

# AT UCT 2017

hydrogen 1 <b>H</b>																	helium 2 <b>He</b>																		
lithium 3 <b>Li</b>	beryllium 4 <b>Be</b>															boron 5 <b>B</b>	carbon 6 <b>C</b>	nitrogen 7 <b>N</b>	oxygen 8 <b>O</b>	fluorine 9 <b>F</b>	neon 10 <b>Ne</b>														
sodium 11 <b>Na</b>	magnesium 12 <b>Mg</b>															aluminium 13 <b>Al</b>	silicon 14 <b>Si</b>	phosphorus 15 <b>P</b>	sulfur 16 <b>S</b>	chlorine 17 <b>Cl</b>	argon 18 <b>Ar</b>														
potassium 19 <b>K</b>	calcium 20 <b>Ca</b>	scandium 21 <b>Sc</b>	titanium 22 <b>Ti</b>	vanadium 23 <b>V</b>	chromium 24 <b>Cr</b>	manganese 25 <b>Mn</b>	iron 26 <b>Fe</b>	cobalt 27 <b>Co</b>	nickel 28 <b>Ni</b>	copper 29 <b>Cu</b>	zinc 30 <b>Zn</b>	gallium 31 <b>Ga</b>	germanium 32 <b>Ge</b>	arsenic 33 <b>As</b>	selemium 34 <b>Se</b>	bromine 35 <b>Br</b>	krypton 36 <b>Kr</b>																		
rubidium 37 <b>Rb</b>	strontium 38 <b>Sr</b>	yttrium 39 <b>Y</b>	zirconium 40 <b>Zr</b>	niobium 41 <b>Nb</b>	molybdenum 42 <b>Mo</b>	technetium 43 <b>Tc</b>	ruthenium 44 <b>Ru</b>	rhodium 45 <b>Rh</b>	palladium 46 <b>Pd</b>	silver 47 <b>Ag</b>	cadmium 48 <b>Cd</b>	indium 49 <b>In</b>	tin 50 <b>Sn</b>	antimony 51 <b>Sb</b>	tellurium 52 <b>Te</b>	iodine 53 <b>I</b>	xenon 54 <b>Xe</b>																		
caesium 55 <b>Cs</b>	barium 56 <b>Ba</b>															hafnium 72 <b>Hf</b>	tantalum 73 <b>Ta</b>	tungsten 74 <b>W</b>	rhenium 75 <b>Re</b>	osmium 76 <b>Os</b>	iridium 77 <b>Ir</b>	platinum 78 <b>Pt</b>	gold 79 <b>Au</b>	mercury 80 <b>Hg</b>	thallium 81 <b>Tl</b>	lead 82 <b>Pb</b>	bismuth 83 <b>Bi</b>	polonium 84 <b>Po</b>	astatine 85 <b>At</b>	radon 86 <b>Rn</b>					
francium 87 <b>Fr</b>	radium 88 <b>Ra</b>															rutherfordium 104 <b>Rf</b>	dubnium 105 <b>Db</b>	seaborgium 106 <b>Sg</b>	bohrium 107 <b>Bh</b>	hassium 108 <b>Hs</b>	meitnerium 109 <b>Mt</b>	darmstadtium 110 <b>Ds</b>	roentgenium 111 <b>Rg</b>												
																		lanthanum 57 <b>La</b>	cerium 58 <b>Ce</b>	praseodymium 59 <b>Pr</b>	neodymium 60 <b>Nd</b>	promethium 61 <b>Pm</b>	samarium 62 <b>Sm</b>	europium 63 <b>Eu</b>	gadolinium 64 <b>Gd</b>	terbium 65 <b>Tb</b>	dysprosium 66 <b>Dy</b>	holmium 67 <b>Ho</b>	erbium 68 <b>Er</b>	thulium 69 <b>Tm</b>	ytterbium 70 <b>Yb</b>	lutetium 71 <b>Lu</b>			
																		actinium 89 <b>Ac</b>	thorium 90 <b>Th</b>	protactinium 91 <b>Pa</b>	uranium 92 <b>U</b>	neptunium 93 <b>Np</b>	plutonium 94 <b>Pu</b>	americium 95 <b>Am</b>	curium 96 <b>Cm</b>	berkelium 97 <b>Bk</b>	californium 98 <b>Cf</b>	einsteinium 99 <b>Es</b>	fermium 100 <b>Fm</b>	mendelevium 101 <b>Md</b>	nobelium 102 <b>No</b>	lawrencium 103 <b>Lr</b>			

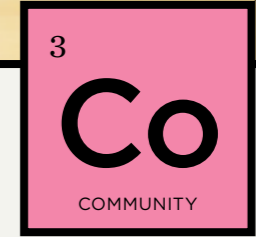
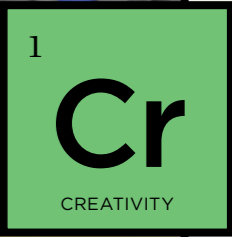


UNIVERSITY OF CAPE TOWN  
IYUNIVESITHI YASEKAPA • UNIVERSITEIT VAN KAAPSTAD

Elements of  
Innovation



# RESEARCH CONTRACTS & INNOVATION

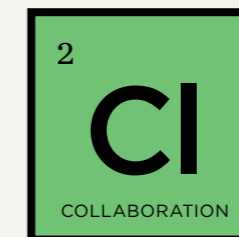


## Message from the Director

This year our theme “elements of innovation” plays on the periodic table of elements and the many “elements” that are involved in successful innovation. Innovation is a multifaceted activity drawing on a range of competencies and disciplines to achieve success. In this introduction though, I want to focus on the 3 Cs of innovation, three elements that were crucial to our technologies this year: community, collaboration and creativity.

As a public institution, we serve our community both at the local and national levels. Many of our innovations focused on improving the lives of people through solving problems that affect some of our most vulnerable people. We aimed to further UCT’s mission of engaging with our citizens in ways that positively impact lives and through our various innovations, we forwarded this objective. From drought tolerant crops to asthma pumps, we sought to improve the lives of people, both in South Africa and abroad.

Our collaborations this year saw UCT work with both local and international institutions and innovators. The innovations of the past year were made possible through collaborations at multiple levels. From inter-departmental cooperation within UCT, to partnering with other South African institutions, and all the way to Norway, our partners came from near and far. It was only through our partnerships and relationships with various individuals and institutions that we were able to achieve our goals.

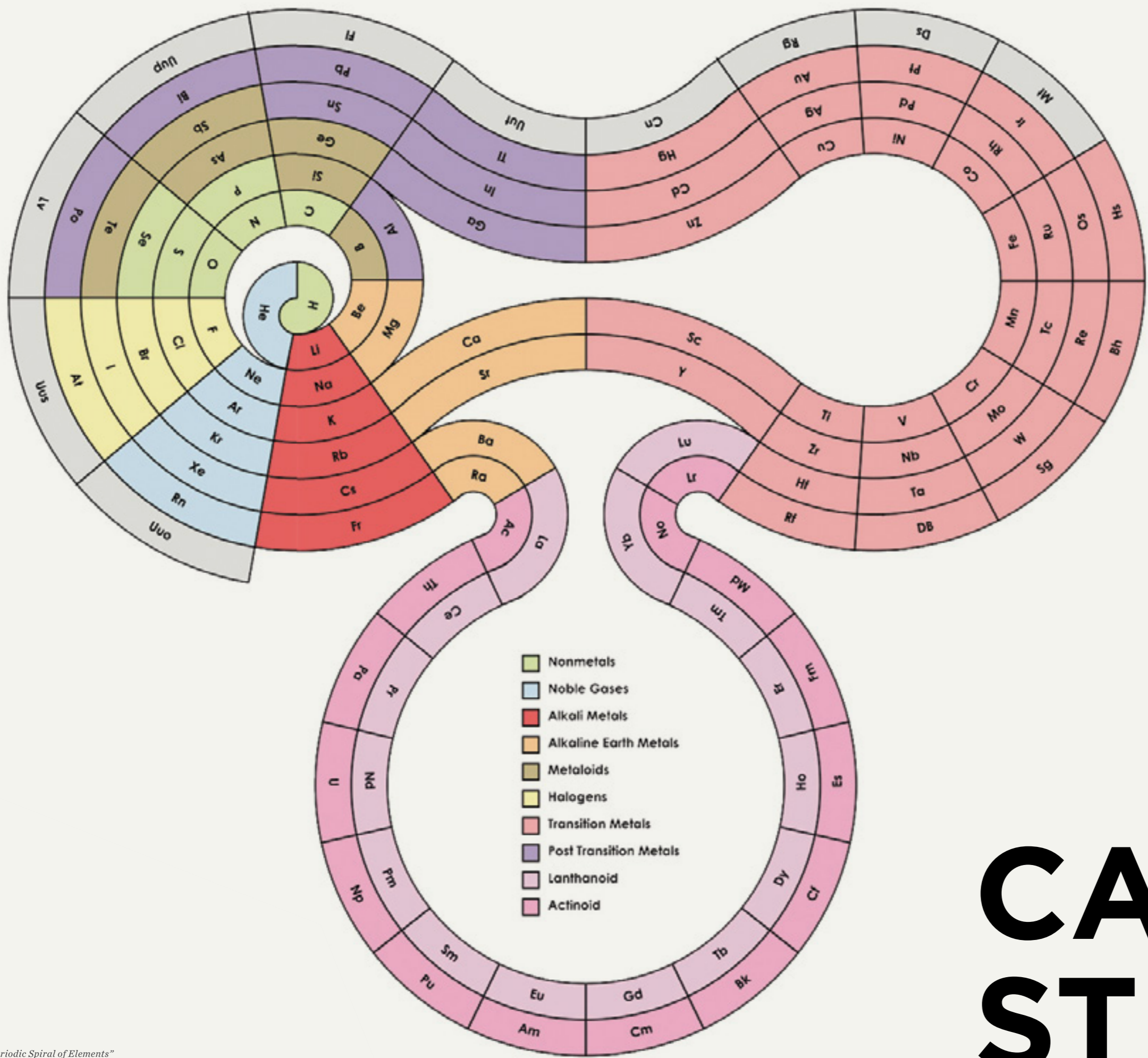


Finally, none of this would have been possible without creativity.

Our innovators constantly seek unorthodox and new solutions to old problems. The work done this year was truly inspired and would not have been possible without a creative approach to problem solving. The individuals involved in the projects profiled in this publication found ingenious solutions to very challenging problems.

These elements of innovation guided our work this past year and will continue to influence our work going forwards. This unique approach to problem solving ensures that our solutions to problems are innovative, that our work serves a greater purpose while also positioning UCT as a leader in research. We hope you enjoy reading about the research being done at UCT and the positive impact of the work both locally and abroad.

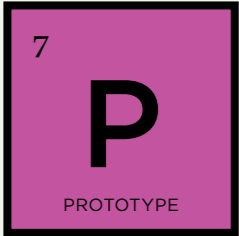
**Piet Barnard**



"Periodic Spiral of Elements"  
[chartgeek.com/alternative-periodic-table](http://chartgeek.com/alternative-periodic-table)

# CASE STUDIES





# Fjords, Friends and First-Rate Inventions

Historically, Norway has been heavily reliant on the exploitation of natural resources, including oil, mining and fishing. In more recent times, declining natural resources and the low price of oil have necessitated Norwegians to seek alternative means to diversify their economy. Technological innovation has emerged as a means to become more competitive as a nation, and today Norway is well known for its vibrant start-up company culture, particularly in the metropolitan centres of Oslo, Trondheim and Bergen.

We were, therefore, very excited when the opportunity arose for UCT to collaborate with a leading Norwegian Research Institute, SINTEF, in establishing a medical devices company to commercialise IP co-developed by UCT and SINTEF.

The collaboration started when Dr Llewellyn Padayachy, a neurosurgeon at UCT's Red Cross Children's Hospital, met medical device experts from SINTEF, found common ground, and became partners despite being at opposite ends of the earth.

The research collaboration is centred on an idea of Dr Padayachy's to develop a new, non-invasive method to measure the Intracranial Pressure (ICP) of the brain using ultrasound.

