

umthombo

INCLUSIVE. ENGAGED. AFRICAN.

Spotlight on African cities

Weddell Sea

An expedition to Antarctica to see what almost no-one else has seen

Powering change

Women taking the lead on advancing innovation in health

CERN and UCT

Working with the world on Earth's largest experiment

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. In the context of the Cape Town water crisis, *umthombo* represents hope itself.

Title conceptualised by Thando Mggolozana, novelist, screenwriter and founder of the Abantu Book Festival. He lives in Cape Town where he works as a research development officer at the University of Cape Town.



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RESEARCH NOTES



New ocean current

A previously unidentified ocean current has been discovered off south-west Madagascar by a UCT doctoral candidate. Juliano Ramanantsoa used observational-system and computer-modelling data to identify the wind-driven, poleward-flowing surface current. The Southwest Madagascar Coastal Current (SMACC), as it is known, is relatively narrow and shallow – some 300 metres deep and 100 kilometres wide – and salty.

It flows more intensely in summer, and its physical impact on the ocean is particularly noticeable in a rich upwelling of nutrient-dense waters at the southern end of Madagascar. This has implications for the commercial and subsistence fisheries in the region.

Antarctica more exposed to change than we thought

Research published in *Nature Climate Change* by an international, multidisciplinary team of scientists, including from UCT, revealed that bull kelp washed up in Antarctica had drifted 20 000 kilometres to reach that shore – making it the longest known biological rafting event recorded.

DNA samples taken from the kelp revealed that one specimen had drifted all the way from the Kerguelen Islands and another from South Georgia. To get there, the kelp had to pass through barriers created by polar winds and currents that were thought to be largely impenetrable.

Observations of kelps drifting at sea collected by Professor Peter

Ryan of UCT's Percy FitzPatrick Institute of African Ornithology confirmed that kelps regularly cross the Antarctic Polar Front. Ryan collected a comprehensive dataset on drifting kelps during the three-month Antarctic Circumnavigation Expedition in 2016/17.

The finding that kelps can drift south across the Antarctic Polar Front means that Antarctica is not as isolated from the rest of the world as scientists had thought. Kelps can carry a suite of associated intertidal organisms, which might be able to transform Antarctic coastal ecosystems as they become more hospitable with global warming.



Barber clippers contaminated with blood viruses

After analysing hair clippers from 50 barber shops in three townships in Cape Town, South Africa, researchers found that 42% of them tested positive for blood and 8% carried markers for Hepatitis B, a virus that infects the liver. None of the clippers in the sample tested positive for HIV. Although the levels of Hepatitis B were enough to pose a risk of infection, the researchers didn't know of any cases of Hepatitis B or HIV infection from clippers in this setting.

The study was led by Nonhlanhla Khumalo, professor of dermatology at UCT.

More light for the universe

UCT is part of a consortium that's taking astronomy to greater heights with the launch of the new optical telescope, MeerLICHT – meaning 'more light'. The customised 0.65-metre telescope has an enormous field of view – 10 500 by 10 500 pixels – matching that of MeerKAT, which was launched in July and is South Africa's pathfinder towards the Square Kilometre Array (SKA).

MeerLICHT is the precursor for an array of telescopes due to be placed in Chile and mandated to search for counterparts to gravitational waves. The project was championed by seven institutions from South Africa, the Netherlands and the United Kingdom.

Modelling an ancient Bagan temple

Kubyauk-gyi Temple in Bagan, Myanmar, is one of almost 300 buildings that were damaged by the earthquake that struck the region in 2016. UCT's Zamani Project has been travelling to the site – one of the world's most remarkable archaeologically – and surveying the damaged buildings to produce 3D models, orthoimages and geographic information systems that enable the restoration efforts. This accurate, 3D model of the Kubyauk-gyi Temple is the result of data gathered by laser scanners, drones and cameras transported to the site by the team in April.



IMAGES: OCEAN CURRENT: PETER PROKOSCH; WWW.GRIDA.NO/RESOURCES/1328; ANTARCTICA: PETER RYAN; BARBER CLIPPERS: EDGAR CHAPARRO; UNSPLASH

New diagnostic tool for TB MENINGITIS

Two percent of tuberculosis (TB) cases develop into an infection of the membranes around the central nervous system. This TB meningitis is a major cause of death in southern Africa, but if diagnosed early, it is easily treatable.



UCT and Antrum Biotech, a UCT-spin-off company, have developed a new rapid test that can diagnose TB meningitis within two hours. This test will compete with TB meningitis tests that either take too long to detect the bacterium that causes tuberculosis or are not sensitive enough to find it when it's there.

The test surpasses smear microscopy and the WHO-recommended GeneXpert diagnostic in sensitivity. And since it takes less than a few hours to yield results, it's much quicker than growing a culture in a lab.

"Detection under the microscope only works 5% of the time. Smear microscopy is a very poor test," says Professor Keertan Dheda, the director of the Centre for Lung Infection and Immunity at UCT and principal investigator of the clinical evaluation studies.

“Although it is rapid in getting the answer on the same day, the problem is that it detects TB meningitis in only 50 to 60% of cases; we have a major unmet need for a more sensitive test.”

- Professor Keertan Dheda

"Another existing test for TB meningitis involves growing the bug in the lab in a culture, and there are problems with that too," he says. The culture-based test has a sensitivity of only 60% to 70%, and it can take many weeks to give a result. "By then most people

would have died, or they would have developed severe disabilities," says Dheda.

GeneXpert is widely used in South Africa, but studies show that it has limited sensitivity. "Although it is rapid in getting the answer on the same day, the problem is that it detects TB meningitis in only 50 to 60% of cases; we have a major unmet need for a more sensitive test," says Dheda.

The new test, which was enabled by funding from the Southern Africa Network for Biosciences' Finnish-Southern African Partnership Programme (BioFISA II), is currently undergoing validation to enter the global market. 

PHOTOGRAPH: ISTOCK

Investigating violence against pregnant women in South Africa



Many South African women, already in difficult situations, are experiencing violence during pregnancy at the hands of their intimate partners, a new study from UCT has found.

Of the 376 women who took part in the research, 15% had experienced intimate partner violence during pregnancy, with forms of abuse ranging from sexual and physical to emotional and verbal.

This is against a backdrop of South Africa having intimate partner violence (among all women, not just those who are pregnant) which is as high as 71% in some communities.

The sample was drawn from women attending antenatal services at a primary-level maternity facility in Cape Town. An in-depth analysis of some cases revealed that the violence some of the women were experiencing was not only perpetrated by their intimate partners, but also by other members of

“Poverty and gender inequalities contribute to the structural determinants of violence.”

their household.

The researchers found that the high level of violence during pregnancy was associated with poverty-related factors including food insecurity, mental ill-health, unemployment and unwanted pregnancies.

"In its most severe form, violence against pregnant women has been reported as a contributing cause of maternal deaths," said researchers Sally Field, Michael Onah, Thandi van Heyningen and Simone Honikman – all part of the Perinatal Mental Health Project.

It has also been associated with "inadequate uptake of antenatal care, with abused women being more likely to delay seeking pregnancy care

and to attend fewer antenatal visits". They added that they found a strong association between thoughts of suicide in pregnant women and their having experienced domestic violence.

They said that in South Africa, high levels of violence occur within a context of multiple contributing social dynamics. "These include prominent patriarchal norms where masculinity is associated with defence of honour, harshness and risk taking."

They added: "Poverty and gender inequalities contribute to the structural determinants of violence." 

Story adapted from one written by Tanya Farber and published by TimesLIVE.

PHOTOGRAPH: B&WETCH_FREETOCKS, UNSPLASH

Universities are conducive to innovation, as researchers and students dedicate themselves to the act of problem-solving through research. Over the past few years, UCT has been central to an array of practical innovations that have been implemented to better the lives of ordinary people. In many cases, women have been taking the lead.

