

Lab+Life SCIENTIST



Bushfire smoke and
mass germination

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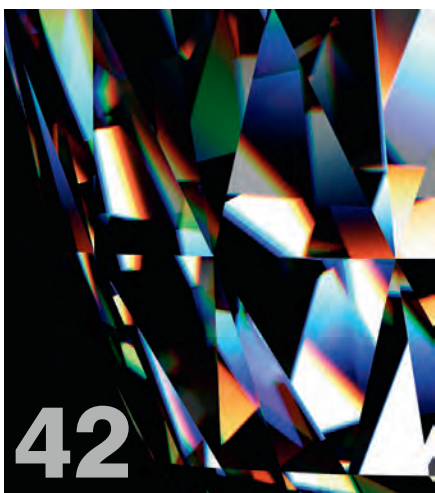
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In August this year, the Monash Institute of Pharmaceutical Sciences (MIPS) officially opened its new laboratory — an analytical hub that is intended to bring together researchers from across Victoria.



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Hormonal traders

make risky decisions

It's no secret that stockbrokers operate in stressful environments, so what happens when these environments affect their hormone levels? A new study has found that the state of a trader's body chemistry can impact the stock market just as much as the state of the economy.

The study, led by researchers from the University of Alicante, Imperial College of London and the University of Cambridge, responded to research suggesting the endogenous hormones cortisol and testosterone may critically influence a trader's financial decision-making. Cortisol is elevated in response to physical or psychological stress, preparing the body for a fight-or-flight response, while testosterone rises before competitive situations.

The scientists simulated the trading floor by having 142 volunteers, male and female, play an asset-trading game in groups of around 10. Those who had naturally higher levels of cortisol were more likely to take risks, and high levels in the group were associated with instability in prices. In a follow-up experiment, 75 young men were given either cortisol, testosterone or a placebo before playing the game.

"We found that both cortisol and testosterone shifted investment towards riskier

assets," the study authors revealed in the journal *Scientific Reports*. "Cortisol appears to affect risk preferences directly, whereas testosterone operates by inducing increased optimism about future price changes."

The researchers believe the stressful environment of financial markets may promote high levels of cortisol and testosterone in traders. Co-author Dr Ed Roberts, from Imperial College London, said, "It would be interesting to measure traders' hormone levels in the real world, and also to see what the longer term effects might be."

Co-author Dr Carlos Cueva, from the University of Alicante, said that "hormonal changes can help us understand traders' behaviour, particularly during periods of financial instability". Dr Roberts added that by understanding what these hormones do, researchers can "look at the environment in which traders work and think about whether it's too stressful or too competitive".

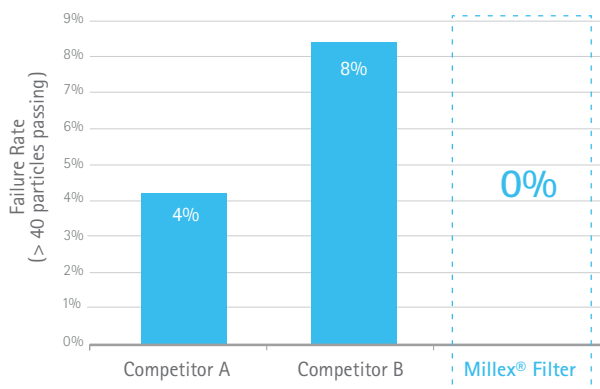
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Compounds called karrikins, present in bushfire smoke, induce mass germination of seeds shed by Australia's fire-adapted plants in the wake of fire. University of Western Australia chemist Dr Mark Waters has traced the story of karrikins right back to the first simple plants to colonise the land, more than 430 million years ago.

Vistas of millions of seedlings erupting from blackened, scorched earth in the wake of a bushfire are all too familiar to people living in south-eastern Australia, the most fire-prone region on the planet. In fact, many of Australia's highly combustible, dry-leaved plants have evolved a dependence on episodic wildfires to reproduce.

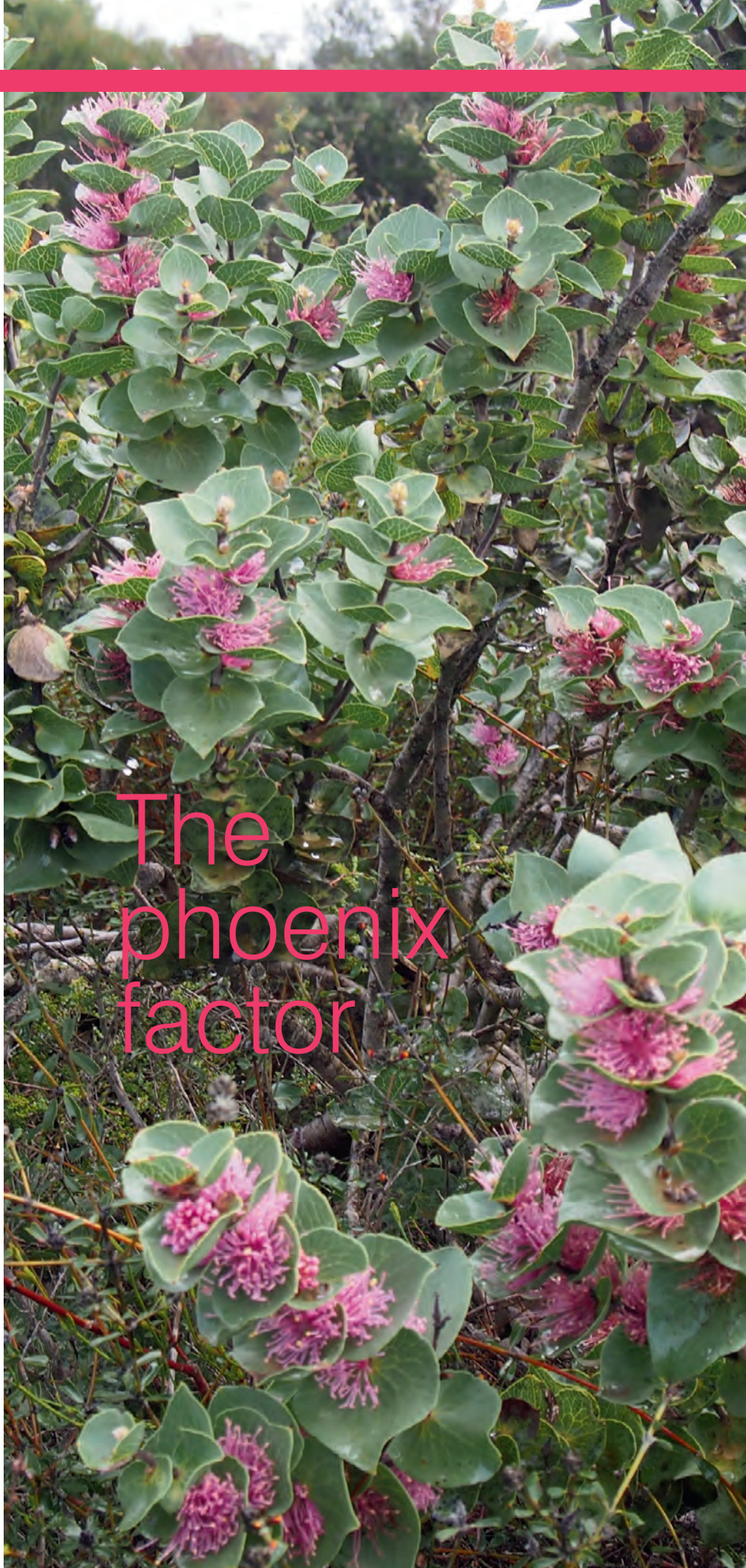
For a long time, the intense heat of bushfires was thought to be the agent that initiated mass germination — it was just a matter of adding water to the ash bed. But in 1990, researchers in South Africa made a surprising discovery: the chief stimulus for mass germination of seedlings in that country's similarly fire-tolerant fynbos heathlands is not heat, but the dense smoke given off by burning plants and leaf litter.

In 1995, South African researchers showed that a dilute aqueous solution of smoke induced germination of a rare succulent species, *Audouinia capita*. The seeds of many other fynbos species, renowned for being very difficult to germinate, sprouted rapidly and almost simultaneously after treatment with a dilute smoke-water solution.

Smoke-water treatments have revolutionised the conservation of rare flora by making it possible to germinate deeply dormant seeds of rare and common plant species, under controlled conditions or in situ in the wild, from the dormant soil seed bank.

Smoke from the bushfires that ravage Australia's typical species-rich vegetation contains

The phoenix factor



The shrub *Hakea cucullata*.

as many as 3000 different combustion products. More than a decade ago, Dr Kingsley Dixon's research group at Perth's Kings Park and Botanic Garden embarked on a needle-in-the-haystack search for the mysterious agent in smoke that, even at extremely dilute concentrations, breaks seed dormancy in a wide variety of fire-tolerant species.

It took several years, but in 2004, Dixon and his colleague Dr Gavin Flematti, a chemist at The University of Western Australia (UWA), announced that they had isolated and identified a class of butenolide molecules that are extremely potent activators of germination. They called the compounds 'karrikins' — karrik meaning 'smoke' in the language of south-west Western Australia's Noongar people.

But the crucial question remained unanswered: how do karrikins stimulate dormant seed embryos to germinate?

Research by UK-born molecular biologist Dr Mark Waters, of the ARC Centre of Excellence in Plant Energy Biology at UWA, has provided the answer. In 2012, he discovered a likely receptor protein for karrikins, called KAI2. He published his finding in the journal *Development*.

Dr Waters, who was honoured with this year's Peter Goldacre Award from the Australian Society of Plant Scientists, will describe his findings in the Peter Goldacre Memorial Lecture at the upcoming ComBio 2015 research conference in Melbourne.

Since Flematti et al identified the first karrikin molecule, KAR1, it has become clear that the karrikin response is widespread among the world's land plants and is not restricted to fire-responsive species. Dr Waters believes karrikins have co-opted elements of a much earlier signalling network involved in plant development — from as far back as bryophytes like mosses and liverworts, which grow in moist environments and rarely experience fire.

The fact that proteins responsive to karrikin signalling exist in bryophytes suggests to Dr Waters that the signalling originated before vascular plants began to diversify — the first vascular plant macrofossils, from a genus called *Cooksonia*, occur in Victorian sedimentary rocks of middle-Silurian age (around 433 million years ago).

"These proteins (in the signalling network) go back a long way," he said.

"All plants — not just angiosperms — have them. We have tested a few plant species that are not

normally exposed to fire and found they respond nicely to karrikins.

"Surprisingly, one of them is *Arabidopsis*, which would almost never be exposed to fire in its natural habitat.

"Conversely, while all plants seem to have the genes, not all of them necessarily respond to karrikins.

"There's a disconnect between those plants that have been identified as fire responsive and those that respond specifically to karrikins. For example, some grasses whose seeds are very dormant do not germinate in response to karrikins, so karrikins are no magic bullet (for germinating all plant seeds)."

Dr Waters says karrikins are structurally similar to strigolactones — plant hormones that were originally identified as seed-germination stimulants produced by members of the broomrape family *Orobanchaceae*, which are root parasites. Strigolactones also regulate branching of axillary shoots and many other aspects of plant development.

Five new members of the karrikin family have been identified since Flematti et al isolated the first, KAR1. Of the six, KAR1 and KAR2 are the most active, so Dr Waters selected these two for his experiments.

He says both karrikins and a synthetic strigolactone, GR24, induce early germination of *Arabidopsis thaliana* seeds and enhance seedling responses to light. One effect is to inhibit elongation of the hypocotyl — the stem of the seedling between the cotyledons (seed leaves) and the radicle, or primary root.

But karrikins don't stimulate seed germination in root parasites like witchweeds (*Striga* spp), the genus in which strigolactones were first discovered. Nor do they have any effect on axillary shoot architecture in witchweeds, which seem to respond exclusively to their own strigolactone signals.

Dr Waters concluded that while karrikins are superficially similar to strigolactones, they are functionally distinct, but both probably targeted members of the same set of protein receptors in plant cells.

Through targeted gene-knockout experiments in *Arabidopsis thaliana*, Dr Waters and US colleague Dr Dave Nelson created three karrikin-insensitive (*kai*) mutants.

The first target, MORE AXILLARY BRANCHES 2 (MAX2), was Dr Nelson's discovery.



Dr Mark Waters.

Dr Waters... will describe his findings in the Peter Goldacre Memorial Lecture at the upcoming ComBio 2015 research conference in Melbourne.

It had previously been implicated in mediating responses to strigolactones. It provided the first genetic evidence that the response pathways to karrikins and strigolactones have certain components in common.

The second karrikin-responsive protein, KAI2, discovered by Dr Waters, is evolutionarily similar to the DWARF14 (D14) protein in rice. Rice D14 mutant plants have reduced apical dominance and increased numbers of axillary branches, giving the plant a bushy appearance. The D14 protein is an enzyme that appears to be essential for the strigolactone response; it is widely recognised as the receptor for strigolactones.

KAI2 is necessary for all karrikin responses in *Arabidopsis* but is unresponsive to strigolactones. This supports the conclusion that, although they have certain targets in common, karrikins and strigolactones differ structurally and functionally.

The third karrikin-responsive protein in *Arabidopsis*, also Dr Nelson's discovery, is SUPPRESSOR OF MAX2 1 (SMAX1). It appears to act downstream of MAX2, abolishing MAX2's function by tagging it for breakdown by the cell's used-protein disposal system.

Freshly harvested seeds of karrikin-insensitive *Arabidopsis* plants carrying MAX2 or KAI2 loss-of-function mutations show significantly reduced

germination rates relative to normal *Arabidopsis*. Both mutants also develop elongated hypocotyls and reduced, downward-oriented cotyledons, symptomatic of impaired responses to light — in contrast, karrikin-activated seedlings grow larger cotyledons that orient towards sunlight and have more robust growth.

In his recent *Plant Cell* paper, Dr Waters said that the KAI2-MAX2 signalling system plays an important developmental role, even in the absence of exogenous karrikins. He stated, "Given that D14 is the likely strigolactone receptor, these observations imply that the mutant KAI2 and MAX2 phenotypes result from an inability to perceive an unknown signalling compound that is the substrate or ligand for (normal) KAI2."

While the KAI2 ligand remains unknown, he said it will likely be a butenolide, like the karrikins.

Dr Waters said KAI2 performs a range of functions in plants. In *Arabidopsis*, its phenotypic effects are a by-product of other KAI2-regulated functions.

"Some plants that really do respond to smoke have become exquisitely responsive to karrikins — they work at nanomolar concentrations, so there has been strong positive selection for sensitivity to karrikins," he said.

"The big question is: if KAI2 did not evolve as a target for karrikins, there should be another molecule that is the original ligand for KAI2. If we can find it, or develop something like it, we could use it commercially to influence germination and plant development.

"For example, we could either promote seed germination, or inhibit it.

"For a long time, there has been this idea that you could spray karrikins or karrikin-like compounds onto farmland to mass-germinate weed seeds so they could be killed with herbicide. The problem is that karrikins are not very stable when exposed to the ultraviolet light in sunshine — they dimerise within a few hours and become inactive.

"Kingsley Dixon's group at Kings Park is looking at using karrikins for restoration ecology —

for restoring mine sites, for example, or stimulating regeneration of native plant seeds in the field.

"One of the problems of spraying with smoke-water is that smoke also contains compounds that inhibit germination, so it would be much more efficient to spray with pure karrikins because they trigger germination at extremely low concentrations."

