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umthombo

INCLUSIVE. ENGAGED. AFRICAN.



Neuroscience in Africa

Minerals to Metals

Mining that is more sensitive to people and planet

Tackling leishmaniasis

After malaria, it's the next most deadly protozoan disease

Flows of fertility

Mapping movements in the global fertility industry

umthombo

Umthombo is the isiXhosa word for a natural spring of water or fountain. The most notable features of a fountain are its natural occurrence and limitlessness.

Umthombo as a name positions the University of Cape Town, and this publication in particular, as a non-depletable well of knowledge.



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RESEARCH NOTES



Benefits of breastfeeding can last a lifetime

Mothers can transfer lifelong protection against infection to their infants by breastfeeding, says a new study by an international team of scientists led by researchers at the University of Cape Town (UCT). The researchers found that infant mice breastfed by a mother who had a worm infection before getting pregnant acquired lifelong protection against this ailment.

Scientists previously thought that immunity against illness was passed from mothers to infants only during the time they are breastfed and ended when breastfeeding stops.

"The work shows that exposure to an infection before pregnancy can lead to a mother transferring long-term immune benefits to her offspring," said lead author, Dr William Horsnell of UCT's Institute of Infectious Disease and Molecular Medicine and the Division of Immunology. "This is remarkable and adds a new dimension to our understanding of how a mother can influence our health."

Rat poison threatens peri-urban wildlife

Urban rat poisons are spilling over into the natural environment around Cape Town, South Africa, and threatening wildlife, according to a team of University of Cape Town (UCT) researchers in the Institute for Communities and Wildlife in Africa.

By measuring the presence and concentration of rat poison in liver and blood samples from 41 animals, they identified six

predators at risk: caracal, Cape clawless otter, Cape eagle owl, large spotted genet (pictured), honey badger and water mongoose. Others are likely affected as well.

The predators aren't eating the poisons directly, though. The poisons are designed to work slowly in their target species, rats, which become sick over days and end up as easy prey for predators.



Flushing guidelines during drought

The devastating 2015–2018 drought in Cape Town and its aftermath saw citizens get behind city-wide water-saving initiatives and adopt the catchphrase "If it's yellow, let it mellow", flushing less and using grey water to do so.

In response, University of Cape Town (UCT) researchers Waseefa Ebrahim and Dr Dyllon Randall published research on different toilet flushing solutions and their impacts.

Ebrahim and Randall calculated that the city's waste-water treatment plants could cope with the additional estimated 893 tonnes of solids added to the system from grey-water flushing and allowing urine to stagnate in toilet bowls. But the immediate toilet infrastructure could become clogged by solids.

They go on to offer practical solutions for water-savers to avoid damaging their sanitation infrastructure.

"It [this work] was inspired by the Cape Town [water] crisis but ultimately we're looking towards what the sanitation of the future will look like," Ebrahim said.

BABY: JOHN MAYER, FLICKR; GENET: SHUTTERSTOCK; TOILET: VECTEEZY; MALARIA: UNAMID, ALBERT-GONZÁLEZ-FARRAN

Malaria drug less effective in malnourished children

The most common malaria treatment worldwide is less effective for those who are particularly vulnerable to the disease: severely malnourished children. This is according to the first study to address the challenge of treating malaria in severely malnourished children, specifically.

"It highlights how important it is to make sure that optimised drug doses are developed for undernourished children and other vulnerable groups – such as pregnant women – who are usually excluded from studies to decide treatment doses," says Professor Karen Barnes from the University of Cape

Town's (UCT) Division of Clinical Pharmacology. She, along with UCT Associate Professor Lubbe Wiesner and Michiel Smit, previously part of Wiesner's lab in the same division, collaborated with international partners on the research.

The results showed that not only were the levels of the most commonly used antimalarial drug worldwide lower in children's blood compared to adults', but that among severely malnourished children there was about 19% less of the drug than in other children. This lower exposure also meant they acquired new malaria infections sooner.



Millions donated to drug discovery

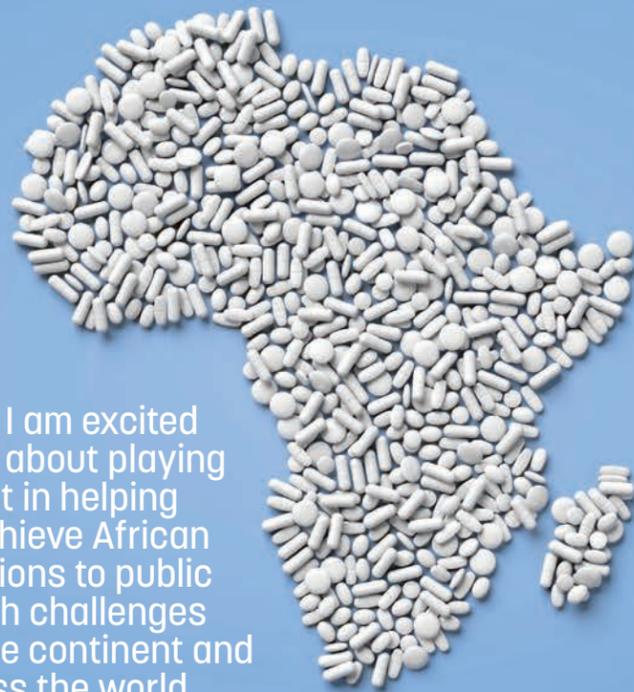
University of Cape Town (UCT) alumnus and former chairman and chief executive of Coca-Cola Neville Isdell has donated USD1 242 160 (about ZAR18 million) towards research into the discovery of new medicines for infectious diseases at UCT's Drug Discovery and Development Centre (H3D).

The generous donation will be used to establish an initial five-year Neville Isdell Chair in African-centric Drug Discovery and Development at H3D. H3D's director and founder Professor Kelly Chibale will hold the Chair, which includes the directorship of H3D.

Through the donation, Isdell, who took the world's largest beverage company to new heights during his tenure, will support solution-orientated research to create life-saving health innovations.

"I am excited about playing a part in helping to achieve African solutions to public health challenges on the continent and across the world. I hope this support will help Professor Chibale to drive and lead innovative research & development (R&D) of new malaria medicines, as well as new tuberculosis (TB) and antimicrobial resistance treatments, and train a new generation of African scientists with key modern pharmaceutical skills required to discover modern medicines," Isdell said.

The donation will be used partly to lead efforts in establishing the H3D African Drug Metabolism and Disposition Project, also known as the H3D "African Liver Project". This will focus on addressing the issue



“I am excited about playing a part in helping to achieve African solutions to public health challenges on the continent and across the world.**”**

of variability in drug response across African populations, which is mostly driven by genetic differences in the expression and activity of drug-metabolising enzymes.

"In addition to providing useful data for targeted clinical trial design, and eventually for the establishment of better directed drug dosage and dosage intervals, the African Liver Project will also make H3D a unique centre of excellence where scientists from the global north and Africa

will work hand in hand to better understand genetic variability in diverse African populations," Chibale explained.

"H3D will need sustainable funding at critical mass if it is to succeed. Should H3D continue to be successful, it could result in the beginning of a home-grown pharmaceutical R&D industry that would focus on the unmet medical needs of African populations and create high-skilled jobs for African scientists." **U**

PHOTOGRAPH: SHUTTERSTOCK

Fair work in the GIG ECONOMY



Two months after launching the first-ever international ranking of working conditions and standards in the platform economy, Fairwork released four new ratings for South African digital labour platforms.

Fairwork is a collaboration between the University of Cape Town (UCT) and the University of the Western Cape in South Africa, and the universities of Oxford and Manchester in the United Kingdom.

The rating system offers a comparison of the best and worst working standards in the digital or gig economy.

As part of a 30-month project funded by the Global Challenge Research Fund, UCT's Professor Jean-Paul van Belle and Dr Paul Mungai (Department of Information Systems) measured digital labour platforms' levels of adherence to five Fairwork principles: fair pay, fair contracts, fair conditions, fair management and fair representation. These include evaluating whether a company pays the minimum wage and ensures the

health and safety of its workers.

"Fairwork aims to encourage platforms to be transparent about the work that they provide and to ultimately create better, and fairer, jobs," said Van Belle.

Ratings: a useful measure

Fairwork scores are useful to companies that want to highlight how the jobs they create are better than those of their competitors. They are also useful to regulators who seek benchmarks against which to evaluate platforms.

"They are useful to consumers and clients who seek to make more informed decisions about how they spend their money," added Van Belle. "And they are also useful to workers as they seek to achieve better working conditions."

The ratings help consumers to make ethical and informed choices about the platforms they choose when ordering commodities and services such as food, cleaning services and transport – or outsourcing a simple task.

Oxford's Professor Mark Graham, lead researcher on the Fairwork project, said the addition of these new platforms will allow for greater comparison among companies with similar missions.

"This is critical in the development of international standards in the gig economy, as workers, clients and managers will now be able to draw direct comparisons between competing platforms," he said.

The platforms evaluated in the survey were Wumdrop, Domestly, Uber Eats and Nomad Now. **U**

PHOTOGRAPH: RAWPIXEL.COM



Nomusa Makhubu,
In Living Colour 1 (2014)

ART exploring what it means to be African

Dr Nomusa Makhubu's work encompasses academic research and the visual arts – photography and film, in particular – to explore ideas of gender, citizenship and what it means to be African.

Today, Makhubu is an award-winning artist and a senior lecturer in art history at the University of Cape Town (UCT). Among her many accomplishments, she co-curated South Africa's presentation at the Venice Biennale with Nkule Mabaso, also based at UCT, earlier this year.

But she could easily have ended up as an architect or medical doctor.

"When I finished high school, I had good grades, and I could have followed a career in the sciences. But I had an 'A' in art and a keen interest in what I could do with it."

The idea of African-ness

After completing her undergraduate studies, Makhubu's first body of work investigated colonial photography. "I

questioned the way that such images are presented as documentary in nature while in fact they are highly subjective and were mostly shot in a studio setting."

Although the work was well received, when Makhubu was given the chance to complete her master's in art history, she jumped at it. Even at that early stage, she was fascinated with the idea of what constitutes African-ness.

"My master's thesis looked at the work of artists Zanele Muholi and Nicholas Hlobo and investigated the assumption that homosexual and transgender identities are unAfrican." Both photographer Zanele Muholi and sculptor Nicholas Hlobo confront stereotypes of gender and sexuality in their work.

Makhubu went on to complete a PhD in art history. "I became interested in the medium of film and video, so I travelled to Lagos – home of the Nollywood film industry. There I explored the ways artists like Peter Hugo and Zina Saro-Wiwa, artists working in film and video, are responding to the Nollywood medium."

Makhubu also became fascinated with the many ways that citizenship is articulated in post-colonial Africa.

"For example, in the wake of the state broadcaster's decline in Nigeria in the late '90s, the film industry sprang up in part thanks to investment from evangelical mega-churches.

"These mega-churches act as proxies for the state in some ways. They offer many of the social services normally provided by the state – housing, health care, banking and childcare – while requiring members to pay tithes, analogous to state taxes."

On borders and belonging

During 2014, Makhubu joined the Michaelis School of Fine Art at UCT as a lecturer in art history. Her research interests have continued to include themes of citizenship and the artificiality of the nation state.

When she was asked to contribute to a roundtable about the film *Black Panther*, she chose the borders of Wakanda as her subject.

"The spatial politics of Wakanda as a place are very interesting," she says. "In the paper, I make an analogy between Wakandan and South African exceptionalism."

