



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

RESEARCH REVIEW 2021



UP RESEARCH
UP Research Review
REVIEW

Cover Image:

A high-speed image of the heat transfer process within a falling film refrigerant evaporator, with the boiling of a thin liquid film of refrigerant R245fa on the outside of the heated copper tubes, with the resulting bubbles sliding down the outside of the tube. The full story of the research undertaken by **Dr Bradley Bock** and **Prof. Josua Meyer** of the **Clean Energy Research Group** in the **Department of Mechanical and Aeronautical Engineering** is available on p. 20.

The adjacent photograph and the wildlife and nature pictures scattered throughout the publication are from the private collection of **Emeritus Professor of Zoology** and **Chair of Conservation Ecology, Prof. Rudi van Aarde**. You can read Prof. van Aarde's contribution to research in this publication on p. 29.



Foreword

— Prof. Tawana Kupe
Vice-Chancellor of the University of Pretoria

A central element of the University's research strategy is developing and nurturing international and local partnerships. This is well reflected in the strengthened links with industrial and academic partners from around the globe. In 2021, we added a new chair – the Exxaro Chair in Extended Reality. In addition, we have grown our network of international partners and collaborators by signing 29 agreements with partners globally, bringing our number of active formal partnerships to 223.

University researchers continued to excel in the fields of astronomy and astrophysics, with further discoveries reported of black holes. Our veterinary researchers published the only study from Africa describing reverse zoonotic transmission of COVID-19 — with captive lions becoming infected with the virus from their human keepers. Our researchers also joined an international team in making advances in the conversion of plant waste to supercapacitors, a component of high-powered devices. The headway we have made has been consistent with our vision of becoming a leading research-intensive university in Africa, recognised internationally for its quality, relevance and impact, as well as for developing people, creating knowledge and making a difference locally and globally.

Reading the articles presented in this Review demonstrates the quality of our research and the calibre of our academics, and proves that we produce research that matters and is able to transform lives and communities.

2021 also saw consistent strengthening the University's position in the world rankings. The 2022 Times Higher Education (THE) Impact Rankings placed UP among the top 150 institutions in the world, and first in South Africa for sustainable Development Goals 8 and 15. This was the University's best performance thus far in this ranking system.

In addition to this, our Mineral and Mining Engineering researchers ranked at position 33 worldwide in the Quacquarelli Symonds World University Rankings by Subject. The University is now rated among the top 1% of universities globally in 13 of the 22 ESI knowledge fields (up from 10 in 2020).

A particular source of pride is that the University is one of only three universities in Africa that has been ranked in the top 200 globally in the 2023 QS Sustainability Rankings. UP was ranked 2nd in South Africa and Africa and in the 171–180 band globally.

These rankings results are partially a result of the ever-increasing qualification levels of our academic staff, with 70.4% now holding doctoral degrees. This academic strength is also reflected in the increasing numbers of NRF-rated researchers, which grew to 592 in 2021. Of these, 17 were A-rated researchers and 106, B-rated researchers.

Innovation and commercialisation remain an important part of research outcomes, and 2021 saw 16 new inventions disclosed and 24 international patents filed, proving that our research can make a meaningful contribution to South Africa, Africa and the world. ■

Introduction

—● Prof. Anton Ströh

**Vice-Principal: Institutional Planning, Monitoring and Evaluation
and acting Vice-Principal: Research and Postgraduate Education**



2021 saw more than 50 000 students enrol at the University, improving on the numbers from the year before. With that has been continued progress in diversity with black staff accounting for two-thirds of faculty (68.6%). 61.5% of undergraduates are black, with this proportion increasing to over 70% for postgraduates.

Out of all South African universities, UP has the highest proportion of academic staff who hold doctorates, as well as the highest number of NRF-rated researchers. In 2021, these academic staff and researchers produced 2 374 research output units across journals, conference proceedings, books, and chapters. Additionally, UP had the highest number of patents recognised in its 2020 submission to DHET.

Another strong indicator of the University's research and innovation culture is the 51 research chairs it hosts across seven faculties. These include 19 chairs funded by the Department of Science and Innovation DSI-NRF South African Research Chairs Initiative (SARChI) and 32 industry-funded chairs.

In 2021, UP remained committed to pursuing "research that matters" to address complex societal challenges and, in particular, the challenges faced by developing regions in the world.

In late 2020, UP launched the African Global University Project (AGUP), its internationalisation and global engagement initiative intended

to ensure that partnerships and collaborations play their envisioned role in achieving UP's strategic goals.

The first phase of the AGUP initiative was implemented in 2021, with 13 global and six African partners being identified. Institutional agreements with these partners have already resulted in collaborative projects. UP was nominated to serve on the board of the Southern African-Nordic Centre (SANORD) for a second term. SANORD is a forum of 53 universities from southern Africa and the Nordic regions that fosters cooperation between academic institutions. The leadership of member institutions meets annually to plan activities for the forum.

In addition, UP is an active member, and the South African coordinator, of the South Africa-Sweden Universities Forum (SASUF). In 2021, UP worked with Uppsala University to request an extension of the final round of the SASUF grants to allow recipients impacted by the Covid-19 pandemic to complete their projects in 2022.

During 2021, 3 230 international students (excluding permanent residents) were registered at UP, with

about 87% of these coming from Africa. The University concluded four student exchange agreements with Antwerp University (Belgium), University of Oslo (Norway), Tokyo University of Foreign Studies (Japan), and National University of Lesotho (Lesotho).

The joint doctoral degree agreements grew to 20 in 2021 as UP partnered with Hasselt University (Belgium) and the University of Turku (Finland). Ten students were registered for these degrees.