Dr Waters has recently published a paper that examined KAI2 function in *Selaginella*, a primitive plant from a group allied to the club mosses, or lycopods. One of the earliest vascular plants, *Selaginella* appears in the fossil record during the Silurian period, 400 million years ago.

A US research team recently sequenced the genome of *Selaginella moellendorffii*, which has become an important model for comparative genomics research and understanding plant evolution. Dr Waters' team found two KAI2 homologues in the *Selaginella* genome and had them synthesised.

The team inserted the KAI2 transgenes into *Arabidopsis* and showed that one of the two proteins could operate in the natural karrikin signalling system in *Arabidopsis*. The experiment supports the hypothesis that karrikins work their smoky magic by appropriating elements of the ancient strigolactone signalling system.

Australia's uniquely fire-adapted flora began to flourish with the onset of locally arid conditions after the continent parted company with Antarctica, around 50 million years ago, in the final episode of the breakup of the Gondwana supercontinent. Between 25 and 10 million years ago, genera like *Eucalyptus*, *Casuarina*, *Banksia*, *Hakea*, *Petrophile*, *Grevillea* and *Fabaceae* pea plants underwent rapid evolutionary radiation across the continent, and eventually came to dominate the flora.

Experiments at Kings Park and Botanic Garden in Perth have identified more than 120 native plant genera in which some or all species exhibit enhanced germination in response to treatment with smoke-water — including smoke bushes (*Conospermum* spp, *Proteaceae*), which had long defied efforts to grow them from seed.

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Karrikins and conservation

In late July, a small team of volunteers from the Australian Native Plant Society's Dryandra Study Group spent five days touring the south-eastern wheat belt of Western Australia, taking leaf samples from fragmented populations of *Banksia densa* (formerly *Dryandra conferta*). Scientists at the WA Herbarium will run a comparative DNA analysis on the leaf samples to determine the taxonomic status of a very rare and distinctive form of *B. densa* with attractive silvery blue leaves and bright yellow flowers, known to enthusiasts as 'Corrigin Blue'.

Just two small, roadside populations of *B. densa* Corrigin Blue were known to have survived extensive clearing of the native heathlands for grain farms in the area around Corrigin, 200 km south-east of Perth. The survey team, with your correspondent as a guest, arrived at the first location to find the area had been razed by a bushfire the previous summer. A thorough search failed to locate any surviving plants of Corrigin Blue.

But across the fire-blackened landscape, the former heathland vegetation was already regenerating vigorously. In places, seed liberated from scorched *Hakea* seed capsules and *Petrophile* seed cones had already germinated in the ashes in such numbers that they resembled a lawn.

Banksias — especially those species formerly included in the genus *Dryandra** — are uniquely dependent on fire to reproduce. If any mature plants of Corrigin Blue existed at the site before the fire, their seeds should have released to germinate in numbers sufficient to replace or even exceed those of the parent population.

Fire is a vital force in maintaining the rich flora of WA's heathlands and woodlands. In senescent heathland, the searing heat of its passage liberates seeds from over-mature plants, leaving a



nutrient-rich ash bed that becomes the nursery for a new generation of seedlings after the first substantial rains.

Fire is more than a seed-releasing agent: the combustion process generates smoke imbued with potent molecules called karrikins that induce mass germination of the newly released seed crop. Karrikins also play a vital role in stimulating regeneration of long-dormant seeds deposited by shorter-lived pioneer species in the soil seed bank, as long-lived woody shrubs become progressively more dominant.

B. densa Corrigin Blue, one of the rarest plants in the WA flora, was in danger of extinction simply because of its anonymity — despite its distinctiveness, it was not accorded species status. Plant taxonomists — an increasingly rare breed themselves — had lumped it with a broad complex of taxa under the specific title *B. densa*.

Corrigin Blue is very distinct from other members of the *B. densa* complex in multiple ways, including the shape and hue of its leaves, its floral structures, its flower colour and its dense,

mounding habit. If the DNA study affirms its unique identity, then, as the first-discovered member of the complex, it would become the holotype or foundation species for *Banksia densa*.

There is a proposal to hive off all the taxa formerly included in the *B. densa* complex, under the holding name '*Banksia* spp "Wheat Belt"', until their own distinctiveness and relationships can be resolved.

On the final day of the survey, team member and *Dryandra* expert Keith Alcock discovered a third population of *B. densa* Corrigin Blue that more than doubles the known number of surviving plants.

The Dryandra Study Group will monitor regeneration at the burned site to see if karrikins have worked their magic. Any new Corrigin Blue seedlings that rise from the ashes will be added insurance for the species' future.

Dryandras differ from the typical members of the genus *Banksia* in having free seed capsules equipped with oil vesicles along the suture between the two halves of the capsule. The oils may contribute to the incendiary brew of karrikin precursors.

If the broad end of a dryandra seed capsule is held over a candle flame for a moment, the oil vesicles ignite explosively, causing a brief flare and an audible 'pop' as the halves of the capsule come apart, freeing the seed.

*In 2007, botanists Dr Austin Mast, director of Florida State University's Robert K Godfrey Herbarium, and Dr Kevin Thiele, director of the WA Herbarium, published the results of a DNA analysis that confirmed the genus *Dryandra* is closely related to *Banksia* and had in fact arisen within *Banksia*. In consequence, all *Dryandra* species are now formally — if controversially — included in the genus *Banksia*, although enthusiasts are free to continue referring to members of the new sub-genus as 'dryandras'.



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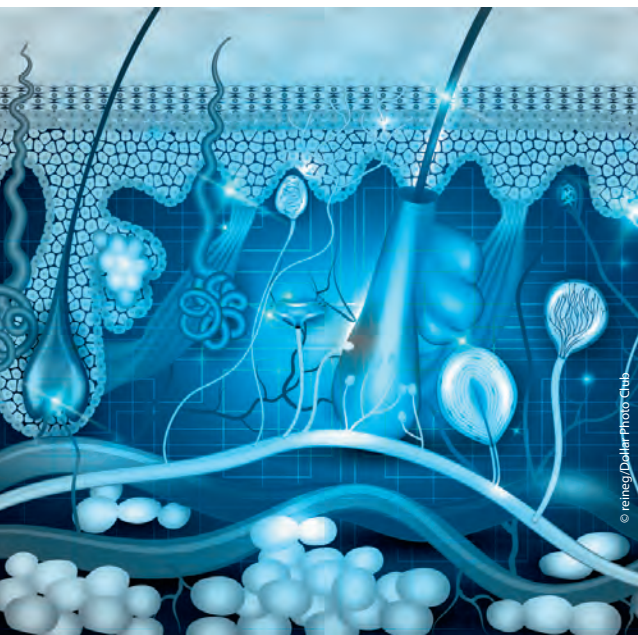
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Improved DNA analysis of human hair

University of Adelaide researchers have developed a simple, low-cost method for the DNA profiling of human hairs. By modifying existing laboratory methods, the team was able to produce accurate DNA profiles at a higher success rate than what is typically achieved.

Associate Professor Jeremy Austin, the deputy director of the university's Australian Centre for Ancient DNA, explained that DNA profiling of human hairs is critical to solving many serious crimes. But as most hairs found at crime scenes have been severely dehydrated, they contain very little DNA. As a result, existing methods to obtain and interpret DNA profiles from shed human hairs are expensive and often unsuccessful.

In collaboration with colleagues at the University of Canberra, and with the assistance of hundreds of human hairs collected from volunteer donors, Associate Professor Austin and his team set out to develop a new method that could produce better results. He said the researchers were able to "retrieve DNA profiles from shed human hairs that contain trace amounts of DNA without compromising the accuracy of our results".

Lead author Assistant Professor Dennis McNevin, from the University of Canberra, added, "Our simple modifications will allow this trace DNA to be analysed in a standard forensic laboratory with improved success rates of DNA profiling and without increased error rates.

"This is very important in forensic science, as false positive results can lead to incorrect identifications and poor outcomes in the judicial system."

The study has been published in the journal *Forensic Science, Medicine and Pathology*.

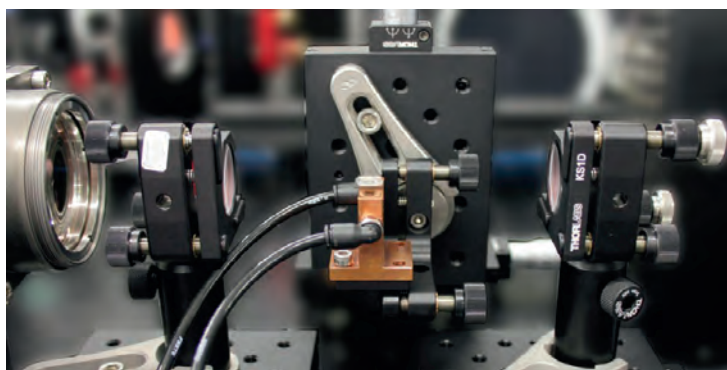
Diamonds are a laser's best friend

Australian and German scientists have collaborated on the demonstration of a diamond laser that is said to be 20 times more powerful than previous diamond lasers. The researchers, from the MQ Photonics Research Centre and Germany's Fraunhofer Institute for Applied Optics and Precision Engineering (Fraunhofer IOF), published their work in the journal *Laser and Photonics Reviews*.

Diamond is a relatively new material for creating laser beams, but it is rapidly becoming a technology leader in terms of generating powerful, high-brightness beams at wavelengths, or 'colours', where traditional lasers are not able to shine. High-power diamond lasers are particularly suited to applications that require beaming power over long distances, such as optical communications in space, laser ranging, and the tracking and removal of space debris.

"Just as X-rays pass through flesh to enable us to see bones within a body, different colours of laser radiation can interact or be transmitted by different target materials," said Dr Robert Williams, the lead researcher on the project.

While average power levels are typically less than 20 W, the new diamond laser provides up to 380 W of output power — the equivalent of approximately 400,000 laser pointers and enough power to easily cut through steel. The wavelength of the laser, at 1240 nm, has high transmission through the atmosphere and is safer to use because of its reduced transmission through the front of the eye and lower risk of damage to the retina.



Diamond lasers have progressed enormously over the last few years due to advances in synthesis of high-quality diamond — better than what can be obtained naturally. As explained by Thomas Schreiber, group leader for the fibre laser research at the Fraunhofer IOF, "Diamond crystals seem to naturally fit to high-power fibre lasers. It's interesting to see that such a development is now possible, and I'm sure much exciting research will follow."

According to Dr Williams, the laser has penetrated so many aspects of industry, science and our daily lives that the number of applications is countless.

"A key to unlocking many more applications of lasers will be the development of high-brightness beams at new wavelengths," he said, "and diamond is providing just that."





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Operators being trained to drive the TESCANA LYRA FIB-SEM at Curtin University (TESCAN TIMA in the foreground).

FIB/SEM commissioned at Curtin University

AXT has completed the installation of a TESCANA LYRA focused ion beam/scanning electron microscope (FIB/SEM) at Curtin University, Perth, as part of the National Resource Sciences Precinct's (NRSP) Advanced Resource Characterisation Facility. The precinct is a collaboration between CSIRO, Curtin University and The University of Western Australia.

The LYRA integrates a Schottky field-emission SEM with a high-resolution FIB column. The system benefits from improved high-performance electronics for fast image acquisition; ultrafast scanning with compensation for static and dynamic range aberrations; and built-in scripting for user-defined applications.

It is also said to include: the highest number of simultaneous analytical tools; a fully integrated time-of-flight secondary ion mass spectroscopy (TOF-SIMS) capability which is unique in Australia; simultaneous EDS and EBSD using static measurement mode, enabling faster data acquisition and 3D reconstruction; and a fully integrated and software-controlled nanomanipulator which is suitable for atom probe and TEM sample prep.

Curtin University's Professor Steven Reddy, who was key to securing funding and undertaking the instrument selection process, said one of the key applications for the LYRA will be sample preparation for the university's atom probe facility.

"The atom probe in particular is used for groundbreaking geoscience research, where it is used for nanoscale characterisation of natural mineral and ore samples for Western Australia's rich mining industry," Professor Reddy said. "The LYRA and its precision milling capabilities will help us to quickly and accurately prepare samples so we can zero in on areas of interest and hence spend more time analysing important features."

The LYRA now resides in a laboratory next to the TIMA (TESCAN Integrated Minerals Analyser) and a TESCANA MIRA, which share the same high-resolution electron microscope column. The TIMA is tailored specifically for high-throughput automated minerals analysis. All three installations are supported locally by AXT's Perth-based service engineers.

Conception: an epic quest

University of Sheffield Professor Allan Pacey has released a handy summary of the journey undertaken by sperm from production to conception, fighting to stay ahead of 250 million rivals along the way.

In a short article and accompanying infographic, Professor Pacey reveals that sperm production in the testicles takes about 70 days, with an additional two weeks for the sperm to receive finishing touches while passing through a long, winding tube called the epididymis. After leaving the epididymis, they can remain healthy and motionless in the man's body for several weeks.

Once ejaculation occurs, sperm stored at the end of the epididymis are propelled by muscular contractions through a tube called the vas deferens and then into the tube passing down the penis. The average ejaculation of semen contains 250 million sperm, but only the fastest, healthiest and luckiest will survive the journey from the vagina to the cervix — 99 out of 100 will die trying.

Women have two fallopian tubes (one for each ovary), but only one ovary releases an egg in any given cycle. Sperm must therefore head for the fallopian tube toward the ovary releasing an egg. Furthermore, the fallopian tube entrance is tiny (only a few sperm heads wide), so those sperm that swim too erratically are locked out.

Only about 100 of the 250 million sperm ejaculated reach the fallopian tube, where they tend to stick to the inner walls waiting for a signal that the egg has been released. Once they receive this signal, they detach themselves from the inner walls by increasing the beat in their tail to give them extra thrust — a frenetic swimming style called hyperactivation.

Sperm swim toward the middle of the fallopian tube in the direction of the ovary in order to find the egg that will shortly be coming the other way. The egg is surrounded by a cloud of cells called the cumulus, which the hyperactivated sperm must swim through before it can reach the egg surface. Only one or two sperm will get close enough to the egg to have any chance of fertilising it.

Once reaching the surface of the egg, a bag of enzymes on the top of the sperm head bursts. These enzymes help dissolve the outer membrane of the egg and, in combination with powerful tail thrusts, helps the sperm penetrate the egg.

