patients and regulatory authorities.

"The company has exhibited a unique flexibility in terms of handling small to very large projects," Kumar stated, referring to Novotech's technologies for electronic data capture, pharmacovigilance and safety management, and clinical trial management. He added that the company has "created a strong brand perception in the minds of its customers, which has resulted in several long-term partnerships and alliances".

Novotech CEO Alek Safarian said the company was honoured to be recognised once again with the Frost & Sullivan award. He said the Asia-Pacific is the fastest growing region for clinical research, and demand from Novotech's USA and EU biotech and pharma sponsors is driving the company's continued expansion of services in the region.

High-resolution gene sequencing technology

Researchers from Sydney's Garvan Institute of Medical Research have developed CaptureSeq (capture sequencing) - a gene sequencing technology that is said to explore the human genome at a much higher resolution than ever before. A study published in the journal *Nature Methods* found the technology was able to measure the activity of many specific genes in a sample - even when they are expressed at minute levels.

Until recently, it was thought that humans have around 20,000 genes - sections of DNA that are 'transcribed' into RNA molecules, then 'translated' into the proteins that perform tasks in cells. But protein-coding genes occupy only 2% of the genome; the other 98% is made up of genes that do not code for proteins.

The new technology was found to explore specific stretches of the human genome at much higher resolution than current RNA sequencing approaches. The team stated, "CaptureSeq was superior for the detection and quantification of genes with low expression, showed little technical variation and accurately measured differential expression."

The researchers believe CaptureSeq will also enable rapid detection of diseases where diagnosis is guided by gene expression and the genes involved are known. For example, fusion genes (two genes fused together) are found in many blood cancers - there are at least 200 in leukaemia alone - but existing amplification-based technology can search for only one fusion gene at a time. CaptureSeq can test for all 200 known fusion genes at once, saving time, money and potentially, lives.

Are lab workers at risk of hearing loss?

One in six Australians are said to experience some kind of auditory loss, and The University of Queensland (UQ) wants to know if chemicals in the workplace are to blame.

Now, Dr Fuente is leading a study to identify the most effective hearing tests to detect problems caused by chemical exposure and the safe levels of exposure to maintain healthy hearing at work. He noted, "There is still not enough understanding of which levels of chemical exposure are safe for our ears."

Dr Adrian Fuente said employees in certain industries are more at risk than others, including painters, spray-painters, those working in textile, clothing and footwear factories, and aviation and lab workers. Such employees are therefore invited to participate in the research, which will involve a series of non-invasive procedures to test their hearing.

"Hearing loss is relevant to many Australians and it affects not just the individual, but also their family, friends and co-workers," Dr Fuente said.

"I encourage people working in these industries to participate in this vital research, the outcomes of which could have a definitive impact on the Australian workplace in the pursuit of healthy hearing for all."

Those interested in participating in the study should contact Laura Sheridan by emailing l.sheridan@uq.edu.au or calling (07) 3346 7489.

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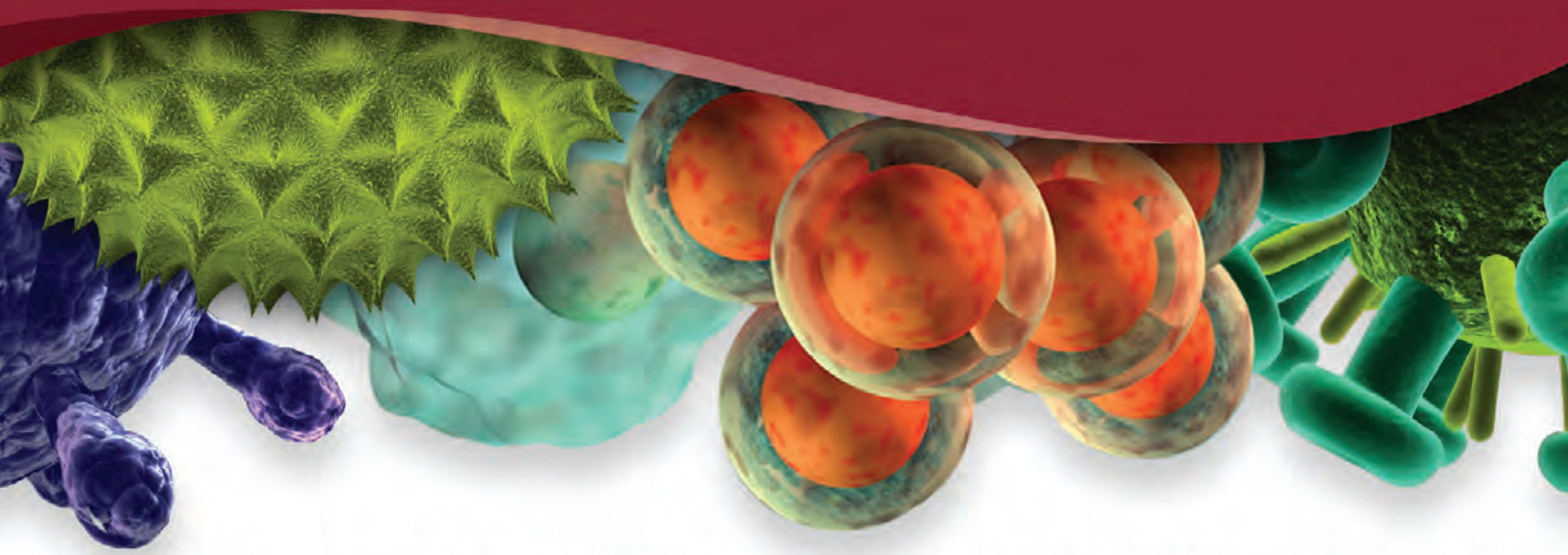

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Light observed as both a particle and a wave

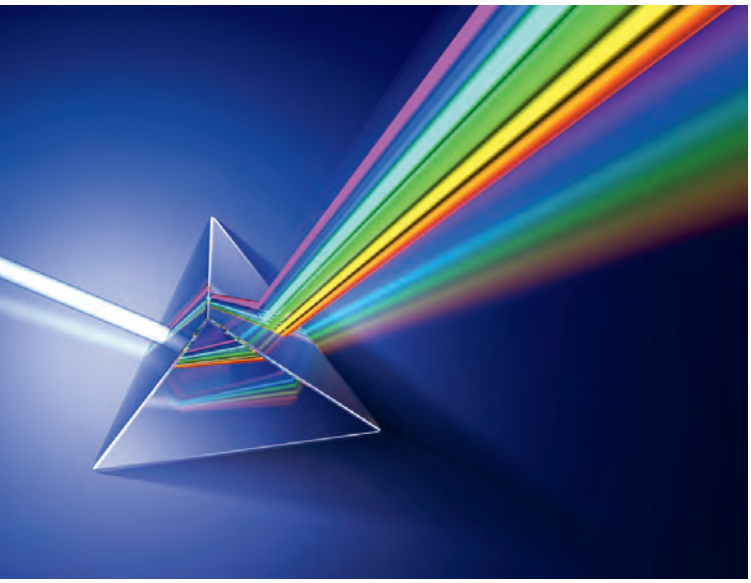
Since the days of Albert Einstein, scientists have recognised that light can behave simultaneously as a particle or a wave. But there has never been an experiment able to capture both natures of light at the same time - until now.

When UV light hits a metal surface, it causes an emission of electrons. Einstein proposed that this 'photoelectric' effect was a result of light being a stream of particles as well as a wave. A research team led by Fabrizio Carbone at EPFL has now utilised electrons to take a snapshot of light behaving as both a wave and a particle. Their results have been published in the journal *Nature Communications*.

The experiment began with a pulse of laser light being fired at a tiny metallic nanowire. The laser adds energy to the charged particles in the nanowire, causing them to vibrate. Light travels along this wire in two possible directions, like cars on a highway. When waves travelling in opposite directions meet each other, they form a new wave that looks like it is standing in place. This standing wave becomes the source of light for the experiment, radiating around the nanowire.

The scientists then shot a stream of electrons close to the nanowire. As they passed close to the standing wave of light, they 'hit' the light's particles (photons), making them move faster or slower. This change in speed appears as an exchange of energy packets (quanta) between electrons and photons, whose occurrence shows that the light on the nanowire behaves as a particle. The team used an ultrafast transmission electron microscope to image the position where this change in speed occurred, visualising the standing wave - and thus the wave-nature of light - in the process.

"This experiment demonstrates that, for the first time ever, we can film quantum mechanics - and its paradoxical nature - directly," said Carbone. He added that the work could have implications for future technologies, stating, "Being able to image and control quantum phenomena at the nanometre scale like this opens up a new route towards quantum computing."



Prototype medical device to improve spinal surgery

Flinders University researchers are developing a surgical instrument that will enable bone graft delivery during minimally invasive spinal fusion procedures.

The concept will receive $30,000 in R&D assistance from the SA Government's Manufacturing Works Medical Technologies Program (MTP), which is delivered as part of the university's Medical Device Partnering Program (MDPP). MDPP Director Professor Karen Reynolds explained, "The proposed product will aim to be compatible with existing fixation systems to enable bone surface preparation and graft deposit without the need to make an additional incision to the patient or remove healthy discs."

The project therefore aims to achieve "the same level of bone graft placement during minimally invasive spinal fusion surgery as achieved during open surgery, but with additional benefits", Professor Reynolds added. She noted that recent studies by the National Centre for Biotechnology Information show that patient benefits of minimally invasive surgeries over open surgeries include significantly less blood loss, fewer scars, shorter hospital stays, lower complication rates and a lower number of residual events.

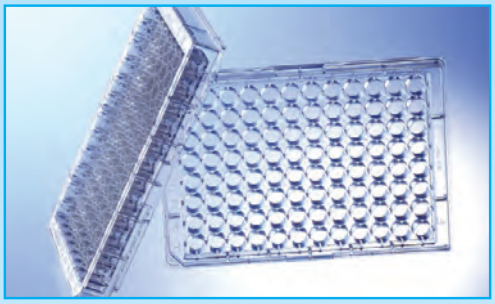
The MDPP is a collaboration between Australian researchers, end users and industry to develop cutting-edge medical devices and assistive technologies and bring them to the market. In the case of this latest prototype, the program will allow the inventors to demonstrate the bone graft concept to future investors, as well as deliver a market intelligence report that can be utilised to craft a business case and commercialisation strategy at a later stage.

SA Minister for Manufacturing and Innovation Minister Kyam Maher said the new concept provides an example of how the MDPP can work with clinicians - such as those who proposed the device - to develop a practical solution that will ultimately benefit patients and reduce the costs incurred with longer hospital stays.

"Often the best ideas for new medical devices come from clinicians, given they are the people who use or administer the technologies," he said.

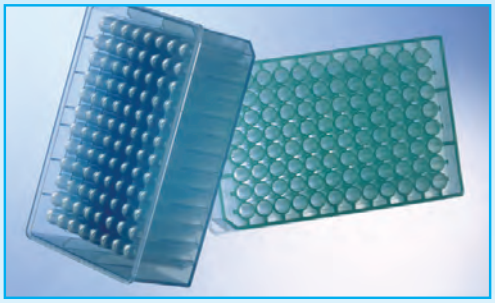
"However, they don't necessarily have the expertise or capabilities to actually develop the products - which is where the MDPP can step in."

The Power of Research

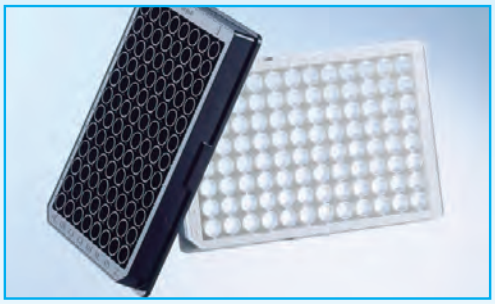


Microscopic Analysis

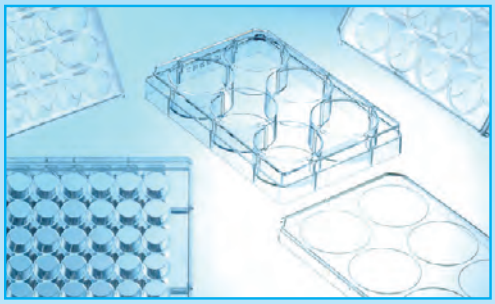
Elisa / Immunology



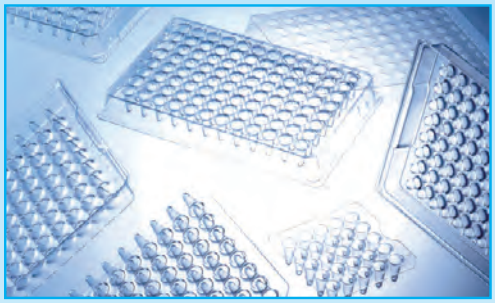
Sample Storage



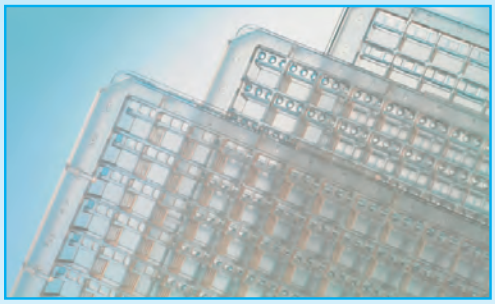
Fluorescence / Luminescence



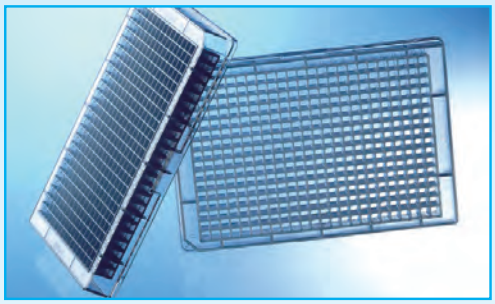
Cell Culture



Molecular Biology / Real Time PCR



Protein Crystalisation



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Janette Woodhouse

Empowering women

to stay in science

In Australia there is a loss of female talent in the scientific workforce, resulting in a chronic under-representation of women, particularly in senior positions.