The monitoring and rapid detection of raised ICP during neurosurgery or medical care is critical for patients suffering from head injuries or stroke. Elevated levels of ICP may result in tissue damage, or, if left untreated, death. The current gold standard is invasive e.g. using micro-sensors placed inside the brain, but with these devices there is a huge risk of infection and brain haemorrhage.

Ultrasound probes placed over the eye can be used to measure ICP using static imaging, but the existing method is not very accurate and unable to pick up all cases. The research team at UCT and SINTEF started working on a dynamic method for measuring ICP that entails choosing one or more locations on the Optic Nerve Sheath (ONS), and measuring the degree of displacement at these locations over time whilst they are subjected to ultrasound. Research indicated that there is a positive correlation between the degree of displacement and the ICP and the method proved to be particularly accurate.

The initial proof of concept trials used conventional ultrasound machines but there is a need (and potentially large market) for a mobile, hand-held device adaptable to suit various eye sizes (e.g. for children, adults) that can be used by

paramedics. Such a device is currently being developed at SINTEF, funded in part by Norwegian government seed funding. The team at UCT has been awarded Technology Innovation Agency (TIA) Seed Funding to perform the initial validation of the device in clinical trials will be conducted in SA.

The patenting strategy was to protect both the method and hand-held device. The institutions have co-filed a Norwegian provisional patent application, and will pursue protection in other countries in due course. As the device develops, further IP including software may arise.

One key element of the process had been the negotiation of the Inter-institutional Agreement (IIA). UCT, on the one hand, had to understand the commercialisation model suggested by SINTEF (the commercial lead party) and how UCT and South Africa will benefit from the commercialisation. SINTEF, on the other hand, had to get to grips with the South African legal requirements relating to IP to which UCT is bound.

A spin-off company, Nisonics, has recently been founded by SINTEF. The IP will be made available to Nisonics via an exclusive royalty-free license to allow for the further development and testing of the technology during the pre-revenue stage. Once certain milestones/

conditions have been reached (one being the commencement of clinical trials), Nisonics will have the option to purchase the IP via an assignment.

Permissions need to be obtained for an exclusive royalty-free licence or an assignment to a foreign entity from the SA Reserve Bank, in terms of the Exchange Control Regulations, and the SA National IP Management Office (NIPMO), in terms of the IPR Act. This process needs to be managed appropriately and expeditiously in order to ensure it does not hinder commercialisation targets.

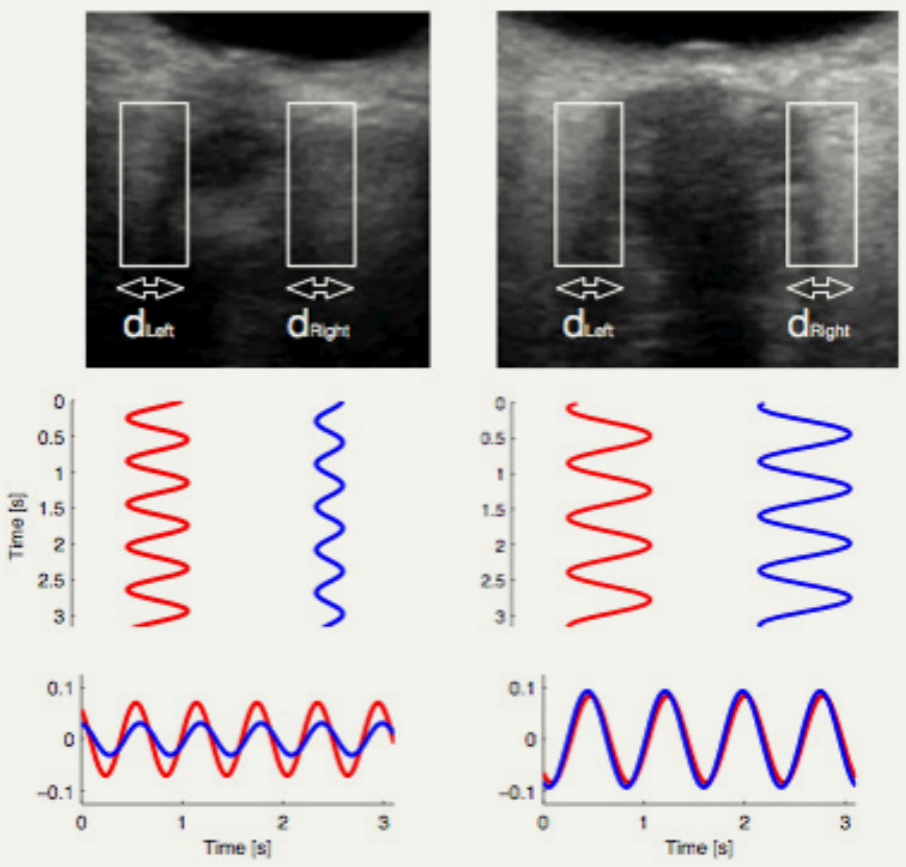
Despite the obvious challenges of managing an international collaboration such as this one, strong communication between UCT and SINTEF, and a willingness of one party to consider the other party's concerns and needs, are the key elements in ensuring the development and negotiations progress favourably. Indeed, our Norwegian collaboration proves that with the right teams in place, international partnerships are feasible and fruitful.

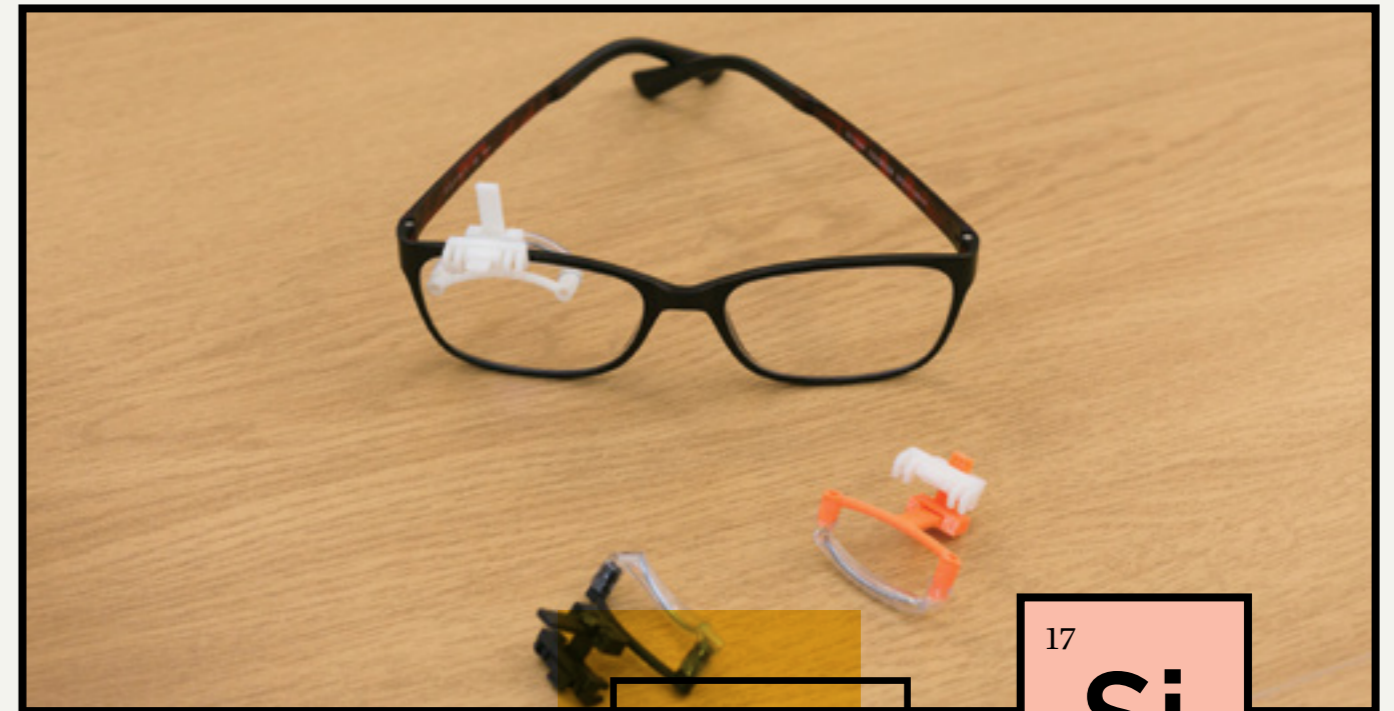
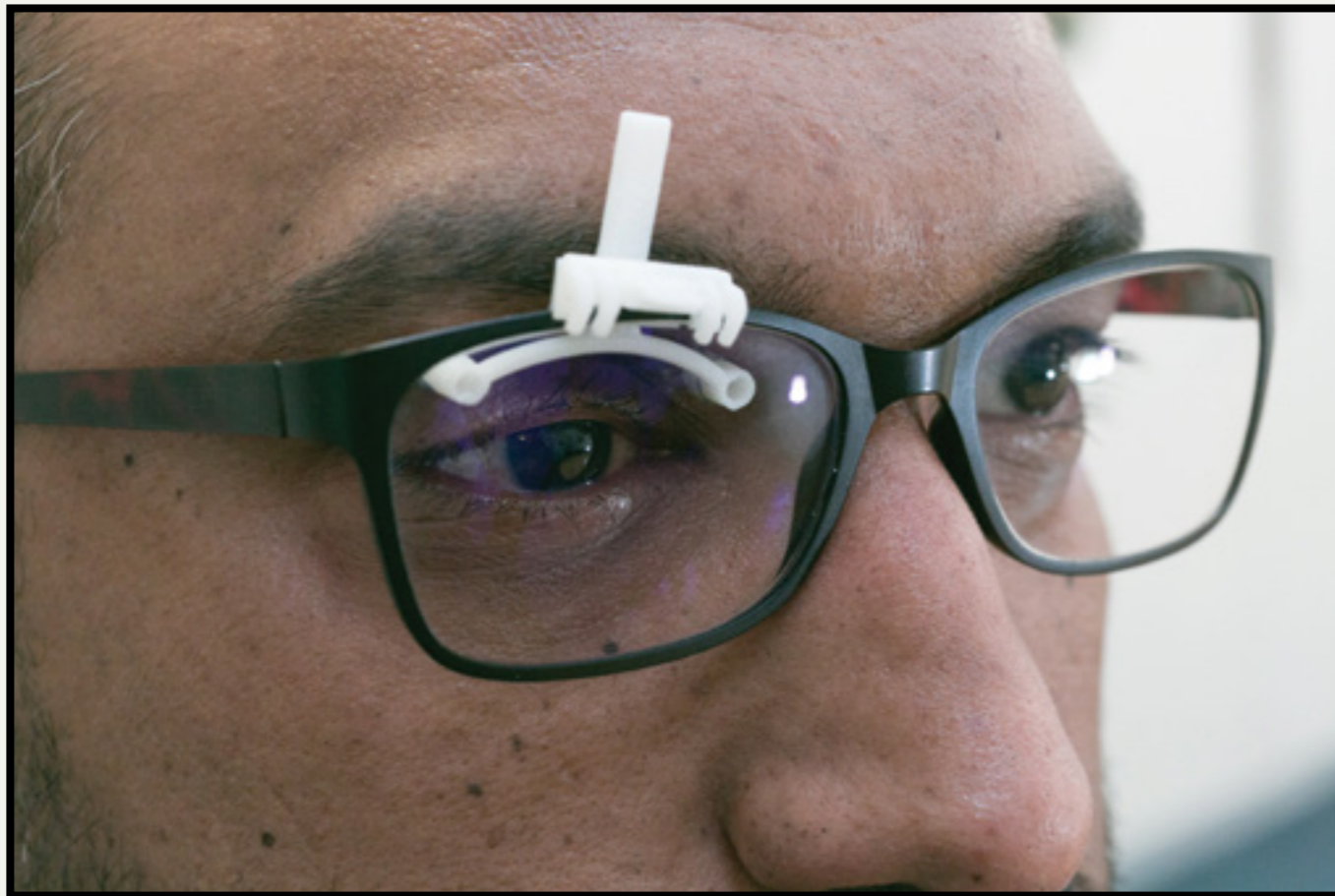


Dr Llewellyn Padayachy with a Philips ultrasound wand that was used for the early research



Ultrasound images showing degree of displacement of optic nerve sheath





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**Si**

SOCIAL INNOVATION

## From Vision to Reality, the UCT Ptosis Crutch

Vision, perhaps our most essential sense, is also one of the most challenging to treat medically. In active Ocular Myasthenia Gravis (MG), the eye muscles are affected in people resulting in the eyelids drooping. Whilst this can severely impact their vision when the eyelids cover their visual axis, patients are not advised to undergo surgery because multiple surgeries would be required to counteract progressive drooping. Medication is available, but not all patients respond to it and a crutch has to be used to prop the eyelid open.