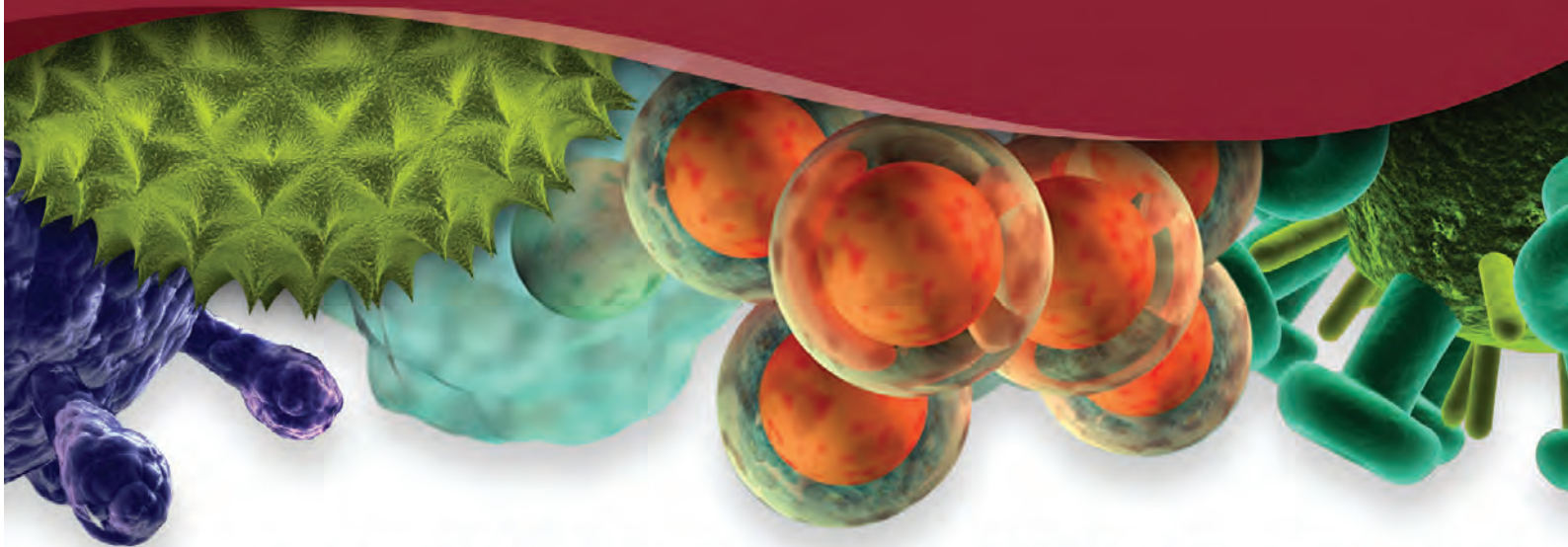
Once the sperm is inside, an immediate chemical reaction hardens the egg membrane to stop any other sperm from following it. Over the next few hours, the sperm tail is detached and the chromosomes inside the sperm head separate to line up with those from the egg. The process of forming a new baby has begun.





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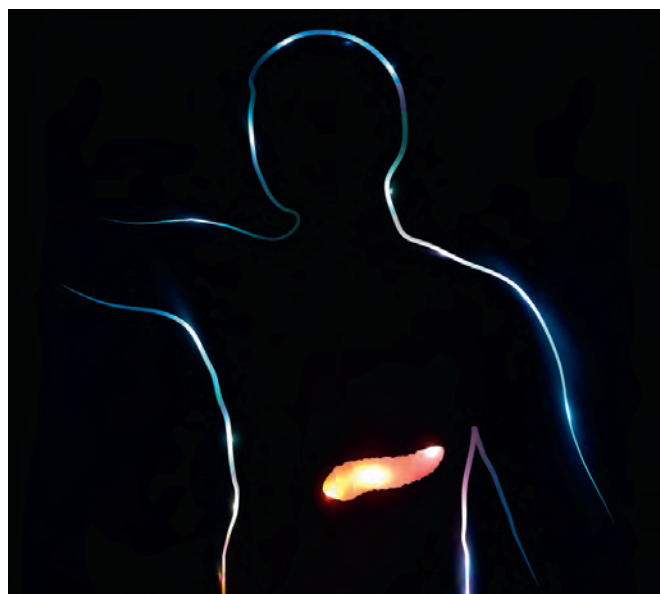
Fungal resistance a growing healthcare threat

The European Society of Clinical Microbiology and Infectious Disease (ESCMID) is imploring global healthcare professionals and bodies to take a more active role in the growing problem of fungal resistance. The society believes that fungal infections are neglected worldwide, with over 300 million people of all ages suffering from a serious fungal infection every year.

The ESCMID Fungal Infection Study Group (EFISG) argues that fungal resistance represents a huge healthcare threat, with a rising prevalence of invasive and deadly forms of fungal diseases in the developed world. Meanwhile, very treatable fungal infections are killing huge numbers in the developing world, due to limited access to good diagnostics and basic drugs. Cryptococcal infections cause half a million deaths every year, making them the second-largest killer in Africa behind HIV.

EFISG is thus calling for young clinicians, scientists and diagnosticians to join its global study group to help improve patient care, diagnostic methods and guidelines. EFISG Chairman Professor Andrew J Ullmann said the group's role at ESCMID is to try and mitigate the spread of fungal resistance, but "more young scientists and clinicians are needed to help our research and improve best practice in clinical settings".

The group notes that diagnostic procedures are still very poor, with autopsy reports showing that 30% of patients who had haematological malignancies also had a fungal disease — but only a quarter of these were diagnosed prior to death. It is therefore imperative that we develop good guidelines for industry professionals and seek to improve diagnostic procedures. The group also argues for 'susceptibility testing' to help predict the most vulnerable patients, so that healthcare professionals can provide treatment and preventative measures earlier.



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Australian scientists join global diabetes research effort

Three Australian research teams will contribute to a global effort to combat the growing incidence of type 2 diabetes, having received NHMRC funding as part of a multicountry grant call through the Global Alliance for Chronic Diseases (GACD).

The GACD comprises 10 of the world's leading health research funding organisations, including the NHMRC, and aims to reduce the global burden of type 2 diabetes and other chronic diseases by coordinating research across the world. The Australian grant recipients are listed below.

Associate Professor Louise Maple-Brown, Menzies School of Health Research (\$2,117,449)

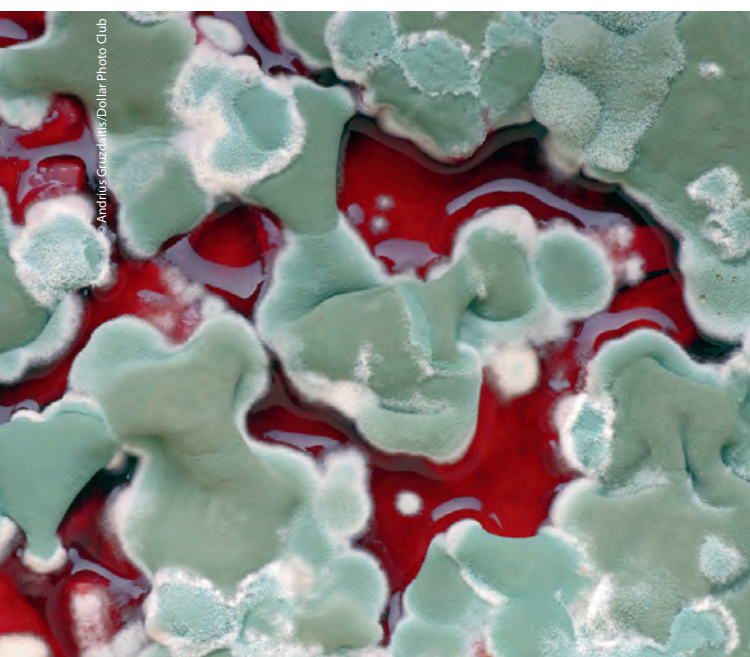
In a study focused on pregnant women with gestational or pre-existing diabetes, Associate Professor Maple-Brown will scale up existing research on Indigenous communities within the Northern Territory and Far North Queensland. She and her team will monitor these women during pregnancy and after birth to identify and minimise the mother's and infant's risk of developing type 2 diabetes.

Professor Anushka Patel, The George Institute for Global Health (\$1,256,500)

Professor Patel will adapt and implement a lifestyle modification program in order to prevent type 2 diabetes in women with gestational diabetes living in India, Sri Lanka and Bangladesh. The research will involve conducting a randomised controlled trial of this program, which has previously shown promising results, to determine whether it can be applied and affordably brought to scale in South Asia. Professor Patel will be working collaboratively with researchers supported by the Indian Council of Medical Research.

Associate Professor David Peiris, The George Institute for Global Health (\$1,385,858)

Associate Professor Peiris will develop and trial a digital intervention program to help people with type 2 diabetes better manage their condition and prevent complications. The trial will involve communities in Beijing and rural villages in China and employ mobile phone technologies to help overcome issues of access to effective health care. Associate Professor Peiris will be working collaboratively with researchers supported by the Chinese Academy of Medical Sciences.



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Comparative genomics: a must for winemaking



In 2004, archaeologists uncovered the earliest evidence for winemaking in the world when a biochemical analysis of organic residues on an ancient ceramic jar at a 9000-year-old Neolithic village in Georgia yielded a suite of compounds characteristic of red wine.

The analysis also detected traces of bacterial preservatives — the Neolithic winemakers appear to have deliberately added tree resins to their brew to extend the wine's life after fermentation, a practice that prefigured the addition of pine resin as a preservative and flavoring agent in latter-day Greek *retsina* wines.

Dr Anthony Borneman, a principal research scientist at the Australian Wine Research Institute in Adelaide, is using whole-genome techniques to study the yeasts and bacteria involved in winemaking. He is an invited speaker at this year's Australasian Genomic Technologies Association annual conference in the Hunter Valley from 11-14 October.

He said the archeological evidence from Neolithic times attests to winemaking being man's earliest biotechnological endeavour.

Winemaking, breadmaking and beer brewing all rely on the same friendly yeast to perform the fermentation process: *Saccharomyces cerevisiae*.

Although it is the major agent in wine fermentation, Dr Borneman said *S. cerevisiae* is by no means a lone player. The 'magic' of grapes spontaneously fermenting after crushing actually involves a complex microbiological progression of hundreds of species of fungi, yeasts and bacteria that proliferate and die in successive waves of microbial boom and bust.

He said *S. cerevisiae* is generally a latecomer to the party (its presence is almost undetectable on intact grape berries), but once its numbers increase, the increasing concentration ethanol it produces kills all but a few other select species, such that *S. cerevisiae* completely dominates the later stages of alcoholic fermentation. However, modern approaches to winemaking have looked to short-circuit what can be a long, drawn-out process that could go very wrong (vinegar anyone?).

"From the 1970s Australian wineries began using commercially available, purified starter yeast strains of *S. cerevisiae*," Borneman said. "Yeast-supply companies sell them as freeze-dried products that are added to the must after the grapes are crushed. They provide a reliable and predictable ferment with little risk of microbiological spoilage.

"The winemaker doesn't have to wait very long for fermentation to proceed as they bypass the normal lag-time in *S. cerevisiae* growth. The

downside is that the complex microbiological progression of a uninoculated ferment is all but replaced by a monoculture of a single strain of *S. cerevisiae*.

"Given the huge efficiency advantages provided by commercial yeast, the vast majority of Australian wineries quickly started to take advantage of these strains.

"Most wineries still do. But while some strains offer to impart different flavour characteristics, many wine experts believe the inoculation monoculture yields a far less complex, somewhat one-dimensional wine. So there are now the beginnings of a backlash, where winemakers are revisiting the past, as has happened with raw-milk cheeses and sourdough bread."

Dr Borneman said a venturesome band of Australian winemakers — especially those aiming at the top end of the market — have gone back to nature. They are experimenting with so-called 'wild' ferments in pursuit of novel flavours and complex mouthfeel, hoping to give their wines a marketing edge over those fermented with commercial yeast cultures.

Wild yeast strains in uninoculated ferments take time to kick off — "You're never really sure what's in there after you crush the grapes," he said. "It's a leap of faith and there's always a risk that undesirable microbes will take hold while the numbers of wild wine yeasts are building up, ruining the wine."

While 'going feral' would seem a risky business, Dr Borneman said some winemakers have become adept at wrangling wild ferments to produce predictable results.

Their enterprise provides fresh fields for inexpensive, high-throughput genomics technologies to explore, to identify the genetic sources of novel characteristics that wine drinkers will appreciate.

He said genomic studies of wild yeast and bacterial species could help the wine industry identify the genetic sources of novel characters that could enhance the distinctively Australian characters that made our wines so successful two decades ago, while taking much of the risk out of wild fermentation.

So, now the wild local yeasts' potentially unique contributions to the fermentation process can be added to the traits that stem from a wine's terroir — the effect of local soils, climate and other environmental factors on the composition of the grape juice.

Given the massive investment in time and money required for classical microbiological research, Dr Borneman said there has been relatively little study of the regional yeast species and strains that colonise Australian grapes.

“We’re currently involved in a collaborative sequencing project with Yalumba, Treasury Wine Estates and the Ramaciotti Centre for Genomics at UNSW, using high-throughput genomics to study wild ferments,” he said.

“We extract the total DNA from samples of the ferment and amplify and sequence a particular variable region that serves as a molecular barcode to differentiate fungal species. We also count the copy number of the various barcodes to see how much each wild yeast species contributes to the ferments.

“Think of the must (the freshly pressed grape juice, including seeds, stems and skin of the fruit) as a sort of palette that will determine the eventual character of the wine after fermentation and ageing.

“The environment, including the weather, can influence the kinds of yeast that colonise the fruit — competition from botrytis and other fungal diseases also has an influence on yeast composition and the eventual flavour of the wine. That’s where we’re heading with metagenomics.”

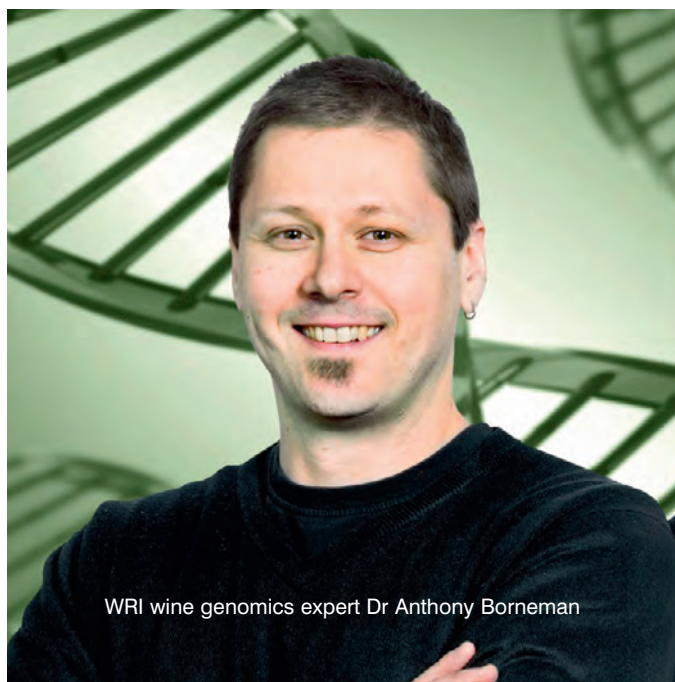
Metagenomics involves sampling every microbe present in the early stages of the ferment, which Dr Borneman describes as “a complex soup of different organisms”.

“As a wild ferment kicks off, *S. cerevisiae* starts from a very low base and eventually wipes out every other microbe as it increases the alcohol content. But early in the ferment, the lesser players are making a range of different metabolites that give the wine greater complexity.

“Conventional microbiological assays are extremely labour intensive, so you can’t afford to analyse the wild microbe community in large numbers of samples in any detail.

“But the cost of barcode-sequencing a particular fermentation sample has recently dropped well below \$100 — closer to \$50, in fact, and it’s still coming down.

“We’re still in the data-gathering phase, getting in more samples of wild ferments from around Australia, that will allow us to begin correlating the wild yeasts’ contributions to the distinctive



WRI wine genomics expert Dr Anthony Borneman

characters associated with particular winemaking regions of Australia.

“We hope the study will tell us if certain winemaking regions have their own ‘special’ yeast species. As we accumulate more data, we want to provide winemakers with information that will make wild ferments more predictable and customisable. We might even be able to predict from early samples of the must how the ferment is likely to proceed, given different winemaking interventions.”

That capability would require inexpensive, real-time sequencing technology. Dr Borneman said one company, Oxford Nanopore, is already marketing an early version of a portable sequencer the size of a chocolate bar, costing around US\$1000, that plugs into a laptop to upload its data for rapid analysis.