International collaboration remains a core strategic focus for the University. Within the University, collaboration is driven by the **Innovation @UP** research investment platform which incubates future-focused world-class research by driving cross-disciplinary collaboration between University institutes like Future Africa, Engineering 4.0 and the Forestry and Agricultural Biotechnology Institute (FABI). ■

Adapted from the University of Pretoria's Annual Report, 2021



Acknowledgements

—● Dr Carol Nonkwelo
Director: Department of Research and Innovation

The following individuals and departments have played various roles in the production of this year's edition:

- It has been another stellar year for research at the University. Our gratitude and respect are accorded to all the diligent academics on our campus and beyond, and especially those whose work we were able to include in this Review.
- The editorial committee comprises senior academics from a wide range of fields within the University. We thank **Professors Robin Crewe, Jan Eloff, Vasu Reddy, Bernard Slippers** and **Brenda Wingfield** for their editorial guidance. In addition, several other senior researchers and Deans were consulted to ensure that the work presented here is representative of the work produced during the year.
- **Sunette Steynberg** and her team in the **Department of Library Services** and several teams within the Department of Research and Innovation for the support and assistance in providing data related to the research achievements of the University.
- **Professor Rudi van Aarde** who generously offered photographs from his collection, taken over a lifetime of research into the mammals of Africa.
- **Dr Bradley Bock** and **Prof. Josua Meyer** of the **Clean Energy Research Group** in the **Department of Mechanical and Aeronautical Engineering** who provided the cover photograph from their research into the use of nanostructures in refrigeration.
- **Simon Gear**, who planned, edited and coordinated the production of the Research Review for the DRI.
- We also acknowledge the design and photography companies that worked tirelessly to ensure that the final product is the colourful, engaging publication that you hold today. ■

The Research Review is an annual publication produced by the **Department of Research and Innovation (DRI)**. It is a celebration of work from a wide range of UP people across almost the entire university.

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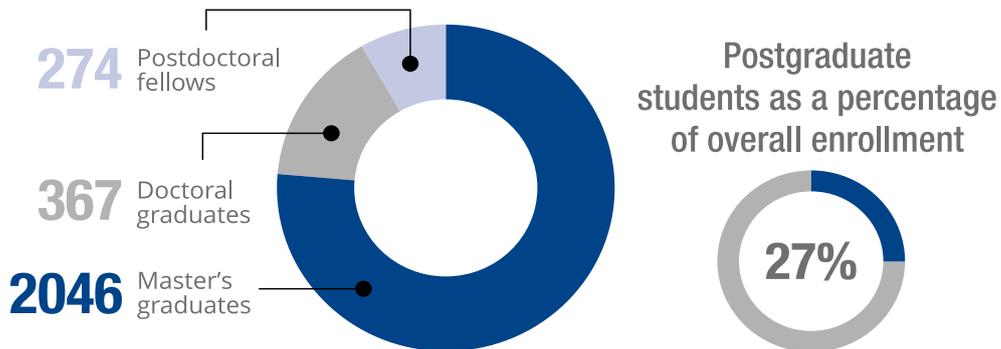


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2021 Research Statistics

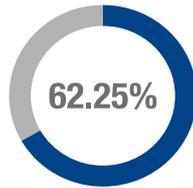
NEXT GENERATION RESEARCHERS



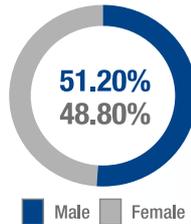
International postdoctoral fellows



Black postgraduate students



Postgraduate students by gender

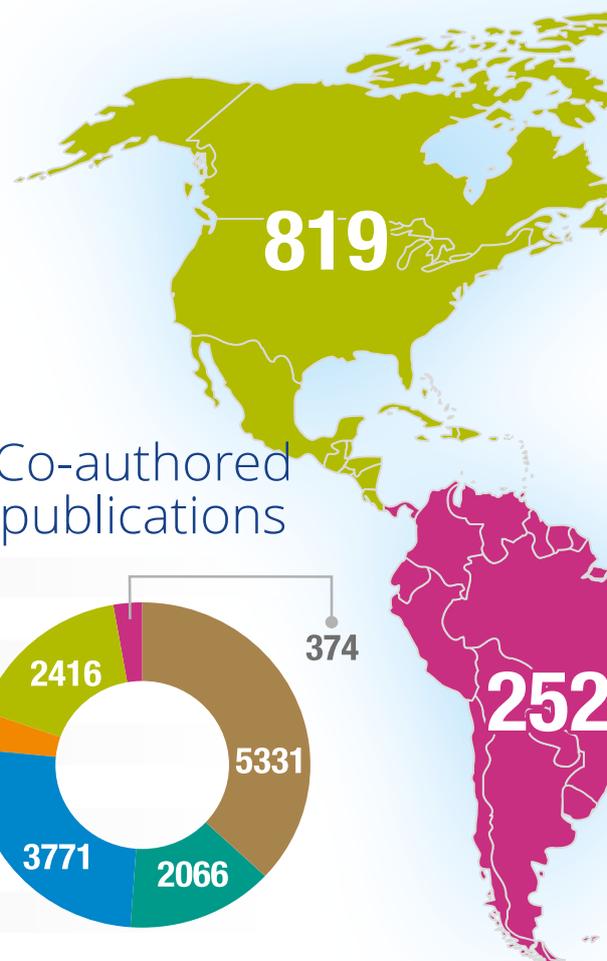
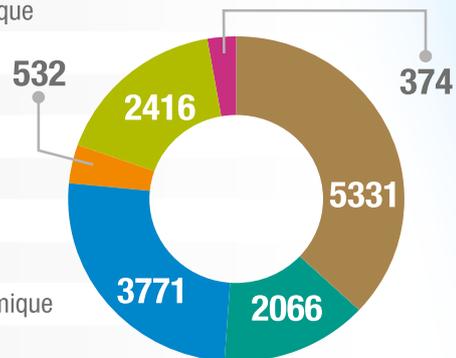