Inventors Dr Sudesh Sivasaru (Biomedical Engineering Division), Megan Findlay (student) and Prof. Jeannine Heckmann (Division of Neurology) designed an adjustable crutch that is manufactured through the use of 3-D printing of polymers. This solution offers a simple, effective

and unobtrusive means to elevate the drooping upper eyelids.

The device is customisable so that it can be temporarily attached to a patient's spectacles and adjusted for fit against the eyelid and manage different degrees of droop. The bar of the crutch contacts the eyelid where it creases and is made from a material that is comfortable but sufficiently flexible to enable the patient to blink with little effort.

The use of 3-D printing facilitated rapid prototyping and revisions to the design of the device, leading to the comfortable and ergonomic final design.

Market research conducted by RC&I found that the market was small, impacting the ability for this product

to be commercialised through traditional routes. The device has been successfully applied to a few patients at Groote Schuur Hospital and costs only a couple of Rand to produce.

The fact that the components of the medical device can be 3-D printed opens up an entirely new opportunity to enable others to benefit - the computer files that direct the printer can be made available so that the crutches can be printed on demand by medical practitioners or optometrists; a first for UCT. The National IP Management Office (NIPMO), who implements the IP Rights from the Publicly Financed R&D Act, granted approval for the invention to be released into the public domain and not patented.





# Waste Not Want Not: Leak Assessment in Distribution Networks

The Civil Engineering Department at UCT have been developing and testing an innovation targeting a critical national need - improved management of existing water piping infrastructure. This need is becoming even more evident as the Western Cape continues to suffer from an extended drought.

Many years' worth of research effort by Prof Kobus van Zyl and his students showed that there is a linear relationship between leakage area and system pressure for all types of leaks. This holds true for all pipe materials and loading conditions, provided that the pipe material undergoes elastic or viscoelastic deformation. This relationship has enabled the calculation of "leakage parameters", which are useful in identifying the size and type of leak, and can be used to describe how changes in pressure will affect losses in a water distribution system.

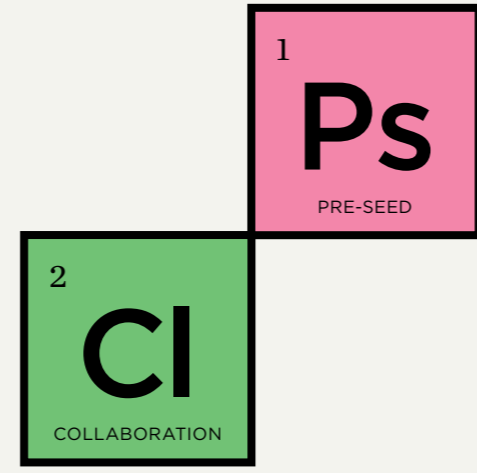
"Prototype 1" was a manual device used in the laboratory to determine the size and type of leaks in a pipe, based on the research findings.

This formed the foundation for the collaboration with the Electrical

Engineers who developed a system to automatically control the various valves and pumps, record the pressures and compute the results.

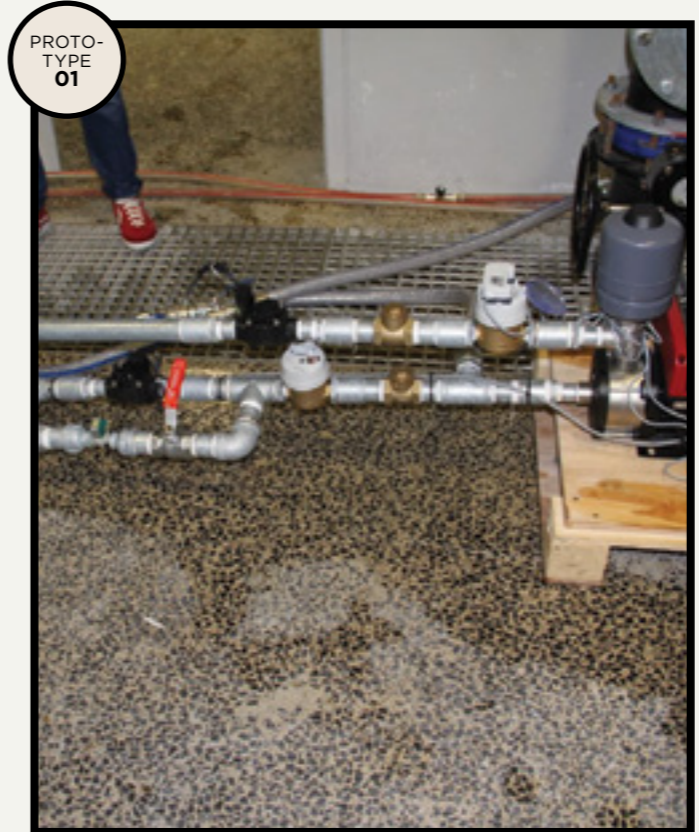
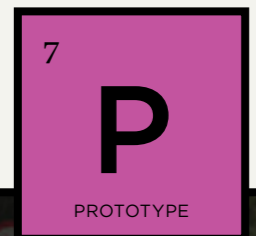
Prototype 2 was developed in collaboration with the Department of Electrical Engineering at Stellenbosch University (SU) using funding awarded by the UCT PreSeed Concept Fund and internal research funding from SU. The automated system could be loaded on the back of a bakkie (small truck), along with a water tank and pumps, allowing municipal workers to easily conduct the tests on an isolated segment of a pipeline network, e.g. along a suburban street. The data were recorded on a laptop and the results uploaded to the cloud, along with the GPS location of the test. Ultimately a "management system" will be developed to analyse the test results so that maintenance work can be prioritised and tracked.

The Concept Fund project culminated in successful field trials that were conducted in Rondebosch in partnership with the City of Cape Town. A joint patent application was filed by the universities at this point.



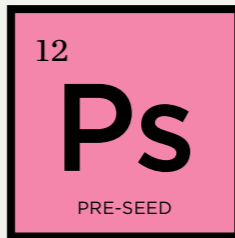
After the success of the Concept Fund project a proposal was submitted to the TIA Seed Fund to develop a third, pre-commercial prototype and to subject it to multiple field tests to ultimately validate the impact. The third prototype is in the final stages of development and is now greatly evolved from some "pumps and tanks on the back of a bakkie"(small truck) that constituted Prototype 2. The chassis-based unit is self-contained, portable, has an on-board generator, an integrated water tank and a control system, with screens and control buttons suitable for an industrial environment. It can be towed to a suburb and then a team of two municipal workers can manually move it to different locations to complete their assessment.

The innovation makes complex maintenance and inspection tasks easy and centralised, location-specific information. The technology allows municipalities to plan pipe maintenance or replacement proactively, facilitating optimum use of their budget and labour.





# The South African College of Music and Electrical Engineering working in perfect harmony



When Francois Oosthuizen, project manager at RC&I, contacted the South African College of Music's (SACM) Senior Lecturer Theo Herbst to ask if he was interested in collaborating on a project to develop a music transcription, he leapt at the opportunity.

The inventor was Dr Paul Cavalier, a postdoctoral researcher in the Department of Electrical Engineering, who had come up with a music application - or signal analysis method - to track and isolate signatures within music. The idea came to him during an evening out at the now-closed Tagore's in Observatory, Cape Town.

"I remember sitting there, listening to jazz," says Cavalier.

"I started having thoughts about the dynamics of musical notes, how they are shaped, and how they play. It was completely unexpected."

Based on his current geophysics research, which enables the recognition of geophysical "signatures", Cavalier decided to attempt the same process with musical instruments. He headed home and began testing his theory, finding enough encouraging results to spur on his patent signal analysis method.

Fortunately for Cavalier, Herbst immediately said yes to a collaboration between the two departments on the

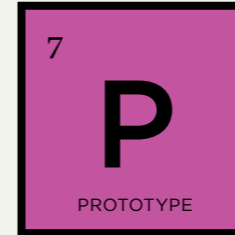
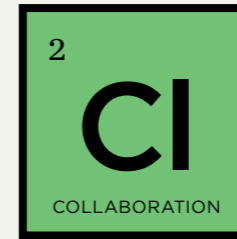
UCT Pre-Seed funded project. Together, with Herbst as advisor and Cavalier as principal researcher, they began testing an application that tracks the "evolution" of an isolated musical note.

### Collaboration and innovation

When they began their collaborative work, the duo contacted an international expert for input and answers. They had crossed disciplinary boundaries and were now transcending national borders for support. However, it appeared that even the expert had limited answers about building an application to isolate notes.

*"We then realised we were approaching a complex and difficult research question," says Herbst. "And the moment you realise that, you know there exists potential for innovation in that field of research."*

So, Herbst and two students began recording audio to create a database of sounds for Cavalier to analyse. And it is in the results of this that Cavalier hopes to find answers to questions such as, "How does the timbre of a musical note evolve?" or "What enables us to tell different sounds apart, such as differentiating a voice from a guitar?"



To be clear, a number of leading companies, service providers and research groups are active in this field.

"However, we are pursuing what we believe is a novel approach to the problem," says Cavalier.

He explains that while the human ear can identify, for example, a piano or guitar playing alongside other instruments, computers struggle to do so.

"This is what we are trying to solve, this is what we are pursuing," says Cavalier.

### Application and implication

"The implications for music are manifold," says Herbst. He adds that from an education and training perspective, the application will provide an additional tool to develop musicians' aural acuity and practical listening skills.

*"A musician's ability to hear, listen critically and to articulate what is heard has to be developed and this application promises huge benefits for this," says Herbst.*

"There are other implications that we know about and others that we are still to discover," Cavalier says.

### Looking ahead

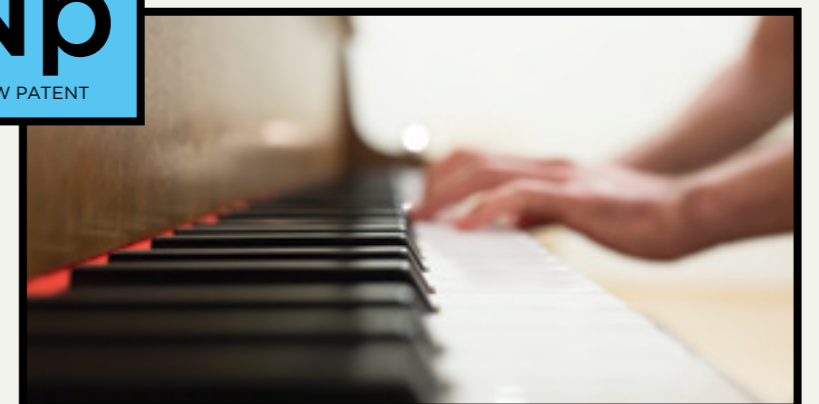
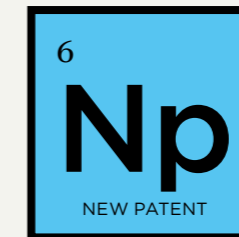
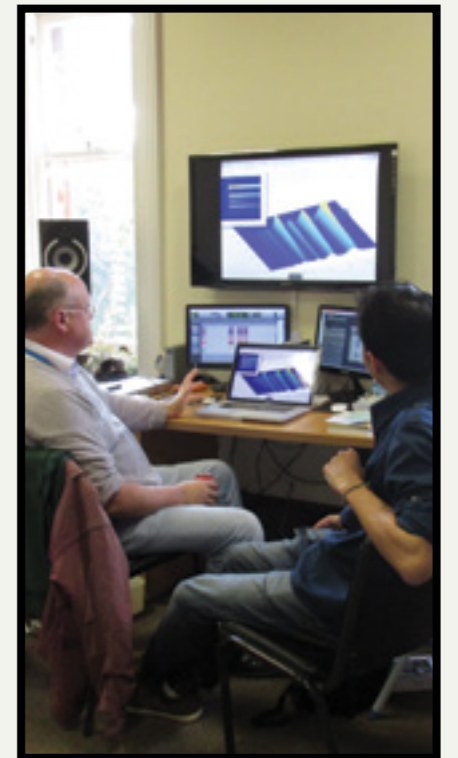
The next stage for the duo is tying up any loose ends, prototyping and testing before approaching additional collaborators.