In 2014, women accounted for 63% of all applications for NHMRC's early-career fellowships, but this figure fell to just 11% for NHMRC's most senior and experienced fellowships.

- Within the sciences at Australian universities, only 17% of level D and above positions are held by women.
- In 2012, 12% of senior scientists at CSIRO were women.
- Nine out of 10 PhD graduates will leave academic research - most between the ages of 35 to 50 - and the majority will be women.

It is 45 years since Germaine Greer published *The Female Eunuch* and half a century since the 'bra-burning' events of the 1960s, yet what has been achieved? Currently the gender pay gap in Australia is 17.1%. This is terrible - but even more horrifying, the gender pay gap in the 'professional, scientific and technical services industry' is 26.6% (according to a 2014 report released by the Australian Government's Workplace Gender Equality Agency). This report says that the professional, scientific and technical services industry is the most proactive in addressing pay equity, with 58.3% of organisations reporting they had conducted a gender pay gap analysis; but even so, the industry has the third-largest gender pay gap of all industries.

Why are women leaving their scientific careers?

Poor remuneration is probably not the main reason and certainly not the only reason why women leave scientific careers.

Casualisation of the academic and research workforce has eroded job security for both women and men. Mid-career researchers are simultaneously at the time in their lives when they are purchasing houses and starting families and they want income and job security. The system of short-term contracts and never-ending grant applications does not create an environment where scientists can feel secure in their employment future. Researchers cannot 'plan forward' either personally or professionally because of the uncertainties caused by reliance on funding which is short-term.

This results in a huge waste of the public funds that were spent on these scientists' undergraduate and postgraduate education. As a society we need the scientists we train to actually use their training.

What can be done to halt this waste of talent?

In the UK, the Athena SWAN Charter is a national scheme that recognises and rewards excellence in women's employment in science, technology, engineering, mathematics and medicine, in the UK's and Ireland's higher education and research organisations. The charter requires institutions to not only collect data about their existing initiatives and policies, but then to critically analyse these data to uncover the reasons for the under-representation of women in their institute. Different departments must develop an action plan to address these issues, which fosters a tailor-made approach that fits the needs of that organisation. An organisation's application to the charter is peer reviewed and receives an award - gold, silver or bronze. From next year onwards, medical schools in the UK will no longer be shortlisted for Department of Health research funding unless they have a silver award. The charter is unique because it requires ongoing evaluation and improvement over time.

The Australian Academy of Science has set up a new national initiative - the Science in Australia Gender Equity (SAGE) Forum. This forum has consulted with the sector and is now looking to develop a pilot program for the Athena SWAN Charter in Australia.

On 18 March, the National Health and Medical Research Council announced a new gender equity policy to support the retention and progression of women in health and medical research. The revised Administering Institution Policy aims to address the under-representation of women in senior research positions across Australia and applies to all institutions that receive NHMRC funding.

Institutions will have until the end of 2015 to update their gender equity policies and submit them to NHMRC for consideration. Under the revised Administering Institution Policy, institutions should have:

- a strategy that addresses the under-representation of women in senior positions;
- mentoring and skills training strategies that promote and seek to increase women's participation;
- the provision of parental/maternity leave and carer's leave, and transitional support to encourage return to work;
- working arrangements that cater for individuals with caring responsibilities;
- remuneration equity between men and women with the same responsibilities;
- employment strategies that encourage the recruitment, retention and progression of women

in health and medical research; and,

- strategies to address the need for the provision of support for childcare.

All submissions will be reviewed by NHMRC in 2016 to ensure the policies are acceptable.

NHMRC CEO Professor Warwick Anderson said he was delighted to be able to introduce the policy.

"If we want to be able to solve the great health challenges facing us today, we need to retain and support all of our most talented researchers. It is not acceptable to see half of our talent go to waste," Professor Anderson said.

The revisions and requirements were developed following extensive consultation with the research sector and follow NHMRC's survey of existing policies last year.

"By and large, this sector is highly responsible and wants to do the right thing by their staff. But unfortunately when the statistics show that women are leaving research in numbers that increase drastically over the course of their careers, I think we can all acknowledge that we all need to do more," Professor Anderson said.

Other initiatives could include:

- Every research position advertised should include a part-time option.
- Funding agencies should allow applicants to choose if they want their grant application to be assessed on past performance or on the quality of the proposed research.
- Career disruptions need to be taken into account.
- Strong, meaningful mentoring.
- Career path for women re-entering the scientific workforce.
- Funding should only be available to institutions that have gender equity policies in place.

Women taking the initiative themselves - Franklin Women

Franklin Women is a new professional community for Australian women working in health and medical research careers. (It is named after scientist Rosalind Franklin, who has an amazing story.)

The overarching mission of Franklin Women is to contribute to the retention of women in the health sciences, whether it is in traditional academic roles or those outside of academia. They hope to go about this by building a community of like-minded women who can offer each other support and opportunities and then investing in these women through various events and initiatives.

Medical research scientist Melina Georgousakis founded Franklin Women because she wanted to connect with other women in the health sciences from different institutes and in different roles.

"There seemed to be a number of professional groups for women in other industries such as business, information technology and engineering, but there is no independent peer-driven professional group for women working in the health sciences and more specifically, in health and medical research," Melina said.

"But, like in other professions, there are gender inequalities within the health sciences. In academia, the disparities between genders increase with career progression, with fewer women holding senior scientific positions than men. The grant-based funding system, as well as cultural barriers within the field and society in general, contributes to this. The result is scientifically trained women looking for alternative careers, often outside of the science field, because of a perceived lack of skills and/or opportunities to transition into scientific roles outside of academia."

Since Franklin Women launched last year, women working across broad health science fields, in diverse roles and at all career levels have joined the community. These women have come together at three events in Sydney with the plan to launch events in other states and territories soon. Through their events, Franklin Women not only want to provide opportunities for networking but also personal and professional development outside of the technical sciences that isn't typically provided through scientific training. In February, Franklin Women launched their first scholarship, a travel scholarship with a difference. The funds are to provide support for child care while the researcher, who is also a primary carer of children less than 5 years of age, is attending a conference in their field. The recipient will be announced next month.

Franklin Women is set up as a social enterprise organised by women in health sciences to invest back into women in the health sciences. They are excited to be a part of the current national and international focus given to the promotion and support of women in scientific careers. Their grassroots approach is just one part of the solution. Wonderful things are also being done at a national level with peak bodies such as the National Health and Medical Research Council and The Australian Academy of Science Early and Mid Career Researchers Forum leading changes in policy and groups such as Women in Science Parkville Precinct (WIISPP) making changes at the institute level.

To join Franklin Women or to find out more about the group, visit franklinwomen.com.au.

inspiring franklin women

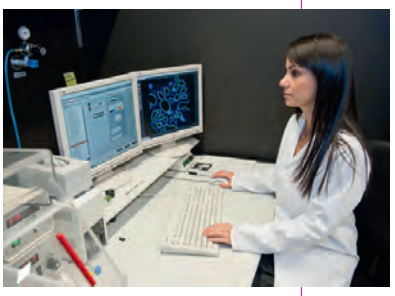
Melina Georgousakis

Melina completed her Bachelor of Science degree at the University of Queensland followed by honours and PhD in the Bacterial Pathogenesis Laboratory at The Queensland Institute of Medical Research. Her research focus was on the design and assessment of novel vaccine candidates against the bacteria Streptococcus pyogenes (Group A Streptococcus) under the guidance of Professors Sri Sriprakash and Michael Good.

During her PhD, Melina was fortunate to be awarded a sabbatical scholarship from the Cooperative Research Centre for Vaccine Technology that funded her placement at a Brisbane science communication firm where she was converted into believing science doesn't have to be communicated with jargon. She puts this into practice when she visits schools and community groups talking about careers in science.

After a laboratory-based postdoc, Melina moved to Sydney to take up a research position with the National Centre for Immunisation Research and Surveillance of Vaccine Preventable Diseases (NCIRS). She is currently a Senior Research Officer within the Government Policy team at NCIRS where her primary role is to provide technical support to the Australian Technical Advisory Group on Immunisation, the peak national immunisation policy body in Australia. In 2012, Melina was awarded her Masters in Public Health and has since been awarded a conjoint appointment as Lecturer at the University of Sydney School of Public Health.

Dr Clare Stirzaker



Clare is a Group Leader at the Garvan Institute of Medical Research, Sydney, in the Genomics and Epigenetics Division. After completing her PhD, Clare became fascinated by the field of epigenetics and joined the group of Prof. Susan Clark as a postdoc at the Kanematsu Laboratories, Royal Prince Alfred Hospital, in Sydney, and later, at the Sydney Cancer Centre at Sydney University. The group moved to the Garvan Institute of Medical Research in 2004 and was established within the Cancer Division.

Clare has since established her own group, which is interested in understanding 'Epigenetic Deregulation in Cancer'. Clare has made highly significant contributions to the field of DNA methylation and epigenetic deregulation in cancer and has also played an integral role in developing new epigenetic technologies that have underpinned many of the seminal findings of the group. Clare's research is focused on understanding aberrant epigenetic events in cancer.

Clare first heard about Franklin Women when it was launched in 2014 and joined immediately as a founding member. She was inspired by the ideal of Franklin Women and excited to have an opportunity to join a community of women working in health and medical research related careers, outside of her own workplace.

Clare attended the launch event in Sydney in September 2014 and met some wonderful women that evening - Clare was more than ever committed to Franklin Women and supporting the founder, Dr Melina Georgousakis, in her energy and vision to create a networking opportunity for women. As a woman scientist for over 20 years, Clare is thrilled and excited to see the support that such a network will provide to women as they juggle the demands of science and medical research with family life (Clare has three boys!) and importantly, the opportunity for friendships within the wider scientific community.

Clare Fedele

Clare is an early-career postdoctoral scientist currently researching melanoma at the Peter MacCallum Cancer Centre. From a young age she was fascinated by science. Clare completed her BBiomedSci(Hons) and PhD at Monash University, specialising in cancer cell signalling. During her PhD Clare became focused on clinical cancer research and the importance of translating lab-based results into improved management of people with cancer.

Supported by early-career fellowships from the Victorian Cancer Agency and the NHMRC, in 2011 she started the current phase of her postdoctoral research, focused on understanding melanoma adaptation and evolution, with the goal of identifying new therapeutic targets and biomarkers of response.

"As an early-career researcher I find myself faced with the daunting decision of how I want my career to progress. At times this can be a lonely journey, with few people outside of research understanding the challenges that lie ahead. I joined Franklin Women to connect with other women at a similar stage in their careers, to have valuable discussion and to seek support. I also wish to engage with women who have already progressed through this phase, to hear their experiences and gain some inspiration as I forge my own career path," said Clare.

Peta Bradbury

"Growing up in a country town in rural NSW, I had no idea what I wanted to be when I grew up, but I'm almost certain scientist wasn't at the top of my list. I was, however, lucky enough to be raised by three generations of the strongest women I have ever met who not only influenced, but also shaped my personality, goals and motivations.

"Currently, I am a PhD candidate at the Kids Research Institute under the supervision of Associate Professor Geraldine O'Neill and study the molecular mechanisms that underpin cancer cell migration. Once again I find myself in an environment surrounded by strong, independent and academically brilliant women. This common theme appears to continually crop up in my life and was probably the reason behind me joining Franklin Women. Throughout my time at the KRI as an RA and now student, I have never experienced any difficulties pertaining to my gender and am hopeful that this will continue throughout my career. My biggest fear at the moment has nothing to do with the fact I am a woman, but instead that I chose to be a scientist given the current research climate. For now, however, I'm going to continue to do what makes me happy and let the future work itself out."

Melanie Shakespear

The complexity of the immune system working in concert to protect against infection and repair damage has fascinated Melanie since high school biology class. She obtained her PhD in immunology in 2013 and is currently a postdoctoral research fellow at The University of Queensland's Institute for Molecular Bioscience in Brisbane.

Melanie's research focuses on a key cell type within our immune system, macrophages, and specifically the role a family of proteins called histone deacetylases (HDACs) plays in regulating macrophage inflammatory responses. Using a novel transgenic mouse model has yielded some unexpected yet exciting insights into how HDACs contribute to inflammation. The group's collaborators are also developing inhibitors of these proteins, which are expected will be potential anti-inflammatory therapies.