POWERING CHANGE

UCT women in HEALTH INNOVATION

Prof Anna-Lise Williamson
Various inventions related to HIV/AIDS, HPV and animal vaccines

Dr Georgia Schafer
Treatment of sexually transmitted infections using surfactant protein A (SP-A)

Prof Virna Leaner
Quinoxaline derivatives with anti-cancer properties better than Cisplatin

Dr Pauline van der Watt
Quinoxaline derivatives with anti-cancer properties better than Cisplatin

Prof Ernesta Meintjes
SARCHI Chair in Brain Imaging, Director of CUBIC-UCT and inventor of methods to improve image quality of MRI scans

Dr Nicola Douglas
Various inventions related to HIV/AIDS and animal vaccines

Prof Carolyn Williamson
Prophylactic and therapeutic vaccines against HIV/AIDS

Dr Lindi Masson
Test for screening women for sexually transmitted infections while asymptomatic

Prof Michelle Kuttel
Software innovations for vaccine development

Prof Sharon Prince
Series of palladium compounds with anti-cancer properties better than Cisplatin

Prof Tania Douglas
SARCHI Chair in Biomedical Engineering and Innovation and co-founder of UCT spin-off Cape Ray Medical (Pty) Ltd

Turn the page to read more about the work of Professor Tania Douglas: an innovator who promotes innovation.

A black and white portrait of Tania Douglas, a woman with short, curly dark hair, wearing glasses and a leopard-print top. She is smiling slightly and looking directly at the camera. The background is a plain, light color.

TANIA DOUGLAS

Biomedical engineer

Tania Douglas, director: Medical Imaging Research Unit in the Division of Biomedical Engineering and the Department of Science and Technology/National Research Foundation South African Research Chair (SARChI) in Biomedical Engineering and Innovation, doesn't identify with the term 'innovator'.

"I consider innovation as only one aspect of my work," she says. "But it's a critical component of the postgraduate education we offer in the Division of Biomedical Engineering. Our aim is to create a learning environment that promotes innovation."

Nonetheless, Douglas has played an integral role in assessing and developing various health technologies. She has also contributed to the establishment of the company CapeRay Medical, which is commercialising a breast-imaging solution that combines X-ray imaging and ultrasound. This combined system will particularly benefit women with dense breast tissue for whom X-ray mammography alone may not be a sufficient diagnostic tool.

Research Chair

Douglas's excellence in her field was recognised when she received the prestigious SARChI Chair in Biomedical Engineering and Innovation. The main goal of the SARChI initiative is to strengthen and improve the research and innovation capacity of South African public universities.

"This was a wonderful opportunity to advance biomedical engineering and health innovation in South Africa," Douglas explains.

As for why this is so important, Douglas recently captured the essence perfectly in a piece titled 'Africa needs to start creating its own medical technology. Here's how' for The

“ African countries need to start producing and developing their own medical devices. A cadre of suitably skilled biomedical engineers is needed for this sort of innovation to take root.

Conversation Africa, where she writes: "Most of Africa's medical equipment is imported. 'Equipment graveyards' become the final resting place for medical devices that aren't suited to local conditions. This can include dust, heat, humidity and an intermittent supply of electricity ...

"African countries ... need to start producing and developing their own medical devices. A cadre of suitably skilled biomedical engineers is needed for this sort of innovation to take root."

This need has led to the establishment of the African Biomedical Engineering Mobility project, of which Douglas is a driving force. It funds postgraduate education in the field across the continent.

New initiatives in health innovation

As an expression of this drive, Douglas has established an MPhil in health innovation at UCT. She says this course was motivated by her experience with UCT's postgraduate degree programme in biomedical engineering, which is oriented towards the development and application of technological innovations.

"We identified a need for a programme with a broader mandate, which welcomes students from a variety of backgrounds, because innovation is not only about technology," she says.

The programme is intended to address the gap that often

exists between solutions and their implementation when context is neglected. It uses design thinking, which relies on contextual immersion. "Our students spend time with communities, trying to understand the communities' experiences and needs, before attempting to design solutions," she explains.

A practical example of the importance of context is addressing hearing loss among the elderly in a low-income area. While the solution might seem as simple as providing hearing aids to those affected, or designing a cheaper hearing aid, stigma may prevent people from acknowledging their hearing loss and seeking assistance. Thus, the problem to be addressed is far more complex and technology on its own may not be the answer.

To share knowledge on addressing the health needs of the developing world through innovation, Douglas also recently launched the *Global Health Innovation* journal. One of the barriers to research and innovation in low- and middle-income countries is access to current scientific knowledge which is often hidden behind unaffordable journal subscriptions. *Global Health Innovation* will be freely accessible online. The journal is the result of a partnership between Northwestern University in the United States and the universities of Lagos and Ibadan in Nigeria. 

UCT and the Weddell Sea EXPEDITION

**“To see what almost
no-one else has seen”**

When the Weddell Sea Expedition departs for Antarctica next year, UCT oceanographers will be among those on board: Dr Sarah Fawcett, Dr Katherine Hutchinson and several UCT students. We found out why the expedition matters and what research they hope to accomplish while they're in one of the most remote regions on the planet.

UCT was one of only a handful of institutions approached to participate in the Weddell Sea Expedition 2019. This almost unprecedented scientific expedition – a joint venture between organisations in the United Kingdom, the Netherlands, South Africa and New Zealand – hopes to survey the underside of the Larsen C Ice Shelf, document the marine wildlife of the Weddell Sea ecosystem and find the wreck of Sir Ernest Shackleton's ship *Endurance*, which sank there in 1915.

The scientists who make up the expedition will travel to the Weddell Sea at the edge of Antarctica aboard the South African vessel *R/V SA Agulhas II* during January and February 2019. Among the glaciologists, marine biogeochemists and archaeologists will be UCT oceanographers Dr Sarah Fawcett, who lectures in oceanography, and Dr Katherine Hutchinson,

who recently completed her PhD.

“This will give us an unprecedented opportunity to investigate and explore one of the most remote and least-studied places on our planet,” says Associate Professor Isabelle Ansoorge, head of the Department of Oceanography.

According to former head of the UCT oceanography department, Emeritus Professor Geoff Brundrit, UCT's involvement with the Weddell Sea Expedition recognises its long and growing expertise in the Southern Ocean. “UCT scientists have made a significant contribution to research in this area, both in the knowledge of the important processes at work in the Southern Ocean and for advancing understanding of their implications for global climate change.” ▶



PHOTOGRAPH: DANIEL SCHILPEROORT



THIS PAGE (clockwise from top left): The Weddell Sea is one of the most remote and least-studied places on Earth. Autonomous underwater vehicles will survey the sea floor, study cavities on the underside of the ice shelf and search for the wreck of *Endurance*. The Weddell seal, found in Antarctica, is the most southerly breeding of all mammals. The Weddell Sea is a deep embayment of the Antarctic coastline.

OPPOSITE The South African polar research and supply vessel, R/V SA Agulhas II, will be used for the 2019 Weddell Sea Expedition.