NETWORKS AND COLLABORATION

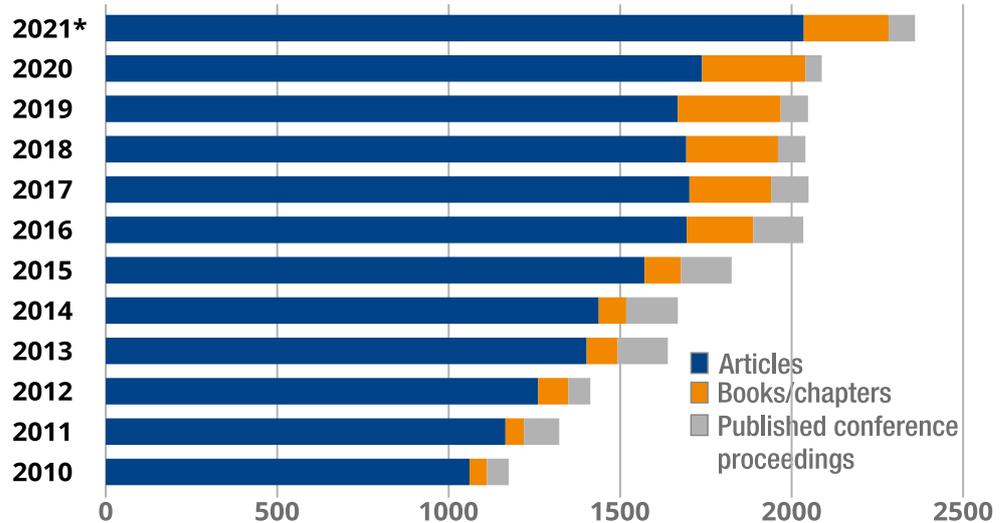
Top 10 Collaborative Institutions

Belgium	267	Ghent University
France	245	Centre national de la recherche scientifique
Australia	208	University of Western Australia
Australia	161	University of Queensland
United Kingdom	146	University of Oxford
Netherlands	146	Utrecht University
United Kingdom	143	University of Cambridge
United States	133	Harvard University
France	122	Institut national de la recherche agronomique
Australia	118	University of Sydney