"I joined Franklin Women to connect with other women from a broad range of scientific backgrounds that are working in roles outside of traditional research, and I hope that I can contribute a little from my experiences. I am a mother to two young children (my daughter was born while I was writing my PhD thesis) and the career interruptions have been challenging to re-establish productivity and rebuild connections. The daily juggle of research and children can be tough; however, finding a scientific area that you are passionate about makes it worthwhile," said Melanie.

inspiring franklin women

Gayathri St George

Gaya is a Research Assistant/PhD student at The Millennium Institute having completed a Master of Science in Medicine degree at the University of Sydney where she majored in Human reproductive health and human genetics. Gaya's PhD project is looking at non-melanoma skin cancers (NMSC), which are the most commonly diagnosed cancers in Australia. Almost 80% of all new cancers diagnosed are NMSC. This project is based on a cohort of subjects with early-onset cutaneous squamous cell carcinoma and their controls. It is predicted that these early onset cases would be enriched for all common squamous cell carcinoma risk factors. The aim of this project is to look at these risk factors such as HPV status, clinic pathological features and genetic markers associated with early onset cases. Gaya has also been working on a genetic epidemiology of melanoma project under Professor Graham Mann at The Millennium Institute.

Gaya said she joined Franklin women because "Franklin women is an organisation where women in science are able to share their experiences of being a women in science. It is an organisation like none other. It is a place where I am not only able to get advice/tips from other women who have gone through the same career path but I am able to share my experiences to upcoming women scientists in the field. It is also a great place to network and collaborate and share ideas of your passion in science. The organisation casts a wider net to bring women across all science arenas and not just from academia. This allows us to get exposed to career paths and opportunities that are outside mainstream science.

"Being the eldest daughter and sister of a special needs sister, I guess 'responsibility' became my middle name from a young age. Trying to manage the family, my sister's health issues and my career has been a struggle. There are times where one takes priority over the other. In this modern world, women all over the world are constantly struggling with balancing their career and family and it is important that we get the support from our families, work and each other. It is important to have support networks like FW where we are not only able to share our ideas but our fears, problems and hurdles of getting through life.

"I entered science with a tunnel vision only knowing a certain career path. The advice I would give young women thinking about going into science is explore all the options. There are many roads you can take. Joining societies, network group or organisations with similar interests, you can meet people or get ideas to explore another science career path you have never heard of but might be best suited to you.

Associate Professor Kristine Macartney

Kristine is a paediatrician who specialises in treating children with infectious diseases and in preventing disease through immunisation. She works at the Children's Hospital Westmead and is a conjoint academic at the University of Sydney. Her main role is as the Deputy Director of the Australian National Centre for Immunisation Research and Surveillance. She completed her medical training at UNSW and then undertook subspecialty training in the USA at the Children's Hospital of Philadelphia (CHOP) where she also completed a doctorate in basic science research on rotavirus (the most common cause of gastroenteritis) and novel vaccine candidates. Kristine now leads a team of vaccine experts who support the development of immunisation policy and practice, and heads up a number of national research collaborations. She has authored >70 peer-reviewed publications and is a chief investigator on NHMRC-funded grants research projects, although her salaried position is derived from government funding to the NCIRS.

Kristine joined Franklin Women because she is passionate about women making the most of their careers in science. Her greatest challenges have been balancing her career-related goals with the other great loves in her life - raising three girls and juggling two-career parenting with her ever-patient husband. Moving countries along the way was also a challenge but had huge benefits. She worked part-time for 10 years after the birth of her second child, a period in which she had to adjust her work-related ambitions but learnt a lot of other things! Her advice is not to be afraid to seize and to make new opportunities and to forge your own way, even if its 'non-traditional'.

Magda Ellis

"I am an early-career researcher in the mycobacterial research laboratory at the Centenary Institute, Sydney. Following my Masters in Genetic Epidemiology (University of Sheffield, UK), I came to Australia to do a PhD at the Queensland Institute of Medical Research to investigate the human genetic susceptibility to parasitic worm infections. All of my fieldwork for this project was done in China where I still run nearly all of my research projects more than 10 years later.

"My main area of research now focuses on tuberculosis (TB) susceptibility and multidrug-resistant TB control. I love my job because of all the different aspects that I get to do from working in the field to the lab as well as all the wonderful places I have been able to travel to. One of the greatest challenges facing researchers today is securing funding, especially if your salary depends on it. I solely rely on the NHMRC for funding and, while I love my job, the lack of job stability is stressful particularly since I had my daughter last year.

I joined Franklin women to meet link-minded women who face the same challenges from whom I could draw inspiration and extend my network within Australia as well as expose myself to other potential careers in health. I think many women both in and outside of science don't appreciate their own value in the workplace. If I could offer any advice to women entering research, it would be to believe in yourselves and don't be afraid to ask for what you need."

Pancreatic cancer researcher is NSW Woman of the Year

Pancreatic cancer researcher Professor Minoti Apte has been announced 2015 NSW Woman of the Year by Premier Mike Baird and Minister for Women Pru Goward. This is not the first significant honour for Professor Apte, who was last year awarded the Order of Australia Medal (OAM) for her services to medical research, tertiary education and the Indian community.

A professor at UNSW's South Western Sydney Clinical School and research group leader at the Ingham Institute for Applied Medical Research, Professor Apte is investigating pancreatic cancer at a cellular level to find out how and why the deadly cancer is so aggressive and spreads so quickly. She was the first in the world to develop a method to isolate pancreatic stellate cells (PSCs), providing a much-needed research tool for studying the path that pancreatic fibrosis (scarring of the pancreas) takes.

Her group established that PSCs were responsible for producing the prominent scar tissue in pancreatic cancer and that there was a close communication between PSCs and cancer cells. This proved that cancer cells 'recruit' normal pancreatic cells to help the cancer grow and spread to distant parts of the body.

The next phase of Professor Apte's work is to stop PSCs working with normal cells. She is currently leading preclinical studies that are anticipated to create a new combination therapy to help improve treatment outcomes for pancreatic cancer patients.

Accepting the award, Professor Apte called on state and federal governments to make increased funding in medical research a higher priority. She also called for better support for women seeking to balance family and career, praising UNSW for providing "family-friendly workplace arrangements and supporting women who want to balance family with pursuing a career in science, academia or medical research".

Professor Apte plays an active role in research training through her supervision and mentorship of PhD, masters and honours students. She is the editor-in-chief of the journal *Pancreatology* and is also an active member of the Marathi Association of Sydney, a community organisation that serves a large section of Sydney's Indian diaspora.

Professor Apte was described by the Premier as "a highly respected researcher and member of the community [whose] achievements inspire other women to follow in her footsteps".

Handheld water quality meter

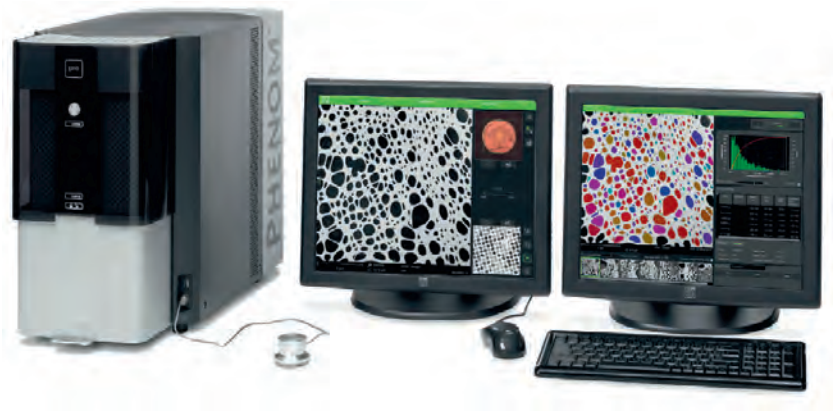
The SAM-1 Smart Aqua Meter from Sensorex converts Apple and Android smart devices into meters to measure and record pH, ORP, conductivity and temperature values. A powerful handheld water quality meter, the product delivers analytical measurements in the lab or field for use in environmental, educational and industrial applications.

The product plugs into the headphone jack of a smartphone or tablet and connects to Sensorex smart analytical sensors for measurement. The SAM-1 app, available as a free download, instantly recognises the smart sensor and provides an easy-to-use interface for taking measurements and managing data.

Readings can be tagged with GPS location and user comments. Stored data can be securely transmitted via email and opens in Excel for analysis and reporting. The potential for data transcription errors is therefore eliminated.

Languages supported by the app include English, French, German, Italian, Spanish and Simplified Chinese. Lab, field and plant applications include environmental monitoring, product quality control, pool and spa testing, aquaculture, horticulture and hydroponics, municipal water sampling, wastewater compliance testing, and educational and technical service.

Envirosensors Pty Ltd
www.envirosensors.com.au



SEM with pore measurement software application

Fully automated visualisation and analysis of pores can be realised using the Phenom desktop scanning electron microscope (SEM) with the PoroMetric software application. Using a long-life, high-brightness CeB_6 electron source, the product creates state-of-the-art images without the delay and difficulty associated with operating a traditional SEM.

The integrated X-ray analysis system and specially designed EDS detector enable both sample structures to be physically examined and their elemental composition determined. Benefits include: imaging power up to 100,000x magnification; ease of use by intuitive system control; fully integrated X-ray analysis; fast time from loading sample to SEM image (<30 s) by using an integrated X, Y motor stage; navigation by combination of optical navigation camera and low magnification SEM imaging.

PoroMetric meanwhile extracts detailed information of the complete set of pores to allow the user to get a better understanding of the characteristics of the materials. The user can easily analyse pore parameters such as pore size and aspect ratio and gather data on distribution of pores.

The combination of speed, ease of use and imaging quality of the Phenom and pore analysis software of PoroMetric creates a powerful tool for inspecting a wide range of samples like filters, membranes, foam, ceramics and other porous materials. Other Pro Suite applications include ParticleMetric, FiberMetric, 3D Roughness and Elemental mapping, allowing users to gather morphology and particle size data and to generate three-dimensional images.

The product is suitable for forensic investigation, material characterisation, metallurgy analysis, process control, pharmaceutical and industrial research and more.

ATA Scientific Pty Ltd
www.atascientific.com.au

Spectrofluorophotometer

Shimadzu has announced the RF-6000 spectrofluorophotometer, which provides stable analysis at a high level of sensitivity for a wide range of samples.

By optimising the internal design, the product achieves a high S/N ratio of 350:1. The speed of 3D measurements has been increased, enabling the acquisition of a 3D spectrum of the full wavelength range in a short time. Samples in low concentrations or in minute amounts can be analysed by making use of optional cells designed for analysing trace amounts.

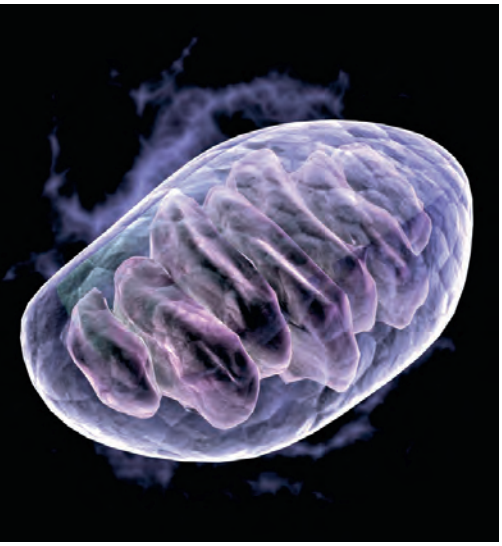
The light source employs a highly stable xenon arc lamp. The illumination lifespan has been increased approximately four times to around 2000 h, which helps reduce running costs. It is possible

to obtain fluorescence spectra up to 900 nm with a standard configuration. Since the device is equipped with functionality that provides for the real-time acquisition of corrected spectra, accurate comparisons with the spectra acquired by other analysis instruments can be performed.

By adopting the LabSolutions RF control software, it is easy to set up an integrated system of analyses and make determinations regarding the suitability of certain instruments. This makes it possible to constantly monitor things such as the reduction in the illumination lifespan of the lamp, the recognition status of options and the operational status of instruments.

The product features a large sample compartment, enabling the use of a broad range of accessories. It can be applied to a variety of applications, including the measurement of quantum yield and quantum efficiency in order to evaluate the efficiency of a luminescent material; low-temperature measurement to enable recovery of a sample in order to elucidate artificial photosynthesis; or a search for methods to determine the place of origin for foodstuffs.

Shimadzu Scientific Instruments (Oceania) Pty Ltd
www.shimadzu.com.au



Membrane potential cytotoxicity kit

Mitochondria play a central role in cellular metabolism, bioenergetics and apoptosis. Decreased mitochondrial function is known to be a major contributor to drug-associated toxicity in various organs. Evaluating the mitotoxic effects of a drug is vital in the early drug development process.

Enzo Life Sciences' Mito-ID Membrane Potential Cytotoxicity Kit measures fluctuations in mitochondrial membrane potential (MMP) by utilising a cationic dual-emission dye. Cells exhibit a shift from orange to green fluorescence as mitochondrial function becomes increasingly compromised. The Mito-ID Membrane Potential dye is said to be 10 times more sensitive than JC-1, with good aqueous solubility, allowing detection of toxicity at lower doses.