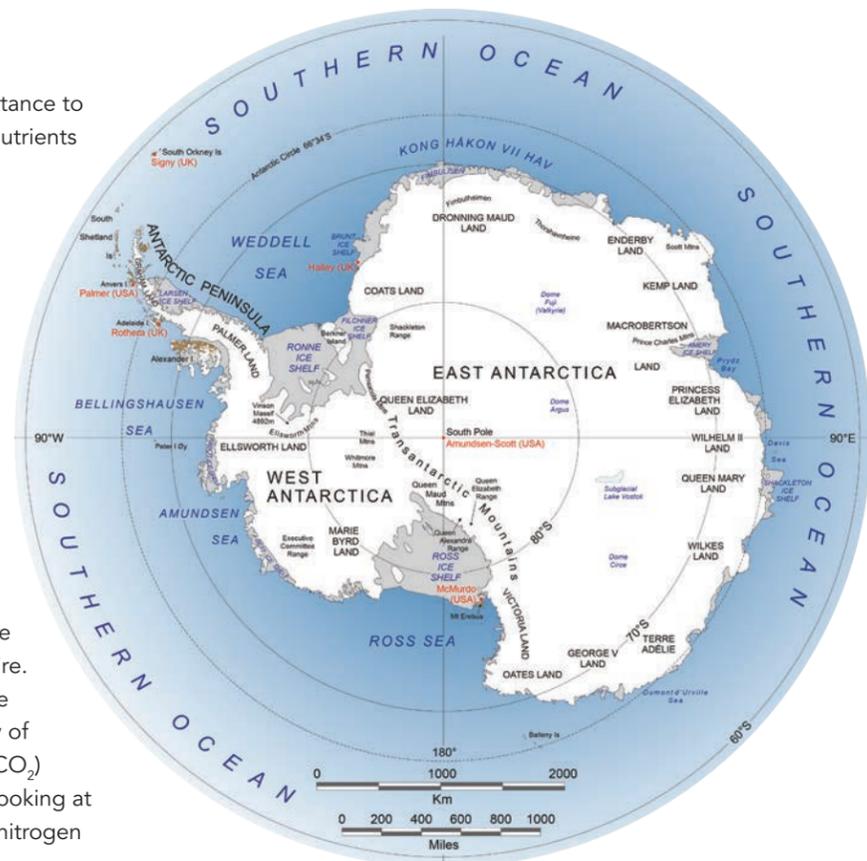
A window into time

According to Ansorge, the Weddell Sea is of importance to oceanographers because many of the waters and nutrients that control the structure and functioning of ocean systems originate in the area.

“Due to differing water densities the ocean is divided into layers,” she explains. “There is the bottom water, the deep water, the intermediate and the surface water. Just off Antarctica there is a water mass called the Antarctic bottom water, which forms along the shelf region in the Weddell Sea, and simply put, creates a waterfall effect down the side of the continental shelf due to its high density. This water mass then travels to all of the sea basins, so whatever happens there really influences the rest of the ocean.”

Fawcett explains that this influence includes the transport of heat and gases, as well as nutrients, like phosphorus and nitrogen, which all ocean life require.

Fawcett and Hutchinson will be measuring all the physical characteristics of the area, from the salinity of the water to the temperature and carbon dioxide (CO₂) concentrations. “While we are there, I will also be looking at the isotopes that are present,” says Fawcett. “The nitrogen



PHOTOGRAPHS: MARK CAWARDINE, SUPPLIED. MAP: LANDSAT IMAGE MOSAIC OF ANTARCTICA TEAM, WIKI COMMONS

isotopes, for example, will allow us to tease apart and thus better understand the different overlapping biological and chemical processes in the area.”

Fawcett will also be working with marine biologist Dr Tommy Bornman from Nelson Mandela University and the South African Environmental Observation Network to investigate the sea’s biological community and the rate of photosynthesis and nutrient cycling by its phytoplankton communities.

“We will be looking at questions like how the extended daylight hours affect photosynthesis and how quickly CO₂ is being removed,” she says.

“The R/V SA Agulhas II is one of the most modern research ships on the planet, equipped with a huge array of cutting-edge scientific instruments,” says Fawcett. “While the expedition is in the Weddell Sea, scientists will also be flying drones over the ice as well as sending remotely controlled robotic autonomous vehicles under it.”

Tracking climate change

The Weddell Sea is the site of the Larsen Ice Shelves. The Larsen A and B ice shelves collapsed in 1995 and 2002, respectively, and in July 2017, one of the biggest iceberg

calving events ever recorded took place when a piece of the Larsen C Ice Shelf broke off from the mainland.

“In the past we have been able to view the ice from above using satellite imaging and photographs taken from planes,” explains Fawcett. “But this will be a chance for us to examine the underside of the ice shelf, which is highly significant because evidence shows that the Weddell Sea is warming and these ice shelves are retreating at unprecedented rates.”

Ice shelves are influenced both by what occurs in the water below them as well as the atmospheric conditions above them, making them particularly important bellwethers in understanding the rate of climate change.

“The thing about the ice shelves is that if they melt, they don’t raise sea levels themselves because they are already in the ocean. But if they go, then the ice behind them – on the land – is more likely to start flowing towards the ocean, displacing seawater as it enters the ocean, thus causing sea levels to rise,” explains Fawcett.

“Hopefully the team will be able to visit the chasm that has opened up between the ice shelf and the iceberg that broke off in 2017,” says Ansorge. “To visit such a place, at this time, and see what almost no-one else has seen is an awe-inspiring thought. U



Botswana's raptors in decline



By recreating a bird survey conducted 20 years ago in Botswana, researchers from UCT have found that many birds of prey are declining in the north of the country – some by more than 80%.

Botswana is a regionally important area for many birds of prey, including vultures. Despite this, we don't know much about their numbers in the country and whether they are decreasing – as they are elsewhere on the continent.

To address this gap, students from UCT's Percy FitzPatrick Institute of African Ornithology participated in a two-year study of raptors in Botswana that saw them retracing the steps of an earlier wildlife biologist who first surveyed the area in the 1990s. To be consistent with the earlier survey, the researchers used a 4x4 vehicle similar to the one used previously and they travelled at around the same speeds. They also spotted birds using the naked eye, only pulling out their binoculars for a positive identification. They ultimately traversed 20 000 kilometres of road.

The team focused on 29 raptors and compared their encounter rates with records from the earlier survey. They found that 14 of the 29 species had declined, 11 of these by more than half in the past 20 years. Three species had increased and the remainder hadn't changed.

Overall, the number of raptors had declined by 40%.

The lesser kestrel, red-necked falcon, African hawk-eagle, shikra and steppe eagle showed the most drastic declines. Certain migrant species previously spotted in the area were not seen at all.

"We found declines across species with varying diets and habitats, which makes it hard to pinpoint the main drivers of decline," explains PhD student Beckie Garbett, who led the survey.

"Although declines in raptor populations have been seen elsewhere in Africa, particularly across West Africa," said UCT Associate Professor Arjun Amar who supervised the research, "we were not expecting these declines to be quite so dramatic in Botswana, which has a relatively low human population size and where nearly 40% of the land is under some form of protection."

The researchers now want to retrace the remaining routes of the first survey in the southern areas of Botswana to see whether trends there are similar to those observed in the north of the country. **U**

ABOVE The fish eagle was one of three eagle species in the study that showed large declines (63%).

THE STEEPEST STOOPS in 20 years



Lesser kestrel

96%

Red-necked falcon



88%

African hawk-eagle



87%

Shikra



87%

Steppe eagle



81%

PHOTOGRAPH: SUJMEET MOGHE, WIKI COMMONS



1919

2018

Trees and shrubs ARE ENCROACHING on open areas over Africa

Scientists can assess how the Earth's surface is changing using satellite imagery: Are deserts expanding? Where are sea levels rising? How much of our planet is now urban? And at what rate is forest cover declining?

That final question we know a fair amount about: Scientists have mapped continental-scale changes in the cover of woody plants – that is, trees, shrubs and lianas (woody vines). And we know that forests are – overwhelmingly and globally – in decline, a trend induced mainly by human clearing.

A less well-known and -understood phenomenon is the gradual encroachment of woody plants into non-forest areas. In Africa, woody plants encroaching into rangeland could mean less space for wild and domestic grazers. It could also mean more habitat and food for browsing animals – those that feed on high-growing, woody plants – more fuel wood and more carbon sequestration.

To better understand encroachment, UCT researchers used satellite data to map changes in woody plant cover across sub-Saharan Africa over the past three decades. They also used a machine-learning model to assess what factors could explain their observations.

Overall, the researchers found there has been an 8% increase in woody plant cover in non-forest areas of sub-Saharan Africa during the past 30 years.

The nature and extent of this change has been variable across smaller scales: Some places have seen increases, others decreases, in the cover of woody plants. But the overall trend is growing woody plant cover.

Over the past three decades, 7.5 million square kilometres (55%) of non-forest biomes in sub-Saharan Africa gained woody plant cover. On the other hand, 2.2 million square kilometres saw declines in woody plant cover. The difference roughly equates to the areas of Algeria and

the Democratic Republic of Congo combined. Loss of woody plant cover was prevalent in parts of the Sahel, East Africa and much of Madagascar; encroachment was dominant in the central-interior of Africa.