"Wakanda, as it is presented in the film, is a fictional kingdom populated by five tribes brought together by the mineral wealth of [the fictional] 'vibranium'. South Africa on the other hand is settled on gold, diamonds, platinum, chromium and uranium. And it is known for its arrogance about its minerals, judicial system, technologies

"I am fascinated by ... the question of what it feels like when you have been so profoundly displaced from a place and yet you identify with nothing else."



PHOTOGRAPH: LIBBY YOUNG

and so on, and the assumption that it will never spiral into the civil war, poverty or political and socio-economic demise that other African countries faced in the 1980s."

Makhubu also considered the film in relation to other black superheroes,

including those that came before: the genre of Nigerian comics that combine elements of African cosmologies and Afrotopian themes; the South African film *Ikati Elimanyama* (isiZulu for "Black Cat"); and the black township comic book superhero, Kwezi.

But *Black Panther*, she says, was the first such offering from a mainstream entertainment giant like Marvel to probe difficult questions pertinent to Africa and Africans, such as about pan-Africanism, black nationalism and the transatlantic trauma of displacement through slavery.

Art interventionism

Makhubu is working on a book about unconventional African art forms and the role of art interventionism in social engagement. "By interventionism, I mean that by doing something unconventional

you are messing with the norm and going against the grain in terms of what is considered decorous and what is thought of as obscene.

"These are works that are often informal, disruptive and temporary, and that focus on the strong symbolic codes often used in public and urban spaces. These are works that can't easily be categorised, sold or archived," she explains. "Some examples include performance art and graffiti or the art collective that put a portable toilet into a Cape Town gallery space."

Makhubu plans to continue to explore ideas of belonging and displacement in her future research. "I am fascinated by ideas of 'uncitizenship' in

Africa and the question of what it feels like when you have been so profoundly displaced from a place and yet you identify with nothing else.

"What does the idea of 'nation state' mean at this point in time? And what does the signifier 'African' stand for?"



Neuroscience in Africa

Exploring the human brain and meeting neuro-health challenges in Africa is the goal of the University of Cape Town's new Neuroscience Institute, designed to be comprehensive in nature and cross-cutting in function. It does this by drawing together expertise across neurosurgery, neurology, psychiatry, imaging, genetics and neuroscience.



PHOTOGRAPH: KARIN SCHERBRUCKER/
SLINGSHOTMEDIA.CO.ZA

Lindizwe Dlamini, UCT PhD candidate in neuroscience, processes blood for research into traumatic brain injury led by Professor Tony Figaji in the Paediatric Neurosurgery Unit.



Brain gain

An African institute of excellence

The University of Cape Town (UCT) Neuroscience Institute is designed to be comprehensive and cross-cutting, making it possible for experts in diverse fields to come together to better understand African challenges: the interplay between the brain and conditions like trauma and infection, and its consequences.

In 1979, former UCT professor and physicist Allan Cormack won the Nobel Prize in Medicine for inventing CT (computerised tomography) scanning. Now, 40 years later and in the same building where Cormack did his research, there is an institute dedicated to the human brain.

The director of the UCT Neuroscience Institute and Mauerberger Chair of Neurosurgery, Professor Graham Fieggen, is a passionate advocate for, in his words, “doing away with false compartmentalisation when it comes to the human brain”.

“While there has been a tendency for clinicians and researchers to get stuck in the perspective of their training – whether that was neurology, neurosurgery or psychiatry – it is important to remember that we are all

treating the same brain,” he says.

“It is therefore essential to give the next generation of specialists a much broader understanding of the brain.”

According to Fieggen this is one of the characteristics which sets the Neuroscience Institute apart from other such facilities. “Having a centre which offers truly multi-disciplinary training and the chance for patients to be assessed in a holistic way is very exciting and a first for Africa.”

Matthew Wood, a UCT alumnus and professor of neuroscience at the University of Oxford, believes that the institute is unique. “It combines clinical excellence with deep expertise in major areas of neuroscience, such as brain infections, which are a high priority for African and developing-world populations.

“This, coupled with a special focus on paediatric populations, means that the Neuroscience Institute will, in time, make a powerful contribution to global neuroscience.”

Breadth of brain research

Another defining characteristic of the Neuroscience Institute is the scope of its research. In addition to offering a postgraduate programme and specialised professional training, the institute’s members are involved in broad-ranging research related to the brain.

“There is a huge array of work being done: in the community and clinics through to operating theatres and the laboratory,” says Fieggen. “These vary greatly: from a multi-year study of 1 000 mother-child pairs to intensive

FROM LEFT TO RIGHT A thin slice of brain from a genetically modified mouse with different components of the neurons visible in green and red; Amalia Awala, a UCT postgraduate researcher in neuroscience; UCT neuroscientist Dr Joseph Raimondo operating a precision microscope; a blue-stained human pyramidal neuron, a type of large neuron named for its triangular cell body.

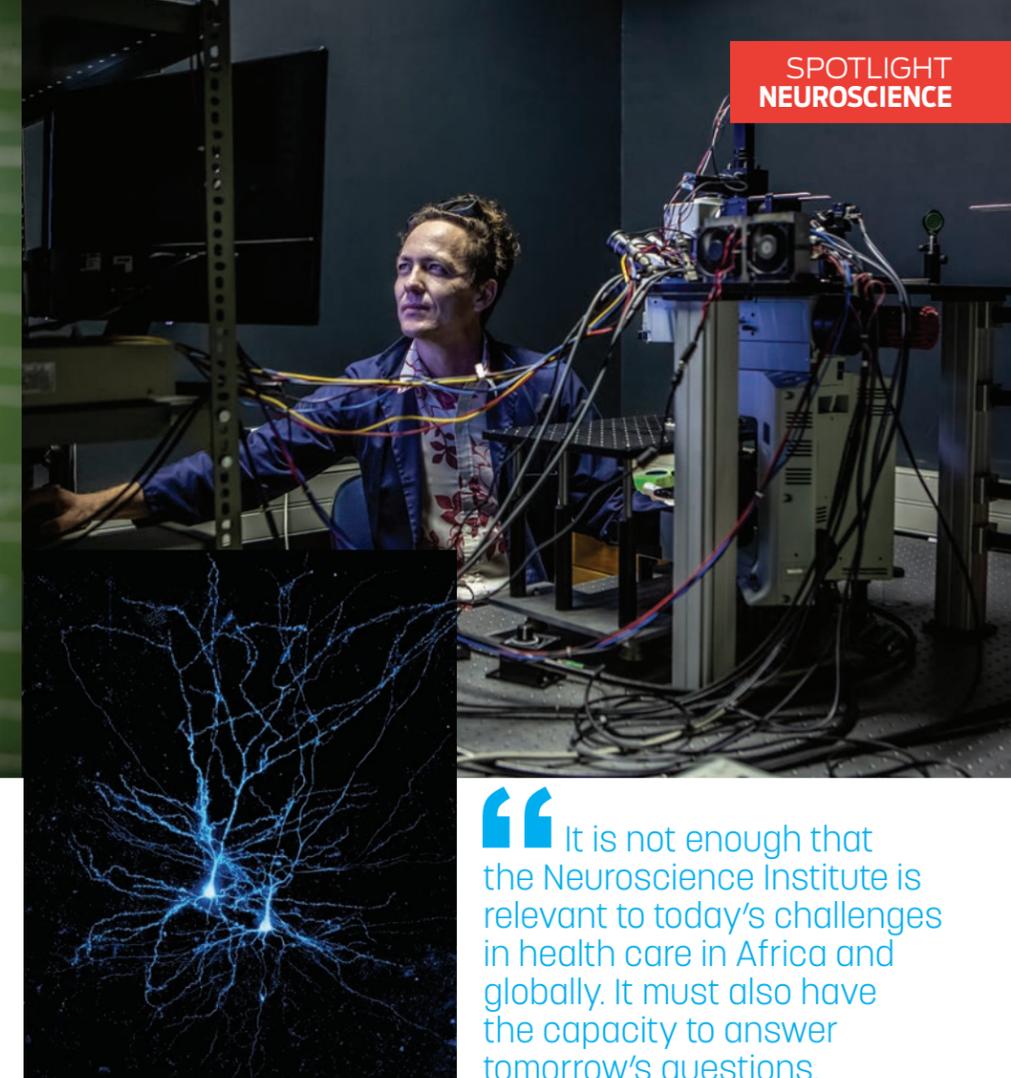
monitoring of the brain to improve recovery from injury and development of new surgical techniques. One example is work done by Professor Darlene Lubbe and her team at Groote Schuur Hospital to access brain tumours via the eye-socket.”

Other areas in which the Institute hopes to build on a strong research foundation are neuro-infection – diseases that affect the nervous system, such as meningitis and encephalitis – and early brain development.

UCT Professor Kirsty Donald, deputy director of the Neuroscience Institute, explains that explosive population growth in Africa could mean that by 2050 a large part of the population will be younger than 18 years.

“This growth represents huge potential,” says Donald, a paediatric neurologist. “But it also means that we must urgently understand how best to support healthy brain development in children, particularly those children who live in high-risk contexts and places in which they are exposed to infections like HIV.

“There are few places in the world that combine deep expertise with



“It is not enough that the Neuroscience Institute is relevant to today’s challenges in health care in Africa and globally. It must also have the capacity to answer tomorrow’s questions.”

insight and understanding of these populations.

“The UCT Neuroscience Institute is one place where this is possible, thanks in part to the special relationship that the university enjoys with the Red Cross War Memorial Children’s Hospital as a teaching facility. The Neuroscience Institute represents an enormous opportunity to improve people’s lives.”

Transforming neuroscience

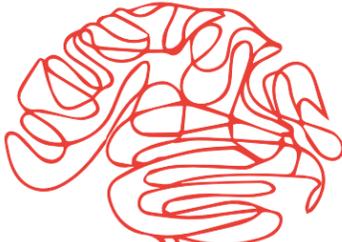
Dr Joseph Raimondo, a UCT senior lecturer and neuroscientist, leads the institute’s basic neuroscience laboratory and convenes its honours programme. He believes that the Neuroscience Institute represents an opportunity to address the issue of transformation in the field.

“There is an urgent need for

transformation in neuroscience to ensure that researchers and academics reflect the diversity of South Africa, which will help us more easily prioritise and address research problems relevant to our context,” he says.

“The honours program in neuroscience is really the entry point for young South Africans interested in a career in neuroscience research. It’s therefore crucial that we make resources available to encourage and support those from under-represented backgrounds to study neuroscience at UCT.”

“It is not enough that the Neuroscience Institute is relevant to today’s challenges in health care in Africa and globally,” concludes Fieggen. “It must also have the capacity to answer tomorrow’s questions.”



Epilepsy:

a collaborative cure

Epilepsy - a disorder that causes abnormal electrical brain activity leading to recurring seizures - can affect anyone. Although daily medication can treat the condition, doctors are increasingly recommending surgery as a cure for patients who don't respond to medical treatment. A multi-disciplinary team of University of Cape Town (UCT) specialists is making sure that more and more patients with drug-resistant epilepsy are cured.



Step 1: Diagnosis

Mikhulu* had her first seizure when she was nine months old. She was referred to the UCT-affiliated Red Cross War Memorial Children's Hospital where she was assessed by the head of paediatric neurology, UCT Professor Jo Wilmshurst, and her team. They diagnosed Mikhulu with epilepsy, identified the type of epilepsy affecting her and started her on medical treatment.