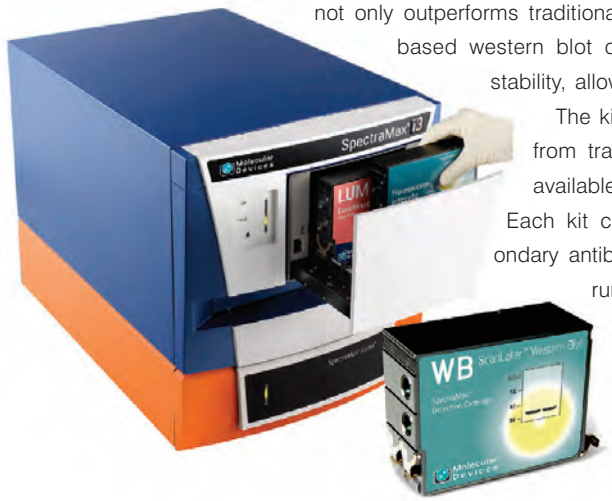
The kit is suitable for time-course studies evaluating intact and compromised mitochondria. With no-wash and no-medium removal, it is compatible with high-throughput applications.

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

Western blot detection system

The ScanLater Western Blot Detection System enables western blot membrane detection in a multimode microplate reader platform. The system includes the ScanLater Western Blot Detection Cartridge, ScanLater Western Blot Assay Kit and image acquisition powered by SoftMax Pro Software. Users can install the ScanLater Western Blot Detection Cartridge in either the SpectraMax i3 or SpectraMax Paradigm systems in minutes, adding western blot detection capability, rather than investing in dedicated western blot detection systems.

The ScanLater Assay is a time-resolved fluorescence (TRF)-based western blot detection assay. TRF is an optimal detection method, as reduction in stray excitation light results in low background and high sensitivity. ScanLater Western Blot Kits contain Europium-labelled secondary antibodies designed to work with existing primary antibodies without further optimisation. This substrate-free method of western blot detection not only outperforms traditional chemiluminescence and fluorescence-based western blot detection, it significantly extends signal stability, allowing membrane scanning at any time.



The kit contains all components needed to go from transfer to detection. There are three kits available: anti-rabbit, anti-mouse or Streptavidin. Each kit contains enough Europium-labelled secondary antibody, blocking buffer and wash buffer to run 30 mini-sized membranes. All kits are validated for use on the SpectraMax i3 or SpectraMax Paradigm microplate readers.

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

Cell culture and environmental control platform

The CellASIC ONIX Microfluidic Platform, in conjunction with the CellASIC ONIX Microfluidic Plates, provides perfusion-based microenvironment control for long-term, live cell microscopy.

The microfluidic chamber recreates the physiologic mass transport condition for optimised cell health. Upstream fluidic channels allow controlled exposure of the cells to different solutions during live imaging. The plates can also be cultured in a standard incubator using a dedicated gravity-driven flow channel.

The cells are in contact with a 170 μm optical glass surface, enabling high-quality imaging using an inverted microscope. An integrated micro-incubator system delivers temperature and gas control to the microfluidic chambers. The system integrates with most existing microscope systems to enable time-lapse experiments previously not possible.

A range of microfluidic plate designs has been used for the following applications: long-term culture of adherent and suspension cells; the creation of dynamic solution profiles (media switching and spatial gradient); immunostaining cells within the microfluidic chamber; host pathogen interaction studies; and analysing gene expression in addition to designs specifically for yeast and bacteria. Because gene expression is influenced by numerous cell cultural parameters, accuracy and physiological relevance of gene expression analysis can be enhanced by performing such analyses in a dynamically controlled, bio-inspired, microfluidic system.

Merck Millipore
www.merckmillipore.com

Electronic pipette series

A&D Weighing's MPA electronic pipette series is said to ensure high precision for every user at all times. Models include the MPA-10 (0.5 to 10 μL), MPA-20 (2 to 20 μL), MPA-200 (10 to 200 μL) and MPA-1200 (100 to 1200 μL).

Unlike many manual pipettes, dispensed quantities will not vary with each individual operator. The high-precision stepping motor moves the piston up and down, resulting in uniform, accurate pipetting for both novices and experts alike.

The electronic pipette requires a minimal amount of operator effort. The strain on the user's hand is kept low, reducing the risk of repetitive strain injury (RSI) on the thumb often associated with other manual pipettes.

Additional features include aspirating/dispensing speeds adjustable to five levels; easy calibration; increased resistance to impacts from falls; and high compatibility with many pipette tips.

A&D Australasia Pty Ltd
www.andaustralasia.com.au

Tissue grinders and serrated pestles

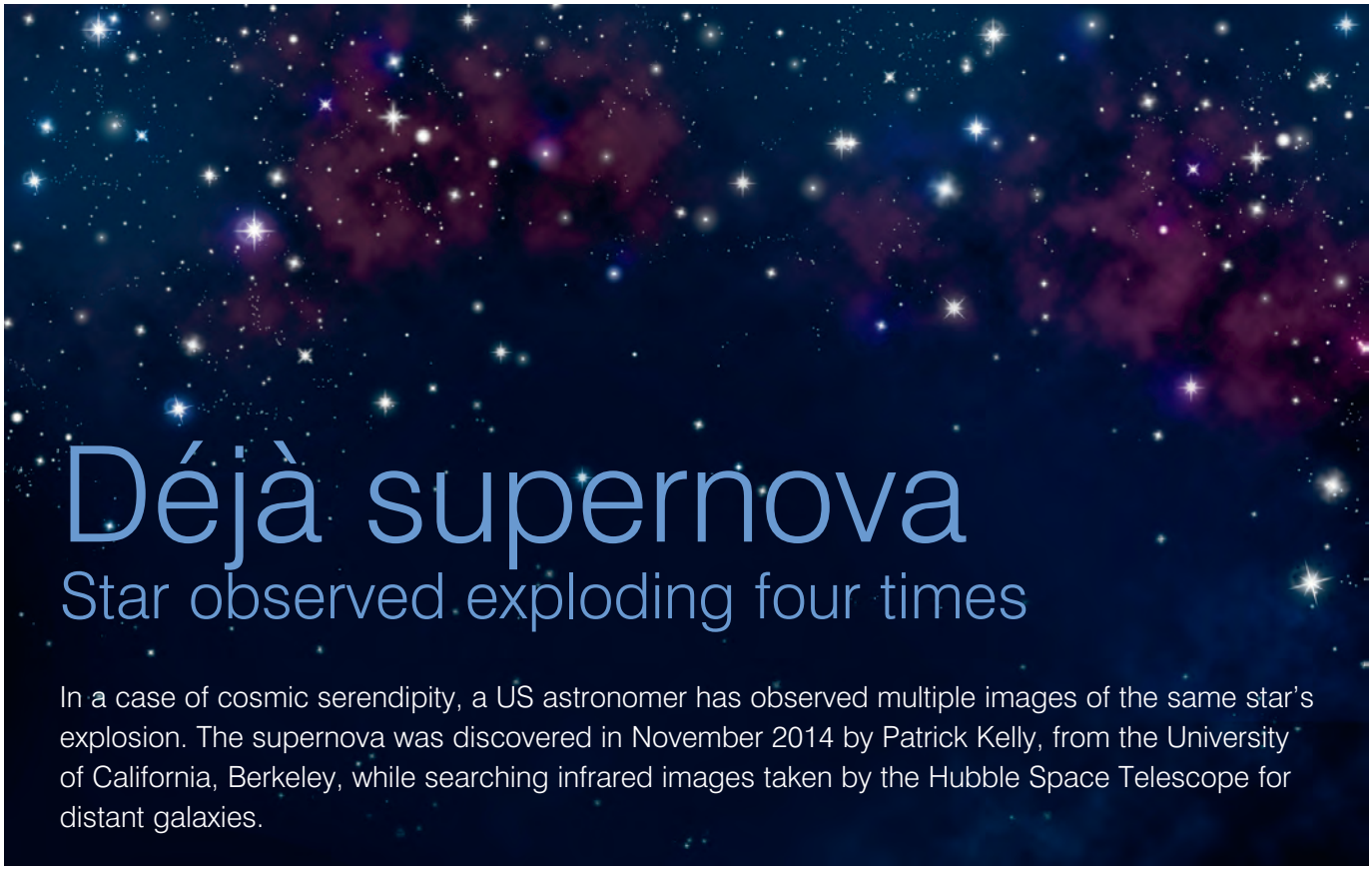
The Kartell range of labware includes a range of different sized tissue grinders and serrated pestles. Completely transparent and suitable for grinding vessels, the product is coupled with the serrated pestles to have a precisely controlled grinding clearance. Both are precision-made for uniformity.

The tissue grinder is made of borosilicate glass, suitable for small amounts of sample tissues. The serrated pestles are made with a PTFE head, suitable for grinding small samples as well as hard tissue samples like tumours.

The tissue grinder comes with a round-bottom tube with capacities of 2, 5, 10, 15, 30 and 50 mL and a diameter of 8, 12, 15, 16, 25 and 32 mm respectively. The serrated pestles range from sizes 2 to 50 mL and heights of 230 to 270 mm, paired to the tissue grinder.

Sieper & Co Pty Ltd
www.sieper.com.au

Lauren Davis



Déjà supernova

Star observed exploding four times

In a case of cosmic serendipity, a US astronomer has observed multiple images of the same star's explosion. The supernova was discovered in November 2014 by Patrick Kelly, from the University of California, Berkeley, while searching infrared images taken by the Hubble Space Telescope for distant galaxies.

In this Hubble Space Telescope image, a large cluster galaxy (centre of the box) has split the light from an exploding supernova in a magnified background galaxy into four yellow images (arrows). Image credit: NASA, ESA, and S Rodney (JHU) and the FrontierSN team; T Treu (UCLA), P Kelly (UC Berkeley) and the GLASS team; J Lotz (STScI) and the Frontier Fields Team; M Postman (STScI) and the CLASH team; and Z Levay (STScI).

Over the years, astronomers have come to realise that the sky is filled with 'magnifying glasses' that allow the study of distant and faint objects barely visible with even the largest telescopes. One of these lenses - a red elliptical galaxy located within a cluster which is gravitationally bending and magnifying light - was found by Kelly to have created four separate images of a supernova located 9.3 billion light years away, near the edge of the observable universe.

"It really threw me for a loop when I spotted the four images surrounding the galaxy - it was a complete surprise," said Kelly, who has published his discovery in the journal *Science*.

This multiplication effect has been previously predicted by Albert Einstein, whose General Theory of Relativity states that dense concentrations of mass in the universe will bend light like a lens, magnifying objects behind the mass when seen from Earth. Dr Brad Tucker from The Australian National University (ANU), a co-author on Kelly's paper, noted that the discovery enables researchers to "test some of the biggest questions about Einstein's theory of relativity all at once" - such as the strength of gravity and the amount of dark matter and dark energy in the universe.

"It kills three birds with one stone," Dr Tucker said.

Astrophysicist Sjur Refsdal also hypothesised that a supernova whose light traversed multiple paths around a strong gravitational lens could be used to measure the rate of cosmic expansion. Kelly explained that the researchers will "measure the time delays between [the supernova's] arrival in the different images, hopefully learning something about the supernova and the kind of star it exploded from, as well as about the gravitational lenses".

Kelly should consider himself very fortunate, with co-author Professor Alex Filippenko noting that scientists have been "searching for a strongly lensed supernova for 50 years". But luck was on his side, with Kelly stating that the combined effect of the red galaxy within a cluster of galaxies provided "a double lensing system".

Astronomers have been closely following the supernova ever since its discovery, with the Hubble Space Telescope to remain focused on that area of sky for the next six months. Additionally, computer modelling has predicted that the supernova will be 'replayed' within the next four years, enabling researchers to once again observe the four images of the explosion. This is because light can take various paths around and through a gravitational lens, arriving at Earth at different times.

"The longer the path length, or the stronger the gravitational field through which the light moves, the greater the time delay," said Filippenko.

BioResearch

Lonza

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www.lonza.com/4d-nucleofector

Humidity meter

The Vaisala HUMICAP HM40 is a compact and portable humidity indicator that provides measurements in a wide range of applications. It is a suitable spot-checking tool for air-conditioning systems, cleanrooms, incubators, warehouses, environmental chambers, etc.

Available in four models, the meter calculates multiple parameters: dewpoint, wet bulb temperature, absolute humidity, mixing ratio and enthalpy. Temperature measurement ranges cover -40 to +100°C, depending on the probe model.

The product has a large, user-friendly graphical display and easy-to-use push-buttons. The simple and intuitive user interface is available in 10 languages. Many settings can be modified to meet users' individual needs.

Vaisala Oyj
www.vaisala.com/en/

Wet chemical analyser for process lines

The ADI 2045TI is a wet chemical analyser for process lines. The analytical system uses Metrohm analysis modules like the Titrando range of titrators. Combining Metrohm's knowledge and experience in laboratory analysis with Applikon's experience in process control instrumentation results in an analyser that can perform online wet chemical analysis in difficult environments.