Most of the change in African woody cover could be explained by factors other than CO₂ levels: Local changes in fire, herbivory and direct human disturbance, such as deforestation, predominate.

The widespread increase in woody plants across the continent corroborates other global trends showing growth in vegetation cover and challenges the long-held narrative of desertification. **U**

The UCT authors on the paper were Zander Venter (PhD candidate, Department of Biological Sciences), Associate Professor Michael Cramer (Department of Biological Sciences) and Dr Heidi-Jayne Hawkins (Department of Biological Sciences).

PHOTOGRAPHS: LEFT: POLE EVANS, ILLTYD BULLER © SANBI [1919] LICENSED UNDER CREATIVE COMMONS CC-BY; RIGHT: LISA DE SPEVILLE

A laboratory for urban thinking: the African Centre for Cities

The African Centre for Cities (ACC), established in 2008, has gained a global reputation as one of the leading knowledge centres conducting meaningful research on how to understand, recast and address pressing urban crises, particularly on the African continent.

Since most urban challenges such as food security, climate change adaptation, economic inclusion and cultural vitality are inherently interdisciplinary and spatially layered, ACC nurtures the co-production of knowledge favouring and cultivating critical perspectives from, and of, the global south. Through its research, ACC aims to contribute to imaginative policy discourses and practices to promote vibrant, just and sustainable cities.

PHOTOGRAPH: THOMAS TRUTSCHEL, GETTY IMAGES

How we put African urbanism on the map

Over the past decade, the African Centre for Cities has become an authority on African urbanism. Professor Edgar Pieterse, director of the centre, tells the story of how an experimental research institute grew into a leading intellectual voice in global urbanism.

Asking better questions

Real-world problems have always been at the heart of the African Centre for Cities' (ACC) approach. "When the ACC was founded as an interdisciplinary UCT Signature Theme in 2007, our mandate was to be responsive to issues facing Cape Town," explains Professor Edgar Pieterse, ACC director.

But instead of starting out by defining the problems facing Cape Town, the ACC's founding researchers took an unusual approach: they listened.

"We asked people who worked in the public sector and civil society what they thought were important issues,"

says Pieterse.

"This meant that as researchers, academics and students, we stepped outside traditional roles towards a deliberative context where we were not the experts. In short, we had to learn how to ask better questions."

Over time this approach generated the ACC's core thematic concerns: the informal economy; hungry cities and urban food systems; urban resilience; and urban systems related to climate and other risks.

Retaining a radical openness

At first, the ACC relied on funding mainly from development agencies. According to Pieterse, they soon

realised that academic grant funding was a more sustainable way to ensure the longevity of multi-year research projects.

"Funding from large research organisations like the International Development and Research Council is extremely difficult to get, but it also has two major advantages," he explains. "First, it often requires comparative work, which has provided many opportunities for us to work with partners around the continent. Secondly, it encourages empirical work, an essential way to guard against our work becoming too rhetorical."

Using this funding, the ACC has created a sustainable model of multiple three- to five-year projects built around key themes. According to

Pieterse this has also meant that the ACC could employ younger scholars while sustaining the academic output expected of an interdisciplinary research institution.

"Even though we are an applied centre interested in grounded problems, I think we have managed to retain a radical openness: We are open to new theory, new practice, new methodologies," says Pieterse.

Local to global impact

Over the past decade, the ACC has become a leading voice in urban issues on a national, regional and global scale. "In Cape Town we have managed to have a profound impact on planning and policy," says Pieterse. As examples he cites the construction of a knowledge partnership between the City and Province that has led to the creation of an energy transition plan for Cape Town and a digital tool that allows citizens and governments to track changes in land values.

At a regional level, the ACC prepared the discussion document circulated to all African delegations before the 2016 UN Habitat Conference. "This was a significant agenda-setting opportunity," says Pieterse.

Questions surrounding governance – of how to co-produce knowledge, regulations and rules in the informal yet complex environments that often

"I saw an opportunity to create a space where people from opposite ends of the spectrum, including leaders from social movements, business, academia, government and non-governmental organisations, had a space to leave their identities at the door and just talk," says Pieterse.

characterise African cities – have been a theme that has run through almost all of the ACC's work. It was therefore significant that the ACC was tasked with drafting the chapter on governance for the world's leading publication on urbanism, the World Cities Report.

"It is a recognition of the ACC as a leading intellectual voice in the urban space," says Pieterse.

Exploring the obstacles to integration in Cape Town

Distressed at the lack of depth and historical memory displayed in recent debates around topics like gentrification and the land question, Pieterse designed a year-long series of conversations, called Integration Syndicate.

"I saw an opportunity to create a space where people from opposite ends of the spectrum, including business, academia, government and non-governmental organisations, had a space to leave their identities at the

door and just talk," says Pieterse.

The result of the sessions has been the identification of five ideas, or provocations, which offer the chance to create wide and lasting change in Cape Town. Provocations range from ideas around subsidising the minibus taxi network in Cape Town to including the means for high school students to create their own digital radio broadcasts. Each provocation has been tested in focus groups and was unveiled at a public event during July 2018 at Guga S'thebe, Langa.

Looking back over the past 10 years of the ACC's existence and his role as director, Pieterse says that he remains energised by the work that the ACC does. "As an engaged scholar I believe you have a responsibility to society to be unflinching in the face of evidence. Working as an urbanist, a lot of this evidence could be a source of depression but I find that it incites me to ask different questions.

"The privilege and delight of having that responsibility is so profound that I refuse the choice between hope and despair." 



PHOTOGRAPH: ANDY MKOSI. ILLUSTRATION: SHUTTERSTOCK

Urbanism across the continent: ACC research projects

The African Centre for Cities (ACC) is building on its earlier activities and epistemic approach, and working collaboratively with a wide range of stakeholders to co-produce knowledge and develop research to support effective and sustainable urban development. This is a selection of their projects.

Sustainable urban futures across the global south

PEAK Urban is a 51-month, international, multidisciplinary programme funded by the Research Councils of the UK Global Challenges Research Fund. The ACC works collaboratively with researchers at the University of Oxford, Peking University, the Indian Institute for Human Settlements and EAFIT University, Colombia,

to uncover and explore ways in which sustainable urban futures can be conceptualised and enacted. This project also supports a new generation of urban research leaders by bringing together scholars across research locations and equipping them to draw on different disciplinary perspectives to address challenges in 21st-century cities.



Examining connections between urbanisation and climate change

The Coalition for Urban Transitions is a special initiative of the New Climate Economy to support national governments to address pressing economic, inequality and climate challenges at the city scale. Working in Ghana and Tanzania, the ACC is developing robust evidence for the best policy options available to national governments and cities to be able to deliver on the 2030 Sustainable Development Goals and Paris Climate Agreement.



Working with the Cities Support Programme

The ACC is working with the South African National Treasury's Cities Support Programme (CSP), a platform for collaboration on urban development for inclusive growth, and the Government Technical Advisory Centre. The ACC supports CSP's activities related to key areas for South African sustainable urban development, including the minibus taxi industry, and the effects and potential mitigations of climate change. The ACC is also conducting research into the development of and processes undertaken by the CSP, reflecting on lessons learnt from supporting municipalities.



Recognising and supporting the informal economy

ACC is also involved in Women in Informal Employment: Globalizing and Organizing (WIEGO), a research-policy-advocacy network with activities and members in 63 countries, predominantly in the global south. The ACC houses the urban research component of WIEGO, which aims to bridge the realities of working informally with policy and academic discourse. The two main focus areas are: giving substance to informal-worker-informed interpretation of the International Labour Organization's recommendations for formalising the informal economy, and analysing the disconnect between urban planning practices and the experiences and needs of informal workers.



Realising just cities

Since 2010, the ACC has been part of the Mistra Urban Futures global network, which focuses on the co-production of knowledge for the realisation of just cities. Two key comparative projects are: urban public finance, and cultural heritage and the just city. Urban public finance plays a crucial role in urban transformation. Examining urban public finance in Cape Town and Kisumu (Kenya), this work focuses on understanding revenue and expenditure patterns and exploring the possibilities for reconfiguring public finance to realise just cities. Cultural heritage is recognised in the Sustainable Development Goals as adding to the development of sustainable cities and communities, but the way it's interpreted in practice is often problematic. This project considers the role of cultural heritage in realising just cities and draws on case studies of cultural initiatives to inform policy and practice.