“You blink, and the technology has advanced,” he said. “Oxford Nanopore’s sequencer sucks DNA through a membrane studded with protein pores and can sequence DNA fragments on the fly.

“If it continues to develop as promised, it would be a game changer, not only for the wine industry, but for medical and agricultural applications — for example, it could allow a doctor to rapidly diagnose a bacterial infection from a blood sample, or a farmer could detect and diagnose a rust disease on his wheat crop and hit it with the right fungicide before it does serious damage.

“Once the technology matures, we’re talking about a medical-type approach to monitoring the ferment. It would give winemakers the ability to check how the yeasts and other microbiota are going, and provide early warning of undesirable

microbes that could contaminate the ferment with off-flavours, so they could use appropriate interventions to suppress them.”

The “other microbes” that Dr Borneman refers to include the malign yeast species *Brettanomyces* (*Dekkera*) *bruxellensis*, better known to winemakers simply as “brett”, and the bacterium *Oenococcus oeni*.

Oenococcus is a key player in malolactic fermentation, with its ability to soften the taste of a wine by converting tart-tasting malic acid to lactic acid.

Dr Borneman has recently published research papers on his genomic investigations of strain variation in *B. bruxellensis* (see below) and *O. oeni*.

In their *Oenococcus* paper, published in *BioMedCentral Genomics* in 2012, and titled Comparative analysis of the *Oenococcus* genome reveals genetic diversity in industrially relevant pathways, Dr Borneman and his AWRI colleagues note that the lactic acid bacterium *O. oeni* is one of a rare few bacteria species that not only survive but actively proliferate at the high alcohol concentrations in wine ferments.

Unlike other bacteria present in wine, *Oenococcus* is positively beneficial to wine quality because of its ability to metabolise tart-tasting malic acid and transform it to lactic acid — hence the term “malolactic fermentation”.

He said little is known about the genetic diversity of *Oenococcus* in Australia. “Australia’s grape vines were brought out from Europe, which makes it hard to determine what was already here, as opposed to what wine-associated microbes hitched a ride,” he said.

Using Illumina sequencing, the AWRI team obtained whole-genome sequences from 11 strains of *O. oeni*, collected from several wineries and wild sources around Australia, to assess the extent of genetic variation in the species. Three other strains sequenced in an earlier study brought the sampled population to 14 strains.

The authors say *O. oeni* has an unusually compact genome for a free-living bacterium — just 1.8 megabases. They speculate that it has undergone genomic ‘streamlining’ during its adaptation to the challenging, narrow ecological niche of fermenting grape juice and wine.

Each individual strain’s genome consists of around 1800 genes, but the collective analysis of



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the isolates identified a total of 2800 open reading frames that comprise the pan genome of the species.

Of this figure, the species' core genome — the subset of genes common to all isolates — consists of fewer than 1200 genes.

The authors say the data they have obtained on the genetic variation across the 14 *O. oeni* isolates is vital for harnessing the phenotypic variation present in economically important bacteria involved in fermenting grape juice to wine.

The expansion of the pan genome, according to the AWRI paper, is partly due to an accumulation of DNA sequences scattered around the genome that help the bacterium to defend itself against bacteriophage attack.

The remainder consists of a variety of genes of potential importance to industrial fermentation systems, including genes involved in cell-wall polysaccharide synthesis, sugar transport and utilisation, and amino acid biosynthesis.

Dr Borneman said there is evidence that, in addition to its primary role in converting malic acid to lactic acid, the growth of *O. oeni* in wine ferments has other effects on flavour, aroma and mouthfeel.

If comparative genomics can link these phenotypes back to the presence or absence of certain genes in identified strains, it should be possible to develop new pure cultures of strains that will help winemakers reliably produce a range of wine styles by malolactic fermentation.

Some wineries already carry out microbiological assays on samples of *O. oeni* and *S.*

If comparative genomics can link these phenotypes back to the presence or absence of certain genes in identified strains, it should be possible to develop new pure cultures of strains that will help winemakers reliably produce a range of wine styles by malolactic fermentation.

cerevisiae strains to check for the presence of desired strains in the ferment, but Dr Borneman said the procedure is laborious and time-consuming. Using genomic tools to directly sequence different strains of *O. oeni* or *S. cerevisiae* is now cheaper, faster and more accurate.

In an article for *Current Opinion in Biotechnology* in 2013, Dr Borneman and AWRI colleagues Dr Isak Pretorius and Dr Paul Chambers described comparative genomics as “a revolutionary tool for winemaking”.

They concluded: “With the growing accessibility and affordability of genome sequencing, we are witnessing the birth of a new era in industrial microorganism strain development; comparative genomics in industrial strains is providing a richer and deeper understanding of the genetic composition and variation of these crucial microbes.

“New genomic technologies are providing us with the means of rapid identification of genetic loci that shape industrially important traits.

“This will enable the development of new wine yeast strains that offer improved fermentation performance, and a means of tailoring wine sensory properties to meet consumer demand.”

A beast of a yeast

The yeast *Brettanomyces (Dekkera) bruxellensis* is a survivor. While almost everything else is dying around it, it weathers the storm produced by the growth of *S. cerevisiae*, waiting patiently for it to die due to a lack of nutrients and a buildup of its own waste (alcohol).

In this highly hostile environment of finished wine, *Brettanomyces* flourishes. Unfortunately for winemakers, as this yeast slowly grows by taking advantage of leftover complex nutrients, which *S. cerevisiae* does not have the metabolic weaponry to consume, it produces a number of volatile compounds such as ethyl-phenols that impart aromas reminiscent of a barnyard floor or even the

medicinal character of band-aids. Such descriptive terms do not lend themselves to the production of fine wine, such that *Brettanomyces* spoilage is a real and present concern for winemakers worldwide.

In their *Brettanomyces* paper, Dr Borneman showed that four Australian isolates of *B. bruxellensis* have a core diploid genome that is sufficient for their survival, but two were triploids: their cells contain an extra haploid genome (a full set of unpaired chromosomes).

He determined that the sequences of the haploid genomes were highly divergent between the two strains.

Dr Borneman said some *Saccharomyces* yeast species, such as the ubiquitous *S. pastorianus*, which produces all of the world's lager beer, possess a similar allotriploid genome that allows them to survive in a wider range of environmental conditions than their diploid relatives.

He suggested the triploid *Brettanomyces* strains arose through multiple hybridisation events between different strains or species.

Remarkably, he said, the triploid strains account for 92% of *Brettanomyces* isolates from across the Australian wine industry.

Their near-total replacement of diploid strains in Australian wineries is evidence of strong positive selection pressure for the triploid forms because of their ability to survive in a broader range of environmental conditions than diploid strains.

“Interestingly, this correlates with the triploid strains being significantly more resistant to sulfite, the main control measure used by winemakers against *Brettanomyces* spoilage,” Dr Borneman said. It suggests that *Brettanomyces*, much like antibiotic-resistant bacteria, is fighting back against the measures used for its control.

The study therefore provided a snapshot of the microbe in the act of evolving resistance to sulfite. Forewarned, winemakers have time to find other preservatives to suppress *Brettanomyces* and delay the development of sulfite resistance.



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Improved sterilisation of medical devices

ONBoard Solutions has announced the launch of a product for the room-temperature sterilisation of tissue-engineered and medical device products: REVOX.

Developed in the United States by Cantel Medical, REVOX offers a solution to what is a typically difficult and complex procedure.

The CEO of US cranial implant manufacturer OsteoSymbionics, Dorothy Baunach, described the sterilisation technology as “a lifesaver for our company”.

The Cleveland-based company, a designer and manufacturer of high-quality patient-specific craniofacial implants, had previously been facing a huge dilemma. Before surgeons could use OsteoSymbionics' implants in surgery, the devices first had to be sterilised. For years, hospitals had relied on an on-site sterilisation process

claimed to be the first new sterilisation technology in the medical industry in nearly two decades. REVOX sterilisation uses a peracetic acid (PAA)-based vaporised sterilant to perform sterilisation at room temperature, between 18 and 30°C.

The REVOX sterilisation method addressed OsteoSymbionics' specific needs. Because the implants are heat sensitive, they could not be sterilised utilising EO. Chemical processes were not an option either, as the product could not retain its physical or biocompatible characteristics with such sterilisation methods. “That’s what made the REVOX method such an attractive option for the company,” said Baunach.

What most appealed to Baunach and her team was that the REVOX sterilisation process enabled her company to deliver its implant to hospitals pre-sterilised, rather than relying on the hospital to sterilise. The goal, said Baunach, is to eventually have a REVOX sterilisation chamber installed and thereby speed up inline processing of the implants.

“It’s nice once again to focus on what our company does best and have peace of mind that the sterilisation part of the equation is being handled so professionally,” said Baunach.

Mason Schwartz, REVOX operations manager and co-inventor, said other experiments similar to their work with OsteoSymbionics are underway in the fields of donor tissue processing, porcine valves and biological — anywhere “sterility versus viability” are long-standing balancing acts. Because REVOX acts at much lower temperatures than other sterilisation technologies, Schwartz points out that it provides manufacturers with much greater flexibility when it comes to material compatibility. REVOX Sterilisation Solutions is positioned to foster increased innovation and production efficiencies for manufacturers of advanced devices.

ONBoard Solutions and Cantel Medical will be presenting the REVOX Sterilisation Process at the AusBiotech Conference 2015 in Melbourne and the 2015 Annual Tissue Bank Scientific Conference in Brisbane in October. For more information on the REVOX Sterilisation Process, contact ONBoard Solutions by calling (02) 9695 1030 or emailing info@onboardsolutions.com.



utilising ethylene oxide (EO) to accomplish that task. But when the chemical was recognised as a known carcinogen back in 1994, hospitals either significantly reduced their reliance on the EO process or discontinued the use of EO sterilisers completely, due to the residual risks of working with, and disposing of, such a dangerous chemical.

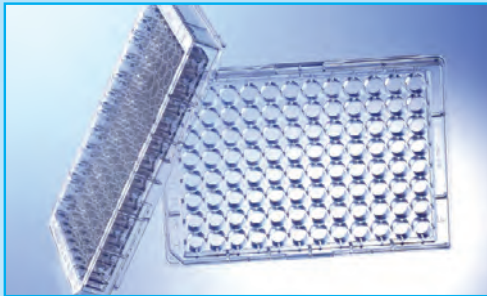
Without finding another reliable sterilisation method, it was getting increasingly difficult for the company to get its implants to patients in a timely manner. This was critical because patients often have a compressed time window for surgery, so alternative, off-site sterilisation methods with long lead times just wouldn't work.

Then, in early 2013, OsteoSymbionics heard about Cantel Medical's REVOX Sterilization Solutions process,

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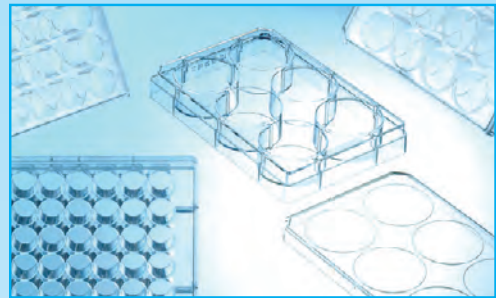
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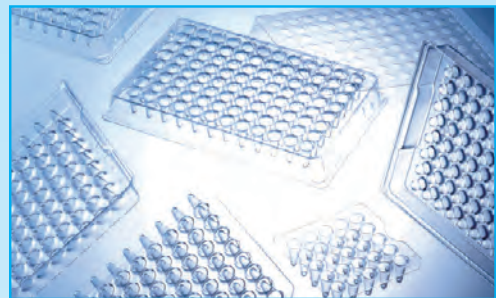
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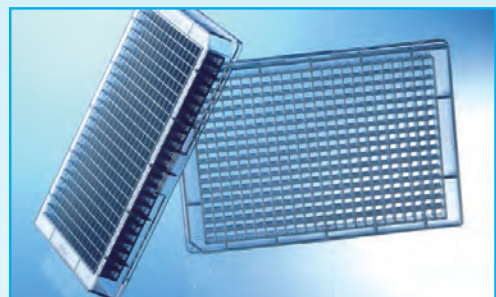
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Users can expect simplified titration straight from the box, with each AT1000 model including an application-specific kit to make it quick and easy for anyone to set up and operate a test. The kit includes a USB key that automatically programs the required endpoints and calculations to ensure testing is done according to standards but without the complex programming.

Other features include easy-to-use product interfaces and compatibility with Hach IntelliCAL probes. The product series is suitable for municipal and industrial markets for testing pH, total acidity, free and total SO_2 , moisture content (KF) and salt content.

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Workstation for agarose gel selection of DNA fragments

The NIMBUS Select Workstation with Ranger Technology provides a fast and economical automated solution to agarose gel selection of DNA fragments, generating high-quality material for downstream use in next-generation sequencing (NGS), cloning and gene synthesis applications.

Agarose gel size selection is a key component in sample preparation and quality control used throughout the life sciences. By automating pipetting steps, the product eliminates the labour-intensive and error-prone step of manual gel preparation. In an average 2 h run, the workstation can accurately process up to 96 samples and then place the fragments in destination labware.

The unit offers numerous performance and quality-control benefits over manual processing and other automated platforms. As an open automation platform, the workstation can be used for many applications and works with multiple NGS instrument manufacturers. The instrument's 96-channel CO-RE head provides a pipetting dynamic range of 1 to 1000 μL .

Because sample processing does not always come in precise 96-sample batches, the workstation has the built-in flexibility to automate workflows from one to 96 samples at a time. Quality-control metrics, including individual gel images and electropherogram traces, are captured for each sample.

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Many industries — including pharmaceutical and food companies, hospitals, schools and workplaces in general — need to determine the level of environmental microbial contamination. This helps provide protection for both product quality and the health of workers in accordance with international standards.

VWR International has introduced the SAS (Surface Air System) portable microbiological air samplers. The SAS is an open system and can be used with 60 or 90 mm petri dishes. The same kind of contact plate can be used for air and surface sampling and is applicable to GLP and GMP air sampling operations.

Three key models are available. The Super ISO100 and ISO180 have specifically been designed for the pharmaceutical and hospital sectors, allowing a sampling rate of 100 or 180 L/min.

The DUO SAS Super 360 has two aspirating heads, which allows for each head to use a different media to capture different microorganisms or the same media to allow for greater sampling confidence. Sampling on the two heads can halve the process time, providing an advantage for busy users.

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Lonza's RAFT (Real Architecture For 3D Tissue) 3D Cell Culture System uses a patented absorber technology to create cell layers in high-density collagen that mimic the in vivo environment. This allows for the formation of complex models and facilitates an understanding of cellular growth, differentiation and cell-to-cell interactions.

The versatile RAFT kit is available in a number of formats and is appropriate for analysis using a wide variety of imaging, biochemical and histological techniques. In combination with Lonza's human primary cells and media solutions, the system empowers researchers to create physiologically relevant cell culture models for use across drug discovery and research applications.

The product has been designed with simple, easy-to-follow protocols that allow researchers to set up 3D cell cultures in under 1 h. The kit includes a collagen type I solution and biocompatible absorbers, which remove the medium from cell-seeded collagen hydrogels and allow researchers to control both cell concentration and matrix density. The flexible system supports a variety of formats, including 24-well, 96-well and insert-well.

The system can be utilised with one cell type or multiple cell types in parallel. Cells can be cultured within and/or on top of the collagen scaffold. The addition of permeable membrane cell culture inserts provides other extensions to the system, allowing the generation of barrier models including air-lift models. The system is compatible with a variety of cell types and has been used to successfully generate 3D cultures in a number of research areas, including oncology, toxicology and neuroscience.