The product can be configured for a multitude of specific applications. With a wide range of available modules (Metrohm burettes, pumps, vessels, valves, loops, digesters and more), there is an analyser for each specific application problem.

The control software allows the user to program sequences of methods, set conditions and alarms, and to manually control the analysers. The results are displayed numerically as well as graphically. All results are stored in a database.

The unit can be programmed for one or more of the following methods: titration for a broad range of applications; Karl Fischer titration for water determination in liquid streams (oil, solvents, glycol, etc); colorimetry for water quality analysis and various process solutions; dynamic standard addition for ion specific analysis that uses ion selective electrodes; and direct measurement for measuring physical parameters such as pH, conductivity and temperature.

The capability to choose a combination of methods means in many cases that a single device will fulfil all analysis requirements. The option for simultaneous analysis to increase response times makes the product an even more powerful analyser.

MEP Instruments Pty Limited
www.mep.net.au

Orbital and linear shaking bath

The Aqua Pro from Grant offers an integration of orbital/linear motion in one water bath, saving space and time in the laboratory. Simply rotate the tray carrier 180° and the motion completely changes.

The bath has good temperature stability and uniformity of ±0.1°C, with adjustable shaking speed and intensity for application optimisation. The set-and-forget technology provides accurate and fast temperature control and ensures flexibility for use over long periods of time. There are many accessories available, giving users more out of the one bath.

The settings include an adjustable high-temp cut-off alarm, countdown timer, presets, calibration facility and dry start/run dry protection, giving users peace of mind and minimising risk in the laboratory, as well as reducing costs on repair services. The discreet magnetically coupled shaking mechanism maximises the working area, making the practical design easy to use. Depending on the load, shaking speed can be between 20 and 200 rpm to accommodate many applications.

The water bath is available in models of 12, 18 and 26 L, with a minimum working depth of 60 mm and a temperature range of 5 to 99°C.

LabFriend
www.labfriend.com.au

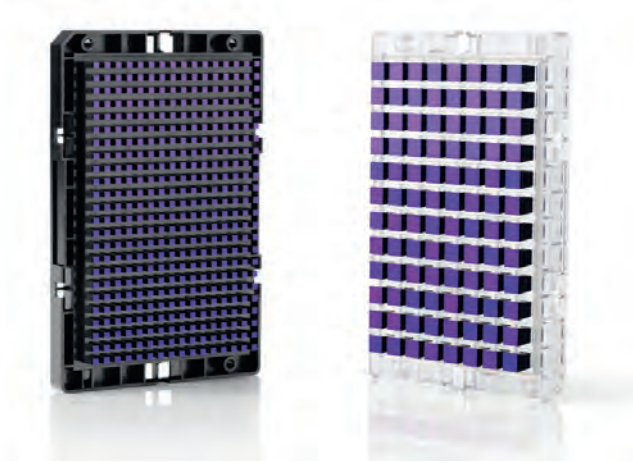
Digital homogeniser

The THq digital tissue homogeniser offers reproducibility and reliability. Using brushless motors, the device is quiet and maintenance-free. Omni says reproducibility of >99.5% is assured, even with variations in sample size or viscosity.

Weighing 308 g, the product is suitable for handheld or post-mounted operation at speeds of up to 35,000 rpm. It can be used with a variety of stainless steel probes in three different diameters (5, 7 or 10 mm) or with the re-usable/disposable plastic Omni Tips (where cross-contamination must be avoided).

The homogeniser is suitable for cell disruption, protein and nucleic acid extractions, general tissue homogenisation, emulsions and suspensions.

Capella Science
www.capellascience.com.au



Genotyping arrays for agrigenomics

Affymetrix has released its latest genotyping arrays for applications in breeding and routine analysis - the Axiom Porcine Genotyping Array and the Axiom Equine Genotyping Array. Each with more than 600,000 markers, the high-density arrays add to a product portfolio that includes bovine, chicken, maize, salmon and wheat.

Axiom genotyping technology offers the agriculture community the capabilities to rapidly design and develop custom arrays. Agrigenomics genotyping arrays, gene expression arrays, reagents and powerful bioinformatics software enable scientists to advance their research and commercial objectives by translating discoveries to routine applications.

With advanced bioinformatics and innovative design strategies, the arrays routinely support genome-wide genotyping and accurately call the genotypes of both diploid and polyploid species. Array-based genotyping empowers the agriculture community with powerful yet easy-to-use genomic tools to rapidly address the challenges posed by the growing food requirements of our world.

Millennium Science Pty Ltd
www.mscience.com.au

Multi-omics cloud-computing environment

AB SCIEX and Illumina have partnered to create what is claimed to be the world's first multi-omics cloud-computing environment for easy, secure analysis and visualisation of large and complex data sets. Consisting of four beta applications on Illumina's BaseSpace plus the CloudConnect plug-in for SWATH, the SWATH Proteomics Cloud Toolkit provides the ability to upload and process data, as well as visualise protein expression results, all securely in the cloud.

The combination of SWATH proteomics and BaseSpace can accelerate users' research. Proteomics core laboratories are no longer burdened with the overhead of local data processing and storage requirements. SWATH users can process data up to 50 times faster and share results instantly worldwide for collaboration. Biologists can visualise integrated omics results with a variety of interactive graphs and charts for enhanced understanding and easy publication. Bioinformaticians can use existing tools and write their own apps to integrate genomics and proteomics data

AB SCIEX Australia Pty Ltd
www.absciex.com

Evaporation system

With the launch of Rotavapor R-100 Essential, BÜCHI Labortechnik presents a complete system for fundamental laboratory applications in evaporation. The solution consists of several individual products: the Rotavapor R-100, Vacuum Pump V-100, Interface I-100 and an optional Recirculating Chiller F-100/105. The Interface I-100 serves as a central control unit, allowing the user to switch the vacuum pump and recirculating chiller on and off.

The complete system offers efficient operation due to the optimal interaction of all components. It features convenient and flexible handling of the digital vacuum control and minimised solvent emissions due to optimised process parameters. Enhanced safety is ensured by the optional coated glassware and safety shield. The system is suitable for a variety of applications due to its multiple flasks of various sizes, including a bump trap.

In Vitro Technologies Pty Ltd
www.invitro.com.au

Protein detection system for immunohistochemistry

Merck Millipore has introduced the SNAP i.d. 2.0 protein detection system for immunohistochemistry (IHC), which is said to streamline immunohistochemistry workflows and decrease slide handling time. The product enables parallel processing of up to 24 tissue slides at a time, making it easier to apply consistent conditions and reduce potential process variability inherent in manual IHC methods.

The system's intuitive format reduces slide handling and speeds wash steps during blocking, washing, antibody incubation and labelling. A controlled vacuum force removes solutions evenly from all slides at once, in seconds. This approach systemises the handling of multiple slides, reducing slide-to-slide process variation without incurring the costs of automation.

The protocol produces robust and consistent staining, without causing tissue degradation or the blotchy artefacts that sometimes plague autostainers. The system is compatible with standard IHC slides and protocols, as well as diverse tissue preparations, including formalin-fixed or fresh frozen samples. Using the device, Western blots and IHC experiments can be performed in parallel.

To conserve precious antibodies, the system enables the manual addition, as well as the removal and recovery, of small volumes of antibodies. Recovered antibodies can be used multiple times.

Merck Millipore
www.merckmillipore.com

Alzheimer's may be an autoimmune disease

In a study published in the *Journal of Alzheimer's Disease*, US neuroscientists have presented evidence suggesting the involvement of autoimmunity against the lipid ceramide in Alzheimer's disease.

The leading hypothesis of Alzheimer's is that an accumulation of beta amyloid plaque first alters communication between brain cells, then prompts cell death. The new study's corresponding author, Dr Erhard Bieberich, states that when inside the brain, ceramide appears to increase beta amyloid production, helping the plaque kill brain cells.

Dr Bieberich's lab, based at the Medical College of Georgia at Georgia Regents University, had previously identified elevated ceramide levels as a risk factor for Alzheimer's and shown that amyloid triggers excess production of the lipid. The team expected that generating antibodies against ceramide would hamper plaque formation.

But the scientists found that the excessive ceramide had already worked its way into the bloodstream, generating antibodies that supported disease progression, particularly in female mice. According to Dr Bieberich, this finding appears to support the theory that Alzheimer's is an autoimmune disease, which tends to be more common in women and is characterised by the immune system producing antibodies against a patient's tissue.

"It's a chicken-egg situation," said first author Dr Michael B Dinkins. "We don't know if the anti-ceramide antibodies that may develop naturally during disease might be a result or a cause of the disease."

The scientists do know that excess ceramide in the brain results in the production of vesicles called exosomes, which start piling up around brain cells. What's in them depends on which cell type makes them, but Dr Bieberich's lab has evidence that when exosomes get taken up by other cells, they trigger cell death. The team thought this might be one way in which ceramide contributes to neurodegeneration in Alzheimer's.

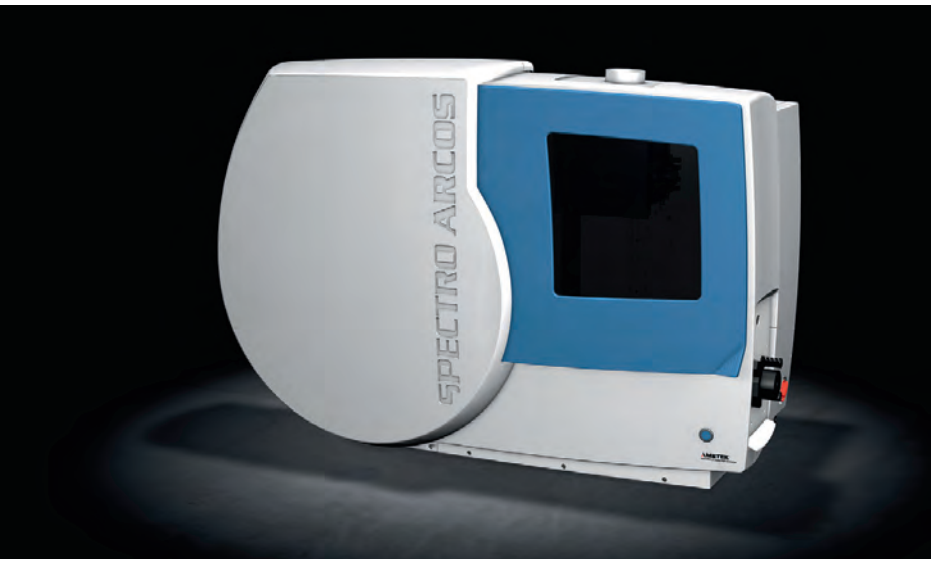
"It takes a while before that becomes toxic because you have ongoing traffic and clearance mechanisms," Dr Dinkins said. At some point, the clearance system stops working and toxic levels of amyloid and ceramide pile up. This led the team to adjust the ceramide levels downward by injecting even more ceramide under the skin, where it would mount an immune response and ideally slow disease progression.

"We thought we can immunise the mouse against its own ceramide - it develops antibodies, which neutralise the ceramide - and we get a similar effect as blocking its production, like a vaccination against it," Dr Bieberich said. The method was expected to also block the subsequent chain of events that contribute to brain cell loss.

But the team found elevated antibody levels already existed in their animal model and, when they added more ceramide, it not only increased antibody levels but also levels of plaque and exosomes. Female Alzheimer's mice treated with more ceramide experienced about a 33% increase in amyloid formation, while their serum exosome levels increased 2.4 times.

The finding has the team wondering if maybe exosomes, which can have a variety of functions including aiding communication, may be trying to intervene and that ceramide antibodies are blocking their efforts. It also suggests that measuring blood levels of ceramide or some of its by-products could be an early test for Alzheimer's, since levels were elevated well before mice showed signs of substantial plaque formation.

The team now aims to directly block ceramide using a genetically engineered mouse that from birth lacks the enzyme needed to make the lipid, then crossbreeding it with an Alzheimer's mouse model. They hypothesise that the mice genetically programmed to get Alzheimer's will produce less ceramide, fewer exosomes and less plaque.



High-resolution ICP-OES spectrometer

SPECTRO Analytical Instruments has announced its SPECTRO ARCOS high-resolution ICP-OES spectrometer. Designed for use in demanding elemental analysis applications in industry, science and academia, the product is said to improve on the sensitivity, stability and precision of conventional ICP-OES instruments, while lowering operating costs with the introduction of innovative components, capabilities and flexibility.

The device is suitable for complex analytical tasks, providing solutions for the elemental analysis of metals, chemicals, petrochemicals and other materials. The company's MultiView capability is said to deliver performance improvements in accuracy and stability and allows for the fast and convenient selection of axial plasma or radial plasma observation with no optical compromise.

The CCD optic system, with a Paschen-Runge mount assembly, delivers a resolution of 8.5 pm in the wavelength range from 130 to 340 nm. Meanwhile, the solid-state power generator provides high plasma power for extreme or quickly changing plasma loads.

The UV-PLUS sealed optical chamber ends the need for the purging of argon or nitrogen gases - along with the related supplies, maintenance costs and downtime. Air-cooled interface technology and the completely air-cooled generator eliminate the need for an external cooling system - along with the associated equipment, power and maintenance costs.