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Building

bodies of knowledge

across Africa

In 2008, the African Centre for Cities launched what would become its primary Cape Town-based research project: the CityLabs programme. From the outset, the focus of CityLabs was engaging with urban issues through the co-production of knowledge. Ten years later, this approach is being replicated on a continental scale with the African Urban Research Initiative.

“African cities tend to be multifaceted and complex,” explains Dr Warren Smit, who coordinates the CityLabs programme. “A lot of existing urban research and theory is based on cities of the global north and is not applicable to the global south.

“Co-producing knowledge that is relevant to our local urban settings

and which provides a nuanced and holistic view of African cities and their challenges is therefore essential work.”

Ntombini Marrengane, the coordinator of the African Urban Research Initiative (AURI), agrees. “Unless an active network of durable knowledge institutions, focused on applied urban research and capacity building is urgently established, most African cities will not be in a position to understand their urban development dynamics, let alone address them effectively,” she says.

“With AURI, we are using what has been learned from CityLabs about the value of co-producing knowledge, but also promoting local expertise through networking and capacity building.”

PHOTOGRAPH: SUPPLIED

Grappling with informality

CityLabs brings together academic researchers and practitioners from government, the private sector and civil society to engage around key challenges facing Cape Town. In all, there have been nine such labs, each anchored by a researcher and typically with a lifespan of three to five years.

Some CityLabs have focused on collaboratively developing new policies, while others have been research-focused. According to Smit, the majority have engaged with issues of informality: “Residents of informal settlements face numerous challenges in their daily lives, such as protection from the elements, access to and the storage of food, and the threat of crime and violence.

“Many of the CityLabs have asked, ‘How can we transform the city through interventions in the built environment, for example, through informal settlement upgrading, and through strategies for providing affordable housing in well-located areas?’” Smit says.

Smit describes one example of the CityLabs’ practical impact: “The Urban Violence, Safety and Inclusion CityLab, for example, culminated in the piloting of a training programme for government officials and other practitioners on informal settlement upgrading.”

Expanding across the continent

“The AURI project came about in 2013 when a number of African urban research centres participated in a workshop in Addis Ababa. Those who participated agreed to establish AURI as a network of credible and resilient

institutions rooted in local realities but engaged with broader trends,” explains Marrengane.

According to her, while AURI researchers are drawn from fields as diverse as architecture, urban planning, geography and sociology, at present the focus is on interventions in the built environment. Earlier this year, the sixth AURI Policy Conference brought together urban researchers from all

over Africa to discuss spatial inequality and encourage a comparative research agenda for African cities.

Marrengane hopes that in years to come AURI can expand both its network and the focus of its research. “I hope that AURI can reflect an even wider diversity of urban settings – from large metropolises to smaller cities – all within a sustainable and cohesive knowledge network,” she says. **U**



Urban food systems: diet and disease in African cities

One of the ACC's newest research projects looks at the relationship between urban food systems and the prevention of non-communicable diseases.

“Some of the questions we are interested in answering include how people's choices are informed by a combination of infrastructure, cost and culture.”

Dr Jane Battersby is a social and cultural geographer who has been researching urban food systems for the past decade. As Battersby explains it, an urban food system is the story of how a city's inhabitants feed themselves, from growing food to harvesting, processing, selling and eating it.

In 2017, Battersby and fellow ACC researcher Gareth Haysom, together with an interdisciplinary team of African researchers, launched a new multi-year project called Nourishing Spaces. It investigates the role of urban food systems in preventing non-communicable diseases such as obesity and diabetes.

The project is being conducted in a mix of six large- and medium-sized cities in South Africa, Namibia and Kenya.

Food security and urban food systems is one of the ACC's core areas of work. Current projects also working

on the food theme are the Consuming Urban Poverty project and the Hungry Cities Partnership.

“Food security has often been thought of only in terms of production and scarcity, but research shows that diseases like diabetes and obesity are manifestations of food insecurity,” says Battersby.

The project relies on in-depth qualitative interviews with two groups: inhabitants and food retailers who operate in the same areas. “In each area we are trying to understand what people are consuming, where they are getting it from and why they are consuming it.

“Some of the questions we are interested in answering include how people's choices are informed by a combination of infrastructure, cost and

culture,” says Battersby.

Using the information they gather, the researchers' aims are two-fold: to suggest possible interventions that go beyond national policy debates and to create food systems committees at each research site that can advocate on behalf of their communities.

As an example, Battersby explains how a lack of local services can affect health: “What if instead of debating sugar taxes, it's actually about installing better infrastructure for water standpipes so that people can cook more safely? Or installing better street lighting so that people are not forced to stay indoors after dark?

“In other words, what are the intervention points that encourage the integration of healthy food systems into the life of a city?” 

A new cohort of African urban scholars

This year marks the first intake of students in the ACC's master's degree in Southern Urbanism. The course will not only provide students with a grounding in the realities, theories and practice of cities of the global south, it also aims to create a new generation of African urban scholars.

Between now and 2060, 86% of growth in the world's urban population will take place in cities in Africa and Asia. This migration of people will bring with it a host of new environmental, economic and social challenges.

“If these challenges are to be understood, we require a new generation of urban scholars with a thorough understanding of the realities of theory and practice in cities of the global south.

“The MPhil in Southern Urbanism hopes to help create this new cohort of scholars,” explains Dr António Tomás who designed the two-year course

“We see this moment as an unprecedented opportunity to question what we mean by urban scholarship and rigour, and to fashion alternative ways of being researchers and teachers.”

alongside Professor Edgar Pieterse and Professor Sophie Oldfield.

Speaking at the launch of the programme, Pieterse said “We see this moment as an unprecedented opportunity to question what we mean by urban scholarship and rigour, and to fashion alternative ways of being researchers and teachers.

“This exploratory project demands a conscious effort to grow an ambitious

cohort of black urbanists willing to equip themselves to build a new kind of urban studies, rooted in the realities and desires of the global south.”

The degree combines a foundation in urban theory with an experimental approach to research. In the first year, it is compulsory for students to participate in a City Research Studio. “This is a laboratory space in which students will learn to walk, see, smell, touch, embrace, explore and reimagine the city through intimate engagements mediated by diverse research techniques,” explains Oldfield.

The MPhil has a relationship with the University of Basel's master's in Critical Urbanisms. As part of the Basel degree, students spend a semester in Cape Town alongside their UCT counterparts. Oldfield, who holds the University of Cape Town–University of Basel Professorship in Urban Studies, teaches on both programmes.

“Harnessing the ACC's 10 years of experience in urban studies, it is our hope that this course not only produces skilled researchers capable of compelling doctoral research but that in time this course will contribute to the creation of a truly southern-based perspective on the issues that face cities in the global south,” she says. 

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BEYOND METRICS

Why care about how we assess research impact?



UCT has been grappling with the challenges of how to measure the impact of science beyond bibliometrics – in particular, the effect of the current system on the progress of young researchers and on encouraging socially responsive, interdisciplinary research that addresses South Africa's and the continent's problems. At a recent symposium intended to bring together thought-leaders to challenge our thinking and help us start to develop alternative tools, **Professor Mamokgethi Phakeng** introduced the event during the week before she assumed her position as UCT's vice-chancellor. What follows are her thought-provoking words.

Why do you do the research you do? What has been the impact of your research? How different would our society be without it? Most importantly, how do you know that your research is making an impact?

These questions are as relevant to individual researchers as they are to university management, funders and government, and this is why we need to consider the important issue of moving beyond metrics to measure research impact.

Measuring the impact of our research is about considering what happens because of research. That's the tricky part, because it means a researcher can't actually "do impact". You can only undertake activities that enable impact.

I want to offer three provocations with a hope that they filter into our conversations about this important topic.