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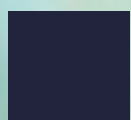
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TABBS 2015: *Realising the Bioeconomy - It's Hot in the Tropics* will seek to engage leaders from the national and international Bioenergy and Bioproducts industry and research community to explore the various opportunities this area provides for future economic development, as well as some of the challenges we as an industry are posed with.

The challenges faced by economies in tropical regions (and worldwide), require innovative and practical solutions. Working to address them, nations have certainly made progress across a range of areas - including environmental and social - but there is still untouched potential to be realised in the Tropics.

TABBS 2015 will provide an opportunity for global industry stakeholders to come together, share their experiences and cooperate to uncover this potential, grow their businesses and help create a dynamic, internationally competitive and sustainable life sciences industry.

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Eppendorf's S41i shaking incubator combines a laboratory shaker with direct-heating CO₂ incubator technology, creating an optimal environment for non-adherent cell culture applications. This combination means the device produces good cell yield and viability.

The product provides a highly stable cell culture environment for secure cell growth. Its touch-screen display gives a clear indication of chamber conditions, while the sealed inner door and advanced control both conserves gas and maintains temperature. The incubator also features high-temperature disinfection.

Eppendorf South Pacific Pty Ltd

www.eppendorf.com.au

Gas generators

Peak Scientific has announced two more models in its Precision Zero Air range, offering users greater choice when it comes to specifying a gas generator best matched to their flow requirements. The Precision Zero Air 7L and Precision Zero Air 18L models complement and expand the existing Precision Zero Air offering, with options ranging from 1.5 to 30 L/min flow rates in a common compact footprint.

The Precision Zero Air models integrate seamlessly with Precision Hydrogen and Precision Nitrogen models GC-dedicated gas generators, allowing users to mix and match modules in a single stack tailored to their specific GC gas needs. The company also caters for those who do not have their own in-house compressed air supply with the dedicated Precision Compressor, which sits neatly within the Precision stack and provides outlet pressure between 120 and 145 psi.

The 7L and 18L models have been engineered to the same exacting standards as the existing range, offering a continuous, consistent and hassle-free source of hydrocarbon-free air to low detection limits. They are suitable single-source solutions for laboratories with larger numbers of GC detectors requiring zero air, such as FID, FPD and NPD, sitting neatly in the range between the 3.5L and 30L units.

Designed with ease of use in mind, the range is said to offer users increased productivity and reduced overhead costs, while eliminating the risk of system contamination from poor gas supply. There is no catalyst chamber replacement required, so ongoing maintenance costs are kept to a minimum. The models are backed up by Peak customer service and product technical support, delivered locally on-site around the world.

Peak Scientific Instruments Pty Ltd

www.peakscientific.com

Antibody labelling kits for multicolour flow cytometry

Flow cytometry is a widely used application for cell analysis, but it is important to consider the combination of fluorescent labels for use within multicolour flow cytometry. Fluorophore characteristics, compatibility with the other fluorescent molecules and the instrument to be used for the sample analysis should all be acknowledged.

Furthermore, the availability of conjugates required for multicolour cytometry can be an issue. It is not unusual to find that the specific fluorochrome conjugate required is not available.

Lightning-Link antibody labelling kits, from Innova Biosciences, enable direct conjugation of antibodies, proteins or peptides to a fluorescent label in under 20 min for use in multicolour flow cytometry. Direct conjugation can be achieved with only 30 s of hands-on time.

The user can choose from over 35 fluorescent dyes in Lightning-Link range. If the specific antibody conjugate is not available commercially, the desired conjugate can be prepared in less than 20 min with a 100% yield from the unconjugated antibody. The simplicity and convenience of the kits provides ease and flexibility in panel design for multicolour flow cytometry.

BioNovus Life Sciences

www.bionovuslifesciences.com.au

Mass detector

With the ACQUITY QDa Mass Detector from Waters, users can minimise the risk of unexpected coelutions or components and confirm trace components with the analytical confidence of mass detection, enhancing the analytical value and productivity of each analysis.

Whether the user's focus is on advancing health care, protecting the environment, safeguarding our food and water supplies or making new materials, the detector is said to improve the capability of existing analytical or purification systems. It is described by the company as the simplest route to versatile mass detection.

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Analysis of differential expression of genes and proteins

The nCounter SPRINT Profiler, from NanoString Technologies, is a benchtop instrument system used to analyse differential expression of genes and proteins.

The product enables users to analyse tens to hundreds of targets simultaneously using single-tube multiplexing and avoid waste by eliminating RNA extraction. Users can process crude cell lysates from as few as 2500 cells.

The system's intuitive workflow requires only 10 min of hands-on time from sample to data. It can thus be deployed without the need to hire additional staff.

Results are obtained from a simple CSV file that contains direct counts for each target. Data can either be analysed in the included nSolver Analysis Software or imported into the user's favourite application.

The system is said to eliminate cDNA synthesis, amplification and library prep so users can experience less technical variation in their assays. They can therefore work faster as the need for experimental replicates is reduced.

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

Rotor mills

The RETSCH SR 300 and SK 300 rotor mills are claimed to have been greatly improved with regard to performance, handling and flexibility. Due to their robust design, the rotor mills are suitable for applications in the laboratory as well as for small-scale production.

The speed of the rotor beater mill SR 300 has been increased and can be set between 3000 and 10,000 rpm, thus allowing for optimum adaptation to application requirements. Further features are the removable cassette and push-fit rotor that can be easily taken out for cleaning without using tools, just like the removable hopper. The cassette allows for almost 100% sample recovery. The grinding chamber, feed hopper and material inlet and outlet are made from high-quality stainless steel. The product is therefore suitable for use in pharmaceutical and food laboratories.

The cross beater mill SK 300 now also operates with higher speed, which can be set from 2000 to 4000 rpm. The grinding insert and rotor are as easily removable as in the SR 300. Both mills can be equipped with an optional cyclone, which improves material discharge, particularly for very fine particle sizes, and provides additional cooling of the sample.

MEP Instruments Pty Limited
www.mep.net.au



High-speed centrifuge

The CM-50MP MiniPrep Master, from EMI, is a vortexing high-speed centrifuge which is programmable for all of the steps in a nucleic acid or protein purification process.

The device functions as a 12-place microcentrifuge at up to 12,400 x g; as a variable-intensity vortex for tubes; in a spin/mix/spin mode for vortexing low-volume samples; and as a programmable extractor for rapid and repeatable sample preparation, whether of DNA, RNA or protein preps. Bead bashing is another application.

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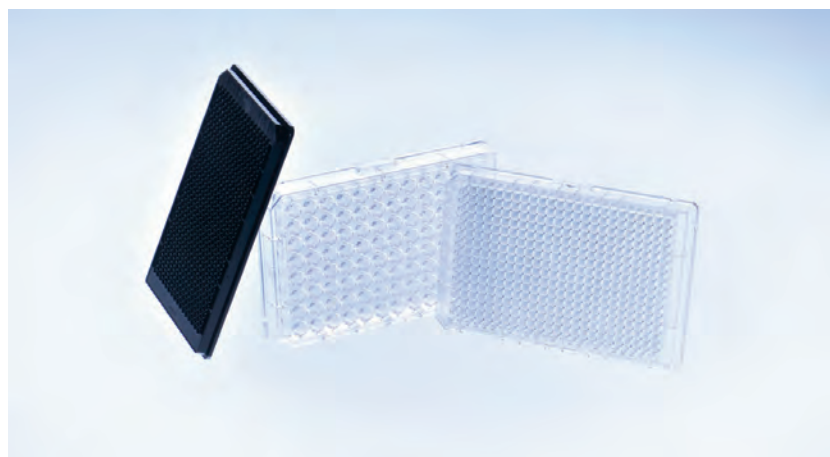
Benchtop freeze dryers

The Lablyo series of benchtop freeze dryers, from JAVAC, suits research and development (R&D), production, educational and pharmaceutical applications. Features include digital microprocessor controllers, with USB data-logging enabling repeatability and true control.

The compact units include electric defrost features and 24 h duty cycles. The series is available in four models and comes with a full range of accessories, including the Australian-made JAVAC VECTOR vacuum pump.

Should an unexpected chemical reaction occur, the company can fix it with specialist pumps and accessories or even dry vacuum solutions. Should the application be aggressive, the stainless steel condenser and the full Teflon anti-corrosive VECTOR vacuum pump will be of use.

Javac Pty Ltd
www.javac.com.au



Microplates

Greiner Bio-One UV-Star microplates for increased assay sensitivity feature technology that allows for extended wavelength transmission of up to 230 nm.

The 96- and 384-well plates are suitable for nucleic acid determinations at 260/280 nm and for protein concentration measurements at 280 nm without background interference.

DMSO resistant and with the ability to be stored down to -20°C, the plates are also suitable for smaller volume spectroscopy samples.

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Microscope for imaging and secondary structure of proteins

The JASCO infrared (IR) microscope is a powerful tool for obtaining IR images in order to analyse molecular structure. It is an alternative to methods for evaluating protein secondary structure such as X-ray crystallography, NMR and circular dichroism, which can only estimate the secondary structure of pure proteins.

While conventional IR microscopes use a single-channel detector to obtain IR imaging data, JASCO has developed a multichannel IR microscope with a built-in multichannel detector, rapid scan and high-performance sample stage which have enabled reduced measurement times. In addition, the system can be used to estimate the secondary structure of proteins.

The FTIR system allows measurements without extensive sample preparation and data can be collected on purified proteins or impure or unrefined protein. The estimation of protein secondary structure using unrefined materials is suitable for the fields of pathology and food preparation. No staining is required to obtain the images.

FTIR can be applied not only for proteins but also for estimating fatty acid and carbohydrate content. The JASCO Secondary Structure Estimation (SSE) software, in combination with principle component analysis, uses the IR spectrum to predict secondary structure within seconds while accounting for the various matrices (solvents, buffers, etc).

The microscope system is a fast analysis tool that enables the user to obtain IR images quickly and correlate functional group distribution and secondary structure of proteins. The system can be applied to various fields such as pathology, pharmaceutical, food science and more.

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Column for LC-MS analysis

The Thermo Scientific ProSwift C4 RP-5H column, for liquid chromatography-mass spectrometry (LC-MS) analysis, uses a capillary design to offer labs with limited samples and complex mixtures a fast and high-resolution solution for the identification of protein samples, facilitating high-sensitivity proteomics and biotech applications. Offering a wide range of operational flow rates, alternative selectivity and low carryover, the product is suitable for rapid LC-MS analysis of protein samples.

The column incorporates a low-pressure monolith with a porous structure, enabling fast low-flow separations without sacrificing resolution. The monolith uses a butyl (C₄) methacrylate co-polymer that is less hydrophobic than PS-DVB columns, meaning there is less column fouling. This is important for MS users, where sensitivity is higher compared to UV and carryover can cause interference.

The porous co-polymer is said to give the flow channels higher permeability in the stationary phase than particulate columns, resulting in increased separation efficiency. Due to this structure, smaller ID columns of 50 µm can be used for analyses, increasing sensitivity.

The product is available in a range of column formats for nano, capillary and micro flow chromatography, offering good resolution for large, hydrophobic intact proteins across biopharma and research proteomics. This enables flow optimisation for increased MS sensitivity, as well as rapid separation of monoclonal antibody and complex protein samples.

Thermo Fisher Scientific
www.thermofisher.com.au

Centrifuge range

Thermoline's Dynafuge range of centrifuges is targeted towards many different industries, including research, hospitals, veterinary, education and high-end food and drink preparation. They are available with various fixed-angle rotors and swing-out rotors to suit nearly all possible standard tubes and bottles. Custom tube adapters are also available.

The centrifuges are said to feature an improved heat exchanger, with large, efficient compressors and condensers. By using hot gas bypass, a high level of control is achieved.

Some centrifuges in the range have a refrigerated version for users wanting to spin samples at controlled temperatures as low as -9°C. The refrigeration systems are said to reduce power consumption by 25%.

All bowls in the centrifuge range are stainless steel (salt saturation tested). The fixed-angle rotors are CNC machined from polypropylene, as are the adapters, providing strength, longevity and chemical resistance. The swing-out rotors and high-speed rotors are made from aircraft-grade, high-strength aluminium and are double anodised for protection.

Thermoline Scientific Equipment Pty Ltd
www.thermoline.com.au



Assay for live cancer stem cell identification

The AldeRed ALDH Detection Assay, from Merck Millipore, provides cancer and stem cell scientists with more capabilities for live cell isolation and characterisation. The AldeRed reagent is a red-shifted fluorescent substrate for aldehyde dehydrogenase, allowing cells to be identified and isolated by flow cytometry with concurrent use of green fluorescent cell lines, antibodies, transgenic animals and reporter assays.

High ALDH activity serves as a universal marker of stem cells, both normal and malignant. Cells can be identified and isolated based on the enzymatic activity of ALDH, a detoxifying enzyme responsible for oxidation of hazardous aldehyde by-products. The marker ALDH has been used to isolate cancer stem cells from various human malignancies, including bladder, breast, cervical, colon, head and neck, liver, lung, pancreas, prostate and ovary.

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Toolkit for nanomechanical measurements

The last several years have seen a surge in the development and use of techniques that enable the measurement of mechanical properties at the nanoscale. The Nano-mechPro Toolkit, from Asylum Research, is a collection of techniques that spans a large modulus range.

The product includes techniques that measure both the elastic and viscous response. It is said to leverage the high speed of the Asylum Research Cypher AFM to make these quantitative measurements faster than ever before. The various techniques each offer their own advantages and cover some portion of the total range of properties that researchers need to explore.

The toolkit consists of standard imaging modes that are included with every Asylum Research AFM, as well as several optional techniques. The standard modes include force curves and force volume mapping, phase imaging, bimodal dual AC imaging and loss tangent imaging. The optional modes include fast force mapping mode, instrumented vertical nanoindentation, force modulation imaging, AM-FM viscoelastic mapping mode and contact resonance viscoelastic mapping mode.

Oxford Instruments

www.oxford-instruments.com



Detecting corrosive contaminants in power plants

High-purity water is used in the water/steam cycle in power generation, and maintaining its purity is essential to ensure that sensitive equipment such as turbines are not damaged by contaminants. Mettler-Toledo Thornton's DCC1000 Degassed Cation Conductivity System, for use in pure water applications in power plants, will help technicians make decisions for increasing load as well as for plant operations.

The product was designed with ease of installation, use and maintenance in mind, offering the user a monitoring system that is easy to operate. With accurate conductivity measurements using UniCond conductivity sensors, the system confirms water purity to maximise power production and minimise corrosion.

Mettler-Toledo Ltd

www.mt.com



Rugged tablet computer

The RTC-900B rugged tablet computer has been designed to meet IP65 and MIL-STD 810G standards, making it resistant to moisture, dust, shock and vibration. The unit features an Intel Atom E3825 1.33 GHz dual core processor with 4 GB of DDR3L memory.

A 10.1" LCD screen with a capacitive multitouch provides the user interface. Onboard communication includes WLAN 802.11b/g, Bluetooth 2.1 and an optional 3G modem module. Additional I/O includes a micro USB 3.0 port, a micro HDMI port and a micro SD card slot.

Built-in features include a front 2 MP camera, a rear 5 MP camera, a G-sensor, a light sensor, an eCompass, GPS navigation, a speaker and a microphone. A high-performance, high-capacity lithium polymer battery provides 7 h of long-life operation.