DKSH Australia Pty Ltd
www.dksh.com.au

ICP-MS systems

Analytik Jena has launched its two latest ICP-MS products. The PlasmaQuant MS series' RF generator is claimed to produce robust plasma that can handle any matrix using only half the amount of argon gas of competitive ICP-MS. The product is suitable for routine applications in environmental analysis, food safety, agriculture, pharmacy, mining, chemistry and petrochemistry.

The unit offers an all-digital detection (ADD10) system, providing 10 orders of linear dynamic range in pulse-counting mode. This eliminates the need for a regular and inaccurate cross-calibration associated with other digital-analog detectors. The ADD10 accurately attenuates strong signals without requiring a separate analog measurement. Benefits include a long detector lifetime and fast multi-element analysis, from ultra-trace to major levels in a single measurement.

The PlasmaQuant MS Elite features 1.5 GHz sensitivity, making it up to five times more sensitive than competitive systems, according to the company. This makes it suitable for semiconductor and research applications in geochemistry, environmental, materials science and metallomics.

The product is suitable for applications that require specialised sample introduction accessories, including laser ablation and liquid chromatography. The high sensitivity allows laboratories in the field of single-particle analysis to detect nanoparticles at less than 10 nm diameter.

The twin-position, bench-mounted design offers flexibility for users to configure the system to their laboratory requirements. Dual entry ports allow for fast and easy connection of third-party accessories while the small 0.4 m^2 footprint requires little lab space.

MEP Instruments Pty Limited
www.mep.net.au

High-purity nitrogen generator

The i-FlowLab from Peak Scientific provides on-site generation of nitrogen gas, delivering a continuous and consistent supply of high-purity nitrogen at the pressure and flow rates required to meet the demands of the user's laboratory or research facility.

Engineered around PSA technology, the product is available in various preconfigured specifications to suit specific flow and purity demands. A single generator can provide nitrogen at flow rates from 35-3386 slpm. Purities are specified at time of system design to meet the needs of the application up to 99.999%. Due to the expandable design, additional CMS column banks can be added to each generator after installation to increase maximum flow rate.

The streamlined, compact footprint design of the system allows for more efficient use of available space in comparison to bulk tanks, large quantities of dewars or pressurised cylinders. In addition to the generator, Peak Scientific also provides a self-contained pre-filtration package in the form of Peak Pure Air, along with necessary ancillary tanks tailored specifically to meet the requirement of the user's facility. All that's required is the provision of a suitably powered air compressor, which can be specified separately if not already available on-site. The company can provide a fully project managed solution or design, installation and commissioning to ensure good nitrogen supply and energy efficiency.

Peak Scientific Instruments Pty Ltd
www.peakscientific.com

Mass flow meters

Aalborg Instruments' ZFM mass flow meters combine meter intelligence, user convenience and good flow performance. They are designed for multigas/multirange functionality up to 8 bar (currently six gases) and standard accuracy of ± (0.5% RD + 0.2% FS) based on actual calibration.

By connecting the instrument to the RS232/RS485 port of a PC or laptop and running the free ZFM Configuration Utility software, the user can select different gas types and flow ranges within a few minutes without removing the instrument from the installation. Supported gases include N_2, air, O_2, argon, helium and CO_2.

Features include: extensive self-diagnostics with status LED or OLED (optional) indication; automatic sensor zero offset adjustment (digital interface or local push-button); digital interface (RS232 or RS485) test/configuration port; two programmable totalisers; full-scale covered flow ranges from 3.5 to smL/min to 10 sL/min in seven models; selectable analog 0-5 VDC, 0-10 VDC or 4-20 mA outputs; universal 14-24 VDC power supply input.

Stanton Scientific Company
www.stantonscientific.com

Thermal mass flow controllers and flow meters

Brooks Instrument has released the GF40/80 Series thermal mass flow controllers (MFCs) and flow meters. The units are available with the company's MultiFlo technology, which enables fast changeover from one gas type to another so research, development and laboratory users can quickly change their experiment conditions and achieve high process accuracy.

With flow rates up to 50 slpm and a 'normally open' valve for non-hazardous gas applications, the devices are suitable for applications that require a higher flow rate with the flexibility of a MultiFlo-capable mass flow controller.

Measurement Plus Pty Ltd
www.measurement-plus.com.au

Automated colony counter and software

Synbiosis has introduced a software module for the ProtoCOL 3 automated colony counter. The software is claimed to make Protocol 3 the world's first commercial automatic microbial identification and counter of colonies cultured on CHROMagar plates and means that with minimal training, microbiologists can use the system to rapidly identify and enumerate all key clinical, water and foodborne pathogens.

The software module, which was developed in partnership with CHROMagar, ensures that the ProtoCOL 3 system can accurately identify any bacteria or yeast cultured on a CHROMagar plate in less than a minute, saving microbiologists hours of visually inspecting colonies and manually recording results. The system performs these tasks by utilising red, blue and green lighting to capture a lifelike colour image of the colonies on the plates.

The software module analyses the image and can distinguish between rose pink and dusty pink, as well as turquoise and steel blue. This allows precise identification of common pathogens, including *Salmonella* spp., *Staphylococcus aureus*, *Candida albicans*, *E.coli*, Group B *Streptococci*, *Listeria* spp., *Vibrio* spp. and *Pseudomonas* spp. The system also simultaneous enumerates the different coloured colonies of each species, providing objective, consistent data and reducing operator errors, to generate accurate results which can be stored as images and Excel spreadsheets.

The product is suitable for clinical microbiologists as well as food, beverage and water quality control scientists looking to obtain precise microbial identification results and increase their colony counting throughput.

Don Whitley Scientific Australia
www.dwscientific.com.au

Ultra-thin keyboard

The iKey SB-101 Ultra-Thin keyboard has a depth of only 15.2 mm. The product is fully sealed and meets IP65 specifications. It is protected against splashing, hose-directed and submerged water; bleach, alcohol and hospital-grade disinfectants; corrosive, abrasive, acidic and alkaline substances; dirt, dust, sand and other airborne debris; and extreme temperatures.

Constructed in a lightweight ABS polycarbonate case with an industrial silicone rubber keypad, the board is easy to clean with disinfectants. A QuickLock key allows the product to be disabled quickly, avoiding unwanted keystrokes during the cleaning and disinfection process. A USB interface allows the device to be used with all modern computer systems.

Interworld Electronics and Computer Industries
www.ieci.com.au

Concern for Mars mission as mineral destroys organic compounds

As NASA's Curiosity mission searches for various minerals on Mars, in the hope of finding evidence of ancient habitable environments, British scientists have found that one such mineral (jarosite) breaks down organic compounds when it is flash-heated. Their research has been published in the journal *Astrobiology*.

On Earth, iron sulfate minerals like jarosite form in the acidic waters flowing out of sulfur-rich rocks. Despite the adverse conditions, these waters are a habitat for bacteria that use these dissolved sulfate ions. This makes the minerals of interest to scientists studying Mars, as their presence provides evidence that acidic liquid water was present at the same time the minerals formed - which could have provided an environment favourable for harbouring ancient microbial Martian life.

On board the rover Curiosity, the Sample Analysis at Mars (SAM) instrument analyses soil samples for evidence of organic compounds by progressively heating samples up to around 1000°C (flash heating), which releases gases. These gases can then be analysed by gas chromatography and mass spectrometry, which can identify molecules in the gas and see if any organic compounds are present.

Researchers from Imperial College London and the Natural History Museum replicated the technique with a combination of jarosite and organic compounds. The team discovered that the instrument's technique broke down jarosite into sulfur dioxide and oxygen, with the oxygen then utterly destroying the organic compounds. They noted that if jarosite is present in soil samples that Curiosity analyses, researchers may not be able to detect it because both the jarosite and any organic compounds could be destroyed by the flash-heating process.

Study co-author Professor Mark Sephton, from the Department of Earth Science and Engineering at Imperial College London, last year found a similar issue with the mineral perchlorate. Flash-heating causes the mineral to break down and to give off oxygen and chlorine gas, which in turn react with any organic compounds, breaking them down into carbon dioxide and water.

"The destructive properties of some iron sulfates and perchlorate to organic matter may explain why current and previous missions have so far offered no conclusive evidence of organic matter preserved on Mars' surface," Professor Sephton said. "This is despite the fact that scientists have known from previous studies that organic compounds have been delivered to Mars via comets, meteorites and interplanetary dust throughout its history."

But Professor Sephton has shown that though the reaction of perchlorate was problematic, scientists could potentially use the spike in carbon dioxide resulting from the experiment to detect the presence of organic compounds in the sample being analysed. The team suggests a similar approach may alert scientists to the presence of jarosite.

The next step will see the researchers using synthetic jarosite in their experiments, which will enable a cleaner decomposition process to occur when the mineral is flash-heated. This will allow for more precise measurements to be taken when the oxygen is released and will hopefully enable such measurements to be taken from potential mineral samples on Mars.

Ergonomic lab seating

The Bimos range of workplace chairs features the Neon, Labster and Fin chairs for lab seating. The chairs are specifically tailored to the movements and postures necessary in laboratory work.

The physically awkward sitting involved in laboratory work can cause excessive strain on the body, resulting in fatigue, circulatory disorders and problems with posture or the musculoskeletal system. The chairs help relieve stress on the body and support a smooth, uninterrupted workflow, so users can sit and stand ergonomically while working in the laboratory.

The range is suitable for any working area, extending from sturdy seating solutions for production workstations through to highly sophisticated laboratory and cleanroom chairs. The company's seating solutions have a common objective: to provide people with optimum ergonomic support, fitting into their working environment without requiring them to adapt.

Healthezone
www.healthezone.com.au

Probe-based video microscope

The next-generation inline PVM tool, ParticleView V19 with PVM technology, is now available. The in situ probe-based particle vision and measurement tool continuously captures high-resolution images under a wide range of process conditions. It then automatically prepares a report pairing the most relevant images to data tracking particle size and concentration changes. This blend of high-resolution images and trend data helps promote quick, comprehensive particle system understanding for significant productivity enhancements during process design, scale-up and manufacturing.

The product's ability to pair relevant images with trend data means a reduction in the time and effort required to investigate significant process events or upsets. As scientists are able to readily determine the influence of process conditions on particle size and shape, processes can be designed so particles behave more predictably. Scientists also eliminate the need for cumbersome and sometimes inaccurate offline sampling.

Continuous monitoring offers researchers knowledge on complex particle systems that might otherwise be too time-consuming or expensive to obtain - such as polymorphic transformations, phase separation events and the formation of delicate structures such as flocs, dendrites and droplets. This information can help characterise transient events and elusive mechanisms to augment sound decision-making and further lower process development costs.

Common applications for V19 with PVM technology include understanding crystallisation; identifying growth, agglomeration, breakage and shape changes; controlling particle size and shape; monitoring polymorphic transitions; identifying the source of batch-to-batch inconsistencies; optimising oil/water separations; and viewing particle and droplet systems in locations where offline sampling is not feasible (such as high-pressure lines).

Mettler Toledo
www.mt.com

PCR products

The SSI range of PCR products allows users to amplify their results.

The company's PCR plates are compatible with most thermocyclers and are available skirted, semi-skirted and non-skirted with a standard or low profile. The plates have high-contrast letters and numbers for quick and easy sample identification.

The PCR tubes have uniform, ultrathin walls for optimum heat transfer and come with flat or dome caps. PCR strips, meanwhile, are available in eight or 12 tube lengths and come in rigid or breakable formats with a variety of flat and dome cap options.

All plates, strips and tubes are also available in coloured and white formats. Racks to hold all products in the PCR range are also in stock.

Interpath Services Pty Ltd
www.interpath.com.au

Custom instrument for drill core analysis

Energy exploration, hydrogeological surveys and geosequestration operations all involve extracting and analysing drilling cores to provide information about the underlying strata. An important objective of the sampling is to determine the per cent porosity of the formation. Geological scientists have used a variety of methods to determine drill core porosity, but a fast, non-destructive, non-hazardous method is most preferable.