Now five years old, Mikhulu has prolonged seizures many times a day. Unfortunately, three kinds of antiseizure medication haven't been able to control them.

As part of her assessment in the neurophysiology department, Mikhulu is monitored with a specialised tool that records her seizures and helps doctors identify the part of the brain where they most likely originate. After a thorough, multi-part assessment, Wilmshurst and her team identify the cause of Mikhulu's epilepsy and recommend her for surgery.

Step 2: Evaluation

Before Mikhulu undergoes surgery, she is assessed by neurologists and neurosurgeon Dr Nico Enslin, who will operate on her to isolate the part of her brain causing the seizures. She also undergoes a full neuropsychological assessment.

Step 3: Treatment

Once the team has confirmed which part of Mikhulu's brain is causing her seizures, Enslin decides which surgical technique to use.

"We decide whether we can do a surgical resection to remove the part of the brain causing her seizures - the preferred choice - or whether we can ... disconnect it from the rest of the brain."

If neither of these techniques is appropriate, they will consider inserting a battery-operated nerve stimulator.

But in Mikhulu's case, the team decides to remove the temporal lobe causing her seizures. After an operation that lasts six hours and involves multiple neurological tests, Enslin successfully removes the brain tissue.

Step 4: Research

The piece of brain Enslin removes is about the size of a matchbox. This would normally go for routine examination, but Mikhulu and her parents have given their consent for it to be used for research too.

So, Dr Joe Raimondo and his team receive the brain tissue in the operating theatre and keep it 'alive' using artificial cerebrospinal fluid, a clear liquid found in the brain and spinal cord that helps to protect the brain.

"We rush it back to the lab and very finely section the tissue," explains Raimondo, who leads the basic neuroscience laboratory at UCT. "Then we use sophisticated electrodes and microscopes to record the activity of individual brain cells."

"We also stain the cells to study their exquisite morphology. This gives us valuable insight into the unique features of human brain cells and the possible underpinnings of epilepsy."

Step 5: Recovery

Mikhulu undergoes rehabilitation after which her doctors will gradually wean her off her epilepsy medication. This begins six months after her surgery.

Due to the nature of Mikhulu's epilepsy and because she was a well-selected candidate for surgery, she has a very good chance of being seizure-free and off medication from a year after surgery.

* While Mikhulu (meaning 'great hope' in isiXhosa) is not a real patient. The case described is typical of many undergoing neurosurgery for epilepsy.



PHOTOGRAPH: KARIN SCHERBRUCKER/SLINGSHOTMEDIA.CO.ZA. ICONS: SHUTTERSTOCK



Inside growing brains

Recent growth in availability of safe and non-invasive techniques for visualising the brain has had a huge impact on how we study children's brains. UCT researchers Professor Kirsty Donald and Professor Ernesta Meintjes explain what they have learnt about how young brains develop in high-risk contexts.

"In the past, it wouldn't have been ethically responsible to expose children to even the small amount of radiation that CT scanners emit unless there was a clinical indication to do so," explains Donald, a paediatric neurologist based at the Red Cross War Memorial Children's Hospital in Cape Town. "But magnetic resonance imaging (MRI) has made it possible for us to conduct this kind of research."

"One major benefit of MRI – which is completely safe, non-invasive and does not involve any harmful, ionising radiation – is that we can ethically study brain development and ageing in



““ They have shown that exposure to HIV can alter the health and maturity of white matter in babies' brains, even if they have not been infected by the virus.

normal, healthy populations from birth, throughout childhood, into adulthood and beyond," agrees Meintjes, the South African Department of Science and Technology/National Research Foundation Research Chair in Brain Imaging.

"This allows us to establish trajectories of normal brain development and ageing – critical if we want to examine how disease alters brain development and function."

Donald and Meintjes are involved in several long-term studies looking at how children's brains develop – both in the womb and after birth

– in the context of high-risk factors like alcohol use, cigarette smoking, methamphetamine use, poor maternal mental health and exposure to HIV.

For example, they have shown that exposure to HIV can alter the health and maturity of white matter – which affects learning and brain functions – in babies' brains, even if they have not been infected by the virus.

"It looks like this is also leading to structural changes later on," says Donald.

Meintjes explains that recent research from the Cape Universities Body Imaging Centre, of which she

is director, showed that particular supplements can help mitigate the adverse effects of alcohol exposure for babies whose mothers consumed large amounts of alcohol while they were pregnant. These babies grew better and performed better cognitively if their mothers took supplements of choline – a nutrient found in many foods.

Both of these studies were made possible by neuroimaging techniques.

"Neuroimaging allows us to investigate relationships between imaging measures, such as brain volumes, with neuropsychological performance, neurocognitive function, socioeconomic measures, inflammatory and genetic markers, microbiome diversity, et cetera," continues Meintjes.

"In the future, this will help us to figure out the brain activity related to specific diseases and disorders." **U**

PHOTOGRAPH: TINA FLOERSCH/UNSPLASH

PHOTOGRAPH: SUPPLIED

UCT Dr Ursula Rohlwink working in the cutting-edge brain monitoring research facility at the Red Cross War Memorial Children's Hospital.



Brain injury and infection: the burden in children

Dr Ursula Rohlwink joined the University of Cape Town (UCT) Division of Neurosurgery in 2009. Since then, her work has focused on children with traumatic brain injury and the neuro-infection tuberculous (TB) meningitis, which comes about when the TB bacterium infects the central nervous system's membranes. In 2018, she was awarded one of the UCT Neuroscience Institute's first fellowships.

"Among African children, both traumatic brain injury and TB meningitis are associated with high rates of death and illness," Rohlwink explains. "My work addresses these two major burdens of disease on our continent."

Although considerable research on traumatic brain injury is being done elsewhere, in Africa it remains a "silent disease", says Rohlwink. "And although TB meningitis is the most fatal form of TB, little research has concentrated on the organ of injury, the brain.

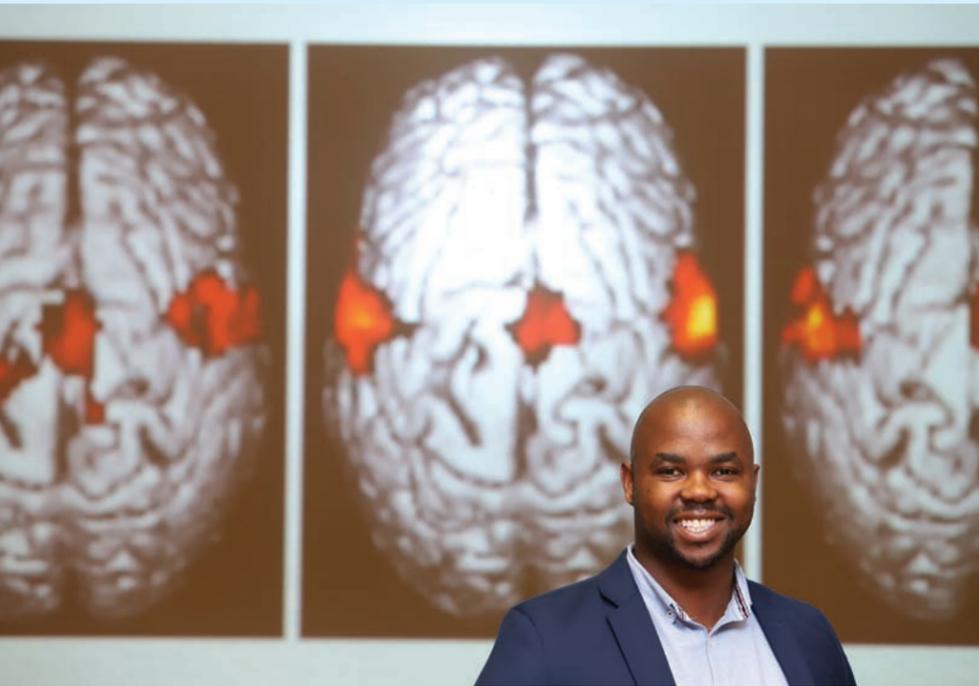
"My work focuses on understanding the mechanisms of brain injury which are relevant to both of these conditions – and other common brain diseases – with the aim of identifying new and improved treatment options."

Rohlwink is based in the Paediatric Neurosurgery Unit at the Red Cross War Memorial Children's Hospital headed by UCT Professor Anthony Figaji. The unit embraces the strategic advantages of its South African context: high numbers of patients and sophisticated monitoring and laboratory techniques.

"This has enabled me to do research on these diseases that, on one hand, cannot easily be conducted elsewhere, and on the other, is driven by its relevance to patients," she continues.

"The brain is the most vital organ for a productive and full life. Ensuring the health of the developing brain is crucial to the future of individual children and society." **U**

Banishing phantom pain



Katleho Limakatso and Associate Professor Romy Parker are studying phantom pain: a debilitating condition affecting seven out of 10 amputees in the aftermath of cardiovascular disease, like diabetes, and trauma. Their recent research adds to evidence that phantom pain is real and simple treatment can help.

People with phantom pain

were until recently thought to be mentally ill or faking their pain, which had been stigmatised as a psychological disorder. But functional magnetic resonance imaging (fMRI) has shown that the condition is driven mainly by functional and structural changes in the brain, specifically in the areas that generate pain.

These changes are also associated with the severity of phantom pain: the greater the changes, the greater the pain. We also now know that the changes can be reversed with simple treatment that provides pain relief.

In 2018, Limakatso, an assistant lecturer and PhD candidate in the University of Cape Town (UCT) Chronic Pain Management Unit, along with Parker, his supervisor, completed a trial investigating the effectiveness of graded motor imagery (GMI) for reducing phantom limb pain in amputees. GMI is a three-step intervention that involves exercises and activities to activate the areas of the brain controlling movement of the amputated limb.

The treatment was initially developed by researchers in Australia. However, this study was the first in Africa and only

the second in the world – and it worked.

“It’s a huge development in pain management,” Limakatso said. “Often pharmacological alternatives don’t work – and medication is expensive – and neither does surgery.”

What’s more, Limakatso is now able to show, via the GMI programme and the results, that the brain is the generator of phantom pain.

“We need to inform patients and healthcare practitioners that it can be easily assessed and managed using the graded motor imagery programme. And that this treatment is affordable, accessible and effective.” 

PHOTOGRAPH: MICHAEL HAMMOND

Sequencing the future

The African genome is the oldest, and as such, the most diverse in the world. But Africans have largely been under-represented in neurogenetic studies. The University of Cape Town (UCT) Neuroscience Institute is helping to change that through a range of forward-looking, international, collaborative projects on genetics and the nervous system.

Genetics & mental illness

Psychiatrist and scientific director of the Neuroscience Institute, UCT Professor Dan Stein, believes that neurogenetics will play an important role in future brain science. He explains that the UCT Psychiatric Neurogenetics Group, co-headed by Drs Shareefa Dalvie and Nastassja Koen, is involved in several projects looking at the genetics underlying mental illness.

One, is the UCT-led, South African Drakenstein Child Health Study: a multidisciplinary study following 1 000 mother–child pairs to investigate a range of factors – including genetic

and environmental – that may impact maternal and child health. The researchers have already assessed a subset of the participants with a panel of markers from across the genome that are relevant to psychiatric disorders, he says. The group is also involved in several multinational psychiatric genomic projects.

“We are working with the international Psychiatric Genomics Consortium,” says Koen, “to include our South African samples in their large-scale, genome-wide studies on post-traumatic stress disorder and major depressive disorder.