Co-authored publications

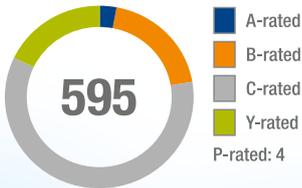


RESEARCH OUTPUTS BY YEAR



* Awaiting DHET verification

Total UP Researchers with NRF-rating

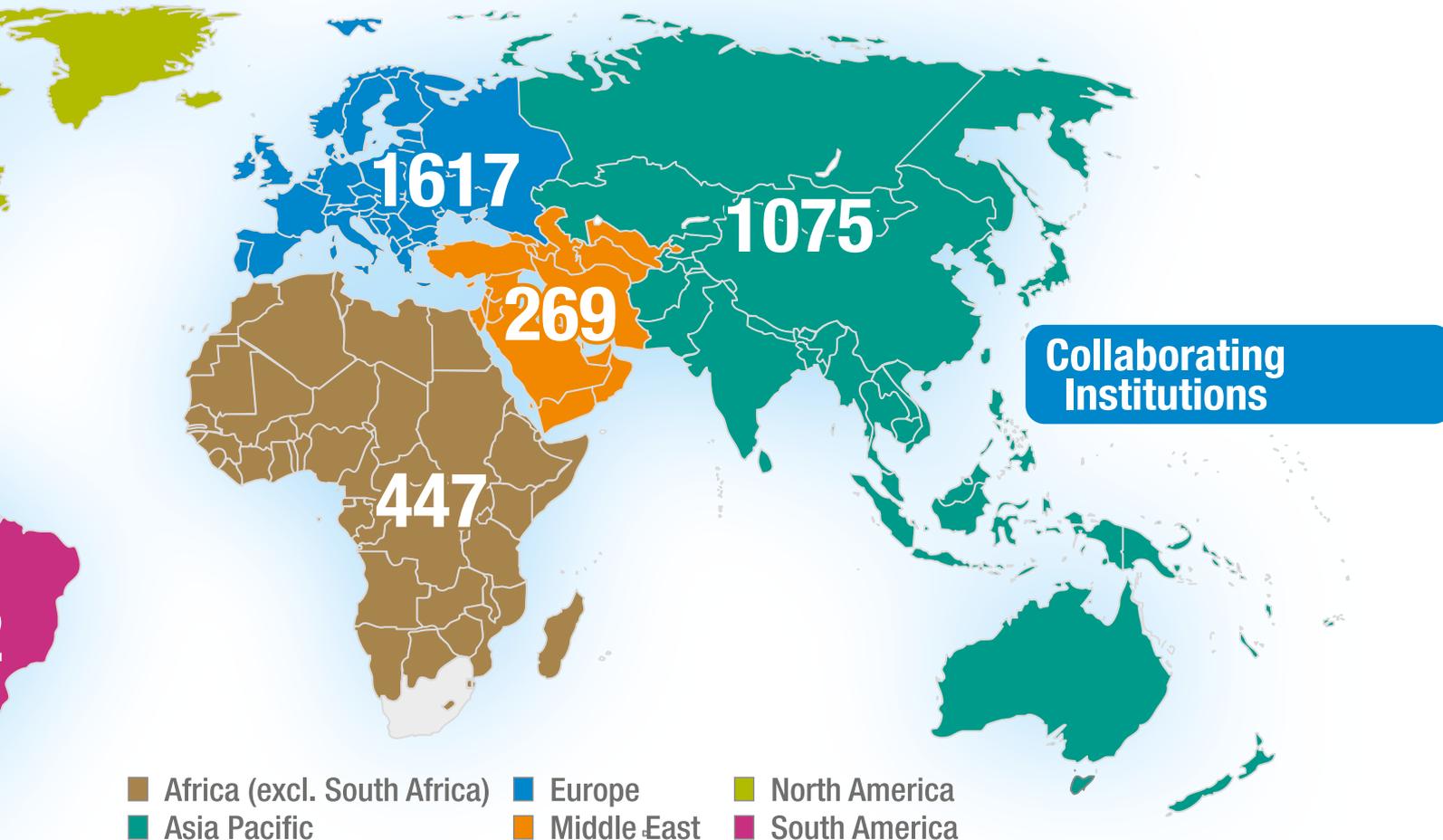


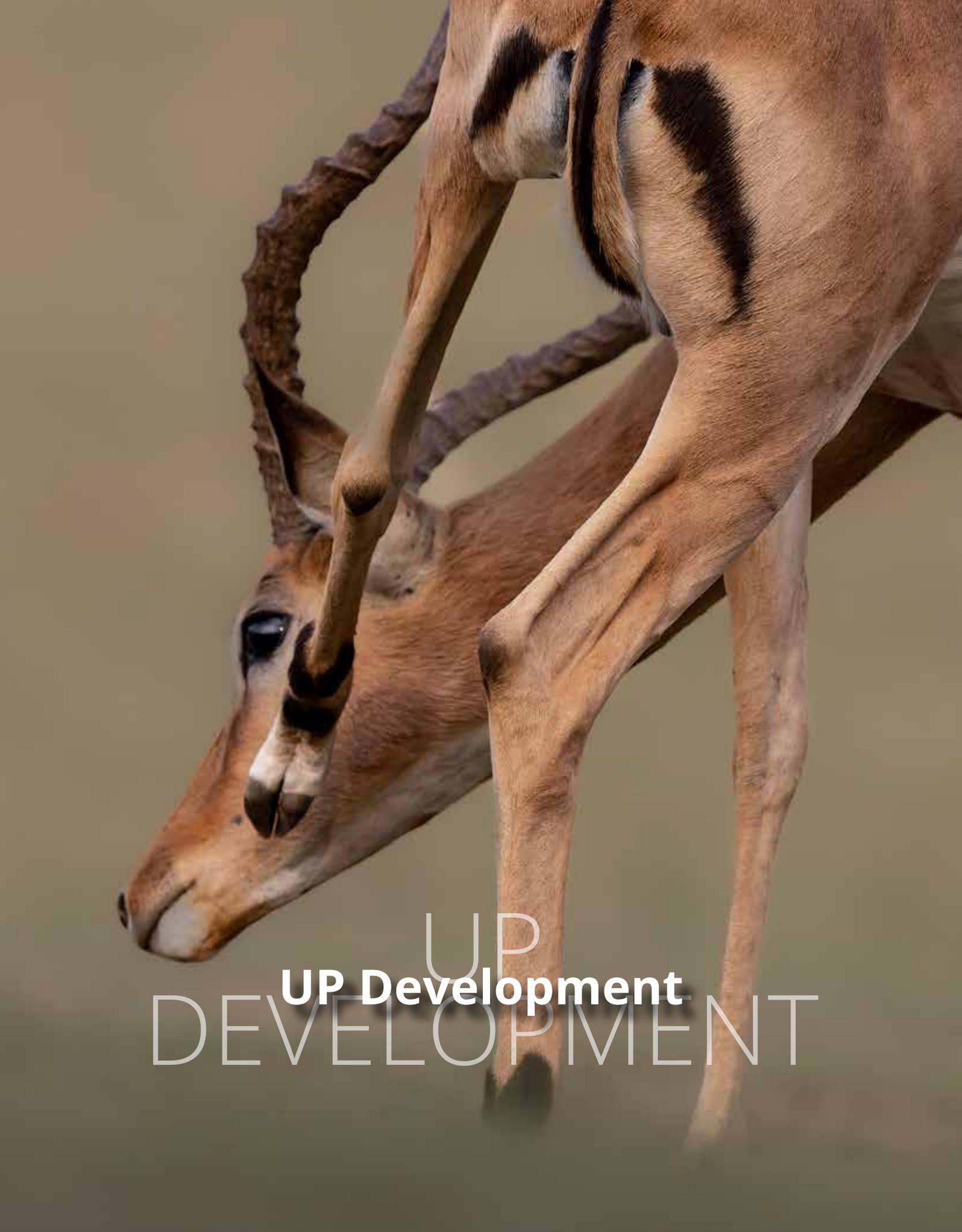
Staff with PhDs



RESEARCH ENTITIES

- 80 UP Research Institutes, Centres and Units
- 32 Industry and Public Sector Research Chairs
- 19 DSI-NRF SARCHi Chairs





UP Development
DEVELOPMENT



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Engineering 4.0

—● Prof. Sunil Maharaj

Dean: Faculty of Engineering, Built Environment and Information Technology (EBIT)

The primary goal of the facility is to address the shortage of civil engineers in South Africa capable of working in a 4IR future. With that in mind, the faculty at Engineering 4.0 has a focus on the development of integrated transportation and infrastructure systems, concentrating on the reduction of energy consumption levels in transportation, maximising productivity in industry and creating a higher quality of life for people.

The research focuses on road construction, road use, traffic flow and smart transport systems, now and into the future. The engineers at Engineering 4.0 are researching road construction materials, vehicle-pavement interaction

issues, infrastructure materials and management, exhaust-related emissions, semi-autonomous and autonomous vehicles.

This entails smart roads and infrastructure talking to smart vehicles, to reduce traffic congestion and to ensure the safety of passengers and cargo.

It has been a pleasure to see this facility become a place where novel ideas, scientific research, global expertise, students, academics, entrepreneurs and industry partners can meet to generate new thought leadership, innovation and training opportunities through collaborative partnerships.