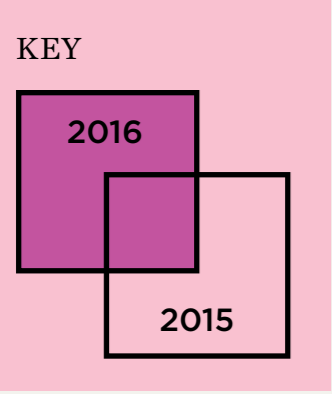
"To me, we are operating in a very beautiful space because we are engaged in fundamental research that has very practical applications," says Herbst.

For Cavalier, the testing and endless questions around signals and sounds are what excite him. He is also looking forward to answering broader questions such as why and how the human ear distinguishes between sounds so effectively.

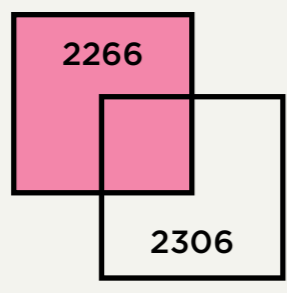
The duo is also excited to be providing a blueprint for interdisciplinary collaboration.

"We firmly believe this is the way forward, namely for the country to invest in interdisciplinary excellence in fields where the hard and soft sciences meet," says Herbst. "I have to say, we have something special in this project and I am really looking forward to how this evolves."

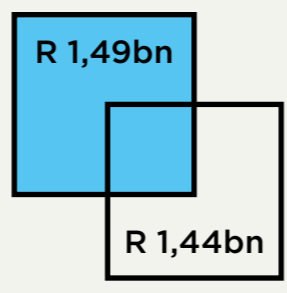




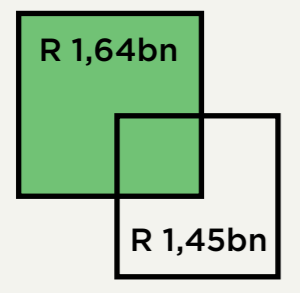
Research Contracts Signed



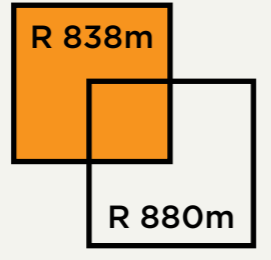
Research Contract Value



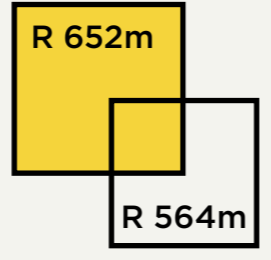
Total Research Income



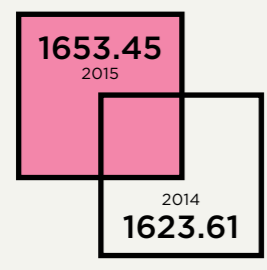
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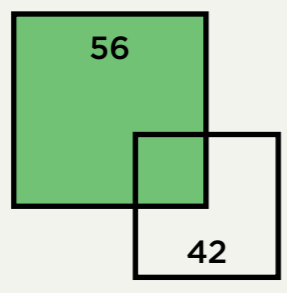
Value Local Research Contracts Signed



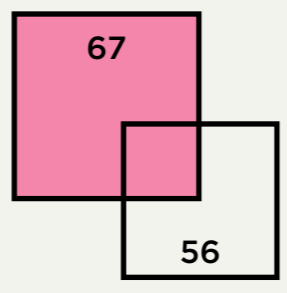
Publications (units)



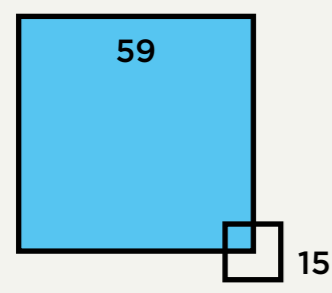
Invention Disclosures



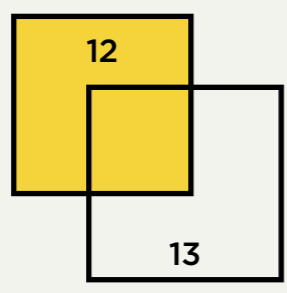
Patent Applications Filed



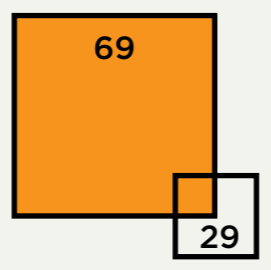
Patents Granted



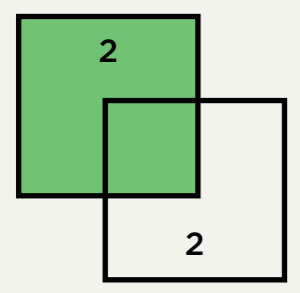
License Agreements (Outbound)



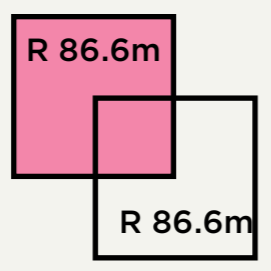
Materials Transfer Agreements (Outbound)



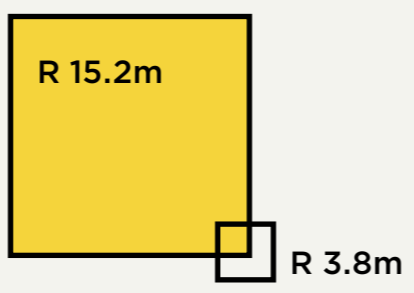
Spin Out Companies



Estimated Value of Equity in Spin-Offs



Total Income from IP



## New Provisional Patent Applications

### ISOLATING A MUSICAL INSTRUMENT'S SIGNATURE

*Dr Paul Cavalier*

Dr Paul Cavalier applied techniques that he originally used to investigate earthquakes to identify a specific 'signature' for a musical instrument, no matter the frequency of the note. This technology enables one to select and remove a single instrument from a recording. A note that is played by the instrument on its own is selected and corresponding spectrogram is created from which a 'signature' for the specific instrument is developed. The technology is useful for sound engineers, but may also find application outside of music, such as in radio astronomy. Read about the ongoing collaboration between this engineer and the SA College of Music elsewhere in this publication.

### SURGICAL IMPLANT TO COMBAT SLEEP APNOEA

*Dr Rushdi Hendricks and A/Prof Deon Bezuidenhout*

Obstructive Sleep Apnoea (OSA) is a condition characterized by blockage of the upper airway by the tongue during sleep, interrupting normal breathing.

This leads to interrupted sleep, day-time drowsiness and increases the risk of developing certain serious conditions such as heart attacks or stroke. It also plays a role in obesity and diabetes and insulin resistance. An implantable "scaffold" device has been developed that facilitates the growth of a biological tendon

inside the tongue via stem cell differentiation. Once formed, the tendon has enough strength to permanently prevent the tongue from collapsing in the throat and the scaffold is absorbed naturally.

### MAINTENANCE OF MUNICIPAL WATER DISTRIBUTION SYSTEMS

*Prof. Kobus van Zyl (with co-inventors from Stellenbosch University)*

Water loss from municipal distribution systems through leaks is a huge problem internationally and of particular relevance in water-scarce South Africa, where a third of the water distributed is lost via leaks. Effective leak management requires frequent maintenance, good technical skills, and appropriate equipment. A system was developed to assess the condition of an isolated section of a pipe network. The analysis is automated and the measured data combined with the GPS location and are sent to a cloud based platform which can be used by municipal teams to support routine maintenance and minimise leaks in the distribution system and enable municipalities to proactively manage maintenance based on reliable data.

### DETECTING AND CHARACTERISING NEW WATER LEAKS IN A DISTRIBUTION SYSTEM

*Prof. Kobus van Zyl*

The early detection of leaks and the monitoring of existing leaks in municipal water distribution systems are important in that they allow authorities to respond appropriately and minimise fiscal damage. Drawing from a significant body of research into the characterisation of leaks, an algorithm that can determine the size, type, and the likely location of new leaks formed in a water distribution network has been created. The data required for this application can be gathered from existing distribution systems by programming specific pressure cycles at times which will have a minimal impact on residents. By comparing and analysing daily reports, vulnerabilities and leaks can be identified in the water supply system and, ultimately, repaired.

### PRODUCING HIV VACCINES IN PLANTS

*Mr Emmanuel Margolin, Dr Ann Meyers, Dr Rosamund Chapman, Prof. Anna-Lise Williamson and Prof. Edward Rybicki*



A major focus of current HIV vaccine research is the development of envelope protein trimers, that appear similar to actual HIV surface, so that an immune response can be stimulated in patients by these antibodies. These antibodies are traditionally produced in mammalian cells, but researchers at the Biopharming Research Unit have shown that plants can produce the trimeric structure of the HIV-1 envelope glycoprotein. The recombinant proteins demonstrate reactivity with several prototype monoclonal antibodies isolated from people with natural infections. Plant-produced trimers are potentially cheaper to produce than mammalian equivalents and free from mammalian contaminants.



### DROUGHT-TOLERANT CROPS

*Prof. Jennifer Thomson, Dr Revel Iyer, Ms Tamaryn Elick, Dr Mohamed Rafudeen, Dr Kershini Iyer and Mrs Bronwyn Arendze-Bailey*

“Resurrection” plants are able to withstand drought conditions and sprout green leaves immediately after rainfall. Using specific genes from these plants the drought tolerance characteristics have been transferred to other crops. A very important advantage of the technology, which was validated in tobacco, is that the collection of genes are only activated when actual drought or stress is experienced. This means that the plant does not continually produce these special proteins when they are not required. The next phase of development will involve the integration of the technology into maize.

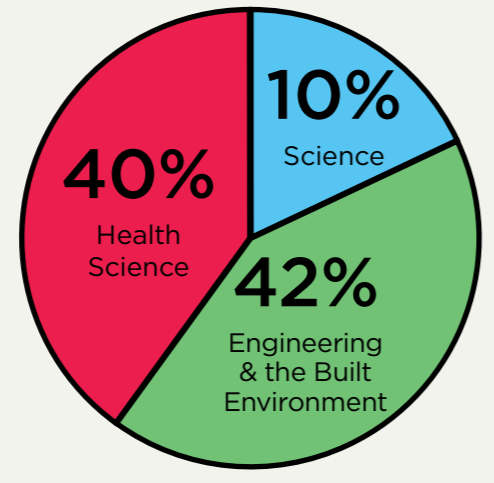


### PLANT-PRODUCED DIAGNOSTIC REAGENTS

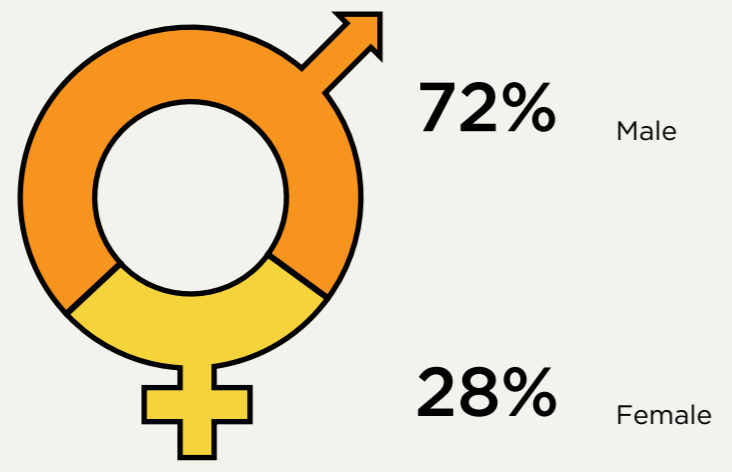
*Prof. Ed Rybicki, Dr Inga Hitzeroth and Dr Ann Meyers*