“And we’re participating in the Enhancing Neuro Imaging Genetics through Meta-Analysis Network,” continues Koen, “70 institutions from around the world investigating brain structure, function and disease using brain imaging and genomics.”

The group also recently partnered with researchers at the University of Oslo’s Norwegian Centre for Mental Disorders Research to build capacity by training young researchers and conducting research in the field of imaging genomics.

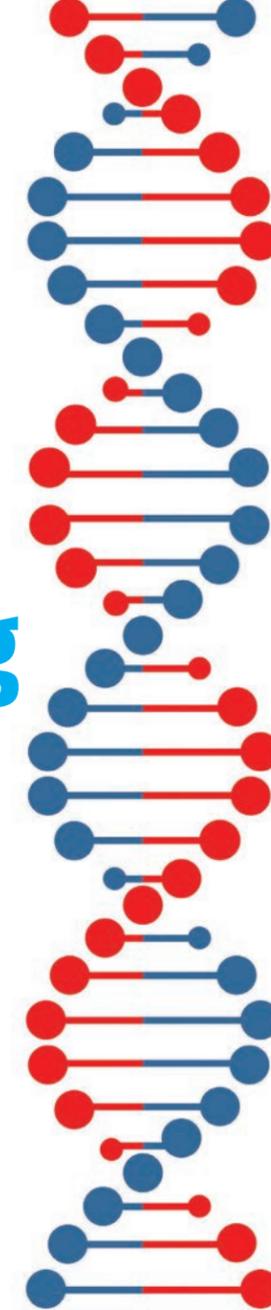
Genetics & neuromuscular disease

Other genetics research of the Neuroscience Institute is concerned with neurological diseases that affect people of African ancestry in specific ways. One example is the important research on myasthenia gravis – an uncommon and complex autoimmune disease that causes weakness in skeletal muscles.

Professor Jeannine Heckmann and her team in the UCT Division of Neurology have, for the past decade, been investigating the cause of a severe and treatment-resistant form of eye muscle weakness that’s more common among African individuals with myasthenia gravis.

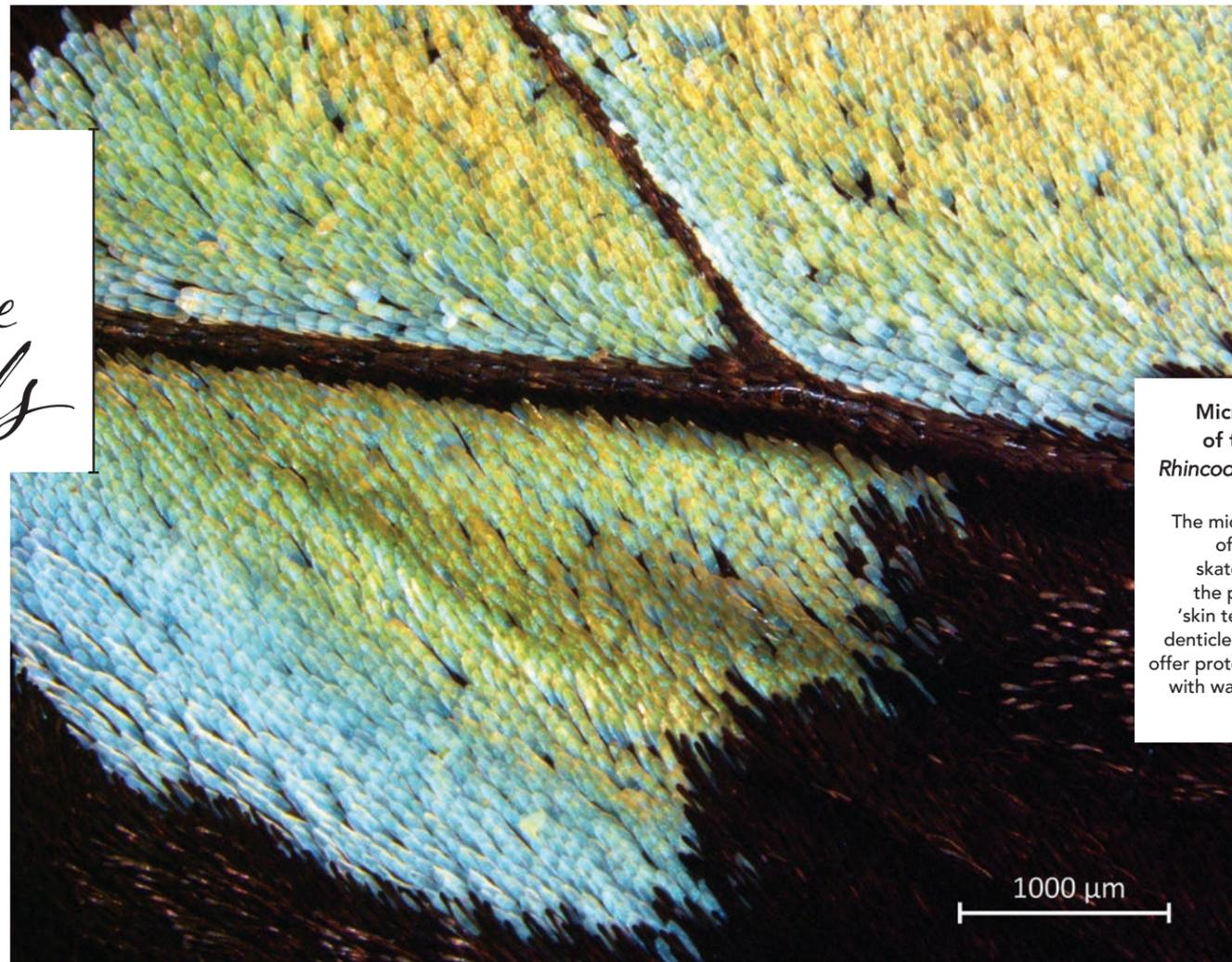
Dr Melissa Nel, who works with Heckmann, says recent research has uncovered new genes and pathways that may be disturbing the healing and energy use of muscles in those susceptible to the condition. Working in collaboration with surgeons has yielded results supporting what they’ve found through their genetic studies.

“Successful collaborations with ophthalmic surgeons have provided opportunities to – for the first time – measure metabolic function and gene expression in eye muscle tissue,” Nel explains. 

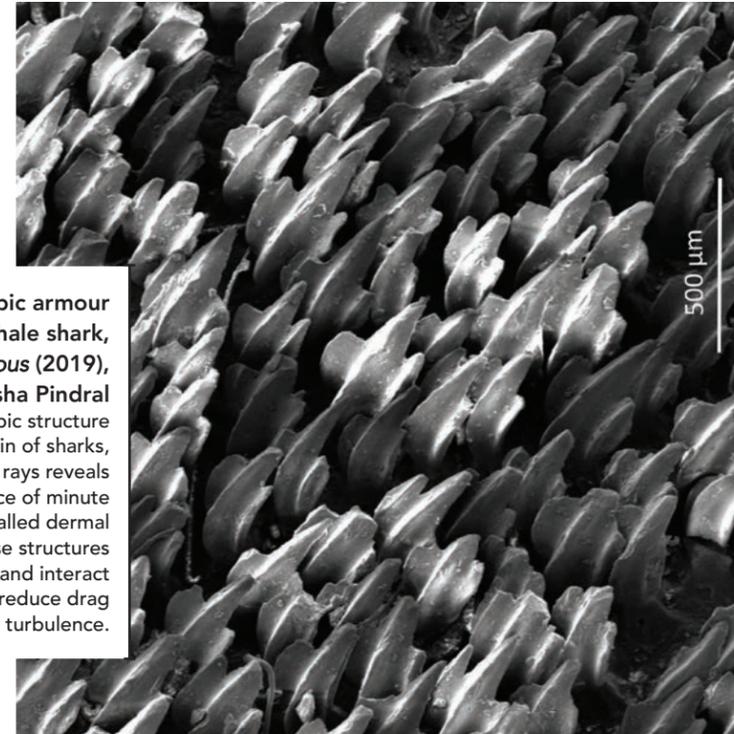


Life is in the details

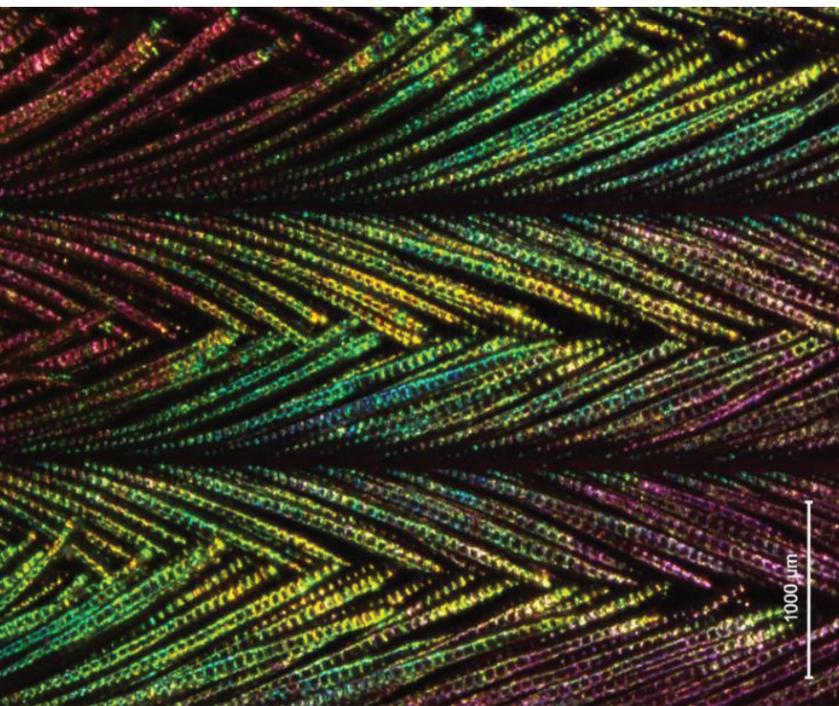
A selection of the best macro-photography images produced by the 2018 and 2019 cohorts of the University of Cape Town biological science honours course.



Microscopic armour of the whale shark, *Rhincodon typus* (2019), Natasha Pindral
The microscopic structure of the skin of sharks, skates and rays reveals the presence of minute 'skin teeth' called dermal denticles. These structures offer protection and interact with water to reduce drag and turbulence.



Feeding frenzy (2019), Amalia de Abreu
As crustaceans, barnacles are close relatives of lobsters, crabs and prawns. Their modified legs, pictured here, have fine hairs that they use to sieve seawater for food.