Situated on the Innovation Africa@UP campus in Hillcrest, Engineering 4.0 has its home in the Faculty of Engineering, Built Environment and Information Technology (EBIT). A first for Africa, it is a collaboration with the South African National Roads Agency (SANRAL), the Council for Scientific and Industrial Research (CSIR) – an entity of the Department of Science and Innovation – and York Timbers. It was officially opened in late 2020 and 2021 saw its first full year of operation.



A flagship feature is an active, two kilometre-long test lane on Pretoria's N4 highway, where we collect real-time data and use big data analytics and the Internet of Things to do tests and analysis on how different road surfaces perform, how traffic moves on the highway, the density and type of traffic, emissions testing, and air quality monitoring. Sensors next to, above and below the lane collect data. The data is monitored from a data house next to the N4. We are able to optimise pavement design and construction. The data collected can be used to model many aspects of transportation systems. Improved and optimised pavement design supports longer-lasting pavements that serve the economy and social well-being of society.

Other features of Engineering 4.0 include:

- A national roads reference laboratory able to conduct standard testing on road materials originating from SANRAL (for national roads projects), the provinces and neighbouring countries
- The York Wood Engineering Laboratory which expands the footprint of mass timber construction, using advanced engineered wood products in collaboration with civil and chemical engineering, architecture, materials science, data science, genetics and other related bio-economy disciplines.
- A training laboratory to train and certify road materials technicians employed by various testing laboratories. This lab has virtual reality options for learning about testing techniques.
- A concrete laboratory where various concrete and structural testing can be conducted for use in areas that include road construction and infrastructure.





Future Africa

—• Dr Heide Hackmann

Interim Director of the Future Africa Institute and Strategic Advisor on Transdisciplinarity and Global Knowledge Networks

The Africa Science Leadership Programme (ASLP) continued to grow and evolve, with **Dr Connie Nshemereirwe**, new Director of the programme, taking over from the founding **Director, Prof. Bernard Slippers**.

2021 saw Future Africa host several seminars and conferences aimed at fostering cooperation and dialogue between disparate researchers, especially within the African continent. A central part of these initiatives is to develop and encourage young career researchers and introduce them to top thinkers in their fields.

The CLAB-Africa Project is typical of these initiatives and was conceived by the Future Africa Institute to provide a platform for the scientific community of Africa for contributing to the developmental work of African governments and development institutions.

The Future Africa Research Leader Fellowship (FAR-LeaF) is a fellowship programme focussed on developing transdisciplinary research and leadership skills for addressing the complex and inter-linked challenges of health, well-being and environmental risks in Africa.

Future Africa continued its journey to develop leadership in transdisciplinary research in Africa. The institute is well positioned as a hub for African and global research networks to address the challenges that hamper transformation towards a prosperous, equitable and sustainable future in Africa.





Future Africa is the vehicle through which the University partnered with UNICEF to expand various skills and capacity building activities as response to COVID-19. The focus was on the youth through the programme YEaH (Youth Empowerment and Health).

The Food and Livelihood Resilience from Neglected and Underutilised Plant Species in Africa (FORENS) is an Africa-Japan collaborative project funded by the National Research Foundation of South Africa. The project focuses on the utilisation of plant species for multiple functional and nutritional purposes, ranging from medicinal, income, food and feed.

The Food Systems Transformation in Southern Africa

for One Health (FoSTA Health) project applies interdisciplinary research and aims to strengthen the contextual understandings of the interactions between human, animal and environmental health at multiple food system scales. The FoSTA project is supported by the European Union and includes 13 partners from European and southern African research, policy advocacy and development organisations. In May 2021, Future Africa and Nepoworx announced a Memorandum of Understanding to develop science and skills in the field of solar photovoltaics. The objective of the programme is to upskill a total of 900 young and female scholars and entrepreneurs over the next three years, ensuring participation in the green economy.





Making Art in a Pandemic at the Javett-UP

— Prof. Vasu Reddy
Dean: Faculty of Humanities

In this third year since launching, Javett-UP rose to the occasion again — amidst lockdowns, the gallery forged ahead with great poise beyond the quarantine from the previous year.

As vaccines, combined with masks and social distancing, provided a glimmer of hope, the Centre responded critically to the multifaceted histories of the creative outputs of Africa and the future aspirations of the continent, the diaspora and the strategic initiatives of UP. An example of the latter is ‘transdisciplinarity’, broadly understood as transcending disciplinary boundaries to demonstrate the connections between knowledge, ideas and concepts.

Interfacing New Heavens provided a stellar initiative as an exhibition that brought together two different positions contemplating the entanglement of science and art; indigenous knowledge systems and their inquiry within the terrain of astronomy and the agency of ‘vibrant matter’. The series of works by Vanessa Lorenzo and George

Mahashe, in particular, reflects on the meanings of these interactions and their effects on the present.

Beyond the signature collections of *Mapungubwe Gold* and *West African Gold* (on show since 2019), *Word Woes* showcased a retrospective of works spanning Willem Boshoff’s artistic practice. Boshoff engages the context in which we receive language and the power it yields to exclude or to privilege. Described as ‘conceptual books’, Boshoff’s project uses unconventional tactics to challenge the use of language as an instrument of cultural identity or exclusion. Read in English, *Word Woes* bemoans difficult issues around words and language. Read in Afrikaans, the same words liberate, prompting us to let go and be wild.

Handle with Care draws its title from a mixed media work by Johannesburg-based artist, Kagiso Pat Matluoa.





As one of the values of Javett-UP, namely care, the exhibition firmly situates the idea of an art centre as a public space of care, as well as its role in the care of collections. The exhibition was arranged into four themes mediated through entry points created by four young artists, namely:

- *Rituals of Self-Preservation* (Neo 'Hlasko' Mahlasela)
- *Dreamscapes* (George Mahashe)
- *Construction of Masculinities* (Sabelo Mlangeni)
- *Abstraction* (Nyakallo Maleke)

Providing 'panorama' and 'scene' to present a perspective of shared networks of experiences, belief, and knowledge systems across different locations in Africa and the diaspora, *Scenorama* activated the gallery space as a living and changing space.