Antibodies are used in a spectrum of diagnostic tests that are used for the diagnosis of disease, environmental monitoring and food analysis. Enzymes are often coupled to antibodies to trigger the “signal” of a positive outcome - e.g. a blue line appearing in a pregnancy test. The researchers have been able to produce Horseradish Peroxidase (HRP) - a common diagnostic enzyme in tobacco plants (normally it is extracted from horseradish), but in a world first they have coupled it to a single

## Invention Disclosures by Faculty



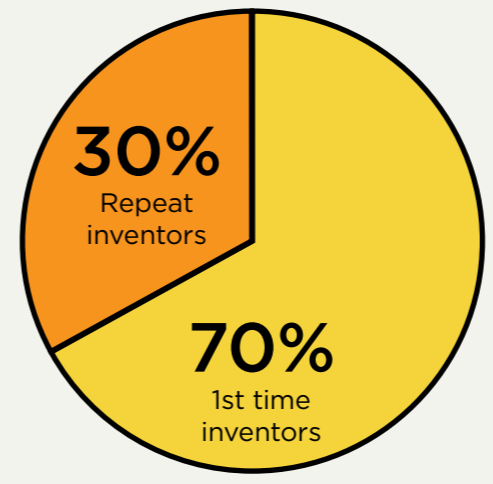
## Invention Disclosures



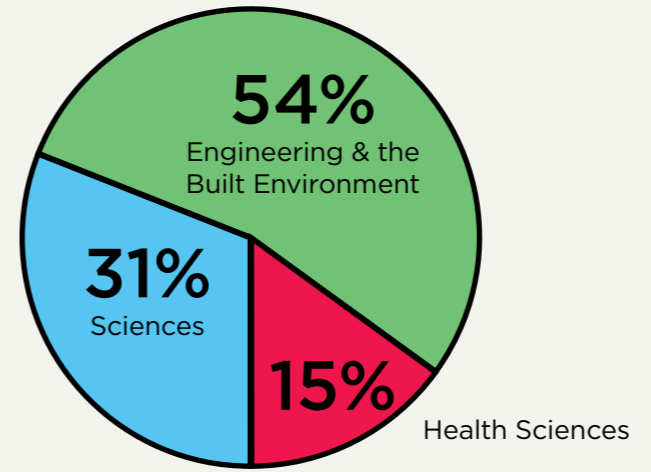
## 56 INVENTION DISCLOSURES WAS A NEW RECORD

## 10% FROM DST HYSA CATALYST CENTRE

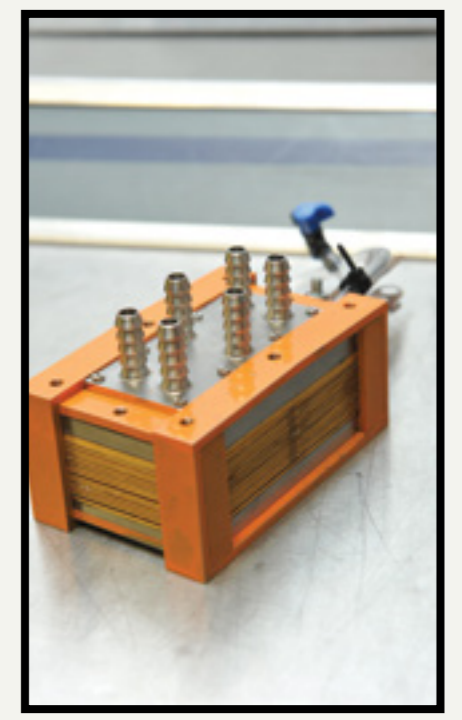
## Inventors on Disclosures



## 8 Provisional Patent Applications



chain variable protein fragment and produced this combined “fusion protein” in tobacco plants. The tobacco leaves are macerated and the protein is extracted and purified for use in diagnostic kits. The plant-produced protein is devoid of mammalian cell contaminants and is cheaper to produce. A commercial-scale production facility is being developed by commercial partners.



### NEW BLUETONGUE VIRUS VACCINE

*Prof. Ed Rybicki, Dr Ann Meyers and Dr Albertha van Zyl*

Bluetongue is a death causing viral disease transmitted by midges that affects common domestic and wild ruminants, primarily sheep, but also cattle. There is no treatment for Bluetongue virus (BTV), so vaccination is the only viable option.

Scientists from the Biopharming Research Unit have developed a second generation candidate vaccine. The Virus-Like Particle (VLP) mimics the virus, without causing disease, and provokes an immune response. They create a Virus-Like Particle (VLP) which mimics the virus, without causing disease, and provokes an immune response creating an effective vaccine against the disease. The vaccine, which is produced in plants, is currently being tested in animal trials through support by the Technology Innovation Agency. Learn more in Dr Ann Meyers' inventor profile.



### HELPING CHILDREN AND THE ELDERLY USE ASTHMA INHALERS

*Dr Sudesh Sivasu, Mr Giancarlo Beukes, Dr Michael Levin and Dr Jason Voorneveld*

Most patients with asthma rely on pressurised inhalers to deliver a metered dose of medicine as they inhale. The amount of force required to activate a typical inhaler is more than most small children and elderly or frail people are able to apply. Researchers at the Biomedical Engineering Division have developed a cost effective, adjustable and reusable device that can be attached to a wide range of standard inhalers. The device has levers that reduce the activation force and it is also able to count the number of doses delivered to assist monitoring by a caregiver or parent.

### INNOVATIVE FUEL CELL GASKET FOR HYDROGEN FUEL CELLS

*Dr Shiro Tanaka*

A hydrogen fuel cell is a multi-layered structure comprising a bipolar plate, a gas diffusion layer (GDL), a microporous layer (MPL) and a catalyst coated membrane (CCM). The layers are sealed together with gaskets that are required to create a gas-tight seal and to facilitate 'electrical' contact between the catalyst layer and the bipolar plate.

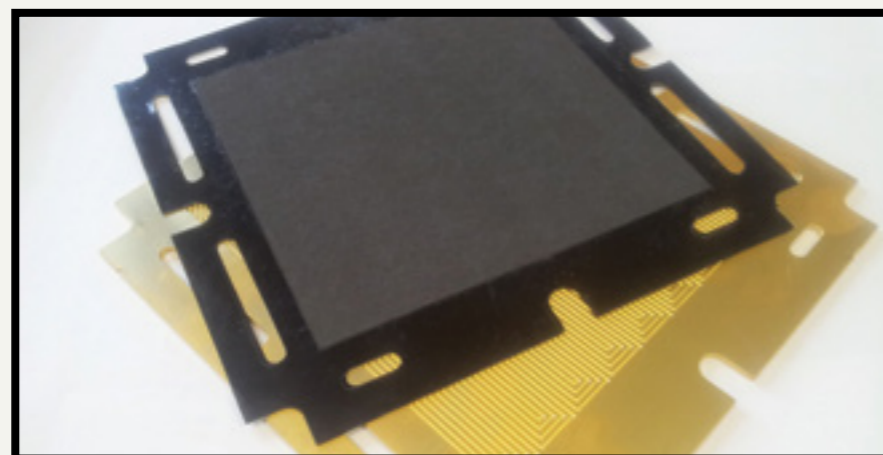
HySA Catalysis has developed a metal GDL that has superior properties to the carbon-fibre GDLs used in most commercial fuel cells. The inflexibility of the

metal though led to poor contact and caused the gaskets to fail. This problem was overcome and the patented gasket solution includes the lamination of the GDL to the bipolar plate and arranging the lamination in such a way that the catalyst has the required connectivity with the diffusion layer.

### METHOD OF COATING BOTH SIDES OF A FUEL CELL MEMBRANE WITH A CATALYST

*Mr Nabeel Hussain and Mr Duarte Sousa*

The catalyst coated membranes (CCMs) of hydrogen fuel cells are typically manufactured using a five-step process. The process involves the use of decals to transfer the catalyst to the membrane. Although effective, the process is slow, labour-intensive, expensive and the decals can only be used once. The patented process eliminates the need for transfer decals. The process includes spray coating and heat curing, using different spray set ups for the two sides of the membrane.



### ATTACHING A GAS DIFFUSION LAYER IN A HYDROGEN FUEL CELL

*Mr Nabeel Hussain and Mr Duarte Sousa*

A new method has been developed to attach the Gas Diffusion Layer (GDL) to the Membrane Electrode Assembly (MEA) gasket of hydrogen fuel cells. Current methods use liquid adhesives, adhesive coating technologies and subsequent high-temperature curing of the adhesive. The new method uses a thin double-sided adhesive film to adhere the GDL to the gasket at ambient conditions. This drastically simplifies the MEA assembly and eliminates expensive coating technologies or heat treatments.

### SURFACE COATING SPRAY MODIFICATION DEVICE

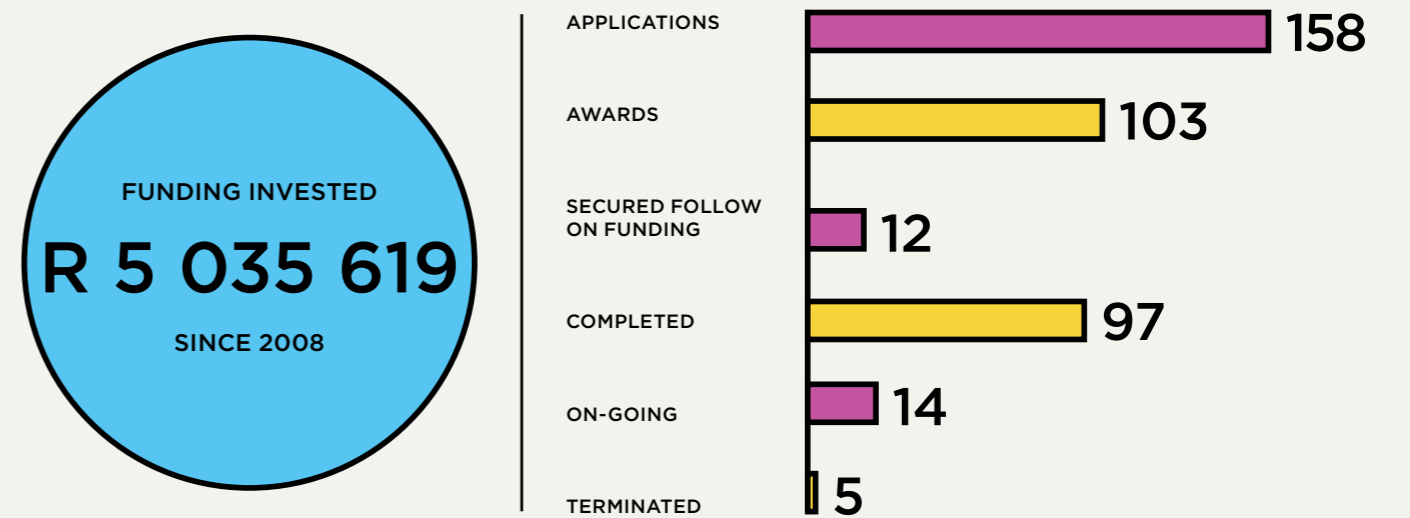
*Mr Nabeel Hussain and Mr Duarte Sousa*

A common problem when spray coating a surface is that the properties required to spray the fluid are not necessarily ideal for actual coating the surface. This innovation includes a 'device' in the spraying system which transforms the properties of the released fluid droplets to be more suitable for coating. The device can provide convective heat or infrared, UV or microwave radiation. The system is currently used for the production of catalyst coated membranes for hydrogen fuel cells, but other potential applications exist in other industries.