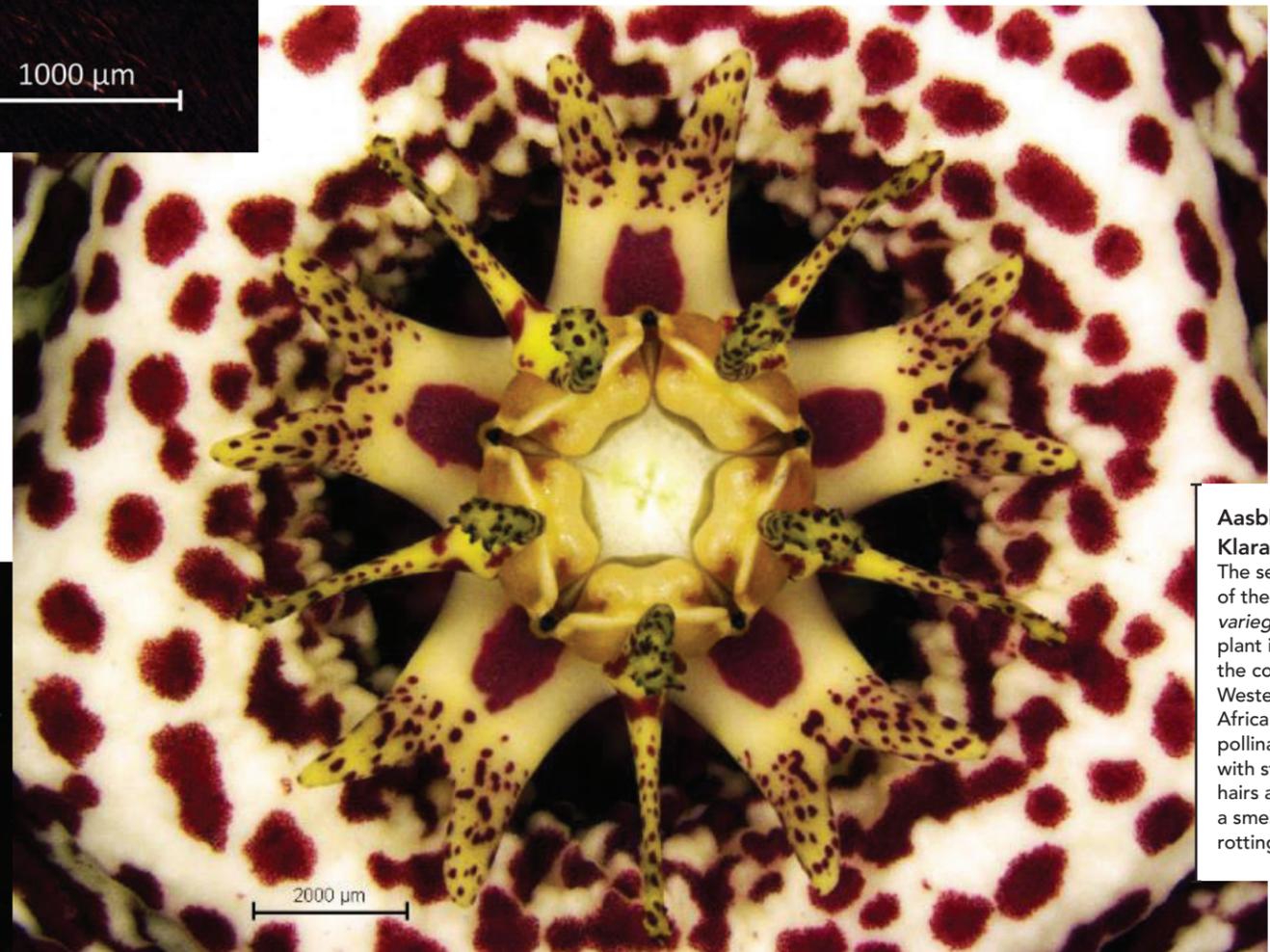


Scales of colour (2019), Jessica Arro
The lattice of scales that cover butterfly wings produce the colours that we see. Depending on their structure, the scales either reflect or absorb light – as seen here on the wing of a green-banded swallowtail butterfly (*Papilio nireus*).

Fynbos guardian (2019), Jess Tyrell
Electrostatic charges attract pollen grains from flowers onto the body hairs of foraging Cape honey bees (*Apis mellifera capensis*). From here, they scrape the grains towards their back legs and into pollen baskets for storage.



Structural splendour (2018), Jess Lund
Peacock tails may seem deeply pigmented and colourful, but those colours are a trick of light. The feathers themselves are a dull brown; it's their microstructure that gives the peacock its splendid iridescent plumage.



Aasblom (2018), Klara Beckerling
The sexual structures of the aasblom (*Orbea variegata*), a succulent plant indigenous to the coastal belt of the Western Cape, South Africa. It attracts its pollinators – flies – with structures, like hairs and warts, and a smell that mimics rotting meat.

JUDGES:

appointing the right person for the job

A new set of guidelines and principles that the Democratic Governance and Rights Unit (DGRU) at the University of Cape Town (UCT) contributed to are helping to improve the process of judicial officer selection in southern Africa.

In 2015, the Southern African Chief Justices Forum (SACJF) met for its annual general meeting and officially committed to creating a set of regional principles and guidelines on the selection and appointment of judges in Africa.

"This was the start of what would become the 'Lilongwe Principles and Guidelines on the Selection and Appointment of Judicial Officers': a document created to safeguard the independence and integrity of the judiciary," explains Chris Oxtoby, a senior researcher for the DGRU who worked with the SACJF to lead research that contributed to the document.

"The first step was to conduct thorough research into the law on paper relating to judicial appointments across the territories studied, which included east and southern Africa," he says.

"We then went into the field and interviewed all kinds of stakeholders – from recently appointed judges to lawyers and interested parties from civil society – to find out what was happening in practice and what challenges they faced. In the end, we managed to cover eight to 10 countries."

But the research was not without its challenges. As an example, he explains, "In some countries, we discovered that there wasn't really a process at all and that judges were still selected through a 'tap on the shoulder' model in which someone would pretty much just get a phone call saying, 'You're now a judge.'"

In other places, the research revealed vastly different views on the same legal system. But according to Oxtoby, the biggest challenge was distilling the vast amount of information into something coherent and useful.

TRANSPARENCY FIRST AND FOREMOST

Once the research was complete, a special subcommittee of pre-eminent justices was formed by the SACJF to draft the principles and guidelines.

"We didn't want to be too prescriptive, but if you look at other similar international instruments, they tend to be very high level. Whereas we did want to go deeper into the details of processes.

"It was at times difficult to walk a tightrope between being overly dogmatic and allowing for differences in the way these processes played out in different countries. But in the end, I think we found a good balance."

To illustrate this, Oxtoby explains the differences that exist between countries in the way judicial officers are sourced.

"How do you get a prospective judge to an interview situation?" he asks.

"In South Africa, judges have to be nominated, but other countries allow for direct application or even something that's more like headhunting. We didn't specify one of these methods over others in the Lilongwe Principles. But because of the need to be sensitive to the particular circumstances in different countries,

"In some countries, we discovered that there wasn't really a process at all and that judges were still selected through a 'tap on the shoulder' model in which someone would pretty much just get a phone call saying, 'You're now a judge.'"

we did say that however applicants are sourced, it has to be completely transparent."

According to Oxtoby, transparency emerged as perhaps the most important principle overall.

"In all these processes, transparency is probably the single most important way that the independence of the judiciary can be safeguarded."

HOME-GROWN SOLUTIONS FOR AFRICA

The document has been extremely well received since it was published in October 2018, after acceptance at the 2018 SACJF annual general meeting held in Lilongwe, Malawi.

"It is the first document of its kind that deals with best practices for judicial selection.

"It is truly a case of African solutions for African problems. It is based on

regional experiences, research and practice," says Oxtoby.

The document is already being used to challenge questionable appointments in southern Africa. And it has come to the attention of the international community. The Council of Europe has released a report that quoted extensively from the Lilongwe Principles, recommending changes to the judicial appointments process in Cypress.

"There has been a great deal of enthusiasm for the document, and I think this testifies to its usefulness. Hopefully, it will continue to be useful in terms of providing best practice guidelines, more coherence in processes regionally and possibly influencing policy.

"If the Lilongwe Principles result in even incremental change, that will be very worthwhile." 

PHOTOGRAPH: ISTOCKPHOTO



Human reproduction no longer relies solely on natural conception. The scientific advances that make this possible combined with ad hoc national legislation and the desires of couples struggling to conceive has created an international trade in fertility. This global industry is what Pande studies.

"The global fertility trade can include anything that goes into the making of a

baby," she explains. "The industry now occurs in many countries and involves multiple kinds of reproductive actors or labourers, including egg providers, surrogates, brokers, doctors and prospective parents."

"It's an industry that has flourished against a legislative backdrop outlawing many of these activities."

To illustrate how these processes might occur, Pande describes a common scenario. "These days, when

you want to make a baby using assistive fertility technologies you can – if you are a very rich, heterosexual couple – do this in a place like California, where commercial surrogacy is legal. But, if you are a single father, a gay or lesbian couple, or if you want a 'designer baby' of a specific race, it gets complicated.

"In these cases, you can travel to an egg bank in New Delhi to be matched with an egg donor who comes from Ukraine, South Africa or another country.

The decentralised industry of global fertility

Over time, the global fertility industry has moved from one country to another as the legislation to regulate it has passed in each successive place.

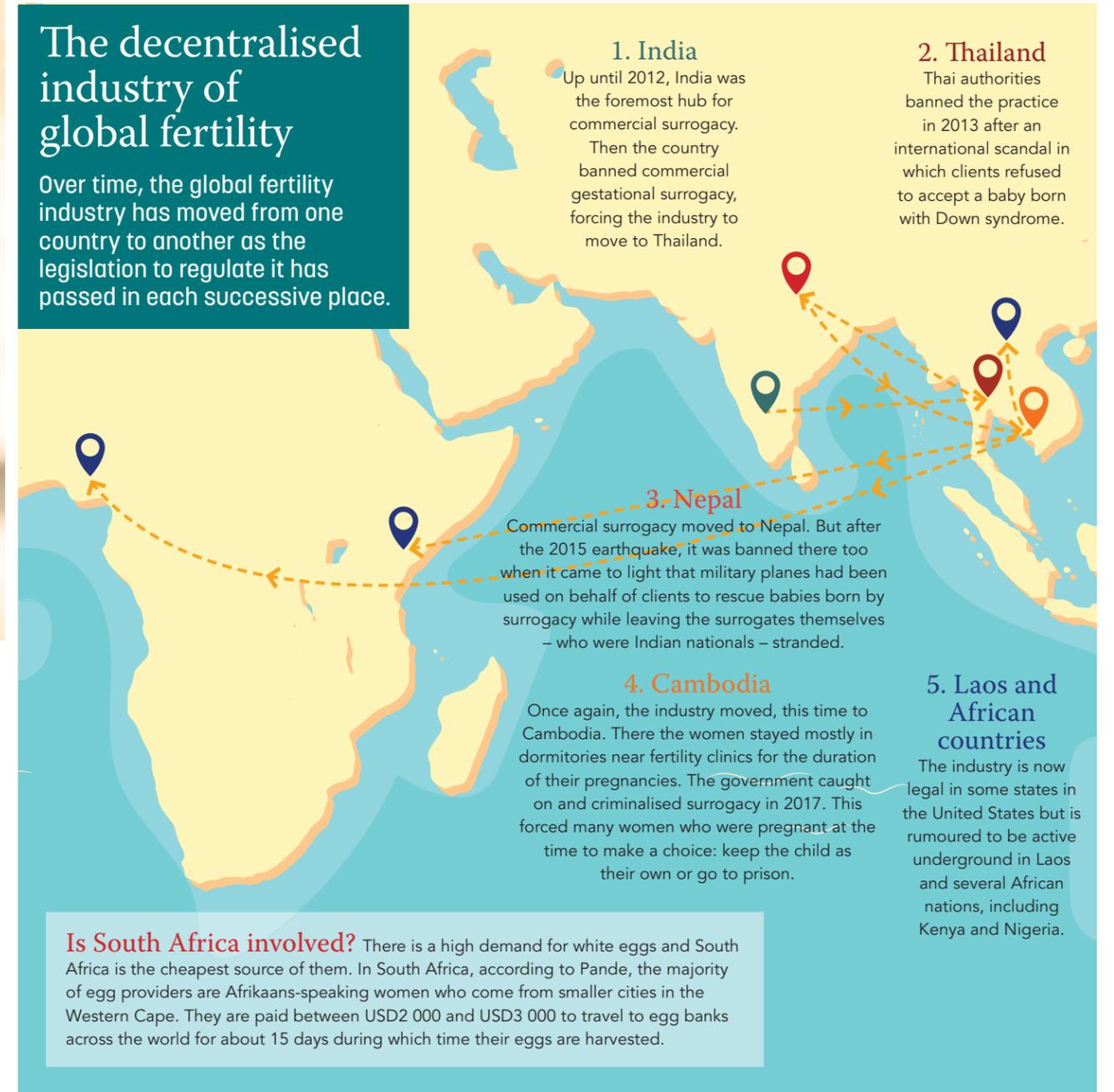


PHOTO: ISTOCKPHOTO.COM MAP ILLUSTRATION: MACROVECTOR_OFFICIAL AT FREEPIK.COM

Global flows of fertility

What does the global fertility industry reproduce – apart from babies? Associate Professor Amrita Pande, a sociologist and feminist ethnographer at the University of Cape Town (UCT), seeks to answer this central question through her research on the global fertility market.