The unit is supplied with Windows Embedded 8.1 Industry Pro.

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



Differential scanning micro calorimeter

MicroCal differential scanning micro calorimeters provide fast and accurate determination of the stability of proteins, nucleic acids, micellar complexes and other macromolecular systems. Differential scanning calorimetry (DSC) directly measures the enthalpy (ΔH) and transition midpoint (T_m) to predict shelf life, develop purification strategies, evaluate protein constructs and rank the affinities of ligands to a protein target in small molecule drug discovery programs.

The MicroCal VP-Capillary DSC system enables the study of folding and unfolding without labelling or the use of artificial probes, so molecules are studied in their native states. The high-throughput, high-sensitivity product requires low sample volumes and features software that streamlines workflow through simplified experiment set-up. Automated data analysis and improved data sorting help relieve analysis bottlenecks, reducing data analysis time for a typical experiment from days to hours.

The systems are in use in over 1000 labs worldwide, both for R&D and commercial applications, and have over 10,000 citations in reference databases.

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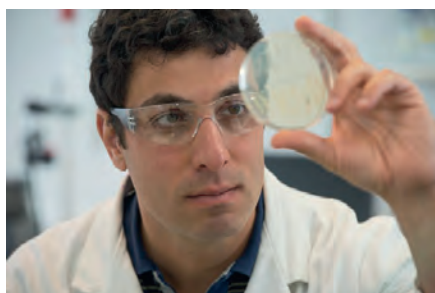
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How to lose weight without exercising

It sounds too good to be true, but scientists have developed a molecule that effectively acts as an exercise mimic. By tricking cells into thinking they have run out of energy, the molecule increases glucose uptake and metabolism, thus improving glucose tolerance and weight loss.



Professor Ali Tavassoli.

Developed at the University of Southampton, the molecule 'compound 14' inhibits the function of a cellular enzyme called ATIC, which is involved in metabolism. This leads to the build-up of a molecule called ZMP in cells, which makes cells think that they have run out of energy by activating the cell's central energy sensor, known as AMPK.

"There is a lot of evidence from previous studies that if you could selectively activate AMPK with a small molecule, it could have potential benefits in the treatment of several diseases, including type 2 diabetes, by acting as an exercise mimetic and increasing the uptake and usage of glucose and oxygen by cells," said Professor Ali Tavassoli, whose research team developed compound 14. "Our molecule, which activates AMPK by altering cellular metabolism, therefore holds much promise as a potential therapeutic agent."

Writing in the journal *Chemistry and Biology*, the team outlined how the molecule was given to two groups of mice — one group having been fed a high-fat diet which made them obese and impaired their glucose tolerance. When mice with a

normal diet were treated with compound 14, their blood glucose levels and weight remained normal. However, a single dose of compound 14 lowered the elevated blood glucose of the obese mice to near normal levels. Furthermore, a daily dose of compound 14 administered to these mice for seven days resulted in improved glucose tolerance and 1.5 g weight loss (about 5% body weight).

"Current treatments for type 2 diabetes centre on elevating circulating insulin levels or improving the insulin sensitivity of an individual," noted study co-author Dr Felino Cagampang. "The issue is that established drugs do not successfully enable patients with type 2 diabetes to achieve glycaemic control and some can even result in weight gain, a leading factor driving the diabetes epidemic. In contrast, this new molecule seems to reduce glucose levels and at the same time decrease body weight, but only if the subject is obese."

The next step for the researchers is to examine the molecule's mode of action in improving glucose tolerance and in reducing body weight long term. If it is found to be safe, a drug could be developed which would help those with diabetes and obesity manage their condition.

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Modules for gas analysis system

Siemens has released two analyser modules for its Siprocess GA700 gas analysis system. With Ultramat 7 and Calomat 7 (together with the Oxyamat 7 module, which is already available), users can configure flexible analytical solutions for measuring oxygen, hydrogen, noble gases or infrared-active components such as carbon monoxide and carbon dioxide.

The modular design of the system enables fast module installation and replacement. Depending on configuration, the units can be used at temperatures up to 50°C, making them suitable for process control and optimisation in incineration plants and for quality control and process monitoring in chemical and petrochemical plants.

The Siprocess GA700 comprises a base unit into which one or two modules can be integrated. The modules provide sensor-based electronics, including evaluation software, as well as the process connections. The influence of interfering gases can be measured and mutually offset.

Users can employ the Calomat 7 to carry out quantitative determinations of hydrogen and noble gases in binary or quasi-binary gas mixtures. Depending on the parameter settings, the measuring ranges for H₂ are 0 to 0.5%, 0 to 100% or 95 to 100%. The module can therefore be used for pure gas monitoring and protective gas monitoring or for determining H₂ in blast furnace or converter gases.

The Ultramat 7 module carries out selective measurements of up to two infrared-active components such as carbon monoxide and dioxide. The unit can be integrated, for example, in measuring equipment for boiler control in incineration plants. Furthermore, the module can be used to measure the concentrations of process gases in chemical plants.

Siemens Ltd

www.siemens.com.au

Microplate reader

BioTek has announced the release of the Synergy Neo2 Multi-Mode Reader. The plate reader is designed for speed and ultrahigh performance, incorporating BioTek's Hybrid Technology with independent optical paths. It has been optimised for biochemical assay performance and provides good results for cell-based assay detection.

Continuously variable bandwidth quadruple monochromators, sensitive, high-transmission filter-based optics and up to four PMTs provide ultrafast measurements with good results. Environment controls — including CO₂/O₂ control, incubation to 65°C and variable shaking — support live cell assays. Cell-based detection is optimised with direct bottom illumination.

Barcode-labelled filter cubes help streamline workflows and limit errors, and the available BioStackNeo plate stacker is suitable for high-throughput requirements. Powerful Gen5 Data Analysis Software is included, and features designed for 21 CFR Part 11 compliance are available in Gen5 Secure.

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Combination freeze dryer/vacuum concentrator

Genevac's miVac SpeedTrap cold trap can now be used for freeze drying or configured as a combined concentration/freeze-drying workstation with a miVac vacuum concentrator.

Utilising the updated miVac SpeedTrap with continuous chill mode, in conjunction with the miVac Super Vacuum pump, up to 250 mL of water or other solvents may be freeze dried in a single operation.

Samples to be dried are simply placed in the rotor of the miVac concentrator and dried at full vacuum. The vacuum boils the samples at below their freezing point; therefore, the samples freeze and the ice sublimates away, leaving the sample

as a dry powder. To reduce drying times, a pre-concentration step, at a controlled vacuum, can be easily incorporated.

The cold trap and pump may also be used as a stand-alone freeze drier. A range of accessories has been designed by Genevac to allow the SpeedTrap to directly accept pre-frozen samples in either flasks or vials. Simply attach the freeze-drying accessory jar in place of the regular SpeedTrap collection vessel. Flasks can be attached to the valves, or vials may be placed directly in the accessory jar, using the holders provided.

At 212 mm wide, the product offers a compact solution for low-volume freeze drying. As a combined system, the miVac provides a versatile concentration and freeze-drying tool for busy life science labs.

Scitek Australia Pty Ltd

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Immunoassay kits

R&D Systems has over 20 years of experience designing, testing and optimising immunoassay kits to ensure a high level of performance in analyte quantification. Quantikine Kits are complete, fully validated, ready-to-run immunoassay kits that are designed to measure proteins in a number of complex sample types.


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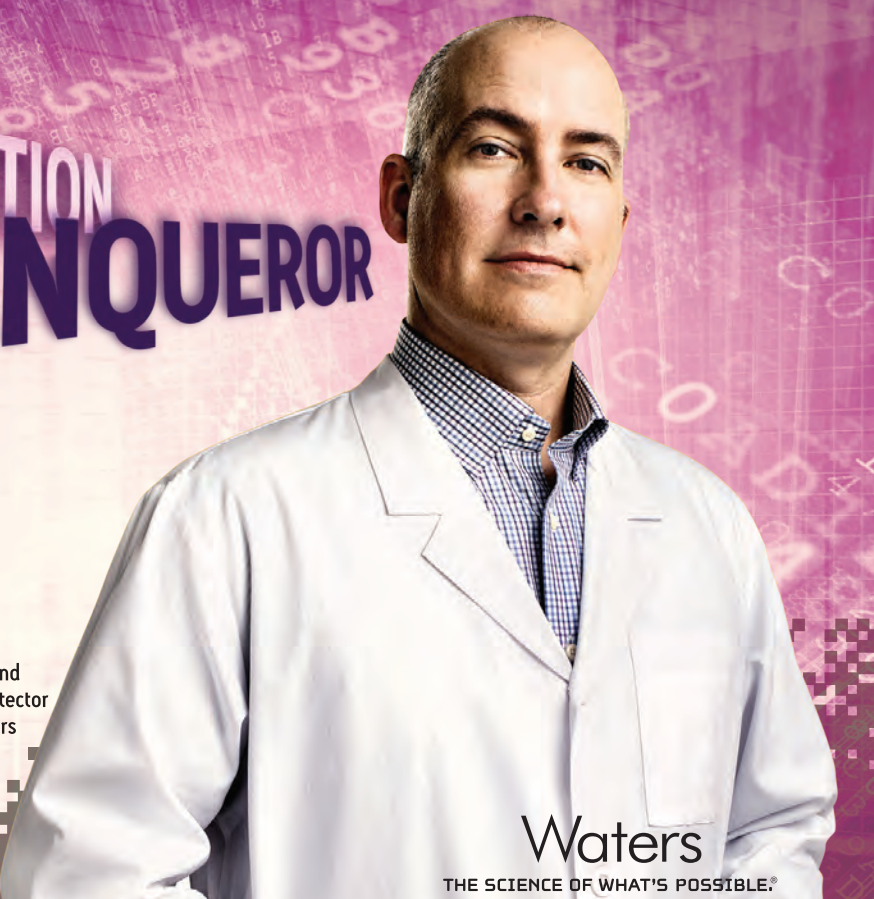


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An abstract, colorful geometric pattern consisting of overlapping, translucent, crystalline shapes in shades of blue, green, yellow, and orange, set against a dark background.

Massless exotic particle found

The elusive Weyl fermion, a massless particle theorised 85 years ago, has been observed by two separate teams of researchers.

In 1928, Paul Dirac discovered a crucial equation in particle physics and quantum mechanics, now known as the Dirac equation. Very fast electrons were solutions to the Dirac equation. Moreover, the equation predicted the existence of anti-electrons, or positrons: particles with the same mass as electrons but having opposite charge. True to Dirac's prediction, positrons were discovered in 1932 by the American physicist Carl Anderson.

In 1929, the German-born mathematician Hermann Weyl found another solution to the Dirac equation, this time massless. 'Weyl fermions', speculated to be one of the building blocks of subatomic particles, were conjectured to have no mass and to behave as both matter and antimatter — which has the same mass but opposite charge and other properties to regular matter — inside a crystal.

A year later, Wolfgang Pauli postulated the existence of the neutrino, which was then thought to be massless, and it was assumed to be the sought-after solution to the Dirac equation found by Weyl.

Neutrinos had not been detected yet in nature, but the case seemed to be closed. It would be decades before American physicists Frederick Reines and Clyde Cowan finally discovered neutrinos in 1957, and numerous experiments shortly thereafter indicated that neutrinos could have mass. In 1998, the Super-Kamiokande Collaboration neutrino observatory in Japan announced what had now been speculated for years: neutrinos have non-zero mass. This discovery opened a new question: what then was the zero-mass solution found by Weyl?

The observation of actual Weyl fermions was made by scientists at Princeton University in New Jersey and the Massachusetts Institute of Technology, and could herald a whole new age of better electronics. The research by both teams was published in the journal *Science*.

The researchers found the fermions independently by firing photons at crystals of the semi-metal tantalum arsenide, which has

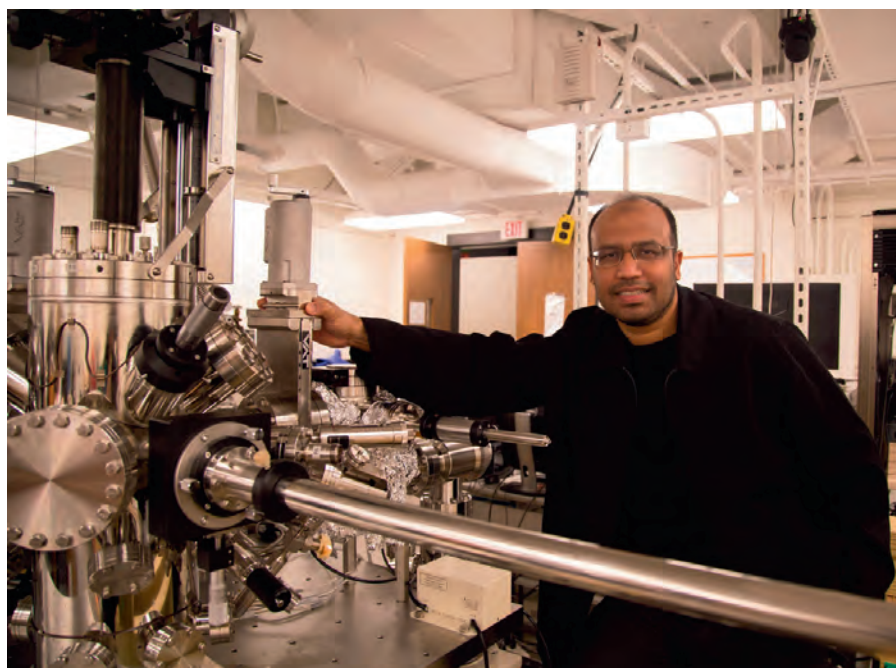
properties between an insulator and a conductor. The researchers noted that the Weyl fermions are not freestanding particles. Instead, they are quasiparticles (a 'disturbance' in a medium that behaves like a particle) that can only exist within the semi-metal crystals. In other words, they are electronic activity that behaves as if they were particles in free space. By shining beams of ultraviolet light and X-rays at these crystals, the researchers detected the telltale effects of Weyl fermions on those beams.

Particles are essentially divided into two groups. Fermions are said to be those that make up matter, while bosons are the force particles that hold them together. All other fermions are known to have mass, making the Weyl fermion unique among its 'peers'.

Electrons, protons and neutrons all belong to the fermion class of particles. Unlike the other major class of particles, the bosons, which include photons, fermions can collide with each other — no



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Hasan (pictured) and his research group researched and simulated dozens of crystal structures before finding the one suitable for holding Weyl fermions. Once fashioned, the crystals were loaded into this two-storey device known as a scanning tunnelling spectromicroscope to ensure that they matched theoretical specifications. Located in the Laboratory for Topological Quantum Matter and Spectroscopy in Princeton's Jadwin Hall, the spectromicroscope is cooled to near absolute zero and suspended from the ceiling to prevent even atom-sized vibrations. (Photo by Danielle Alio, Office of Communications)

two fermions can share the same state at the same position at the same time.

Surprisingly enough though, the Weyl fermions are very stable. They will also only interact with other Weyl fermions, staying on the same course and at the same speed until they do. This means that, unlike electrons, they can carry a charge for long distances without getting scattered or creating heat.

These unique properties could make the Weyl fermion incredibly useful for electronics in the future, including the development of quantum computing. For one thing, they can move independently of one another, and they can also create massless electrons. The consequence is they could flow more easily and lose less heat, making electrons more efficient.

Their basic nature means that Weyl fermions could provide a much more stable and efficient transport of particles than electrons, which are the principle particle behind modern electronics. Unlike

electrons, the massless Weyl fermions possess a high degree of mobility; the particle's spin is both in the same direction as its motion — which is known as being right-handed — and in the opposite direction in which it moves, or left-handed.