## UCT Pre-Seed Fund (2008-2017)

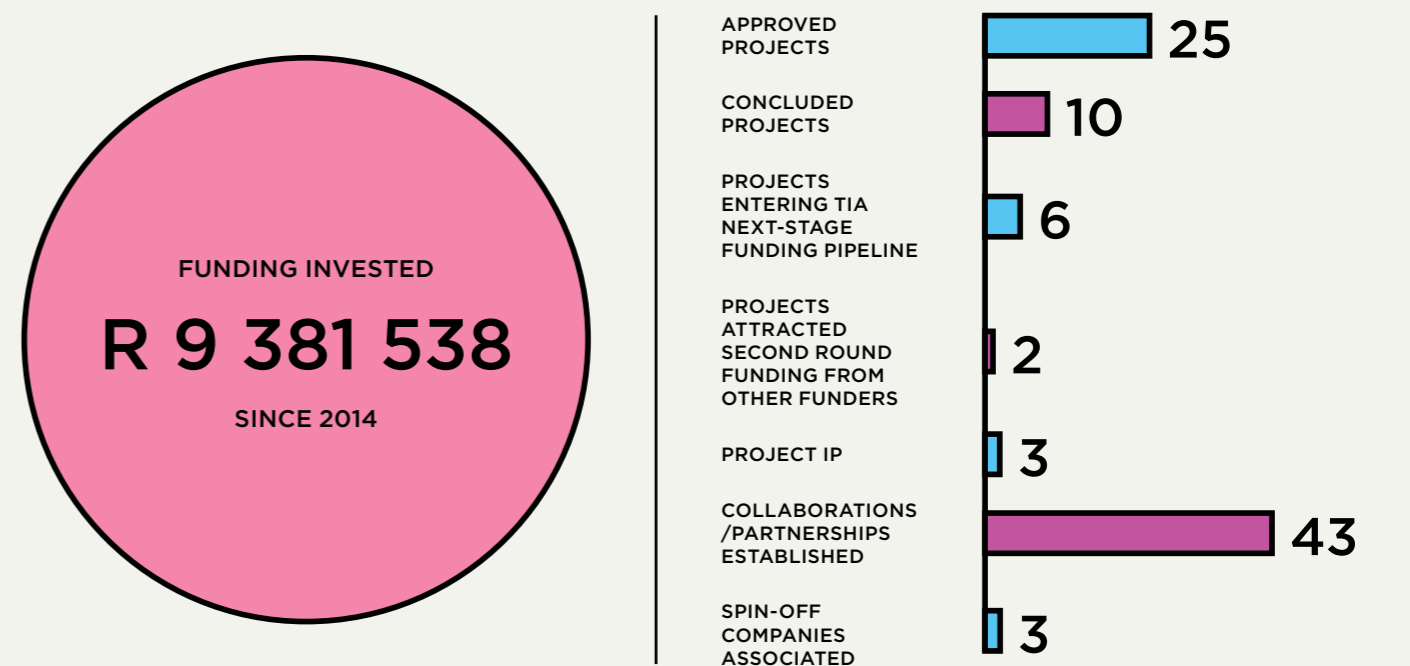
Launched in 2008, the Pre-Seed Fund aims to provide hard-to-get financial support for early stage development to bridge the funding gap between research and the point where external innovation funding streams can be accessed. UCT allocates R 500 000 per annum to fund Pre-Seed projects in two categories: Explorer (up to R20 000) and Concept (up to R 100 000).

### Summary of the performance of the Pre-Seed funds

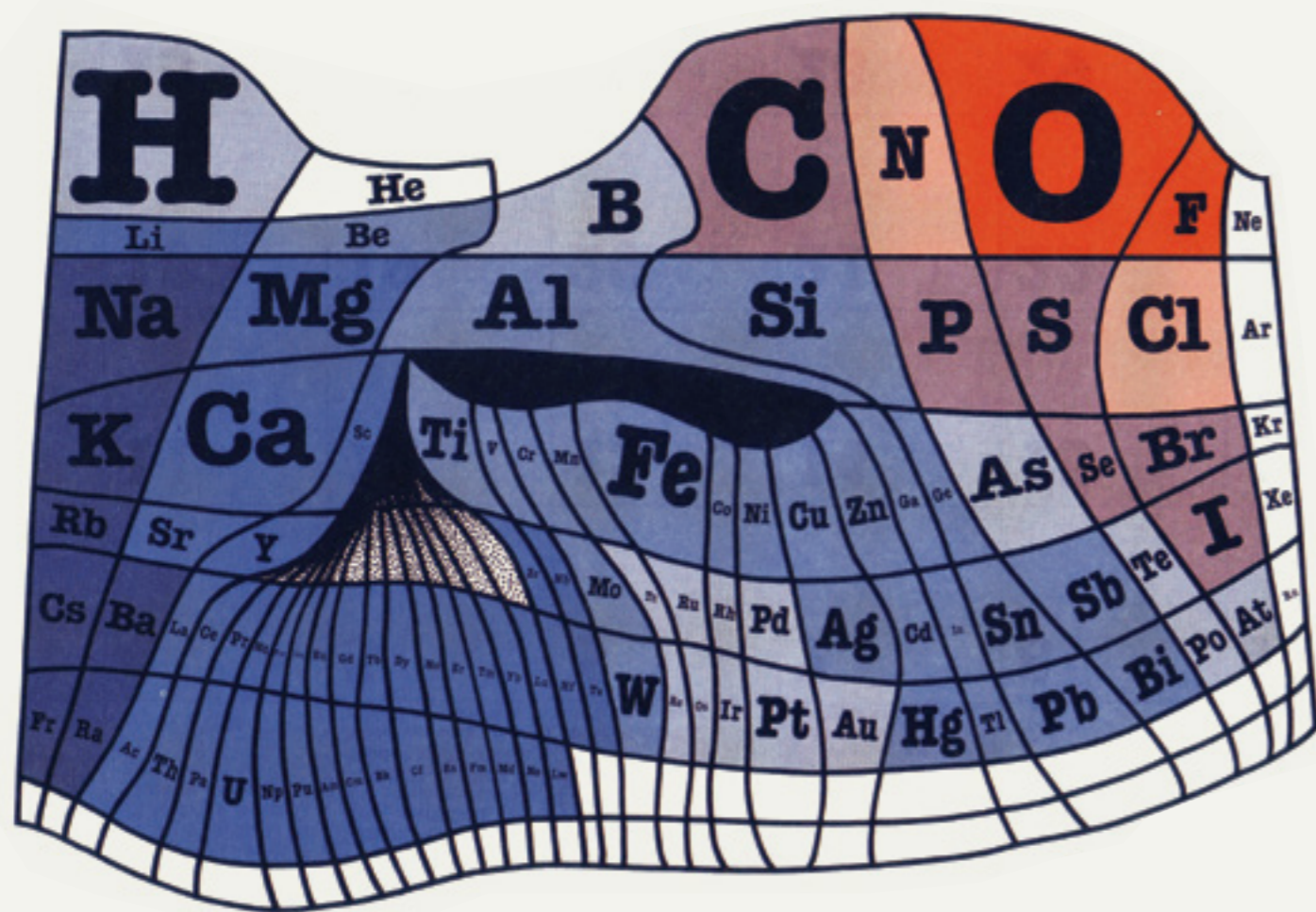
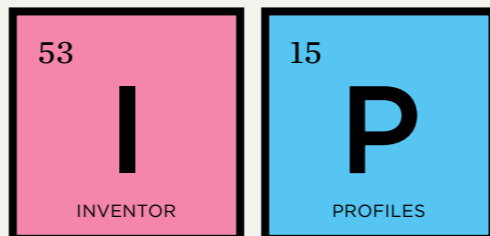


## TIA Seed Fund (2013 - 2017)

The Technology Innovation Agency (TIA) provides seed funding of R500,000 per project. The initiative, started in 2014, has resulted in considerable success and has significantly impacted the maturation of technologies within UCT.







# INVENTOR PROFILES



## NABEEL HUSSAIN

MEET NABEEL HUSSAIN, FAMILY  
MAN, OPERATIONS MANAGER  
AND THE CO-INVENTOR OF AN  
INNOVATIVE PROCESS THAT COULD  
OFFER THE WORLD A CLEAN AND  
RELIABLE ENERGY SOURCE.

The world needs alternative energy supply, one that is not only clean but also reliable. Fuel cells convert energy from a fuel - like hydrogen - into electricity and according to Dr Sharon Blair, Director of the HySA Catalysis Centre of Competence, South Africa, with its local platinum resources, has great potential to develop the fledgling fuel cell industry and capture a share of the growing sector.

Key to this is a process invented by Nabeel Hussain, Chemical Engineer and Operations Manager at UCT spin-off company HyPlat (Pty) Ltd, and his co-inventor Duarte Sousa.

"The manufacturing method involves a new way of combining the different layers of the core component of a fuel cell called the membrane electrode assembly (MEA), a process which results in lower cost and better quality," says Hussain.

HyPlat, the specialist fuel cell technology company, is manufacturing and selling the MEA products using Hussain and Sousa's method. The invention has allowed HyPlat to expand its product portfolio and offer a new cost competitive product line.

For Hussain - who holds a Masters in Chemical Engineering and a postgraduate diploma in Business Administration from the Graduate School of Business - life as a qualified

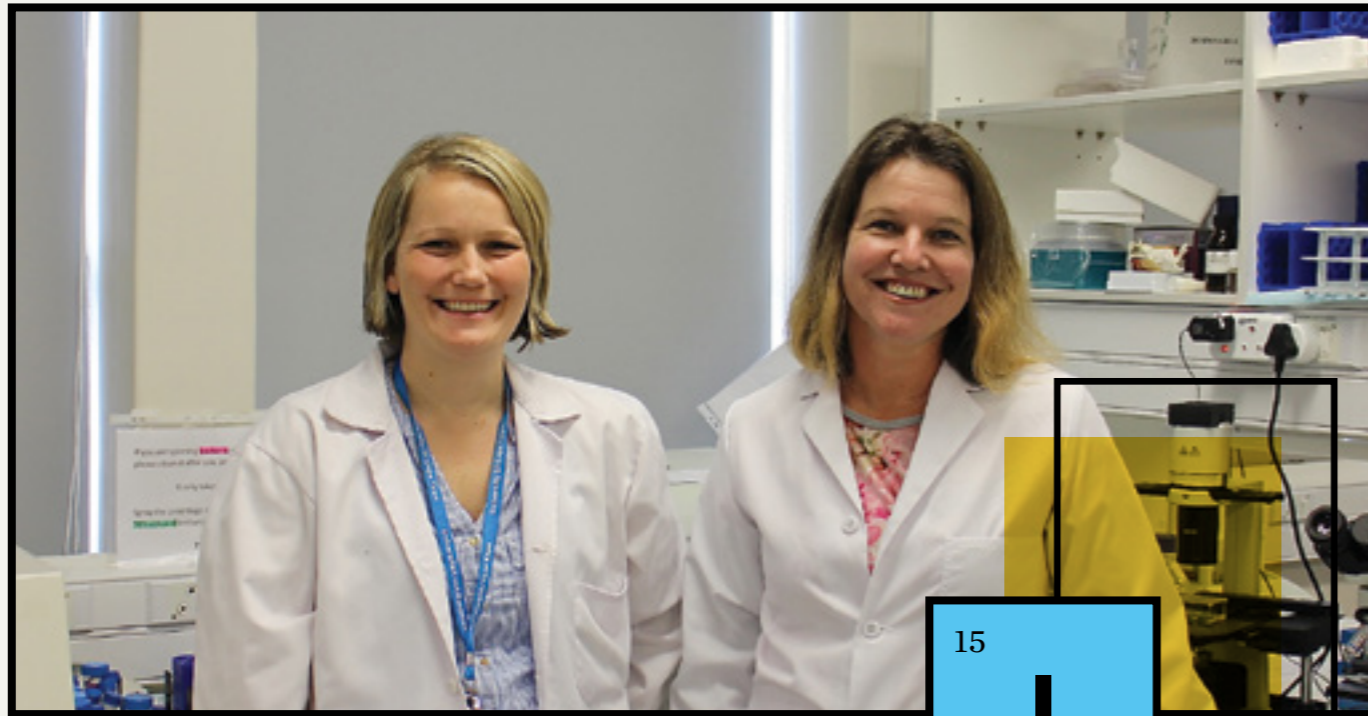
chemical engineer was not always on the cards for him. Initially, he wanted to become a medical doctor. He enjoyed mathematics and high school chemistry so much though, especially learning about the industrial processes, that when he was in matric, Hussain made the decision: he would pursue chemical engineering.