Your sperm will be used to fertilise this egg.

"The embryo will be flown to Laos where it will be inserted into a woman from Mexico, Cambodia or Thailand. The woman will live in a dormitory next to the fertility clinic for the duration of the pregnancy. When she gives birth, you will take the child and return to your home country."

This, says Pande, is one global fertility flow – the subject of her current research on the industry.

The paradox of surrogacy

Pande's first book, *Wombs in Labor: Transnational Commercial Surrogacy in India*, was the result of a decade of ethnographic research at a fertility clinic in western India.

"After spending so much time with the women at this clinic, I came to realise that my perspective was very Eurocentric. In the book, I tried to shift the focus away from the ethics and morality of the subject towards an understanding of this as a new form of reproductive labour market." *Wombs in Labor* explored the different forms this market takes, from ideas of surrogacy as 'God's work' to a conception of it as 'dirty work'. This is what Pande terms the paradox of surrogacy.

"Often it is the first time that the women involved in this labour market are ever celebrated, praised or rewarded for their fertility. An irony in an anti-natal state like India where women are told not to have babies or where having many babies is linked to poverty," says Pande.

The book goes on to describe the

"You might think that new fertility technologies would remove the burden of reproductive labour from women, or at the very least, challenge societal norms."



convenient way that the bodies of these women are celebrated when they're serving others, but regulated when they do the same thing through their own agency – through punitive measures, such as long-term forced birth control – as a form of neo-eugenics.

Race, reproduction and inequality

In her current research, Pande has zoomed out from surrogacy to look at the many interwoven processes that make up flows of fertility around the world.

"You might think that new fertility technologies would remove the burden of reproductive labour from women, or at the very least, challenge societal norms. But in fact, my recent research shows that the global fertility industry reaffirms pre-existing inequalities."

These inequalities are reproduced in several ways, according to Pande.

On an individual level, most of the surrogates and egg providers are women from poorer countries in the global south, who bear children for richer couples hailing from the global north. Pande is careful to describe these women as active participants in this process but admits that they are also vulnerable to exploitation.

On a national scale, she likens the industry to other factory industries that move from one country to another as the legislation to regulate the industry is passed in each successive place.

There is also the question of how race and reproduction intersect.

"In my second book, I look at the reaffirmation of the desirability of

whiteness and the reasons that people seek out egg providers of a specific race," says Pande. In many cases this happens when a woman who is part of a couple feels insecure that she is not providing her own genetic material and therefore wants as close a match as possible physically. The other instance in which prospective parents request an egg provider of a specific race is when they are intent on 'racial improvement'.

"This is a phenomenon seen often among Chinese and Israeli clients. The prospective parents are looking for white mixed-race babies, for a variety of reasons, and the clinics are ready to provide them this strategic choice," explains Pande.

This research is part of a large initiative funded by the South African National Research Foundation, titled *Global fertility flows*, based in the UCT Department of Sociology. **U**

Antarctic cyclones reshuffle sea ice

University of Cape Town (UCT) researchers have measured – for the first time – the impact of an unusual and intense storm on the sea ice around Antarctica, home to some of the most severe storms on Earth.

During 2017, UCT researchers on a cruise to Antarctica saw first-hand the effects of an explosive polar cyclone as it passed over the marginal ice zone: the section of sea ice close to the open ocean where atmospheric, oceanic and ice processes are interlinked. The cyclone they observed was explosive because of the sudden, intense deepening of low pressure at its centre.

What Associate Professor Marcello Vichi and his colleagues saw provided the first direct evidence of a winter polar cyclone rearranging the marginal ice zone. The storm altered ice distribution – by increasing waves and drift of floes, for example – and the effects extended as far as the Antarctic continent.

After analysing more storms in the region, the team was able to confirm how storms in the Southern Ocean maintain sea ice that is less compact and more mobile than previously thought.

More to come

As part of future expeditions – one of which departed during July 2019 – UCT researchers intend to continue their research into this phenomenon as well as the other aspects of Antarctic sea ice.

The researchers on board the cruise – 25 from UCT and 70 from the rest of South Africa and the world – are studying winter conditions in the Southern Ocean. Winter cruises such as this are essential for improving our

understanding of Antarctic sea ice because, up to now, scientists have not been able to take many direct measurements of it during winter.

"Lots of exciting new science is expected from this project. It will provide the first coverage of an entire seasonal cycle of sea ice in the Atlantic sector of the Southern Ocean," says Vichi, who also is the cruise's chief scientist.

The cruise – which is part of a project sponsored by the South African National Antarctic Project (Southern Ocean seAsonaL Experiment, SCALE) – is a collaboration between several South African institutions and international partners in Australia, France, Germany, Sweden and the United Kingdom. **U**

PHOTOGRAPH: MARIA LINDSEY/PEXELS

PHOTOGRAPH: JEREMY KRANTZ

Winter in the Atlantic Southern Ocean aboard the SA Agulhas II. In the distance, you can see the waves from a polar cyclone approaching the ship.

MINING for the FUTURE

How can the mining industry continue to provide the materials that are essential to our lives while also becoming more people- and planet-centred? The Minerals to Metals Initiative at the University of Cape Town (UCT) aims to answer this question through research, education and engagement that unites technical expertise with a wide-ranging interdisciplinary approach.





I think globally there is a growing realisation that we have to find more sustainable ways to mine, in which the sector moves from an extractive model towards a developmental one,” says UCT Associate Professor Jennifer Broadhurst.

Broadhurst is part of the core leadership team of the Minerals to Metals Initiative, a UCT signature theme established in 2007 that aims to integrate and expand capacity in minerals beneficiation research. Or, as Professor Jochen Petersen, another member of the leadership team explains it, “We aim to create a platform for sustainable development in Africa through minerals and metals.”

Petersen describes the current challenges facing mining as complex. “Whatever solutions we use in the future have to be grounded in an understanding of the complex nature of the problems we face today.

“Mining remains important and necessary, but it must also tread lightly when it comes to people and the planet.”

Why can't we do without?

“Africa is not just the cradle of humankind but also the cradle of

mining,” says Broadhurst. “Modern mining might have emerged during the 17th century but people were mining in Africa centuries before that.”

The oldest mine in the world, she says, is in Eswatini. People there were mining haematite – an important ore of iron – 43 000 years ago, around the time that humans were reaching Europe. According to Broadhurst and Petersen, metals and the minerals they are derived from have been indispensable to human development ever since.

“Metals and minerals are not just found in the places you might expect, like your smartphone. These materials are in everything we use; even your toothpaste contains about six mined minerals,” says Broadhurst.

Petersen explains that some people argue that we no longer need to mine because we have other sources of energy – wind and solar power – or because we can replace minerals with other materials, such as carbon fibre. But that thinking is misconceived.

“In fact, mining is fuelling the green economy. This is because the complex minerals we mine help to build the infrastructure that supports renewable energy and the move away from coal,” he says.

Mining is integral to the generation, storage and transport of green energy. For example, new commodities like lithium, cobalt and rare earth metals are used in batteries and communications equipment. Rare earths, together with more established commodities, such as aluminium and copper, are used in wind turbines and electric cars.

“Many of these minerals are found in South Africa,” Broadhurst explains. “The platinum-group metals (including platinum, palladium, rhodium and others) are used as exhaust catalysts in petrol and diesel vehicles, but they are also used in fuel cells.”

Towards less waste

One of the most pressing problems facing mining is one in which Minerals to Metals has done a great deal of research: how to better deal with mine waste?

Mine waste currently accounts for 70 to 90% of all ore extracted. According to UCT Associate Professor Jennifer Broadhurst, as long as there are tailings dams – which are used to store waste products of mining operations – the long-term risks of pollution and catastrophic failure events will persist. Take, for example, the recent environmental and social impacts of the Brumadinho dam disaster in Brazil that killed hundreds of people.

“In the past, tailings dams have led to dust in the air, seepage into the soil and pollution plumes,” she says. “Even in the case of new facilities, these repositories of waste are hard to rehabilitate.”

And because of inefficiencies in extraction processes, tailings dams have taken a lot of water and energy to produce and often still hold valuable resources that are lost.

Minerals to Metals is working on a variety of projects that aim for minimal waste.

“Instead of stockpiling waste, let's use it in a myriad of other ways, from bulk stock in the construction industry to the production of stone paper, bricks and ceramics, and even fabricated soils created from coal waste,” she explains.

Less-than-perfect legacy

Mining may be an essential human activity, but it also has a poor track record of social exploitation.

“Historically mining was more of a craft. But, during the 1800s in Europe, an industrial model of mining was created and exported to colonies around the world.

“One of the consequences of this model was that in many places, the people who lived and worked in mining areas did not share in any of the wealth produced by the mines,” says Petersen.

Mining's history is also marred by widespread environmental degradation.

“There is no getting away from the fact that mining is an invasive practice that uses resources, power and vast tracts of land,” says Broadhurst. “Historical mining practices have left a legacy of land degradation and pollution from emissions, such as mine dust and acid mine drainage, that directly impacts the health, quality of life and livelihoods of people.”

Sometimes the environmental effects of mining are more indirect but no less pervasive.

In Zambia, for example, mining has changed human migration patterns. During mining booms, people gather near mines. But when there is a slump, they seek out alternative livelihoods, such as farming or producing charcoal. This often has unforeseen consequences, deforestation for instance.

Broadhurst believes that the answer to addressing this legacy and avoiding these problems in the future lies in a multidimensional approach that combines depth and breadth.

“At Minerals to Metals, we aim to integrate fundamental research and new technology with the twin imperatives of guarding against environmental degradation and

ensuring that the benefits of mining can be distributed equitably to the whole of society.”

“At Minerals to Metals, we aim to integrate fundamental research and new technology with the twin imperatives of guarding against environmental degradation and ensuring that the benefits of mining can be distributed equitably to the whole of society.”



Dangerous mine dust

Tackling the long-term health and environmental problems caused by mine dust is at the heart of a pioneering network at UCT that spans several African countries and brings together researchers and stakeholders from various disciplines and professional backgrounds.

“We plan to develop a common understanding around the risks of mine dust and work together towards integrated and inclusive solutions,” says UCT Associate Professor Jennifer Broadhurst, who heads up the cross-disciplinary and inter-sectoral Mine Dust and Health Network hosted by Minerals to Metals.