1 What are the shared values between sound research and sound democracy?

The first provocation is that research impact is a result of not only the knowledge that is produced. We should look at research impact also from the perspective of the values that the practice and process of research inculcates, especially in a young democracy such as ours.

But does research have a place in building democracy?

There are important similarities between research and democracy: The sound conduct of research and the sound conduct of democracy depend on the same values. The virtues that make democracy work are also those that make research work: a commitment to reason and transparency, an openness to critical scrutiny, a scepticism towards claims that too neatly support reigning

“It is important to have a balance between curiosity-driven and mission-oriented research; research that tackles fundamental questions and research that serves corporate interests; and research for pleasure and research for pay.

values, a willingness to listen to countervailing opinions, a readiness to admit uncertainty and ignorance, and a respect for evidence gathered according to sanctioned best practices.

Looking at research impact from this perspective elevates not only research, but also democracy.

In strengthening democratic values, we also renew the preconditions for scientific discovery and technological innovation, and thus, high-impact research. The converse of this is also true – research with impact can serve as a precondition for building a vibrant democracy.

2 Should all research be for the public good?

The second provocation is that questions about research impact are often about the contestation of resources: where we invest them and why. We spend billions in public money on research annually, so we must be accountable and consider its social, economic and environmental impact, as well as its impact on health and well-being, and technological developments.

Questions about research impact also force us to consider whether our research spending is the best way to use our limited resources. Considering the source of our research funding, it is easy to argue that research should be for public good. But the question is, should all our research be for the good of the public?

My view is that it's important to have a balance between curiosity-driven and mission-oriented research; research that tackles fundamental questions and research that serves corporate interests;

and research for pleasure and research for pay.

Despite the need to engage in research for the public good, it is also necessary to create safe spaces where smart minds can tackle hard questions without any expectation of immediate applications. Like democracy, research is also a value to pursue for its own sake. The argument for engaging in curiosity-driven research that tackles fundamental questions for pleasure is always going to be difficult to sell because in a developing country, such as ours, research has a big responsibility to respond to the triple challenge of unemployment, inequality and poverty. But scientific knowledge is a public good, therefore courageous policy-makers and funders should be prepared to pay for that resource without imposing a utilitarian approach on all publicly funded acquisition of knowledge.

3 How does the way we measure impact shape our research?

The third provocation is that the way we measure impact has implications for how we recognise and reward performance. It will therefore shape our research activity, output and training. If metrics drive research, the danger is that research can become formulaic – focused only on citations and impact factors for purposes of career advancement and winning grants. This will encourage unethical behaviour and destroy our scholarship.

This is why we need to be clear about what counts as research impact and how we measure it. U

Collaborating with the world to understand our universe

How did the universe begin and where is it going? How did matter form? What are we made of? At CERN (the European Organization for Nuclear Research) in Switzerland, scientists from around the world come together to answer our biggest questions. And UCT researchers are there among them: running experiments, analysing results and managing upgrades. The collaboration between UCT and CERN was formalised 15 years ago as the UCT-CERN Research Centre. Since then, a national collaboration between South Africa and CERN has been launched, and we have been on the frontlines of some of the biggest scientific collaborations and discoveries.

15 years of working with CERN

2003

- **Launch of the UCT-CERN Research Centre:** formed out of a confluence of research programmes in the Department of Physics.
- **UCT begins sending researchers to the Lawrence Berkeley and Brookhaven national laboratories:** building capacity in preparation for collaboration with CERN.
- **Discovery of jet-quenching:** Relativistic Heavy-Ion Collider (RHIC) at Brookhaven finds evidence of jet-quenching: the reduction of energy in the streams of particles that emerge when ultra-high-energy particles collide.

2004

- **Recreation of the perfect liquid:** RHIC produces a state of matter thought to have existed in the earliest moments of the universe. This, coupled with the discovery of jet-quenching, provides the first strong evidence for quark-gluon plasma: a state of matter predicted to have existed in the first moments of the universe.
- **First major heavy-ion conference is held in South Africa:** UCT brings the 8th International Conference on Strangeness in Quark Matter to South Africa.

2005

- **Development of THERMUS software:** designed by Spencer Wheaton, then a UCT PhD student, it is used by researchers worldwide to analyse the relative abundance of particles produced by heavy-ion collisions and measure the temperature of quark-gluon plasma.

2008

- **Launch of National SA-CERN Programme:** UCT-CERN serves as a stepping stone and Director of UCT-CERN Professor Jean Cleymans is appointed chair.
- **Large Hadron Collider (LHC) emits its first particle beam:** the first few billion protons are circulated through the collider – the world's biggest – at CERN.

2009

- **SA-CERN sends first students to CERN:** students from UCT, and other SA-CERN institutions, travel to Geneva.
- **Data collection at LHC begins:** following a failed first attempt to run the collider, low-energy beams are circulated in the tunnel for the first time.

2010

- **First direct observation of jet-quenching at the LHC:** based on experiments with heavy-ion collisions, which involved ATLAS, ALICE and another detector at CERN.

2011

- **South African Minister Naledi Pandor visits CERN:** her official visit includes a guided tour of the ALICE and ATLAS experiments.
- **UCT hosts inaugural POETIC conference:** the International Workshop on Electron-Ion Collider Physics.

2012

- **Higgs boson-like particle identified by CERN:** since then, CERN has shown that the particle behaves, interacts and decays in many of the ways predicted for the Higgs boson, an elementary particle thought to give all matter its mass.

2013

- **UCT brings Hard Probes to South Africa:** a premier meeting in the field of high-energy nuclear physics, the 6th International Conference on Hard and Electromagnetic Probes of High-Energy Nuclear Collisions, is held in South Africa – recognition by the international community of the important contributions South Africa has made to the field.
- **New evidence for the Higgs boson:** the results evidence one of the particle's quantum properties – its spin.

2015

- **Most precise measurements of Higgs boson's mass to date.**

2016

- **DST commits around R20 million/year to SA-CERN:** Department of Science and Technology increases annual funding for the SA-CERN programme to approximately R20 million following past incremental increases.
- **Confirmation of the rate of Higgs boson production:** ATLAS scientists study some of the main processes that produce the Higgs boson, as well as the particle's decay into other particles.

2017

- **W boson measured by UCT student:** Kgotlaesele Johnson Senosi, based at iThemba LABS, contributes to fundamental

understanding of this elementary particle.

- **UCT student wins ATLAS PhD Grant:** a prestigious grant enabling Chilufya Mwewa to spend a year at CERN.

2018

- **UCT co-hosts ATLAS Muon Week:** an annual conference relating to one of the ATLAS sub-systems.
- **UCT to contribute to LHC upgrades:** agreement finalised that defines UCT's and other South African contributors' involvement in the upgrades to ALICE.
- **SA-CERN celebrates its 10th anniversary:** now a collaboration of nine South African universities and research laboratories.

Upgrading the largest experiment on Earth

From December 2018 until early 2021, CERN's Large Hadron Collider (LHC) will be shut down. After almost five years of hard work accelerating particles to almost the speed of light and crashing them into one another, the facility needs maintenance – and upgrades, which will see the rate of collisions increase by five times.

This will also be a time of upgrades to the experiments on the LHC circuit. South African scientists, including from UCT, will be among those developing the new hardware, installing it and testing it.

Taking on greater challenges

Although South African physicists have been collaborating with CERN on the ALICE experiment for 10 years, SA-CERN's responsibilities have been expanded ahead of the upgrades and formalised with a memorandum of understanding.

"The agreement between CERN and the Department of Science and Technology has put in writing that South Africa is officially a member of the collaboration and involved with upgrades to two of the detectors used in the ALICE experiment," explains Dr Tom Dietel, a CERN collaborator since

2004 from UCT's Department of Physics.

The upgrades to ALICE will take the form of a massive collaborative effort by physicists from all over the world to rebuild the experiment's muon detector and transition radiation detector from scratch. These detectors pick up signals from muons – sub-atomic particles that rarely interact with matter – and electrons, respectively.

Although a lot of the groundwork has already been laid, efforts will be ramped up over the next two years while the LHC is shut down.

Why upgrade?