"I was told that chemical engineering requires strong mathematical capability and it seemed the natural fit," says Hussain.

When Hussain is not taking care of operations at HyPlat or serving as its technical point of contact for customers, he is a family man who also enjoys the Cape Town outdoors.

The Zimbabwean-born Hussain is a husband and the father of two young children, a two and a half-year-old daughter and a five-month-old son. Hussain's wife is also a chemical engineer and the two love spending time outdoors while he is also an avid hiker and runner.





## JO-ANN PASSMORE & LINDI MASSON

A LOVE FOR THE STUDY OF INFECTIOUS DISEASE HAS LED THESE INVENTORS TO CREATING A DEVICE THAT COULD LESSEN THE RISK OF HIV INFECTION AMONG YOUNG WOMEN.

Major causes include sexually transmitted infections and bacterial vaginosis, an inflammatory condition caused by an overgrowth of unhealthy bacteria in the vagina. Research indicates that many of the women with these conditions show no identifiable symptoms and, currently, there are no inexpensive and accurate screening tests on the market. This has driven Associate Professor Passmore, head of the Genital Mucosal and STI (GEMS) Laboratory, and Masson, a NRF Research Career Advancement and Carnegie Fellow and lecturer, to work on developing a simple and inexpensive test to detect inflammation of the vagina in asymptomatic women.

The test, functioning much like a home-based pregnancy test, will help identify women with high levels of inflammation, thereby paving the way for treatment and perhaps, one day, lessening the rate of HIV/AIDS infection.

Work on this test began when Masson was a PhD student in the GEMS Laboratory, working under Passmore. During her PhD, Masson looked at immune factors associated with HIV risk in women and how inflammatory responses were related to disease progression.

“One of the significant findings was that with inflammation in the female genital tract, there is a very high risk of becoming HIV-infected,” says Masson. Based on the data generated by the

group, and Masson's PhD, she and Passmore applied for a South African Medical Research Council (MRC) grant through its Strategic Health Innovation Partnerships (SHIP) initiative.

Part of the grant supported the development of a prototype test device that measures markers of inflammation, to identify women with sexually transmitted infections and bacterial vaginosis. Currently, the proof of principle phase has been completed, while the actual device will soon be finalised and tested in the clinical setting.

The MRC was so excited by the outcome of the initial project that they asked Passmore and Masson to reapply for further funding. While Masson is now the principal investigator, the two remain a team on the project and the next step will be to test the device in women visiting clinics in Cape Town. Once proven to work, they will begin a larger pilot trial rollout across Cape Town, Durban and Johannesburg.

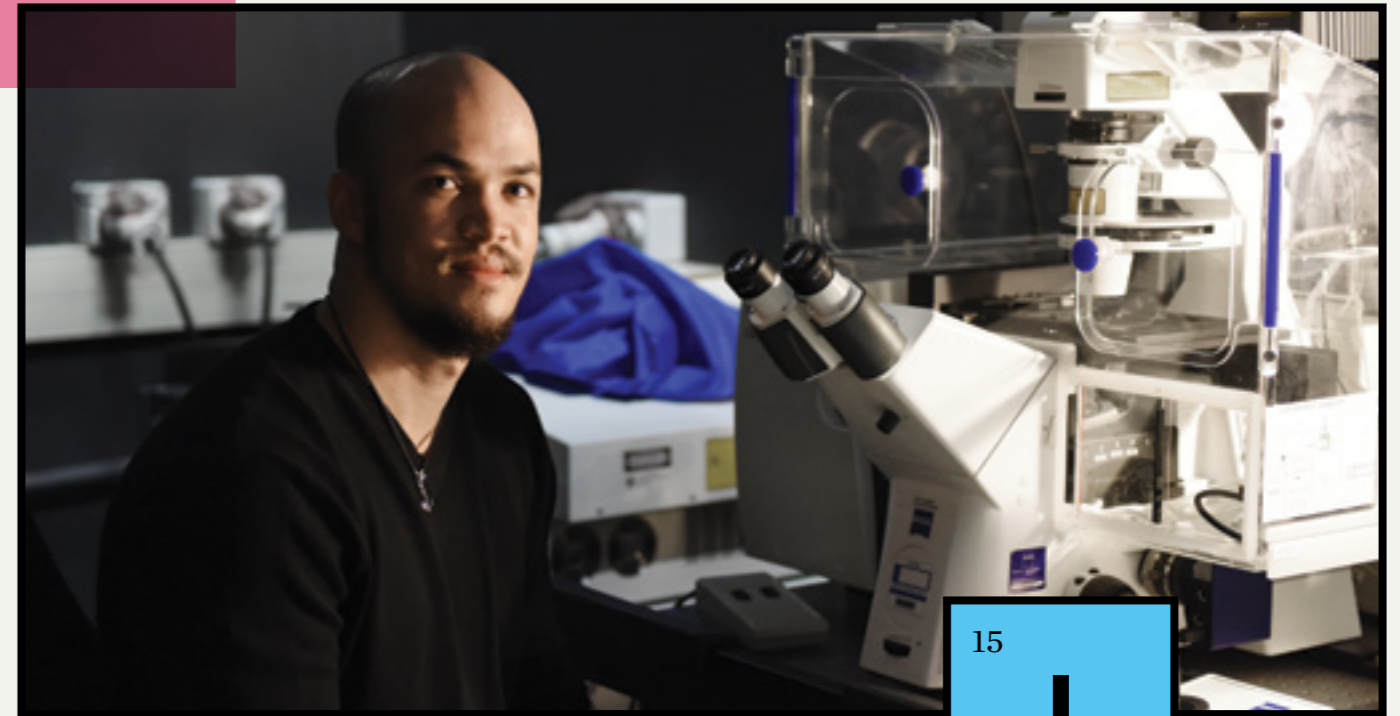
Masson says once the device is on the market it will be an affordable, easy-to-use, stand-alone device that can be utilised by nurses across the country and, hopefully, even made available to women for self-testing.

According to a 2015 publication produced by the University of Cape Town and Centre for the Aids Programme of Research in South Africa (CAPRISA), South Africa's young women could be biologically predisposed to contracting HIV.

The Division of Medical Virology's Dr Lindi Masson says a type of vaginal inflammation that is very common in young South African women could be providing the ideal conditions for HIV infection.

15

INVENTOR



## GIANCARLO BEUKES

WITH THIS INVENTION, YOUNG OR ELDERLY ASTHMATIC PATIENTS WILL BE ABLE TO ACTIVATE THEIR INHALERS WITH FAR LESS FORCE AND EFFORT THAN CURRENTLY REQUIRED.

Asthma attacks are frightening experiences that can cause acute breathing problems. Currently, inhalers are the primary device used to relieve any symptoms experienced from asthma attacks. Existing inhalers require large amounts of force to activate, requiring a pinch action. This force is found to be difficult to perform for children and elderly patients. Said difficulty in activating their inhalers can potentially lead to more severe asthma attacks.

Giancarlo Beukes, from the Division of Biomedical Engineering, began his work with the above in mind when he created a plan for an invention that reduces the amount of force needed to activate a standard inhaler.

The origin of the project was when Beukes was given a project by his supervisor, Dr Sudesh Sivarasu, which was conceptually developed by his co-inventor, UCT alumnus Dr Jason Voorneveld (who had previously developed an assistive device concept called the Paediatric Metered Dosage Inhaler (PMDI) with Dr Levin). The Namibian-born Beukes took the concept of the PMDI and developed it further. He (along with co-creators Dr Sivarasu, Dr Voorneveld and Dr Levin) significantly reduced the amount of force needed to activate the inhaler from approximately 4 kilograms to 1.25 kilograms.

An added bonus of the design of the PMDI is that it allows patients to use more than two fingers, thus acting as a force multiplier. Users of the device are able to use their entire grip strength to activate their pumps.

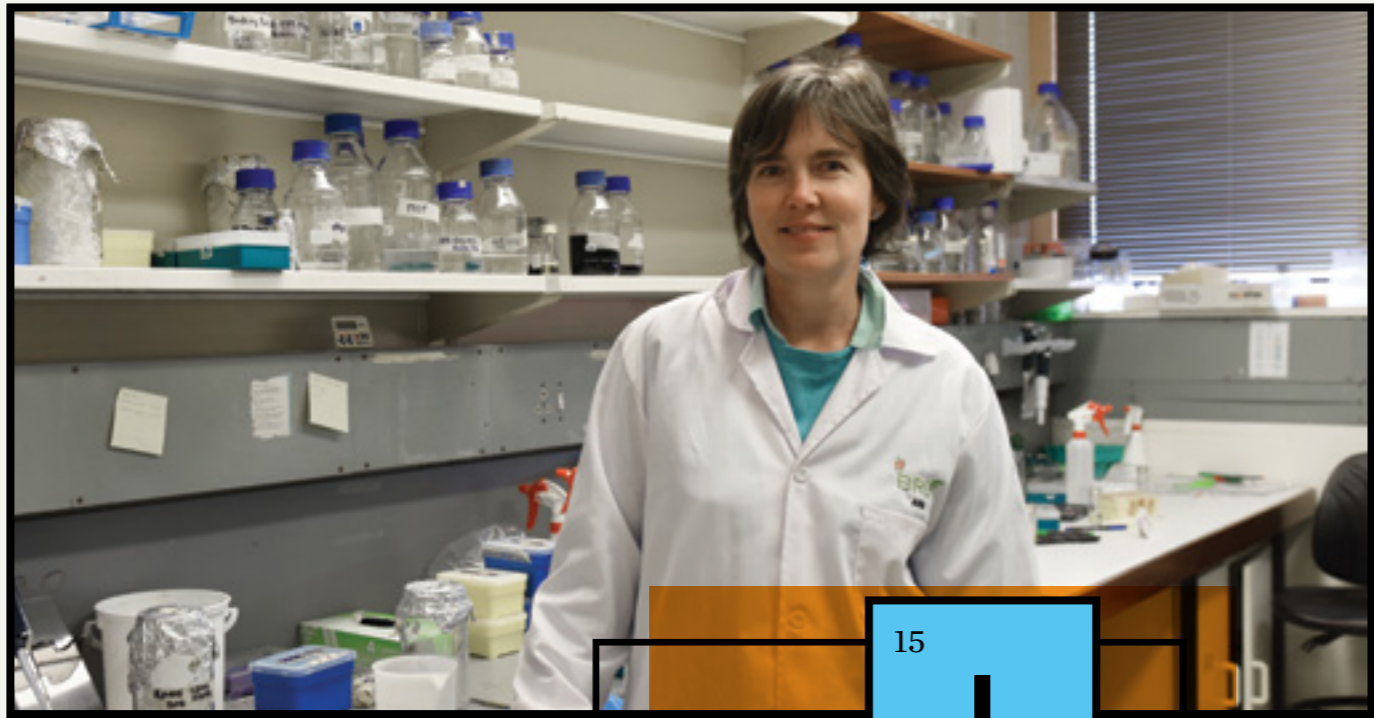
Affordability was a key concern in enhancing the PMDI. Expensive dry powder inhalers require little to no strength while cheaper ones – the metered dosage inhalers – do. A cost effective solution was paramount due to the groups the device was primarily designed for (elderly and children). Related, another factor was the need for a metered dosage counter. The device needed to include a counter that was generic, covers the full range of dosages (from 30 - 300), as well as being resettable to keep costs down for the consumer. This allows the device to be reused, reducing waste as well as cost to the consumers of the device.

Having managed to achieve all of the above mentioned goals and secure the key features, the only thing left to do before taking the PMDI to market is manufacturing enough of the devices for a consumer feedback trial. Assuming a successful trial, the next steps would be licensing, finding a commercial partner or potentially starting a Biomedical Engineering company.

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INVENTOR





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INVENTOR

## ANN MEYERS

A LIFE-LONG FASCINATION WITH MICROBES BEGAN WITH A BOOK ABOUT YOGHURT, AND CULMINATED IN THE INVENTION OF AN INEXPENSIVE WAY TO MAKE ANTIBODIES.