Mine dust – emitted from open-pit mines, ore-processing plants, mine-waste deposits and other mining sites – contains fine mineral particles that can cause lung disease and other respiratory problems when inhaled.

“When gold miners drill into the rock, it liberates silica particles,” says Dr Shahieda Adams, co-director of the steering group leading the network and a senior lecturer at the School of Public Health and Family Medicine at UCT. “Once silica gets into lungs, you can't get rid of it.”

Gold miners who have been working on the mines for many years are particularly at risk. Adams explains that they often end up losing their jobs, as they are too ill to work. This places a huge burden of care on already-strained public health and social security systems.

One of the goals of the network is to establish the economic burden of disease among mineworkers, their families and communities around mines – for which little data exists.

Another key aim is to find common ground between the mining industry, policymakers and communities. “Beneath the tension and mistrust that can develop between stakeholders in the mining industry, there is a real willingness among them to try and solve the problem of mine dust and to create solutions,” says Broadhurst.

“We need young people who have an understanding of how to work in multi-stakeholder groups if we are to solve the complex problems facing humanity.”

Greening abandoned mines

Another major research theme in the work of Minerals to Metals is post-mining rehabilitation as a means to encourage sustainable development.

“There are now 6 000 abandoned mines in South Africa alone with more closures expected,” explains Broadhurst. “Often mines offer a hub of infrastructure and services, which can include providing water and electricity, housing, transport and health care. When they close, they leave an economic vacuum.”

Minerals to Metals is piloting the use of restorative agriculture through a Community of Practice project with UCT Mineral Law in Africa, the UCT Centre for Bioprocess Engineering Research and UCT Development Policy Research Unit. Restorative agriculture can be used to ecologically rehabilitate land that was previously mined and to provide post-mining economic activity.

“One of the options we are looking at is fibre-based plants, such as bamboo, which generates a multi-product value chain from simple products like rope to complex products like polymers,” she says.



Urban mines

The practice of recovering useful minerals from post-consumer waste – mostly by recycling items that would end up in landfills – is known as urban mining. It includes scrap metals and e-waste – electronics goods often contain circuit boards and other components with significant amounts of valuable metals.

The e-waste chain in South Africa was something that Zaynab Sadan, a former Minerals to Metals postgraduate researcher, studied as part of her master’s research. She discovered that the technology to recycle e-waste already exists, but it was not being used due to social, economic and legislative barriers.

“E-waste collection and upgrading is

a small-scale industry in South Africa,” she says. “It’s currently limited by the lack of public awareness, the public’s perception of costly and once-valuable devices, as well as the risk associated with data leakage from storage devices.”

Also, the legal regulations governing the collection and processing of e-waste are ambiguous, which leads to confusion and the danger that the industry might go underground. Minerals to Metals is working with Mineral Law in Africa to clarify the regulations surrounding e-waste recycling in South Africa and better support a waste economy. It is also teaming up with a local manufacturer to develop a process for recovering metal from e-waste.

PHOTOGRAPH: DOKUMOL/PIXABAY

The mine of the future

“I think instead of seeking endless automation, we need to ask ourselves: for whom are we mining?”

“People need to be put back into the heart of the mining model because mining is central to human activity,” says Petersen of the ideal mine of the future.

“Good practice – in processing mined minerals and metals, and manufacturing goods from them – involves incorporating a number and variety of smaller enterprises. This leads to more medium-scale industry,” he continues. “This in turn creates integrated and adaptable communities in which the original mine provides just one element of thriving business infrastructure.”

Broadhurst agrees. “The ideal mine of the future would be a mine not only for the people but also with them.

“The mining industry has made great strides in the way it thinks about sustainable mining practices, but much remains to be done and none of it is possible without good governance. Right now, there is an understandable trust deficit in mining in Africa, but in the future, I believe we can remedy this if we ensure that mining is cleaner, greener and more socially acceptable.” **U**

Growing T-shaped leaders

Minerals to Metals strives to fast-track the development of students as T-shaped individuals who have a depth of disciplinary knowledge coupled with a broad perspective.

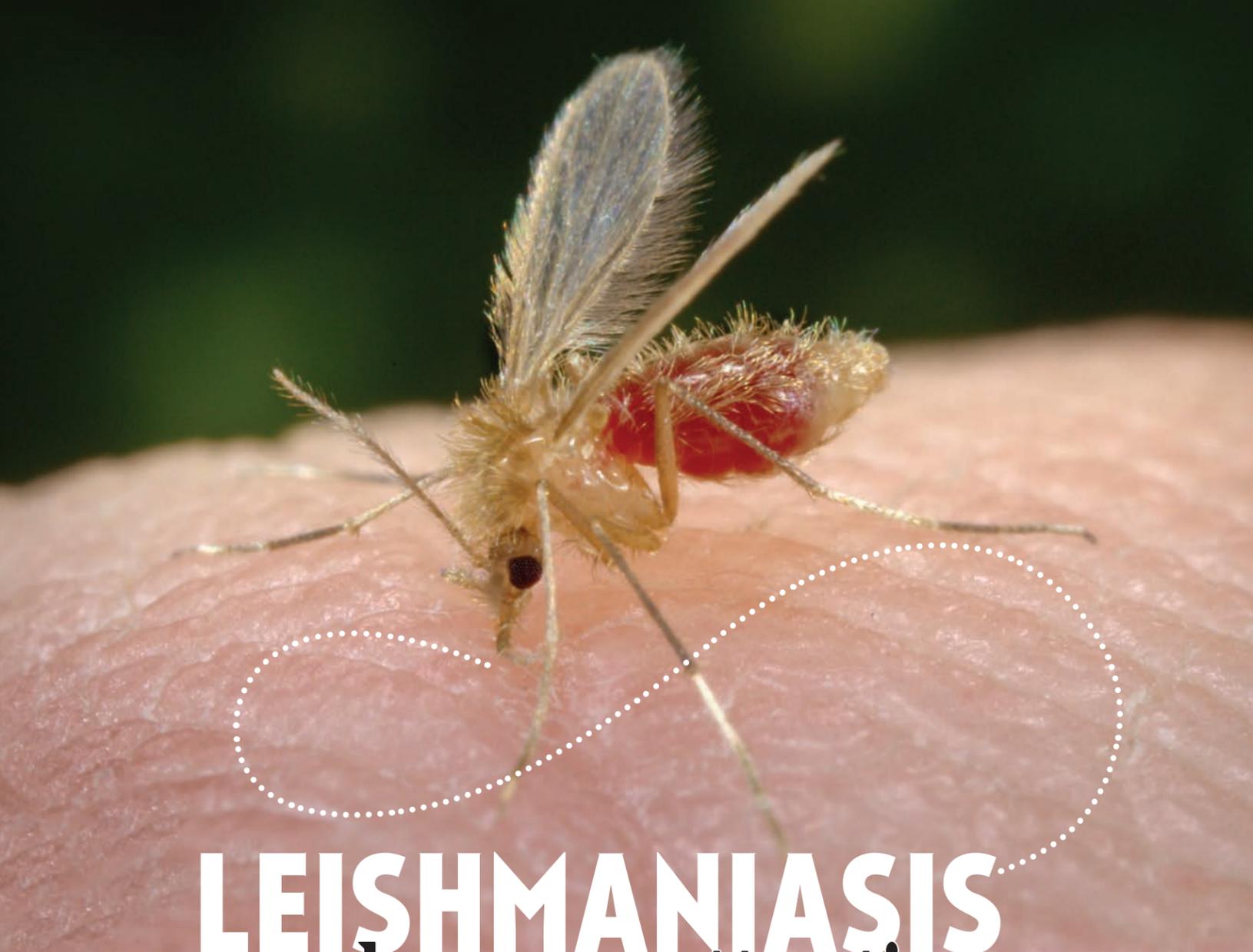
“Society can’t wait a lifetime for this perspective to be developed. We need young people who have an understanding of how to work in multi-stakeholder groups if we are to solve the complex problems facing humanity,” says UCT Associate Professor Jennifer Broadhurst.

The Minerals to Metals Initiative at UCT offers three educational programmes:

- An MPhil specialising in sustainable mineral resource development. This course is a transdisciplinary and inter-institutional, research-based degree offered through the Minerals to Metals Research Initiative in the UCT Department of Chemical Engineering. It combines qualitative

and quantitative research methods in a two-year course covering sustainable development, strategic social engagement and environmental stewardship in mining and minerals.

- Leaders in Extractives and African Development (LEAD). The LEAD programme promises to equip a new generation of African mining professionals with skills needed to become leaders in the responsible extraction of minerals in Africa.
- Upcoming: postgraduate programme in mineral resource governance. Minerals to Metals and UCT are working to develop a new blended (online and on-campus) master’s degree and short courses in resource economics and law, environmental protection and community development aimed specifically at an African audience. This work is supported by the University of Massachusetts in the United States.



LEISHMANIASIS needs more attention

DR RAMONA HURDAYAL, RAPHAEL TAIWO ARULEBA

Leishmaniasis ranks on the World Health Organization's (WHO) list of neglected tropical diseases along with the usual suspects, such as dengue, chikungunya and rabies.

But there's a strong likelihood that it's a disease you have never heard of. What's even more surprising is that thousands of people in 89 countries across all continents, except Antarctica,

die from the disease every year, while an estimated 1.5 million to 2 million are infected annually. Another 1 billion people are at high risk of infection.

Like malaria, leishmaniasis is caused by parasites that are carried by an insect – in this case, a female sandfly (pictured). The parasites are of the *Leishmania* type. After malaria, it ranks as the second most deadly protozoan disease in humans. But, unlike

mosquitoes that give just one form of malaria, the sandfly can give four forms of leishmaniasis, ranging from lesions on the skin to infection of internal organs. Lesions can lead to disability, disfiguring scars – and stigma. The other infections can be lethal if left untreated.

Leishmaniasis was first identified in the 1900s. Since then, significant progress has been made in its

// **After malaria, leishmaniasis ranks as the second most deadly protozoan disease in humans.**

diagnosis, treatment and overall management. But despite all efforts, there's still no vaccine. Which is why the WHO considers it a neglected disease of the world – under-funded and under-researched by both private and public organisations.

There is no convincing explanation as to why this is the case. One reason may be because it affects people who live in remote areas where reporting and diagnostic systems are poor and health care is a luxury.

The gap in knowledge – and treatment – of the disease is particularly bad for Africa. This is because the disease presents as an opportunistic infection in patients infected with HIV, tuberculosis and malaria. Sudan, for example, holds one of the highest rates of *Leishmania* and HIV co-infection. This co-infection is known as a 'deadly gridlock' as both microbes strengthen each other. *Leishmania* infection accelerates the development of HIV to AIDS while HIV infection increases the risk of developing *Leishmania* infection between 100 to 2 320 times.

But all is not lost. Several groups in different continents, including Africa, are working at understanding the complexities of this disease. For example, we are part of a unit at the University of Cape Town (UCT) that's been shedding more light on the disease. We are analysing how host factors contribute to the rate of natural healing – or recurring infection – with the aim of targeting these for development as host-directed therapies.

PHOTOGRAPH: WIKIPEDIA

Tackling a fatal disease

Leishmaniasis is medically complex and the fact that it 'hides' in cells of the body makes treatment complicated. Sodium stibogluconate and liposomal amphotericin B are widely used to treat infection. But this involves a long duration of treatment that needs to be administered into the vein.

These drugs were introduced in the 1940s. Almost 80 years later, they're still being used with only one other drug, Miltefosine, approved in 2002.