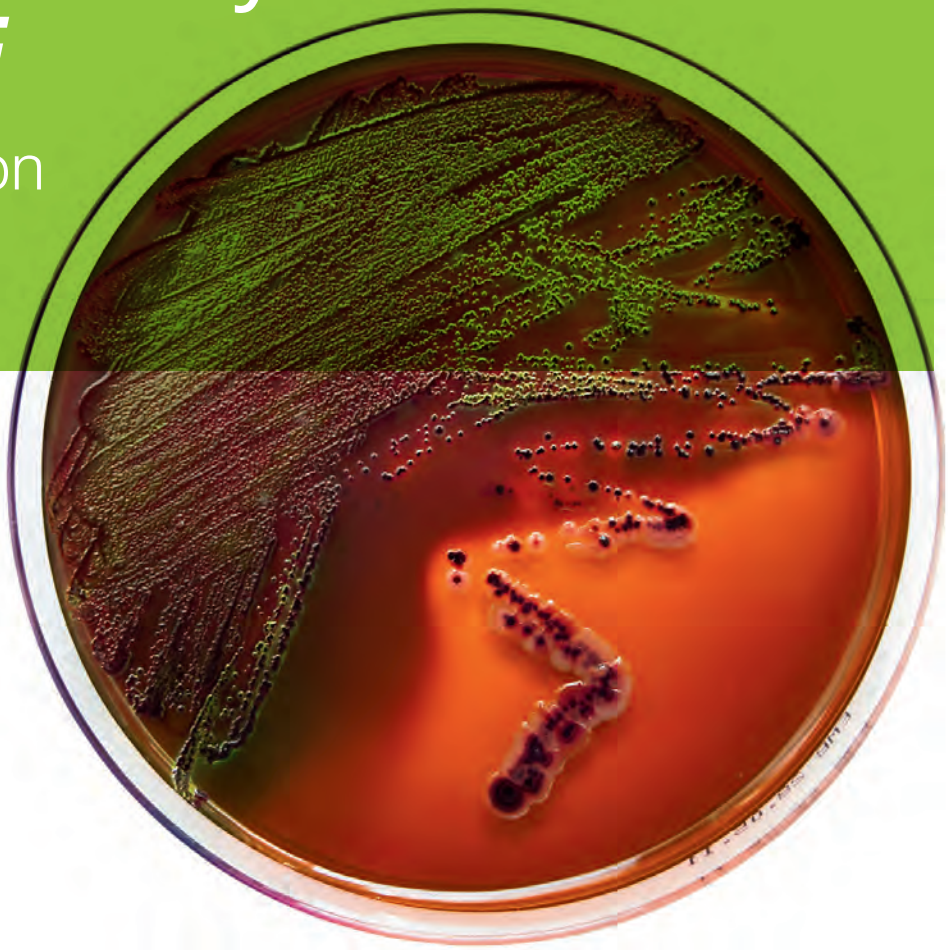
A gas displacement pycnometer is a suitable technique for measuring skeletal volume, but until now, this technique was very tedious because the maximum volume sample chamber capacity of existing models required the geological scientist to break a core into many smaller pieces that were each analysed. An average of the many analyses was used to arrive at a reliable value for the skeletal volume.

Micromeritics has designed a gas displacement pycnometer for users who want to measure the pore volume of drilling cores without having to break off small pieces that fit into a standard sample chamber. The AccuPyc II 1340 was custom-engineered with a large sample chamber (a volume of approximately 2000 cm^3) to accommodate a 95 mm diameter core of up to 278 mm in length, thus improving sampling statistics by eliminating the need to run multiple analyses. A sample chamber can be custom-made to accept essentially any one of the various core sizes used throughout the world for reservoir evaluation.

Applications include: testing drill cores intact (mineral research, deep drilling exploration, identifying underground reserves, precious minerals in ore, oil or gas storage potential); testing rock parts (mineral exploration, selling products by density instead of weight); and testing unusually shaped large items (prosthetics, castings).

Particle & Surface Sciences Pty Ltd
www.pss.aus.net

Genetically modified *E. coli* dependent on synthetic nutrients



While genetically modified organisms (GMOs) have imparted many benefits on society - including churning out drug ingredients, helping produce biofuels, teaching scientists about human disease, and improving fishing and agriculture - they also have the potential to upset natural ecosystems if they were to escape.

Physical containment of GMOs is not foolproof, so attention has since turned to biocontainment: building in biological safeguards to prevent the organisms from surviving where they're not meant to. In the case of Professor George Church of Harvard Medical School's Wyss Institute, the secret was making an organism whose life was dependent on something only he and his group could supply.

In 2013, Church and his team created the world's first genomically recoded organism - a strain of *Escherichia coli* with a radically changed genome. Writing recently in the journal *Nature*, the scientists reported that they had further modified the *E. coli* to incorporate a synthetic amino acid in many places throughout their genomes. Without this amino acid - which cannot be created by the organism or found anywhere in the wild - the bacteria are unable to perform the vital job of translating their RNA into properly folded proteins.

"We now have the first example of genome-scale engineering rather than gene editing or genome copying," said Church. "This is the most radically altered genome to date in terms of genome function. We have not only a new code, but also a new amino acid, and the organism is totally dependent on it."

The process built on the existing method of turning normally self-sufficient organisms like *E. coli* into auxotrophs - creatures which can't make certain nutrients they need for growth. The team also made 49 genetic changes to protect against the possibility that the *E. coli* could acquire the ability to synthesise the nutrient over time. According to Church, the chance one of the bacteria could randomly undo all of those changes, without also acquiring a harmful mutation, is incredibly slim.

These criteria limited Church and his team to "a small number of genes", he said. The group used computational tools to design proteins that might cause the desired "irreversible, inescapable dependency". They took the best candidates, synthesised them and tested them in actual *E. coli*.

They ended up with three successful redesigned essential proteins - whose combined capacity was "more powerful than using them separately", Church said - and two dependent *E. coli* strains. By targeting the proteins that drive the essential functions of the bacterial cell, the *E. coli* would be unable to flourish even if it did escape.

The group grew a total of 1 trillion *E. coli* cells, and after two weeks none had escaped. "That's 10,000 times better than the National Institutes of Health's recommendation for escape rate for genetically modified organisms," said Church.

Church's team also made the *E. coli* resistant to two viruses, with more to follow. The modifications offer theoretically safer *E. coli* strains that could be used in biotechnology applications with less fear that they will be contaminated by viruses, or cause ecological trouble if they spill.

A separate group, led by a Farren Isaacs of Yale University (a long-time collaborator of Church's), has meanwhile been able to engineer the same strain of *E. coli* to become dependent on a synthetic amino acid using different methods. The success of the two studies suggests scientists may one day develop something that, according to Church, "will be so biologically contained that we won't need physical containment anymore".

Benchtop freeze dryers

The Martin Christ Epsilon 1-4 LSCplus and Epsilon 2-4 LSCplus benchtop freeze dryers are high-performance, universal laboratory and pilot systems for lyophilisation of solid or liquid products in ampoules, vials, glass flasks, plasma bottles or dishes. They share a geometrical likeness with large production machines and use similar temperature-controlling systems.

The Epsilon 1-4 LSCplus and Epsilon 2-4 LSCplus units have an internal ice condenser temperature with a minimum of -55 and -85°C respectively and are available with one shelf with 0.11 m^2 useable surface area. The dryers are suitable for pre-freezing products on temperature-controlled shelves; freeze drying (sublimation) of products according to pre-selected desired time, temperature and pressure profiles; and final drying of products.

The latest cooling techniques provide for shelf temperatures of -45 or -70°C (pre-freezing) in the compact chamber. This permits sensitive pharmaceutical and biotech products, eg, amorphous structures with a low glass transition point, to be freeze dried safely.

John Morris Scientific Pty Ltd
www.johnmorris.com.au

Firmware for mass flow meters and controllers

Alicat Scientific has expanded its Gas Select firmware to include a library of up to 130 preloaded gases, referenced to NIST Prop 9 and a utility for defining mixed gas compositions. The Composer utility gives users the ability to quickly program and store up to 20 personalised gas compositions directly on Alicat mass flow meters and mass flow controllers. The utility allows the devices to adapt to a range of laser manufacturing applications and users' changing needs.

The firmware comes on all Alicat mass flow meters and controllers. Version 5.0's expanded library includes up to 130 preloaded full gas calibrations, depending on the instrument series. In addition to many pure gases, the firmware includes six gas mixes common for carbon dioxide and helium-neon lasers. The library has also been updated to include complete NIST Ref Prop 9 gas properties data for the preloaded gases and gas mixes.

For precise control of virtually any type of laser gas, the Composer module brings customisation and flexibility to accurate mixed gas measurement. Using the device's integrated digital display, users can define gas compositions to 0.01% for each of up to five constituent gases. Up to 20 laser gas mixes can be created and stored simultaneously on each device. Users who operate their instruments via computer can generate gas lists for multiple devices in seconds with single line RS232 commands. As personalised gas compositions can be added or deleted quickly, the instruments easily adapt to different flow needs in the future.

Duff & Macintosh
www.duffmac.com.au

Ion chromatography system

The IonQuest ion chromatography system is suitable for analysing complex samples, such as primary potable waters, finished waters, effluent waters, processing fluids, blood plasma, pharmaceuticals, foods and beverages, semiconductor processing fluids, etc. The product enables anions and cations, such as fluoride, chloride, bromide, cyanide, arsenic species, organic acids, sodium, potassium, calcium, caesium and magnesium, to be detected with ease.

Features include ultralow noise and drift, regenerative anion suppression, modularity, 21 CFR Part 11 compliance PowerStream software and biocompatibility, all of which ensure the system will accommodate current and future requirements. The software is easy to use and there are no limits on the choice of eluents, columns, pumps, sample pretreatment, samples, column conditions and detectors.

BEST Lab Instrumentation Pty Ltd
www.bestlab.com.au

Brushless DC servo motor

maxon motor's brushless DC servo motor, with a 6 mm diameter, is a motor gearhead and feedback combination featuring a high motor speed capability of up to 100,000 rpm on very low 3, 6 and 12 V winding options. There is also the possibility to customise the company's coreless winding to suit the desired speed range.

The 6 mm diameter planetary gearhead can reduce the speed and increase the torque of the motor by up to 854 times. The motor is fitted with a hall sensor network for feedback that gives a state change every 60°. Considering both the speed of the motor and the increased resolution from the gearbox reduction, this equates to high-resolution control over the motor.

Fitted with multiple stainless steel ball bearings, the motor and gearhead offer high radial and axial load levels and the motor preloading controls excessive resonance at such high speeds. The winding constants and the gearhead ratios must be carefully considered to best suit the application.

maxon motor Australia Pty Ltd
www.maxonmotor.com.au

Infrared thermometer

The optris thermoMETER P20 is an infrared thermometer suitable for fast recognition of object temperature from 0 to 2000°C. Available in four models, the product adopts non-contact measurement, detecting target temperature at a maximum distance of 12 m. Integrated laser aiming, together with optional telescopic sight, allows exact sighting of measuring targets.

The handheld temperature sensor features adjustable emissivity from 0.100 to 1.000 with a spectral range from 525 nm to 14 μm. The series is used in blast furnaces, forging processes, temperature measurement of liquid metals and OEM.

Bestech Australia Pty Ltd
www.bestech.com.au

A more sensitive peanut allergy test

Chemists at the University of Connecticut (UConn) have developed a peanut allergy test which is said to be far more sensitive than current procedures. It is hoped that the blood test will be better able to diagnose the severity of an individual's allergic reaction, which can range from hives to anaphylactic shock.

When an allergic person eats peanuts, their immune system releases the antibody protein immunoglobulin E (IgE). These antibodies fight off peanut allergen molecules by binding to them and flushing them out of the body. But the release of the antibodies causes tissue cells in the body to produce histamine, which in turn generates a variety of allergy symptoms. The more antibodies that are released, the more histamine is generated - and the stronger the allergic response.

Existing peanut allergy tests can generally measure IgE antibodies found in a blood sample, but the presence of other biomolecules can distort the results. Co-author Associate Professor Mark Peczuh said the traditional method of measuring these antibodies "uses a mixture of all the peanut proteins … [which] can lead to readings that a patient is allergic when she or he is not" - or vice versa.

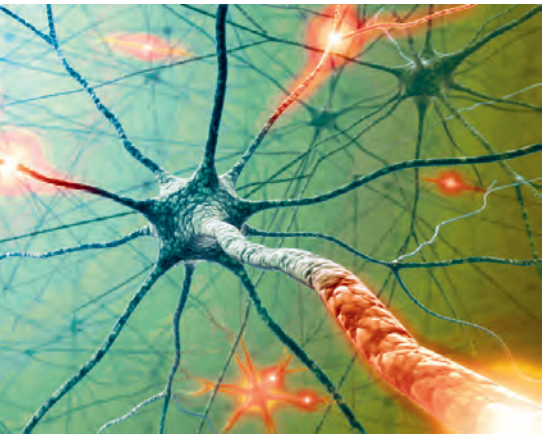
The new test screens out other biomolecules and measures the presence of antibodies that bind to very specific protein fragments, called peptides, and carbohydrate residues found in peanuts. The chemists tested both these components in their new system, then injected blood serum from patients known to have peanut allergies into the array.

As the blood serum floated over the samples, IgE antibodies were pulled down by the allergens and bound by them. This meant the team could measure the quantity of antibodies to determine how strong a reaction a person would have to peanuts. The researchers also attached magnetic beads to the allergen samples, which captured the IgEs and amplified the final measurements.

The results, published in the journal *Analyst*, correlated with the patients' known allergy levels from other tests. And while the trial test was limited to just a few allergic components from peanut glycoproteins, co-author Professor James Rusling says it could be expanded to screen for more than 20, allowing for even more selective results.

"Eventually, we'd like to use maybe five different peptides and carbohydrate samples to see how these IgEs bind to them," Professor Rusling said. "That way, we could determine a clear fingerprint of a patient's susceptibility to a specific allergen."

Professor Rusling added that the test may eventually be used as "an analytical tool to investigate the actual biology of the allergic response to peanuts and other food items in general". As there has been some debate over the role carbohydrates play in allergies, and the new system can test both protein peptides and carbohydrate residues, the researchers hope they may learn more about how specific protein and carbohydrate epitopes bind to antibodies to gain a better understanding of how allergies are induced.