Another potentially useful quality of Weyl fermions is that they cannot move backwards — instead of bouncing away from obstacles, they zip through or around roadblocks. In contrast, electrons can scatter backwards when they collide with obstructions, hindering the efficiency of their flow and generating heat.

"Weyl fermions could be used to solve the traffic jams that you get with electrons in electronics — they can move in a much more efficient, ordered way than electrons," said Zahid Hasan, a Princeton professor of physics who led one of the research teams.

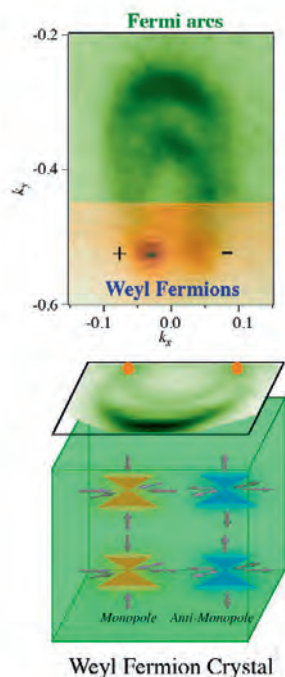
The way that Weyl fermions are constrained from moving backwards is similar to how electrons behave in exotic materials called topological insulators. Such constraints can help current flow highly efficiently; Hasan says that electricity in these crystals can (theoretically) move at least twice as fast as it does in graphene and 1000 times faster than in conventional semiconductors, "and the crystals can be improved to do even better". The

upshot could be faster electronics that consume less energy. Power consumption and associated heating is currently limiting a further increase in processor speed in our computers.

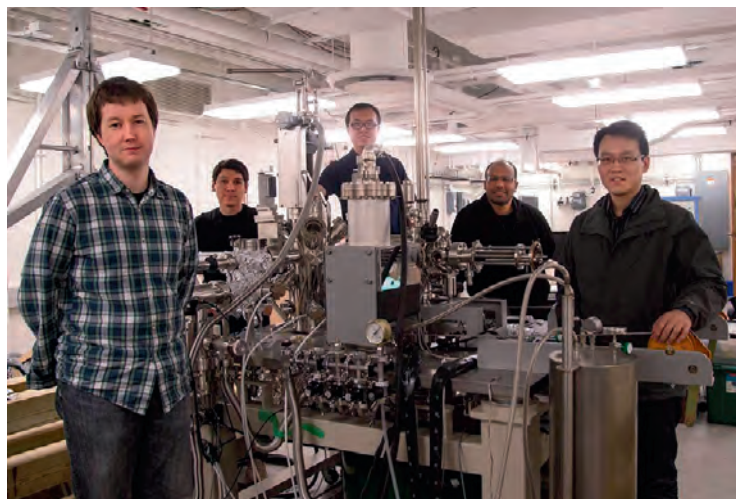
In addition, Weyl fermions could also lead to new kinds of quantum computers that are more resistant to disruption. Quantum computers rely on states known as superpositions, in which a bit can essentially represent both one and zero at the same time. Superpositions offer the chance to solve previously intractable problems, but they are notoriously prone to collapsing if they interact with the environment.

How the Princeton team did it

Prior to the *Science* paper, Hasan and his co-authors published a report in the journal *Nature Communications* in June that theorised that Weyl fermions could exist in a tantalum arsenide crystal. Guided by that paper, the researchers used the Princeton Institute for the Science and Technology of Materials (PRISM) and Laboratory for Topological Quantum Matter and Spectroscopy in Princeton's Jadwin Hall to research and simulate dozens of crystal structures before seizing on the asymmetrical tantalum arsenide crystal, which has a differently shaped top and bottom.



A detector image (top) signals the existence of Weyl fermions. The plus and minus signs note whether the particle's spin is in the same direction as its motion — which is known as being right-handed — or in the opposite direction in which it moves, or left-handed. This dual ability allows Weyl fermions to have high mobility. A schematic (bottom) shows how Weyl fermions also can behave like monopole and antimonopole particles when inside a crystal, meaning that they have opposite magnetic-like charges and can nonetheless move independently of one another, which also allows for a high degree of mobility. (Image by Su-Yang Xu and M. Zahid Hasan, Princeton Department of Physics)



An international team led by Princeton University scientists has discovered Weyl fermions, elusive massless particles theorised 85 years ago that could give rise to faster and more efficient electronics because of their unusual ability to behave as matter and antimatter inside a crystal. The team included numerous researchers from Princeton's Department of Physics, including (from left to right) graduate students Ilya Belopolski and Daniel Sanchez; Guang Bian, a postdoctoral research associate; corresponding author M Zahid Hasan, a Princeton professor of physics who led the research team; and associate research scholar Hao Zheng. (Photo by Danielle Alio, Office of Communications)

The crystals were then loaded into a two-storey device known as a scanning tunnelling spectromicroscope that is cooled to near absolute zero and suspended from the ceiling to prevent even atom-sized vibrations. The spectromicroscope determined if the crystal matched the theoretical specifications for hosting a Weyl fermion. "It told us if the crystal was the house of the particle," Hasan said.

The Princeton team took the crystals passing the spectromicroscope test to the Lawrence Berkeley National Laboratory in California to be tested with high-energy accelerator-based photon beams. Once fired through the crystal, the beams' shape, size and direction indicated the presence of the long-elusive Weyl fermion.

First author Su-Yang Xu, a postdoctoral research associate in Princeton's Department of Physics, said that the work was unique for encompassing theory and experimentalism.

"The nature of this research and how it emerged is really different and more exciting than most of other work we have done before," Xu said. "Usually, theorists tell us that some compound might show some new or interesting properties, then we as experimentalists grow that sample and perform experiments to test the prediction. In this case, we came up with the theoretical prediction ourselves and then performed the experiments. This makes the final success even more exciting and satisfying than before."



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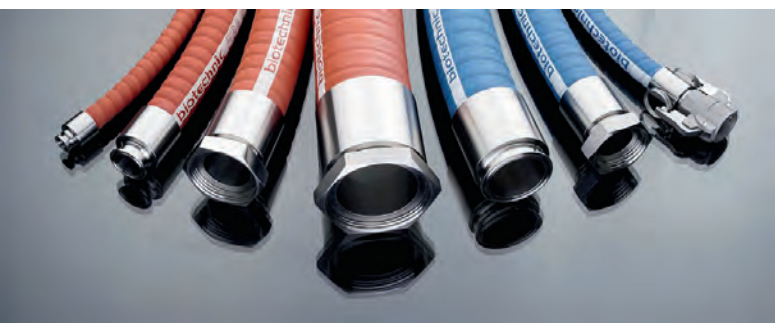
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Hygienic hose assemblies

Tudertecnica, an Italian manufacturer, designs and manufactures specialty technical hoses for a wide range of applications in food, chemical and other industries requiring high-performance specifications. It maintains all the essential ISO certifications, together with global testing certifications.

Biotechnic has acquired the distribution rights in Australia for the Tudertecnica brand of hoses. The company will supply purpose-built food hoses which are suitable for both fatty and non-fatty products.

The Glidotech hose has a clear, scuff-resistant cover incorporated in the vulcanisation process, which means it can be readily cleaned to maintain its appearance. Assemblies can be supplied with radially crimped, sanitary stainless steel fittings in sizes from 3/4" to 4" in both BSM and Triclamp styles.

Biotechnic

biotechnic.com.au

Batch media system

SAFC Commercial has launched the EX-CELL Advanced product line. Designed to address the needs of an industry where speed to market is important, the product line provides for increased performance, streamlines regulatory compliance and offers the supply chain security needed in the current biopharmaceutical environment.

The first EX-CELL Advanced product is a high-performing batch media system developed for a range of widely used industrial CHO cell lines, including SAFC's CHOZN cell line. The EX-CELL Advanced CHO Fed-batch System is said to outperform other commercially available equivalents by displaying significantly higher titers. Robust scale-up and easy adaptation offers those in biopharmaceutical development the opportunity to get their process up and running quickly and efficiently. Protein quality is said to remain uncompromised.

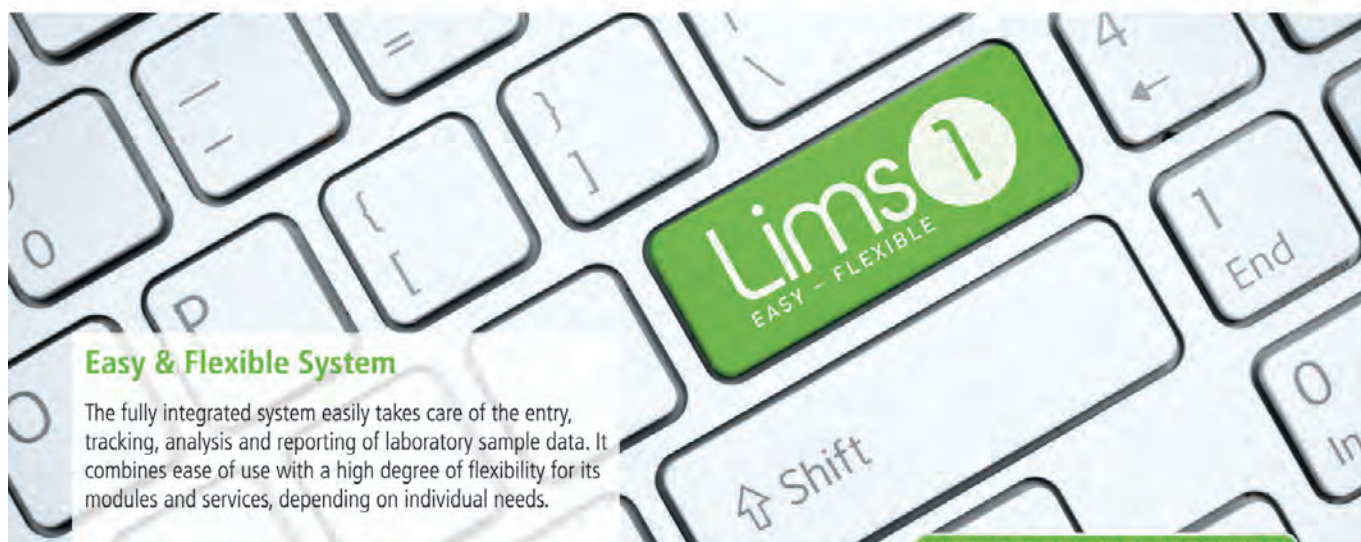
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Single-use gloves for high-risk tasks

Ansell has released its Microflex 93-856 single-use gloves for workers in high-risk, heavy-duty environments where there is a danger of contamination from hazardous substances, pathogens and other harmful materials.

Said to have a second-skin feel and good tactile sensitivity, the high-visibility gloves have been developed for the needs of people involved in crime scene analysis and emergency

services, and anyone who may come in contact with chemicals or corrosive materials.

The company says the gloves resist a variety of industrial chemicals for longer periods than other disposable nitrile gloves, while an extended cuff offers an increased level of protection in the highly sensitive wrist and forearm areas. Powder-free and not made with natural rubber latex, the gloves help protect from type I skin allergies, skin irritation and dryness caused by latex.

The gloves deliver chemical splash resistance to a variety of industrial chemicals. The textured fingers enable the wearer to maintain a strong grip that helps workers to carry out tasks with good comfort, performance and protection, while the bright orange colour allows hands to be visible in low-light situations and at great distances. This results in increased safety conditions for a variety of work environments.

Ansell Healthcare
www.ansell.com.au

Microbial identification and colony counting software

Synbiosis has announced the availability of its next-generation Chromogenic ID software module for the ProtoCOL 3 and Protos 3 colony counters. The software enables precise identification of pathogens including *Acinetobacter* spp, *Candida* spp, *Klebsiella* spp, *Enterococcus* spp, *E.coli* 0157, *Listeria* spp, *Salmonella* spp, methicillin-resistant *Staphylococcus aureus* and *Vibrio* spp.

The powerful software analyses chromogenic agars from media supplier E&O Laboratories and means microbiologists can use ProtoCOL 3 and Protos 3 systems to identify and count any bacteria or yeast cultured on chromogenic plates from E&O Laboratories and CHROMagar in seconds. This saves microbiologists time examining colonies and ensures that critical microbial identification results are consistent from one microbiologist to another.

The ProtoCOL 3 and Protos 3 systems allow precise chromogenic colony identification by capturing true-to-life colour images of colonies on chromogenic plates utilising their patented red, blue and green lighting. The systems simultaneously count the different coloured colonies of each species, providing objective, consistent data and reducing identification and keying errors. They generate accurate, fully traceable results which can be stored electronically for future audit.

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Direct excitation EDXRF elemental analyser

The Rigaku NEX DE is a direct excitation energy dispersive X-ray fluorescence (EDXRF) elemental analyser. Engineered for heavy industrial use, whether on the plant floor or in remote field environments, the analyser was developed to maximise flexibility and ease of use.

The instrument was designed for demanding applications or for situations where analysis time or sample throughput is critical. It is suitable for exploration, research, bulk RoHS inspection and education, as well as industrial and production monitoring applications.

The analyser is equipped with a 60 kV, 12 W X-ray tube to deliver improvements in elemental peak resolution and counting statistics, resulting in good calibrations and precision for challenging measurements. The high voltage, along with multiple automated X-ray tube filters, provides a multi-element analysis capability for high performance with low limits of detection (LOD). With direct excitation, energy requirements are reduced.

Next-generation silicon drift detector (SDD) technology provides a high count rate capability with good spectral resolution. This enables the product to deliver high-precision analytical results in short measurement times. Peltier cooled semiconductor detector technology is incorporated to deliver good short-term repeatability and long-term reproducibility with high elemental peak resolution.

The optics are protected by a safety film that can be changed without tools. The system's large sample chamber accommodates samples up to 30 cm in diameter and 10 cm tall, as well as a variety of single-position and autosampler options. Removable autosampler trays are interchangeable and support 32 and 40 mm cups.

The spectrometer is suitable for elemental analysis in basic quality control or its more sophisticated variants, such as analytical quality control, quality assurance or statistical process control.

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How I fell in love with the cloud

From the early days of PLC systems, DCS and distributed instrumentation, the need for data monitoring in centralised control rooms was apparent. Remote monitoring and general remote access to sites followed soon thereafter by all users.

Remote access was mainly driven by system integrators who needed to provide technical support, which was rapidly followed by project managers and production supervisors. For the first few years, access was provided (and still is) by PC-based software remote access utilities. Later, when the web interface evolved, software developers started adding remote desktop connectivity and web-server functionality as add-on options to the PC-based SCADA software station servers. Access by remote operators and authorised users suddenly became even simpler.

SCADA software - with its GUI interface, data monitoring, data logging, alarming and reporting - has been, and still is, notoriously expensive. In order to set up a multistation SCADA network with on-site and off-site access, the user needs to add extra licences to the existing SCADA server station - and that's in addition to adding multiple PCs and operating systems. Such a solution can rapidly become commercially prohibitive, especially for small to medium-sized projects.

Back in 2009, being a veteran of many years of SCADA and telemetry systems, I was listening to a presentation discussing data monitoring utilising the internet as a new paradigm for SCADA monitoring. The new service was referred to as SCADA in the 'cloud'.

My first reaction was: Why on Earth would anyone wish to display or upload their system's data to a website which is physically not installed on-site? How secured can a cloud-based website be? What is actually required to achieve all that the cloud is promising? How robust is the concept and how are clients going to pay for the service?