It all began in a public library in Pietermaritzburg. A school-going Dr Ann Meyers discovered her love and lifelong passion for microbes while reading a book about how to make yoghurt and cheese.

"It was an amazing book," says Meyers, laughing as she recalls what was ultimately the start of her microbiology journey.

Meyers is now a research officer in the Biopharming Research Unit (BRU), working with Professor Ed Rybicki, and the inventor behind an innovative way

of making cheap reagents: components that are needed for chemical analysis in tests that are carried out to diagnose veterinary or human diseases.

The invention came about after the unit was given sample genes from an immunology unit at the Onderstepoort Veterinary Institute that had created a phage display antibody library derived from chicken - effectively, a whole chicken immune system in a test tube. These were pieces of DNA that could make antibody fragments, which could in turn be used to detect the rabbit antibodies that are commonly used as diagnostic reagents in many different laboratories worldwide.

Meyers went on to test the DNA molecules and found a couple that made proteins that proved to be good candidates. These were then fused genetically to another gene that makes an enzyme. The enzyme activates an indicator when an antibody is detected - like the blue positive of a pregnancy test.

Meyers' method also uses plants as a means of production rather than bacterial or mammalian cells, which is a novel and far cheaper way of making sophisticated products such as this.

"We have a method for making this protein in plants where you simply treat them with a bacterium containing the DNA, leave them to grow a while,

then grind up the plants, and purify the protein out in a very simple process. You can also use it immediately, instead of having to bind it chemically to something else, and repurify it," she says.

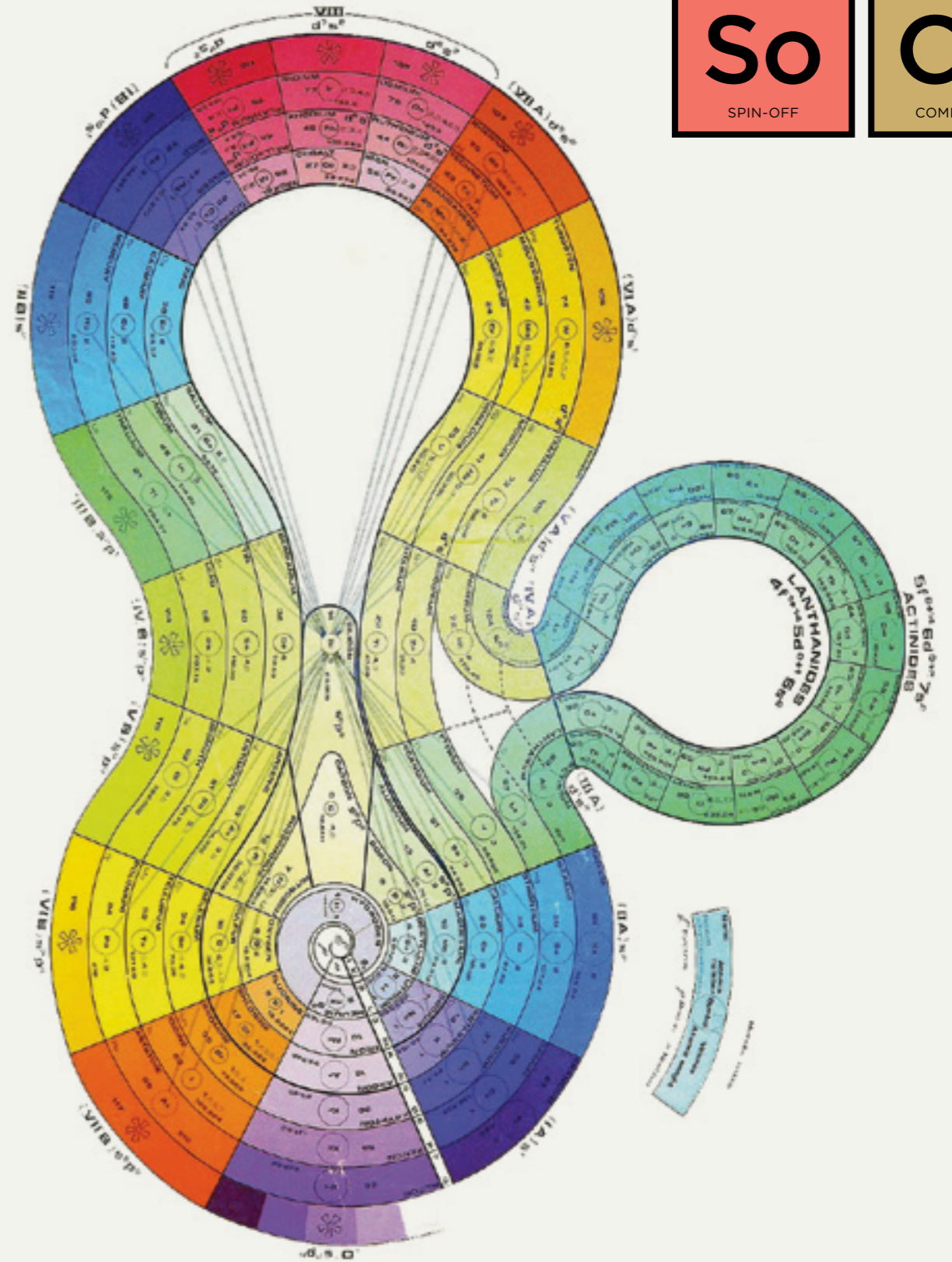
The benefits of Meyers' invention will be felt throughout test laboratories that usually pay exorbitant amounts for the antibodies made by conventional processes - and which are increasingly difficult to obtain in South Africa, because of legislative problems around importing animal products.

"This product can be made in this country, and in plants, and both the upstream and downstream costs are definitely cheaper," she says.

The next step is to improve the purification technique and to decide on how it will be formulated for storage and transport. After that, the process of enrolling outside individuals to test the product will begin.

She hopes government will see the value in this work and look at establishing a plant production facility in South Africa that can one day be the hub for a novel 'molecular farming' biotechnology industry that includes the creation of vaccines that are presently unavailable or imported.

J. F. Hyde, "A Newly Arranged Periodic Chart"



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# SPIN-OFF COMPANIES



# UCT Spin-Off Companies

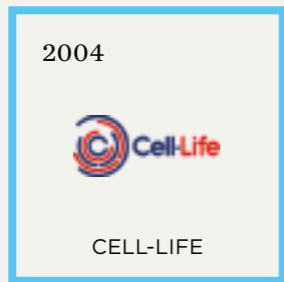
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2004



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CAPE CAROTENE (PTY) LTD

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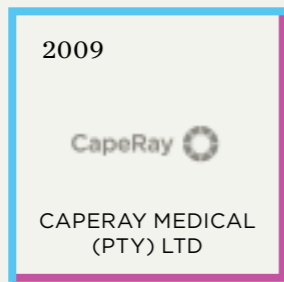
HOT PLATINUM (PTY) LTD

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CAPERAY MEDICAL (PTY) LTD

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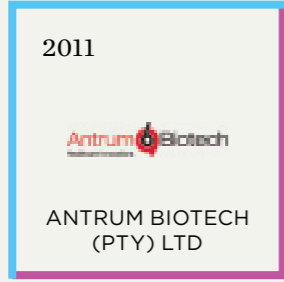
PST SENSORS (PTY) LTD

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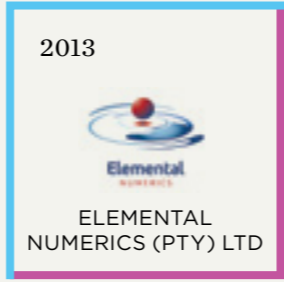
ANTRUM BIOTECH (PTY) LTD

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TULUNTULU (PTY) LTD

2013



ELEMENTAL NUMERICS (PTY) LTD

2014



ANGIODESIGN (UK) LTD

2014



HYPLAT (PTY) LTD

2014



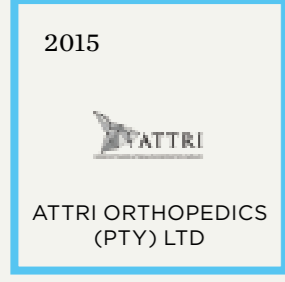
DRONE SAR (PTY) LTD

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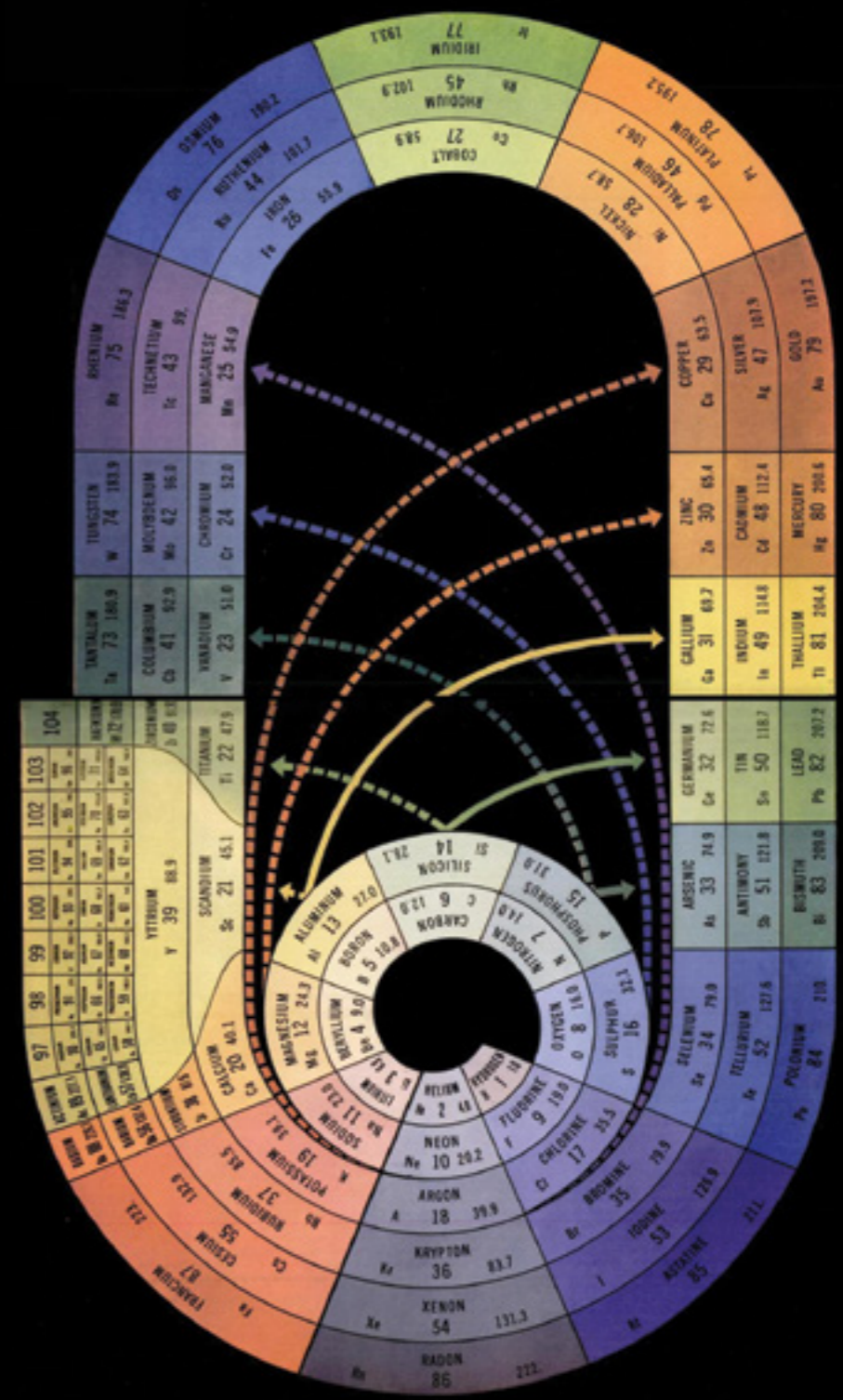


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2016



DREAM HAVEN (PTY) LTD





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NEW PATENT



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