Neural engineering support reaches milestone

A generous gift of $5 million to the Centre for Neural Engineering at the University of Melbourne brings the Believe campaign to reach the significant milestone of $400 million.

Donated by Mr Leigh Clifford AO, Mrs Sue Clifford and their family, the $5 million will endow The Clifford Chair in Neural Engineering.

The new chair will help facilitate the development of new medical point of care devices, providing clinicians with the information they require to undertake faster, more reliable diagnoses and better management of patients, especially those located in Indigenous and rural communities.

It will also work across a number of disciplines to further links between life sciences, engineering and physical sciences such as developing new biotechnologies, treatments and engineered systems that replicate biological networks.

Mr Clifford, the current chairman of Qantas Ltd and former CEO of Rio Tinto, is an engineering alumnus from the university and deputy chairman of Believe - the campaign for the University of Melbourne. The campaign is aiming to raise $500 million by the end of 2017 to support key research, scholarship and engagement goals.

Professor Stan Skafidas, director of the centre, is passionate about the interface between engineering, medicine and the future.

"This is an exciting challenge as we work together to create not only portable diagnostic tools, but the next generation of bionic devices and implants."

NCRIS funding secured

Funding of the National Collaborative Research Infrastructure Strategy (NCRIS) will continue in the short term, with the Australian Government securing a further 12 months of funding for the scheme.

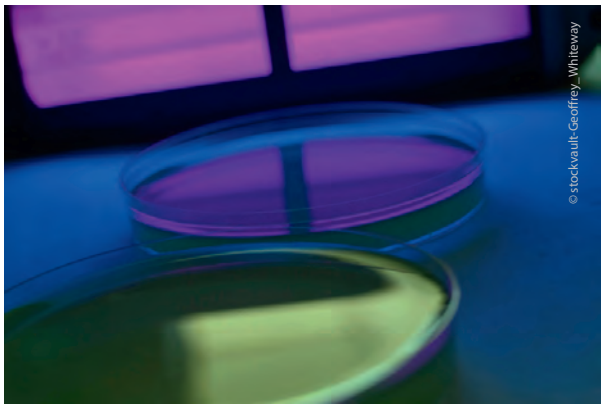
Australia's major national research facilities can now breathe easier with the government backing away from linking NCRIS funding to the passage of higher education reforms through the Senate - the proposed deregulation of the university sector was voted down this week.

The funding decision follows numerous approaches to the government from across the science community and business sector warning that uncertainty over NCRIS funding from 1 July put over $2 billion of public investment at risk and several facilities were likely to shut down.

The Australian Academy of Science's President Professor Andrew Holmes welcomed the announcement.

"This decision will mean researchers can get on with the job of developing the new technology and innovative ideas that Australia needs for the future," said Holmes in a statement.

"It means they are back from the brink of closure. Now what we need to see is long-term funding for this essential infrastructure that gives researchers and industry in Australia the certainty they need."



Introduced by the Howard Government in 2004, $150 million a year is distributed through NCRIS to fund facilities that provide services to other researchers. Since 2004, about $2.5 billion has been invested in national research infrastructure.

The 2015-16 funding will allow the continued operation of 27 facilities that support fundamental and applied research across Australia; for example, in molecular bioscience and big data, medical research and biosecurity.

NCRIS-funded facilities directly employ 1700 highly skilled staff that support the work of more than 35,000 researchers in Australia and overseas.

The scheme provides researchers with access to world-class infrastructure, a much-needed service given the small size of Australia's research community. NCRIS has also been a resounding success in contributing to world-class research around the country.

In the longer term, a review of infrastructure requirements for Australia is underway with the Research Infrastructure Review. The review will aim to understand the investment needed to support national science infrastructure and where to make this investment.

2016 Academy honorific awards open

Nominations for the 2016 Australian Academy of Science honorific awards for scientific excellence are now open.

The 2016 awards are open to career and early- and mid-career researchers normally resident in Australia, and recognise scientific excellence across a range of disciplines in the biological and physical sciences.

Nominations may be made by anyone in the scientific community, with the exception of the Macfarlane Burnet or the Matthew Flinders Medals and Lectures for which nominations may only be made by Academy fellows.

For more information see the awards section on the academy website. The closing date for award nominations is 30 April 2015.

Applications are also open for research awards, travelling fellowships and conference and research support for 2016-17. The closing date is 15 June 2015.

Walkaway clinical chemistry analyser

The Diatron Group has launched its walkaway clinical chemistry analyser, the P500. The medium-throughput system (215 tests/h on a typical sample mix) is ergonomically designed and user friendly, with a high level of automation.

The intuitive, Windows-based software and smart architecture means the product is able to offer many features on an accessible platform. These include uninterrupted workflow, enhanced walkaway operation and remote-access diagnostics.

The unit has a well-structured, easy-to-service design and 'one window' software featuring an easy-to-use icon interface menu and inventory management. The minimal usage of consumables and low water consumption enable good performance, while the product's high-quality components ensure accurate results. There is also an optional ISE module available which significantly increases the throughput to over 450 tests/h.

Diatron has also released a range of high-quality clinical chemistry reagents which have been developed to complement the P500 and the company's other clinical chemistry analysers. The QC-guaranteed range includes substrates, enzymes, electrolytes, lipids, specific proteins and special tests, all with good sensitivity, precision and linearity.

The reagents are manufactured in an ISO9001-certified production facility and undergo extensive performance testing for each batch and lot, ensuring minimal variation and maximum shelf life. The tests' liquid reagents are safe and easy to use and are designed and performance-optimised for direct loading and use on the clinical chemistry analysers.

Diatron
www.diatron.com

Confocal Raman microscope

The inVia confocal Raman microscope, from Renishaw, enables users to study a wide range of samples with the broad range of Raman imaging techniques. The company's suite of complementary imaging options makes it easy for users to get the chemical and structural information they need.

Transmission Raman mapping is a suitable method for the fast, quantitative analysis of bulk material homogeneity. Transmission Raman mapping is said to be particularly advantageous for pharmaceutical applications such as tablet dose and blend uniformity, in comparison to static Raman transmission.

Renishaw Oceania Pty Ltd
www.renishaw.com

Lauren Davis

Forensic scientist sticks to his guns

Professor Paul Kirkbride may not be a detective, but he's on mission to catch the perpetrators of gun crimes - even when they haven't left behind a weapon or bullet cartridge.

Image credit: Sam Noonan.

The SHRIMP from Australian Scientific Instruments.

Formerly the assistant director at Forensic Science SA and chief scientist at the Australian Federal Police, the Flinders University researcher is now employing cutting-edge instruments to examine gunshot residue at a very high level of detail. He explained that the tiny, smoke-like particles "effectively leak out of a firearm when it's discharged" and may end up on the victim, the shooter or witnesses nearby - but because of their small size, analysis of the particles has, until now, been "quite a challenge".

Professor Kirkbride's decade-long search for new analytical techniques gained new ground when he collaborated with the University of South Australia's (UniSA) Ian Wark Research Institute and was granted access to its time-of-flight secondary ion mass spectrometer (ToF-SIMS). The device was the only one in Australia at the time, and was additionally "not an instrument that a typical forensic lab would be able to afford to buy", he said.

Yet the ToF-SIMS, which is typically used for the analysis of mineral particles rather than forensic work, was ideal for Professor Kirkbride's research. Unlike other scientific instruments, the surface analytical technique allows researchers to work with very small particles and to only sample a very small quantity of materials at any one time.

"It gives us a lot of opportunity to work with a small particle and gives us plenty of time to acquire good data, and the ToF-SIMS, being a mass spectrometer, allows us to identify a wide range of elements that are present in the material we're analysing," Professor Kirkbride said.

"It allows us to get down to the level of concentration of around tens of parts per million in a particular material. So it not only allows us to get an idea of the general make-up of something, but also the trace-level stuff, which is often far more informative than the gross level of composition."

Working with his then-PhD student John Coumbaros in a collaboration with Western Australia's ChemCentre, Professor Kirkbride found that there are two types of gunshot residue: that of the gunpowder (the propellant), which comprises organic compounds like nitro-glycerine; and the primer, which is a primary explosive that detonates when the fire pit hits the cartridge and contains a mixture of various salts and ground glass. Many of these primary ingredients change their composition when the explosive detonates and the gun fires - but the glass does not.

"We have something that carries its composition through from the unfired stage, through to the fired stage, through to the residue stage," Professor Kirkbride said. "So we recognised that this was actually a residue from the firearm, and that it carries with it unique properties … [and] allows us to form a link, a chemical link, between a residue and the ammunition."

The project marked a significant milestone in Professor Kirkbride's career. It helped to close a Western Australian murder case, and Coumbaros went on to become a senior scientist at ChemCentre. Professor Kirkbride, meanwhile, successfully applied for financial support through the South Australian Government's Premier's Research and Industry Fund.

The funding was "absolutely vital" to Professor Kirkbride's research, he said, and has enabled him to utilise a new piece of scientific equipment - this time a Sensitive High Resolution Ion Microprobe (SHRIMP) at Geoscience Australia in Canberra. Manufactured by Australian National University spin-off company Australian Scientific Instruments, the SHRIMP is a huge, high-precision SIMS which is particularly suited to the analysis of oxygen and other stable isotopes.

Professor Kirkbride explained that the identification of stable isotopes in the glass fragments will provide "another level of complexity" to his work. Like the elements in the glass identified by the ToF-SIMS, its isotopic characteristics are like "a fingerprint", he said, "which doesn't change before, during or after the gun is fired".

"The isotope fingerprint carries clues as to the particular geographical origin of the minerals that make up the glass, and we expect that this will point us towards the factory or country of origin of the ammunition," he continued.

Should it prove successful, Professor Kirkbride's work will provide obvious benefits to law enforcement. The Australian Institute of Criminology states that 17.5% of homicides in 2012 were carried out using a firearm - only a small drop since records began in 1995 (18.4%) and a fair increase since 2005's low of 9.6%. The potential to link residue back to its ammunition - and the ammunition back to a suspect - would therefore be an "incredibly valuable - and previously unachievable - piece of information for law enforcement agencies", Professor Kirkbride said.

Additionally, Professor Kirkbride is simply pleased to have spent so much of his career collaborating with various researchers and up-and-coming PhD students, such as Coumbaros. Having worked in forensic science since 1986, he feels particularly privileged to have watched his students learn, work and continue into the profession.

"It's fantastic to bring students through and to contribute to the next generation of forensic scientists," he said. Given the potential impact of Professor Kirkbride's work on the industry, it's fair to say that he's contributed to the next generation of crime fighters as well.

BioKorea 2015
8-10 April 2015, Seoul, Korea
www.biokorea.org

5th International Congenital CMV Conference and 15th International CMV/ Beta Herpes virus workshop
20-24 April 2015, Brisbane
www. conference.qimrberghofer.edu.au/page/international_CMV_workshop

25th European Congress of Clinical Microbiology and Infectious Diseases (ECCMID 2015)
25-28 April 2015, Copenhagen Denmark
www.eccmid.org

AusMedtech 2015
29-30 April 2015, Melbourne
www.ausmedtech.com.au

ESA Seminar 2015
1-3 May 2015, Manly, NSW
www.esaseminar.org.au

Lowy Cancer Symposium 2015
4-6 May 2015, Sydney
www.lowycancersymposium.org

19th Congress of the International Society for Human and Animal Mycology
4-8 May 2015, Melbourne
www.isham2015.com.au

3rd Prato Conference on Pore Forming Proteins
12-15 May 2015, Prato, Italy
www.pores2015.org

Cooperative Research Centres Association annual conference - Australia 2040
25-27 May 2015, Canberra
www.australia2040.com.au

Australian Society for Microbiology ASM 2015
12-15 July 2015, Canberra
www.theasm.org.au

2015 Chemical Proteomics Symposium
16-17 July 2015, Sydney
www.cmri.org.au/Research/Workshops-and-Symposia/2015-Chemical-Proteomics-Symposium

2nd Asia-Oceania Conference on Neutron Scattering
18-23 July 2015, Manly, NSW
www.ansto.gov.au/ResearchHub/Bragg/CurrentResearch/ConferencesandWorkshops/#sthash.EQmDE6UV.dpuf

48th Annual AIFST Convention & the 15th Australian Food Microbiology Conference
11-13 August 2015, Sydney
www.aifst.asn.au/convention

ESA Clinical Weekend
21-23 August 2015, Adelaide
www.esaclinicalweekend.org.au

ESA-SRB 2015, ASM
23-26 August 2015, Adelaide
www.esa-srb.org.au

25th ISN-APSN Biennial Meeting
23-27 August 2015, Cairns
www.neurochemistry.org/biennial-meeting/isn-2015-biennial-meeting.html?id=18

ENSA
24 August 2015, Adelaide
www.ensa.org.au

ADS-ADEA ASM 2015
26-28 August 2015, Adelaide
www.ads-adea.org.au

ADIPS ASM 2015
28-29 August 2015, Adelaide
www.adipsasm.org

Agricultural Bioscience International Conference (ABIC) 2015
7-9 September 2015, Melbourne
www.abic.ca/abic2015

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