For a while, I was still contemplating the benefits and the potential risks involved in using a central SCADA monitoring station, which in reality is not here 'on Earth' but rather elsewhere in the cloud. My initial hesitations came slowly to a halt when I was asked to set up a system to remotely monitor, alarm and report on a medium site which included multiple refrigerators and deep freezers. Access was to be given to multiple users from anywhere in the world at any time. The total number of sensors was not more than 50. I have decided to try this new approach in SCADA by implementing cloud monitoring, which offered

a direct data link to a secured website to multiple users at no extra cost.

Enter 'the cloud controller'

A ZigSense cloud controller combines multiple hardware and software features in a relatively low-cost system. It includes few built-in I/Os (analog and digital); a built-in Modbus RTU serial port for interface to external systems such as PLCs, other data loggers and smart controllers (temp, flow); and an optional short-range wireless RF extender port to remote wireless I/Os.

The main point to remember is that the controller's ability to upload its sampled I/O data to a secured website will be called, from now-on, 'ZigCloud'. To achieve robust upload routes, the cloud controller includes two communications channels: an ethernet port and a built-in 3G modem that requires a cellular network SIM card. The two communications channels are backing up each other to ensure data is not lost as it travels to the cloud.

A data logging functionality is built into each controller. Local data logging is activated when both uplink communication channels are lost, ensuring no monitored data is lost.

From Earth to the cloud and back

Once data generated on Earth arrives at the cloud, it is recorded according to the data logging settings defined by an authorised user. Sampled data can also be viewed using standard built-in cloud GUI 'widgets'. Widgets resemble SCADA software GUI objects, eg, gauges, bar graphs, charts and tables.

Alarm conditions will generate and send alert messages in the form of SMSs, emails, tweets and voice messages. Should the project require additional programming capability, a powerful 'C'-style script language is built in as standard and is accessible in the cloud.

By now it is clear that all the settings associated with the I/Os, alarms, graphical interface and statistical reports are all done in the cloud and the user only requires access to a standard web browser, available anywhere. To access the cloud, no PLC or SCADA software is required, there is no PC hardware or operating system to deal with and there is no network to set up. Everything you

need to set up a multi I/O monitoring system is achievable in the cloud via the browsers.

Security, security and more security

All communications to/from the cloud controller must go through the data centre servers. The cloud itself is supported by multiple data centres continuously backing up each other. The cloud servers are exclusively dedicated to cloud controller communications and are not used for any other email/web or non-controller-related applications. Each server is located behind a firewall and only the necessary ports are opened for communication. Management of the servers is only made available to the data centre server owner.

The cloud controller strictly uses UDP traffic to communicate with the servers. Each message is fully 128-bit encrypted. When data arrives at the cloud controller after being sent by the data centre, the controller will run multiple security checks on the decrypted data and will only accept the data if it has passed all tests; otherwise, the data will be dropped. This means that only genuine traffic from the server will be accepted and any other traffic will be ignored. We can conclude that the cloud controller poses no risk to any network and there is no way to load any other software into its memory.

Summary

Using the cloud for remote data monitoring and control functionality provides a suitable tool for small to medium-sized SCADA applications.

The main advantage of using the cloud for SCADA applications is its low price tag when compared to the price of SCADA software, PC-based servers and operating systems. The cloud enables authorised employees and programmers to be anywhere, in any time zone. Management can now outsource work to highly specialised contractors while maintaining a handle on the project at all times.

Last but not least, by reducing the need to travel to site the cloud saves on energy and carbon footprint.

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Flash freezing for biobanking

Milestone has developed the FlashFREEZE unit — a tabletop system that, without isopentane or liquid nitrogen, enables standardised and documented tissue banking in 15-60 s. This avoids the variability associated with procuring biospecimens using different collection, processing and storage techniques, which can lead to significant differences in biospecimen molecular integrity.

The product makes it possible to run evidence-based biospecimen freezing protocols with the full documentation needed for QA purposes. The heart of the system is the Stirling cooler technology, which is said to overcome the limitations of the conventional, compressor-type cooling system.

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maxon motor's brushless DC flat motor, with customisations for high torque and low speed, is suitable for the user's positioning requirements. With a 68 mm diameter and 38 mm length, the motor delivers 100 W of power on a controlled 24 V supply.

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The high torque and high positioning resolution make the brushless motor suitable for food manufacturing, the positioning of heavy loads in the manufacturing industry or for the control of sensors or valves in fluid handling processes.

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Connector for medical applications

The ODU MEDI-SNAP is a push-pull circular connector with a plastic housing for medical applications. The push-pull system is said to ensure reliable contact, colour coding makes the connector visually recognisable and the plastic housing material means the product remains economically efficient.

The connector has high chemical resistance, simple assembly, a light weight, 2000 mating cycles and designs that can be autoclaved and sterilised. It is used to monitor physical data, such as blood oxygen content, in applications such as intensive care and sports medicine, dental treatment devices, respiratory humidifiers and portable patient monitors.

ODU offers users the opportunity to create their own push-pull solutions. Simply select the number of contacts required in a plug or receptacle housing and then choose the cable OD for the cable collet and the colour of the front or back nut.

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The Smartalyzer is a bifluorescent standard added to each sample prior to separation. The standard provides precise normalisation and quantification of protein gels and western blots within one experiment.

The Calibrator is a second fluorescent standard which is applied to the gel and allows for quantification of data derived from different experiments. It also works as a fluorescent protein molecular weight ladder.

The system enables simultaneous detection of the amount of target protein and total protein in a gel and also between gels. It allows the user to compare lane-to-lane, gel-to-gel and blot-to-blot.

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Digital multimeter

When calibrating process control calibrators, the voltage source, current source and resistance function can make it difficult to achieve test accuracy ratios (TARs). The Transmille Model 8081 8.5-digit digital multimeter has the high accuracy needed for the calibration of process control calibrators.

Features include: 8.5-digit resolution, AC/DC voltage to 1000 V, AC/DC current to 30 A and resistance of 0.01 $\mu\Omega$ to 1 T Ω . The product can measure frequency and temperature and additionally functions as an electrometer. It is suitable for any calibration laboratory.

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From little grants **big** labs grow

In August this year, the Monash Institute of Pharmaceutical Sciences (MIPS) officially opened its new laboratory — an analytical hub that is intended to bring together researchers from across Victoria. It was the culmination of a series of events that began way back in 2006, explained associate professor and lab director Michelle McIntosh.

The idea

“When I first started at Monash, in about October 2006, one of the first things that I did was sit down and go through the websites of all the different philanthropic funding organisations that fund biomedical research,” Associate Professor McIntosh said. “I’d written a research proposal asking for funding for equipment to help me establish a lab that would allow me to look at drug delivery via the lungs. That grant was submitted early in 2007.”

A few months later, Associate Professor McIntosh received a grant for \$50,000 from the Helen Macpherson Smith Trust (HMSTrust), which funds projects that seek to benefit the people of Victoria. This enabled her, through MIPS, to purchase an analytical separation system.

“It was kind of the first piece of equipment that allowed me to set up my own lab,” Associate Professor McIntosh said.

Fast-forward to a meeting between Associate Professor McIntosh and her colleagues, where they were looking to come up with a suitable Master’s project for a student with an interest in analytical chemistry and bioequivalence. Their idea was to formulate oxytocin — a hormone which is typically injected into new mothers to treat postpartum haemorrhage — to be absorbed via the lungs.

“In developed countries, oxytocin is the gold standard therapy, so deaths from postpartum bleeding are very rare,” Associate Professor McIntosh said. “Yet women in developing countries don’t have access to this life-saving drug because it requires refrigeration and trained staff to administer it.”

Associate Professor McIntosh sought to develop an aerosol delivery system for oxytocin that can be inhaled by patients from a simple, disposable device immediately after childbirth.



Monash University President and Vice-Chancellor Margaret Gardner AO, Victorian Minister for Health Jill Hennessy and Associate Professor Michelle McIntosh. Image courtesy Greg Ford.

The analytical equipment purchased with her HMSTrust grant would enable the project to get underway, but this was just the beginning.

“We had support from the AusAID scholarship for the student who was doing the Master’s degree,” Associate Professor McIntosh said. “We also managed to get a small grant from the ANZ Trustees, for \$19,000, and the grant for the equipment to allow us to do the work from Helen Macpherson Smith. And then the next grant we got was a Grant Challenges Explorations grant of \$100,000 from the Bill & Melinda Gates Foundation, and that was sort of at the point that we really recognised, globally, what a need there was.

“And then funding again the following year from Saving Lives at Birth with \$250,000, and it was that grant where we were also given an award for being the technology innovation most likely to transform maternal and neonatal health. That was probably the pivotal moment for us in thinking, ‘Okay, this project’s really important.’”

Things came to a head in September 2014, when an international group of funders announced that they would partner with MIPS to develop the new medicine. The McCall MacBain Foundation, Grand Challenges Canada and the Planet Wheeler Foundation would provide US\$2.7 million funding to leverage a GlaxoSmithKline (GSK) cash and in-kind contribution to ultimately deliver a US\$16.6

million early-phase development program. The resulting technology will be licensed to GSK, which will be conducting a phase 1 clinical trial of the technology in conjunction with MIPS in the very near future.

The lab

With the inhaled oxytocin project set to save countless lives in developing countries, MIPS wanted to give other Victorian researchers a chance to develop their skills and projects. With the assistance of \$1.2 million from the HMSTrust, \$1.1 million of in-kind contributions from PerkinElmer and Shimadzu and a further \$350,000 from the McCall MacBain Foundation, the HMSTrust Laboratory was born.

“What we wanted to do was set up a real analytical hub for other researchers from across Victoria — or Australia, if there was a desire — to come in, access something for a short period of time or on a routine basis, and get some training and advice,” Associate Professor McIntosh said.

Supporting capacity building, skills growth and education development, the facility’s training capabilities will enable the development of the next generation of scientists. As explained by Associate Professor McIntosh, “It makes less sense for individual research groups to have their own capabilities in their own labs that are only used by a few people, rather than centralising these capabilities and making sure that they’re

available to as many people as possible and used as much as possible.

“We’re not charging rates that will preclude people from accessing the instruments.”

Not only has the facility brought together various research institutions and organisations, but also two instrument suppliers who would normally be competitors.

“PerkinElmer and Shimadzu both operate in the same space in terms of instruments for the pharmaceutical industry, but we’ve had discussions and found a way that we can all work together with the view of ensuring maximum use of instrumentation,” Associate Professor McIntosh said. As a result, equipment from both companies is available for use inside the lab.

“Instrument support companies don’t do drug development, but both companies see the value in what we’re doing for inhaled oxytocin, so they could be providing support for projects such as that ... [and] there are other projects going on that the companies are keen to see progress,” Associate Professor McIntosh explained.

Associate Professor McIntosh anticipates the HMSTrust Laboratory will be beneficial to both pharmaceutical and non-pharmaceutical industries, including foods and beverages, dairy and petrochemicals. Should any visitors to the facility go on to have half as much success as the inhaled oxytocin team, the lab is sure to have a significant and ongoing impact on global health.



AGTA Conference 2015
11–14 October, 2015, Hunter Valley, NSW
Australasia's genomics community will come together at the AGTA 2015 conference and exhibition to share information and research, innovative practices and evidence-based practice case studies.
This year's conference themes include: cancer genomics, epigenomics, bioinformatics, transcriptomics, functional genomics, clinical sequencing and plant genomics with a special focus on the genomics of good wine.
The event will host an array of exhibitors and is anticipated to attract more than 250 researchers and industry representatives who work with genomic technologies from Australia and around the world.
agtaconference.org

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Agricultural Bioscience International Conference (ABIC) 2015

7–9 September 2015, Melbourne
www.abic.ca/abic2015

65th Australasian Grain Science Conference

16–18 September 2015, Sydney
www.ausgrainscience.org.au/conference

7th International Conference on Relaxin and Related Peptides

20–24 September, 2015, Malaysia
www.relaxin2015.org

BioProcessing Network Conference 2015

21–22 September 2015, Te Papa
bioprocessingnetwork.com.au/eventlist

CIM 2015: International Congress of Metrology

21–24 September 2015, Paris
www.metrologie2015.com/metrology-2015

BacPath 13: Molecular Analysis of Bacterial Pathogens Conference

27–30 September 2015, Phillip Island, Victoria
www.bacpath2015.org

ComBio 2015

27 September – 01 October 2015, Melbourne
www.asbmb.org.au/combio2015

AGTA Conference 2015

11–14 October 2015, Hunter Valley, NSW
agtaconference.org

TEMTIA-VII 2015

11–14 October 2015, Melbourne
www.emtmeeting.org/TEMTIA-VII_about.htm

The Australasian Bioenergy & Bioproducts Symposium 2015 (TABBS)

12 October 2015, Brisbane
www.tabbs.com.au

Thermo Scientific Laboratory Informatics Symposium 2015

13–16 October 2015, Gold Coast
www.signup4.net/public/ap.aspx?EID=LIS241E&OID=50

5th Annual Conference Association of Biosafety for Australia & New Zealand

9–13 November 2015, Canberra
hotevents.eventsair.com/QuickEventWebsitePortal/absanz-5th-annual-conference/home

Laboratory Management and Laboratory Design Conference 2015

16–19 November 2015, Melbourne
www.events.r20.constantcontact.com/register/event?oeidk=a07ea4hj3t6ffd374b1&llr=s6ww5cdab

NHMRC 4th annual Research Translation Faculty Symposium

27–28 October, Sydney
www.nhmrc2015.com

Greenhouse 2015: Atmosphere, oceans and ice

27–30 October, Sandy Bay, Tasmania
www.csiro.au/en/Events/2015/October/27/Greenhouse-2015

The 25th Annual Astronomical Data Analysis Software and Systems Conference

25–29 October, Sydney
www.caastro.org/event/2015-ADASS

International Conference on Accelerator and Large Experimental Physics Control Systems

17 October, Melbourne
www.icaleps2015.org/

AusBiotech 2015

6 October, Melbourne
ausbiotechnc.org

9th Asia-Oceania Forum for Synchrotron Radiation Research (AOFRR 2015)

24–27 November, Clayton, Victoria
events.synchrotron.org.au/event/12

Quantum computing

10 November, Acton, ACT
www.science.org.au/events/quantum-computing

Robotics

1 December, Acton, ACT
www.science.org.au/events/robotics

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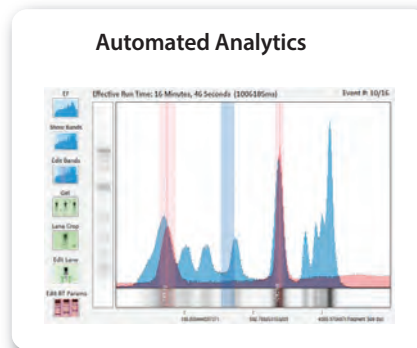
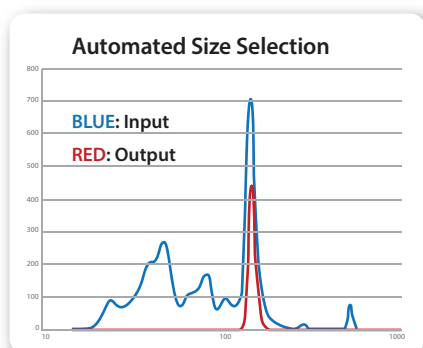
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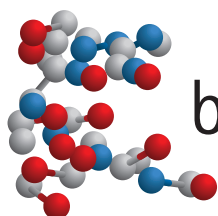
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