Designed as an experimental platform, the exhibition features research and artistic positions by Luana Vitra, Paulo Nazareth, Nolan Oswald Dennis, Zara Julius, Amanda Mushate, Manyaku Mashilo, Oscar Murillo, Nyakallo Maleke, Thierry Oussou, Simnikiwe Buhlungu and Tessa Mars.

Performances, discussions, music, education and visual art student exhibitions shaped Albert Luthuli Day (*A Turn to Black Hope*), a joint initiative with the Albert Luthuli Leadership Institute and the School of the Arts. It is worth noting that this initiative marks 60 years since Chief Luthuli became the first African to be awarded the Nobel Peace Prize for his role in the non-violent struggle against apartheid.

Beyond active engagements with high schools and inter-faculty engagements, rounding off the year



to commemorate the National Day of Reconciliation was *Mapungubwe — The Reconciliation*. Aimed at acknowledging and profiling the importance of the Gold collection, the event highlighted the social interconnectedness and remediation of our collective, albeit contested histories. ■





UP INNOVATION
UP Innovation
INNOVATION



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Using nanostructures to reduce the global warming impact of refrigeration equipment

—• Dr Bradley Bock
 Department of Mechanical and Aeronautical Engineering

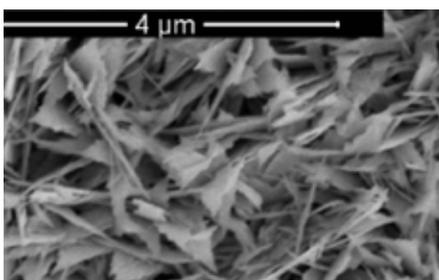
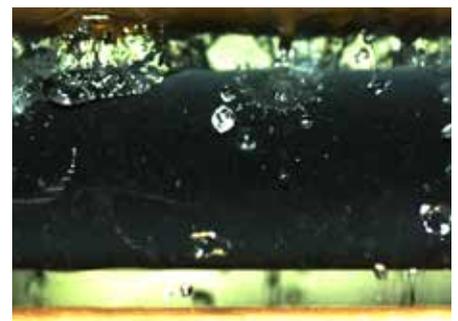
Dr Bradley Bock and Prof. Josua Meyer of the **Clean Energy Research Group** in the **Department of Mechanical and Aeronautical Engineering** collaborated with an international team from the Swiss Federal Institute of Technology, Massachusetts Institute of Technology and Imperial College London in an effort to improve refrigeration equipment and reduce its impact on global warming by using nanostructures.

The research was aimed at determining whether nanostructure coatings, developed for the nuclear industry, could be used to improve the heat transfer on the surfaces of the heat exchangers used in refrigerant equipment. The researchers found that the coatings did just that, increasing the heat transfer by up to three times compared with that of the plain copper surfaces they were applied to. Moreover, when applied to falling film technology, under certain conditions, the nanostructures reduced the dry spots seen, while still increasing the heat transfer.

efficiency of the refrigeration industry, which, currently, causes an estimated 10 to 15% of worldwide CO₂ emissions.

Falling film technology, which utilises thin falling films of refrigerant inside refrigeration equipment, is a solution utilising less refrigerant and is, therefore, less harmful to the environment. It is also used in other applications, such as thermal desalination, implying this research could potentially help several industries. ■

This work could have significant implications for increasing the



Rolling Stock Monitoring with Wayside Train-Monitoring Systems Using Fibre Optic Cords

—• Prof. Hannes Gräbe
Research Chair, Department of Civil Engineering

Professor Hannes Gräbe, who holds the **Railway Safety Regulator (RSR) Chair in Railway Safety** in the **Department of Civil Engineering**, coordinated with colleagues in France to develop a more cost-effective means of monitoring the health of trains in real-time.

Real-time train monitoring is a major challenge for infrastructure managers, as they struggle to keep track of infrastructure failures caused by the poor condition of trains. Such failures significantly increase maintenance costs and cause numerous delays in train services. Currently, a conventional approach based on the total tonnage supported by the track over one year is used to plan maintenance work. Tonnage measurement and wheel-condition analysis stations, offered by many companies, enable managers

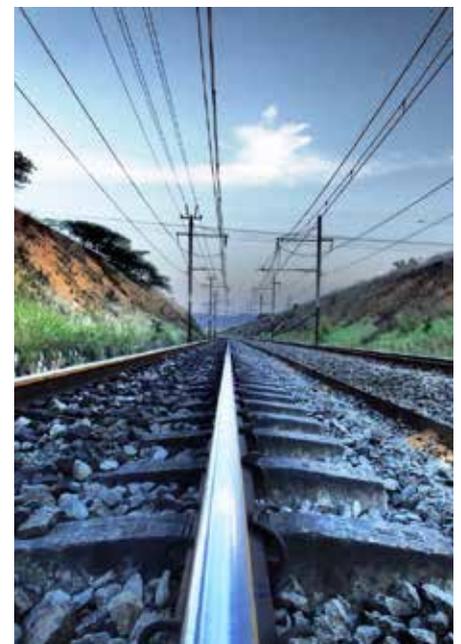
to determine the status and load of trains in real time and to alert railway companies in the event of a defective train.

These systems provide infrastructure managers with the tools required to transition from passive to proactive maintenance. The main disadvantage of such systems is their high acquisition cost, which limits their use to main tracks. For instance, monitoring the French network requires the acquisition of about 100 stations installed on the main



and secondary tracks, representing an investment of approximately €15 million.