Adding to this, new challenges keep emerging. For example, the efficacy of sodium stibogluconate is now being eroded by resistance. In addition, while liposomal amphotericin B deoxycholate has been shown to be highly effective, it's expensive, restricting its access to poor populations.

This is why accessible, cheap, high-quality medicine is important. The lack of a vaccine against leishmaniasis also complicates matters.

The hope is that our research will identify host factors that could be developed for alternative or complementary treatments – termed host-directed therapies – since an effective host response is required to support anti-leishmanial drugs.

Beyond the therapies, the next important area of work is integrating awareness to prevent and manage the spread of the disease.

Prevention better than cure

Mass drug administration, like that used for other tropical diseases such as schistosomiasis and malaria, is not

recommended for leishmaniasis due to the invasive route of administration and associated drug toxicity. Thus, preventative measures instead must be strengthened. These include vector control – the use of pesticides and insecticides – social mobilisation to educate people in endemic areas on behavioural changes, treated nets and environmental management.

In addition, innovative ideas into alternate treatment options, such as host-directed therapies, must be explored.

In line with this, the WHO has targeted neglected diseases, including leishmaniasis, for control and elimination by 2030. This roadmap is being implemented to achieve the health-related 2030 United Nations Sustainable Development Goals, together with policymakers, governments, non-governmental organisations, philanthropists, stakeholders, industries and – essentially – the public.

The starting point is that prevention is better than cure. Central to this theme is awareness – in endemic areas as well as more broadly. But, to build this awareness, we need a wider platform to reach a larger audience, both public and private. **U**

Dr Ramona Hurdayal, lecturer and team leader of the Leishmaniasis Research Group, University of Cape Town and Raphael Taiwo Aruleba, PhD candidate, University of Cape Town.

This article first appeared in The Conversation (theconversation.com/africa), a collaboration between editors and academics to provide informed news analysis and commentary.

RESEARCHERS WITHOUT BORDERS

A novel collaboration with the University of Bristol

The University of Cape Town (UCT) has joined hands with the University of Bristol to launch a novel Researchers without Borders PhD programme that Vice-Chancellor Professor Mamokgethi Phakeng has described as a “profound collaboration”.

The two universities have developed a framework agreement for co-tutored PhDs, providing opportunities for students to work on research projects that exploit the strengths and capabilities of both institutions.

Phakeng and Professor Hugh Brady, president of the University of Bristol, signed the agreement in Bristol after the university conferred an honorary doctorate on Phakeng in recognition of her substantial contribution to the development of mathematics education in South Africa.

Participating PhD students will be registered at, and have supervisors and co-supervisors at both universities, spending almost equal amounts of time at each institution during the four-year, fully-funded scholarships. Phakeng said the novel programme, with its focus on early-career researchers, has great potential to support future leaders in research and society, while “bringing two great universities together in a profound collaboration”.

Brady said he was delighted to mark the signing of the agreement with UCT, calling it “a watershed moment in our relationship and partnership work in Africa”.

It will support world-class research



UCT VC Prof Mamokgethi Phakeng and Prof Hugh Brady, president of the University of Bristol, shake on the new agreement following the signing ceremony.

“This is a watershed moment in our relationship and partnership work in Africa”

in new, exciting, co-evolved projects, he added.

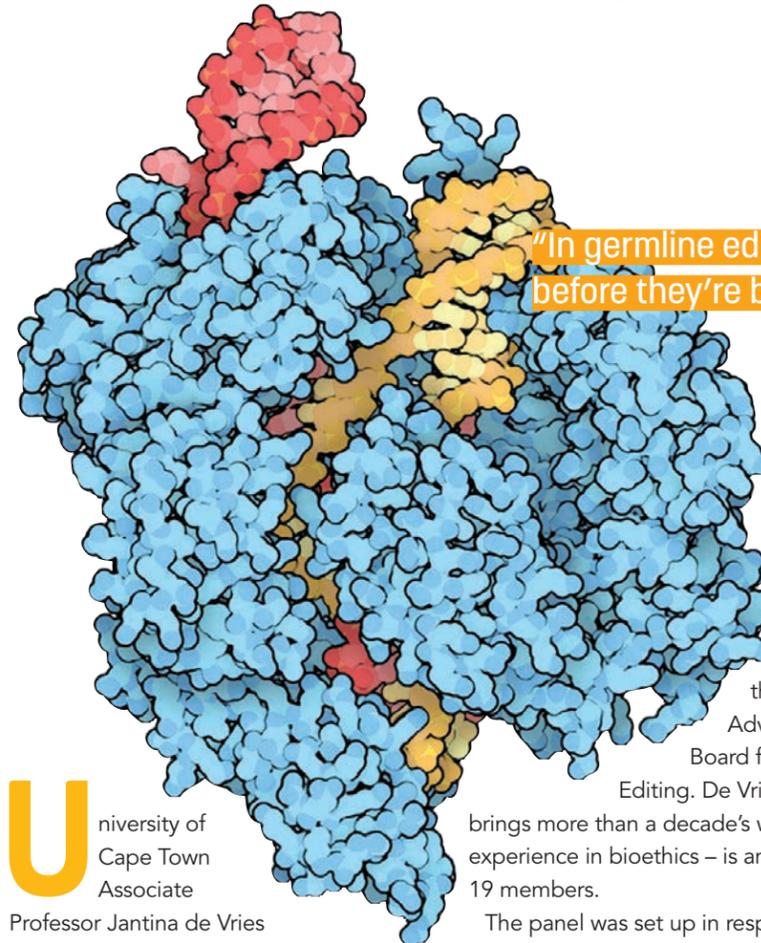
Initial support for the programme has come from the two universities, the Global Challenge Research Fund and the University of Bristol’s alumni

community.

The first cohort of seven students, will start projects this year across the diverse research areas of migration and mobility, public health, exercise and epidemiology. **U**

An African perspective on GENE EDITING

Scientists have the power to change our DNA, but should they?



This drawing represents the basis of the technology, known as CRISPR-Cas9: the enzyme Cas9 (blue) is bound to a piece of DNA (yellow) that’s complementary to the target strand of CRISPR RNA it’s carrying (red).

“In germline editing you actually change a person before they’re born and change their offspring.”

University of Cape Town Associate Professor Jantina de Vries is part of the World Health Organization’s (WHO) recently established Advisory Board for Gene Editing, which is developing a framework for just how far gene editing should reach.

“For all its incredible potential, gene editing carries complex ethical and social questions, the answers to which could impact the human genome forever,” says De Vries, an associate professor in bioethics in the UCT Department of Medicine.

To help establish parameters around gene editing and how legislation can guide its use, the WHO has established

the Advisory Board for Gene Editing. De Vries – who brings more than a decade’s worth of experience in bioethics – is among its 19 members.

The panel was set up in response to the 2018 announcement by Chinese scientist He Jiankui that he’d successfully used CRISPR to edit the genes of twin girls to protect them against HIV infection.

CRISPR refers to a family of specialised DNA sequences and an associated protein (Cas9) that can be used for germline editing. This is when genes are edited in an embryo. Both human germline and somatic editing – when genes are edited in a living person – are being considered by the WHO panel, but it is germline editing that raises the most cause for concern.

“In germline editing you actually

change a person before they’re born and change their offspring,” says De Vries. “This is why the technology is so tricky, because you edit the human gene stock forever.

“The work of the panel is to set out the overall narrative of how to make decisions about using gene editing and how to design an appropriate regulatory framework,” says De Vries.

It is a “challenging task” she says, that involves first proposing what values should guide the technology and then establishing good governance models. The core principles – decided on at the panel’s initial meeting – that will underpin its recommendations are transparency, inclusivity and responsibility.

“Decisions about genetic data and research have been handled on the continent as an agenda largely driven by the global north,” says Professor Ntobeko Ntusi, head of the UCT Department of Medicine.

“Jantina has skills both in bioethics and genomics in Africa and understands the complexities and challenges we face as a continent,” says Ntusi. “To have her as part of the WHO panel affirms our belief that at a global level – where key policy decisions are taken around the ethics of genetic research and genetic material – Africa needs a voice.” **U**

PHOTOGRAPH: COURTESY UNIVERSITY OF BRISTOL

ILLUSTRATION: DAVID S GOODSELL, RCSB PDB (CC BY 4.0)



5

QUESTIONS WITH

Hafeni Mthoko

As a postdoctoral researcher in information systems, Dr Hafeni Mthoko aspires to go beyond the boundaries of her discipline to explore how information systems and technology can support the social sector. She is based at the University of Cape Town's (UCT) Centre in Information and Communications Technologies for Development (ICT4D).

1 What is the difference between information systems and information technology?

At a basic level, information systems combine information technology with people and processes to address a problem and achieve a desired goal. Therefore, it covers a broad spectrum of areas beyond the information technology itself.

2 Why are information systems important in an African context?

Information is all around, and yet, there is untapped knowledge within the African context. Why not use information systems to better mine, create and disseminate information suited to this context to address the challenges we face?

3 Can you describe your research in simple terms?

Currently, I am trying to understand broadly how people access and disseminate information: what communication mediums do they rely on and to what extent does that understanding facilitate the design of locally relevant communication

innovations that support the achievement of community goals and strengthen community cohesiveness. For example, I have been focusing on health promotion in a township community in Cape Town and how to improve health communication activities there.

4 How can information and communications technologies (ICTs) help foster social change?

ICTs as tools open easier and different avenues for communication and information flow. This can influence our social interactions for good or bad. Such access to information and knowledge can – if used meaningfully – facilitate better decision making, problem identification and action in response to social challenges.

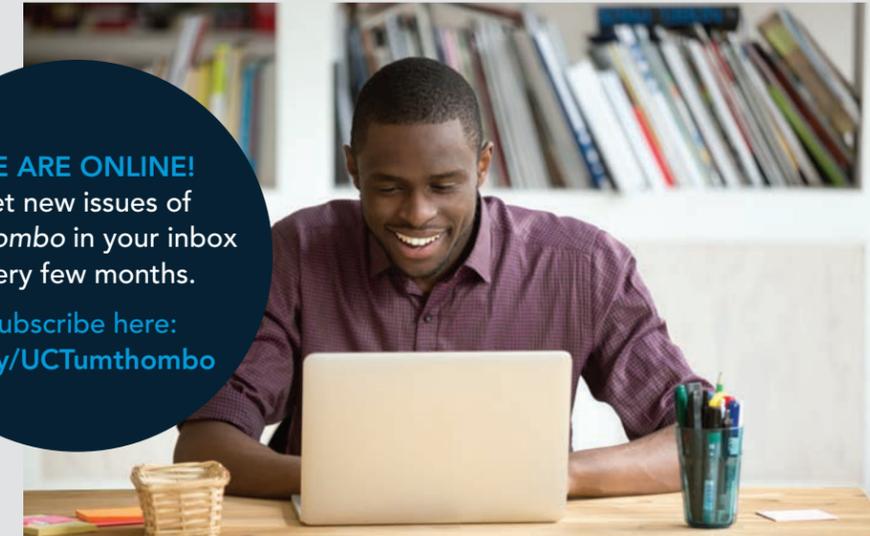
5 What is the best piece of advice you've received as a young researcher?

My work doesn't have to be perfect, but it does have to challenge the boundaries of existing knowledge. So I should be easy on myself and embrace the process one step at a time: I don't have to have all the answers on the first day, if I did then it wouldn't be research. 

PHOTOGRAPH: MICHAEL HAMMOND

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