On completion of the LHC's upgrade in 2021, it will be five times more powerful than it currently is. In other

words, it will be able to produce five times more heavy-ion collisions. In many ways, this will be a quantum leap for the LHC experiments and increase the capacity for new discoveries immensely.

In addition, these new technological advancements will allow scientists to collect all the data generated by ALICE; at the moment, they have to throw away 95% of it because the computers installed 10 years ago were too slow.

The new system will handle 100 times more data – about three terabytes per second – which means the software for processing it will also have to be rebuilt.

South Africa's responsibilities

South African institutions are shouldering responsibility for three areas of the upgrade to ALICE: readout

electronics for the muon identification detector, data processing for the transition radiation detector, and low-voltage power supply and distribution for the muon tracking detector.

"On the muon detector, our focus will be upgrading the readout electronics: taking the data from the detector and transferring it to computer files," explains Dietel. "On the transition radiation detector, it's mostly about what we want to do with the data once it's in the computer. Basically, building software that can process it."

As far as power supply for the muon tracking detector goes, Dietel explains it in terms of plugging in a laptop and admits that it sounds like a boring job.

"Essentially, we are plugging the electronics into a power supply. However, this becomes a bit complicated if, first, you've got 1 000 electronics. Second, your power

supply is 10 or 20 metres away. Third, you want to remotely control everything.

"And lastly, you're pretty much locking away your whole system for 10 months per year for the next 15 years – so it needs to work for a long time."

UCT's responsibilities lie mostly with data processing for the transition radiation detector. UCT's Department of Electrical Engineering will also be involved in the readout electronics upgrade.

A network of expertise

Dietel has no illusions about the steep learning curve lying ahead for SA-CERN, in general, and UCT, in particular. However, he sees it as an immense opportunity for growth.

"We get to tap into a huge network of expertise. CERN is an amazing environment to work in, in every respect." 

TWO EXPERIMENTS to understand the nature of the universe

Beams of particles travelling in opposite directions at the speed of light shoot into each other inside the Large Hadron Collider (LHC). When they crash, they create debris in the form of new particles that fly in all directions. Detectors along the collider record this particle debris. Two of them are ALICE and ATLAS.

ATLAS: looking for the smallest units of matter

What are the basic building blocks of matter? What are the fundamental forces of nature? These are the sorts of questions – essential to particle physics – that ATLAS (A Toroidal LHC Apparatus) tries to answer.

ATLAS is designed to exploit the full potential of the physics opportunities that the LHC provides and to test

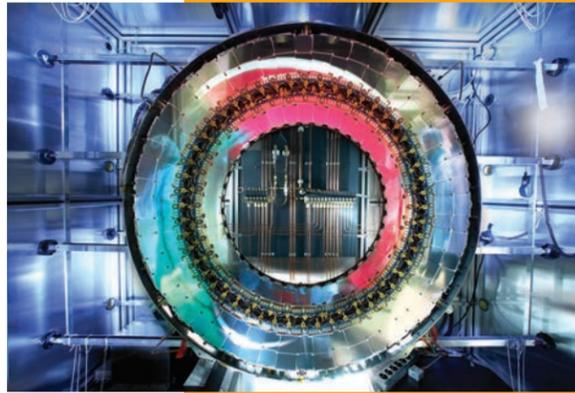
the predictions of the Standard Model of physics, which explains how the basic building blocks of matter interact.

ALICE: recreating the early universe

By crashing massive ions – such as gold or lead nuclei – into one another, ALICE (A Large Ion Collider Experiment) tries to recreate the state of matter predicted to have existed in the earliest moments of the universe. Quark-gluon plasma, as it's called, last existed billions of years ago, a fraction of a second after the big bang.

Whereas particle physics and ATLAS are concerned with the most basic building blocks of the universe, ALICE is concerned with heavy-ion physics and how those building blocks make up more complex systems.

INSPIRING WONDER in how the universe works



Dr Sahal Yacoob's involvement with SA-CERN and his work on the ATLAS experiment as a representative of not only his country but also his alma mater has been a hugely gratifying experience.



Yacoob's journey with CERN started in 2010 – the same year that the LHC and ATLAS started producing data – with a postdoc appointment at the University of the Witwatersrand. During his two years there, Yacoob had the opportunity to assist with some of the background work to the discovery of the Higgs boson, which has come to be one of the greatest feats in the recent history of particle physics.

This was followed by an attempt to build an ATLAS group at the University of KwaZulu-Natal, before returning to UCT – where he had earlier completed his studies up to master's level – to work on ATLAS together with Dr Andrew Hamilton. Hamilton has since

taken a position elsewhere, leaving Yacoob as UCT's sole academic ATLAS representative.

"CERN and ATLAS are an international collaborative community," Yacoob explains. "It is not always the friendliest place in the world: It is competitive and full of very smart people who are ambitious. But it's also full of people who understand that they need a healthy community and try to foster young researchers."

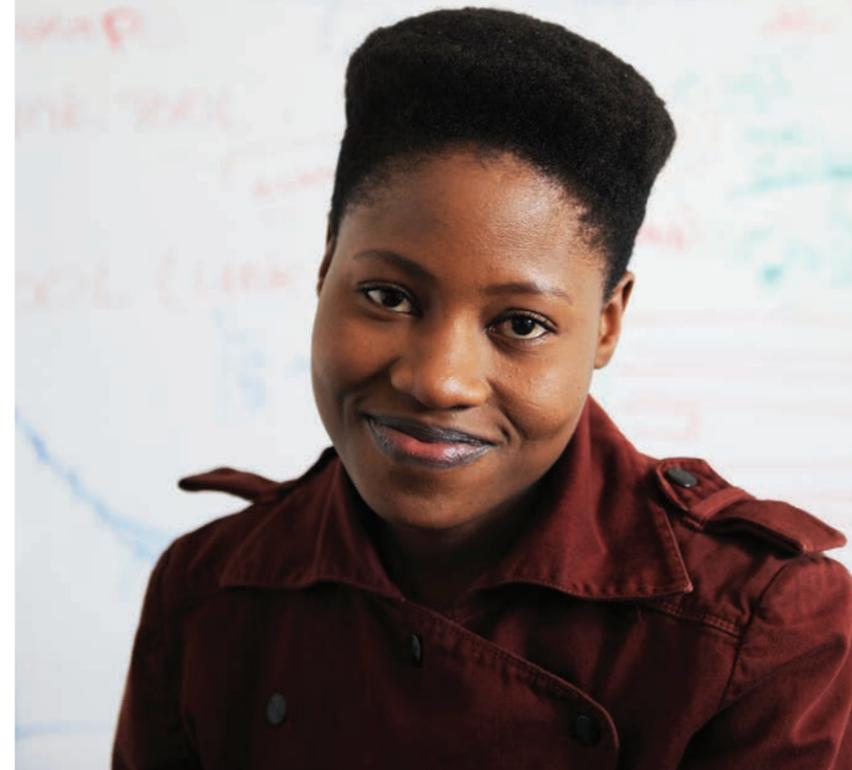
Having played a small, but essential role in the Higgs boson discovery, Yacoob has first-hand experience of how valuable it can be to form part of this elite academic network. Because of this, drumming up excitement for SA-CERN among students is almost second nature.

"There's a certain wonder in finding out how the universe works," says Yacoob. "To be able to work with students who've had that same feeling and to give them the opportunity to see that there's a commonality in this search for understanding that transcends our cultural, geographic and racial backgrounds – it's key." 

ABOVE Sahal Yacoob speaks to Kofi Annan on a visit to CERN in 2011.

PHOTOGRAPHS: PETER GINTER, © 2011-2018 CERN; MAXIMILIEN BRICE

From particle physics to BIOMEDICAL INNOVATION



another month thereafter, arranged by Hamilton.

With collaboration being key at CERN, Thusini saw how important teamwork is in the process of innovation and plans to incorporate this skill into her PhD studies.

"It's very inspiring when you see people working together towards a shared goal," she says.