Professor Gräbe and the French team sought to develop less expensive solutions to equip the secondary tracks, for which using the more expensive systems was not economically justified. One specific intervention was achieved by transforming rail bridges into dynamic scales. The calculated acquisition cost of the new system represents a saving of more than 30% over existing technologies. ■





A cost-effective response to hexavalent chromium pollution

—● Mpumelelo Matsena
Department of Chemical Engineering

—● Prof. Evans Chirwa
Department of Chemical Engineering



In a study published in *Nature*, research student **Mpumelelo Matsena** under the supervision of **Prof. Evans Chirwa**, both of the **Department of Chemical Engineering**, explored a simple yet cost-effective method for synthesising palladium nanoparticles for the treatment of hexavalent chromium.

A culture of *Citrobacter sp.* was isolated by Matsena and used to produce biologically synthesised nanoparticles.

The presence of elemental palladium was confirmed by scanning electron microscope, electron dispersive spectroscopy and X-ray diffraction. The biologically synthesised nanoparticles exhibited an improved catalytic reduction of hexavalent chromium because of their smaller size and being highly dispersed compared with the chemically synthesised nanoparticles. ■

Adapted from an article that first appeared in Nature: Scientific Reports, in August 2021.

Toxic hexavalent chromium is discharged in wastewater from a wide range of industrial activities and is a significant component of heavy metal pollution.



Creating value from biodigester plant waste in electrodes for supercapacitors and microbial fuel cells

—• Dr Bridget Mutuma
Future Africa



Dr Bridget Mutuma, working through the **Future Africa** programme, combined a team from the **Department of Physics** and a range of Italian researchers in this study.

The team demonstrated that wastes from anaerobic biodigester plants can be effectively harnessed as functional materials to be implemented in technologies that enable efficient energy management and water treatment. This type of work is an effective means of simultaneously addressing Water-Energy-Waste Nexus challenges.

Lignin, the main solid residue of the biodigester plant, was converted into activated biochar with a mild activation agent to produce electrodes for supercapacitors and microbial fuel cells. In addition, the same sludge that is the liquid effluent of the biodigester plant was exploited as inoculum and electrolyte for the microbial fuel cells.

The lignin-derived carbons exhibited a superior specific capacitance. A supercapacitor with these electrodes was built displaying energy specific power up to 10 Whkg⁻¹. Durability tests showed that the device was able

to maintain a capacitance retention of 84.5% after 15,000 charge-discharge cycles.

The lignin-derived carbons were also studied as electrocatalysts for oxygen reduction reactions in a neutral medium. The interconnected porous network and the high surface area made the lignin-derived porous carbons suitable electrode materials for dual applications. ■

Adapted from an article that first appeared in Electrochimica Acta in September 2021.



Developments in Cognitive Radio Networks

—• Prof. BTJ (Sunil) Maharaj
Dean of Faculty of Engineering, Built Environment and IT

—• Dr Babatunde Awoyemi
Postdoctoral fellow, Department of Electrical, Electronic and Computer Engineering

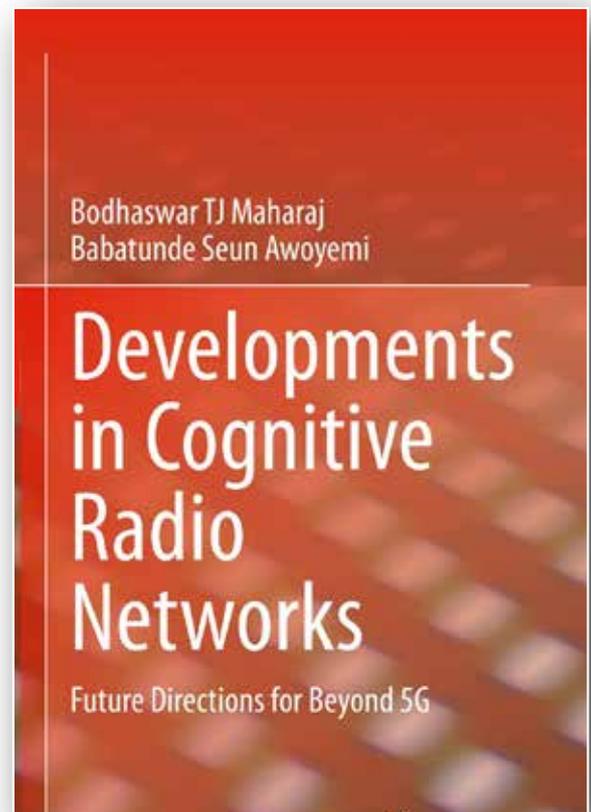


Prof. Sunil Maharaj and Dr Babatunde Awoyemi of the **Department of Electrical, Electronic and Computer Engineering,**

collaborated to publish a holistic yet concise book, *Developments in Cognitive Radio Networks*. In this work, they explain what modern cognitive radio networks are, how they function, and their possible future directions.

The book contains in-depth discussions on the key tools (such as optimisation and queuing theory) and techniques (such as cooperative diversity and relaying) that are being employed to formulate resource problems, investigate solutions, and interpret such solutions for useful and practical modern cognitive radio networks realisation.

Further, the effects of modern cognitive radio networks on other



emerging technologies, such as 5G, Internet of Things, and advanced wireless sensor networks are analysed. In addition, the role that cognitive radio networks play in the evolution of smart cities and in the realization of a highly interconnected world is discussed. ■

Re-establishing silviculture in South Africa

—• Prof. Paxie Chirwa

Forest Chair and Director of the Forest Science Postgraduate Programme in the Faculty of Natural and Agricultural Sciences



A team led by doctoral student, **Muedanyi M Ramantswana**, and including **professors Paxie Chirwa** and **Michal Brink** of the **Department of Plant and Soil Science**, together with colleagues from Nelson Mandela University (NMU) and Italy analysed the perspectives and drivers of the modernisation of silviculture re-establishment in South Africa.