From the building blocks of the universe to biomedical innovation

Thusini's pursuit of biomedical engineering may seem like a stark change in academic direction, but to her it's merely an extension of what she's already achieved. During her master's degree, Thusini had used a mathematical tool known as the Monte Carlo technique to simulate and produce data similar to what results from experiments at CERN.

"Basically, I was using simulation tools to analyse the behaviour of particles in the proton-proton collisions that happen in the Large Hadron Collider, and I started to wonder if there was a way I could use these tools in medical school."

This idea gave rise to Thusini's PhD in which she is trying to use the same mathematical principles in a novel way to produce three-dimensional structures from two-dimensional X-ray imagery. "We are trying to figure out how to produce a 3D, patient-specific anatomical structure similar to that produced by a CT scan – if you don't have access to a CT scanner." 

Growing up in rural KwaZulu-Natal, South Africa, Xolisile Thusini was an anomaly in her community. While her friends were dreaming of getting married, she had one goal in mind: to continue studying after school.

Shortly after finishing high school in 2008, she set off to enrol in the School of Physics and Electronics at the University of Zululand with little more than money for transport – and determination.

Ten years and four degrees later, Thusini is in the first year of her PhD in biomedical engineering at UCT, where she hopes to apply her knowledge of maths and physics to practically serve society. Although her academic career is

sprinkled with milestones, Thusini cites her time as a summer school student at CERN as one of the most meaningful.

Summer at CERN

Thusini enrolled in a master's degree in particle physics at UCT during 2015 under the supervision of Dr Andrew Hamilton, and later, Dr Sahal Yacoob. As part of her degree, she started working on an experimental physics project in collaboration with CERN.

After applying to the CERN summer school in 2015, Thusini was one of only two South Africans – both from UCT – and five Africans to be included that year. She ended up spending three months at CERN: two attending lectures as part of the summer school and



Governance of BAOBABS: with big trees comes great responsibility

One of Africa's most iconic species made global headlines when researchers discovered that some of the oldest and largest baobab trees on the continent had died during the past 12 years.

While all signs point to climate change being at least partly to blame for this dying-off, there are socio-political factors that are undoubtedly also affecting the overall well-being of baobabs.

Witness Kozanayi, a student in the Bio-economy Research Chair at UCT's Department of Environmental & Geographical Science, recently

completed a PhD thesis on the governance of non-timber forest products, focused on baobabs.

Conducting his research in the Chimanimani District of eastern Zimbabwe, Kozanayi looked at the way commercialisation of baobab products has had an impact not only on the well-being of the species, but also on the communities making a living from it.

Much more than just a tree

Kozanayi's study area has one of the highest densities of baobabs in the district – three to 21 trees per hectare. Most of these trees are communally owned and have been managed via customary systems.

Historically, baobabs have served a multitude of purposes for the communities living around them. In addition to providing fruit, bark and leaves, the baobab's size and shape make these trees perfect vessels for water storage, shelter and burial grounds. In some cases, baobabs have

been used for prisons, toilets, ritual sites and venues for prayer.

Over the past few years, however, the allure of the baobab tree has reached far beyond these immediate communities. As demand for novel natural products grows, so does the drive for commercialisation and the need to regulate access.

"Baobab fruit is now recognised as a novel food in the European Union," explains Kozanayi's supervisor Professor Rachel Wynberg, South African Research Chair in Bio-Economy at UCT (funded by the Department of Science and Technology and the National Research Foundation).

"Governments are increasingly interested in pursuing biodiversity-based economies and in regulating their use, yet this can also lead to negative consequences for resource custodians."

Benefits of commercialisation

The commercialisation of baobab products holds great promise of entrepreneurship and financial gain for local communities. Most baobab-related industries centre around harvesting and processing the fruit, seeds and bark.

Baobab fruits are sold whole in urban areas or processed into pulp for which confectionery companies are the main market. Oil is extracted from baobab seeds and exported for use in the cosmetics industry, and local residents have been making crafts with the fibrous bark and exporting them to South Africa since the 1990s.

Kozanayi's research suggests that some households in Nyanyadzi, one of the wards he studied, make between US\$350 and US\$1 500 per year from their involvement with baobab-related projects. The tree's products are regarded as the most significant contributor to livelihoods in many instances.

The challenges of governance

Despite these promising figures, the relatively sudden commercialisation of baobab products has brought on a crisis of a different sort: implementing effective regulation and governance of this resource.

Throughout their history, communities have relied on strong customary systems to regulate and protect baobabs. However, with the increasing commercialisation of baobab products has come an increasing drive to formalise their management.

“In some cases, baobabs have been used for prisons, toilets, ritual sites and venues for prayer.”

"Formalisation of baobab governance is driven mainly by the state to ensure ecological sustainability," explains Kozanayi.

Shifting the management of baobab resources from traditional leaders to the state has led to disregard for local practices and other negative consequences.

"This is problematic, as evidence on the ground shows that local people do care about the baobab tree which is central to their livelihoods, history and culture," he says. "Without access to natural resources, local people's livelihoods are compromised and they are forced to use a range of overt and covert means to regain access."

The consequences of excessive state regulation include women opting out of

the export businesses due to *malaitshas* – informal cross-border transporters – often demanding sexual favours for facilitating the illegal movement of products. Traders engage *malaitshas* to circumvent the stringent permit system at the border.

Is there a solution?

As is often the case with the commercialisation of age-old resources, the successful governance of baobabs in the Chimanimani District requires a hybrid of solutions from both the traditional and government sector. Statutory forms of governance can be introduced to assist customary practices on a demand-driven basis.

Kozanayi argues that due to their proximity to the resource base, traditional leaders are often better placed than the government to be the first line of contact. Simultaneously, the onus is on the state to devote more resources to the management of the baobab tree.

Ultimately, the commercialisation of baobab products can either herald a renewed drive to protect these iconic African trees and the communities whose livelihoods are intertwined with them – or lead to their demise. The outcome will depend on how successfully this precious resource is governed and if compromises can be reached. **U**



PHOTOGRAPHS: ROD WADDINGTON, WIKI COMMONS; ISTOCK



5

QUESTIONS WITH

Mohlopheni Jackson Marakalala

Dr Mohlopheni Jackson Marakalala has his roots in rural Limpopo, South Africa, where he completed his BSc and honours degrees. After finishing his PhD at UCT, he completed a fellowship at Harvard before returning to his home country. Now a senior lecturer and group leader in UCT's Division of Immunology, he hopes to help combat the infectious diseases most prevalent in sub-Saharan Africa.

1 What is the focus of your research?

My research seeks to identify factors that drive the progression of tuberculosis (TB) by studying lung surgical tissues called granulomas. We aim to develop diagnostics and therapies that limit the disease's progression and augment current treatments. We also study the mechanisms used by TB to survive our immune systems.

2 Why are you interested in this field?

Growing up during the harshest times of HIV/AIDS and TB in sub-Saharan Africa, I wanted to choose the research field that would allow me to help eradicate these diseases. TB remains a leading global health challenge and we direly need better diagnostics and treatment strategies. I hope to fill some of these gaps. More importantly, being an African scientist, I have a great interest working on solutions relevant to local health challenges.

3 What have been the highlights of your research career so far?

Receiving the Bronte Stewart award for the most meritorious doctoral thesis submitted by a PhD student at UCT in the presence of my mother and sister. Attending the graduation

of my first postgraduate students; I believe that the success of a good teacher is measured through the progress of their students. Being hosted by Queen Elizabeth II and chatting with her about my work and its global impact. Publishing my research in *Nature Medicine*.

4 What is the most important role science can play in developing countries, like South Africa?

I believe investing in science, technology, engineering, mathematics and innovation will result in economic growth and development. We will also be able to counteract brain drain and see a pool of home-based scientists driven by a desire to invent solutions tailor-made for local challenges.

5 What piece of advice would you offer a budding African scientist?

Pursue research questions with a potential to solve local problems. There is nothing as fulfilling as seeing your work translated into positive impact among those in need. In pursuing such excellence, however, things may be difficult sometimes. That is normal and character-building, even if it may not seem so at the time. Never surrender in the face of challenges but have faith in your abilities and passion. 



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