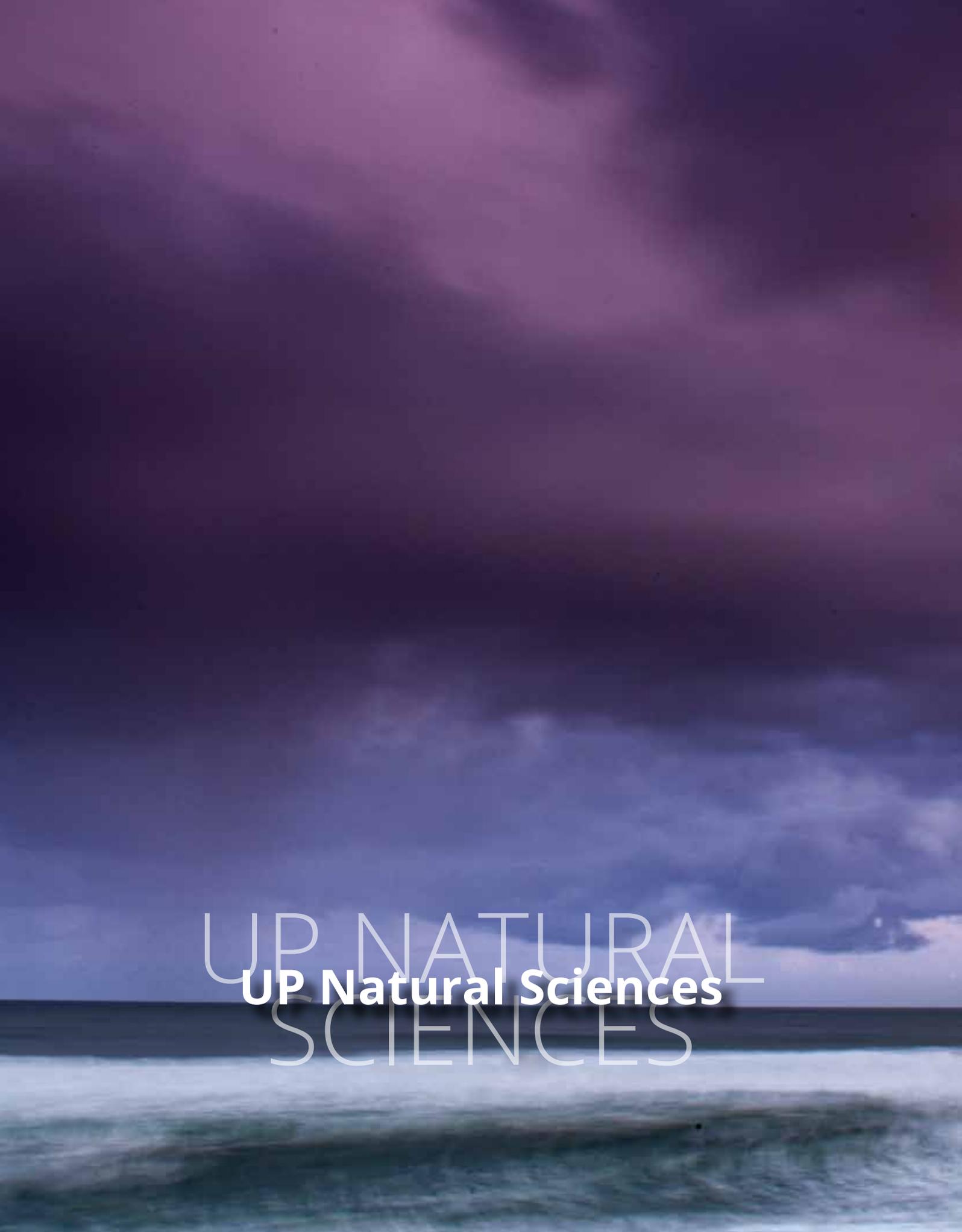
Efficient and cost-effective re-establishment practices are important aspects of any sustainable forest re-establishment programme. Re-establishment activities include residue management (post-harvest slash), preparation of a planting position, planting, fertilisation and vegetation management. In South Africa, these activities are labour intensive, time-consuming and relatively costly. Although mechanisation of site preparation during afforestation was achieved in the mid- to late-1990s, plantation re-establishment operations in South Africa have remained manually oriented.

However, over the past decade, notable technology developments have taken place. Semi-structured interviews were conducted with 66 experts (grower company specialists, foresters, contractors and machine manufacturers) to obtain their perspectives on modernisation of re-establishment activities in South Africa. Frequency distribution and

chi-square test analysis indicated that two-thirds of the experts believed that re-establishment activities had progressed in terms of technology over the past decade. This development was reported as being primarily due to the need to improve health and safety (91%), increase production whilst reducing costs (89%), improve stand productivity (quality) (86%), mitigate social (mainly labour

risks (80%) and reduce prevalent negative environmental impacts (50%). Key barriers to modernisation were identified as the capital cost of equipment (65%), reduction in employment opportunities (44%) and low utilisation of equipment owing to the seasonality of silviculture work (18%). The experts indicated that the efficiency of mechanised re-establishment equipment could be affected negatively by residues, high stumps and compaction of the site after harvesting. The results of this study will assist forestry stakeholders in making informed decisions when planning and implementing modernised silviculture operations. ■





UP Natural Sciences

UP NATURAL
SCIENCES

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Mortality among birds and bats during an extreme heat event in eastern South Africa

—● Prof. Andrew McKechnie
 South African Research Chair in Conservation Physiology

As the earth warms, so heat-related mortality events involving birds and bats are expected to occur more frequently. In the past decade, reports of mass mortalities have emanated from Australia, mostly involving birds and fruit bats (colloquially known as flying-foxes).



In a collaboration with colleagues from Ezemvelo KZN Wildlife and the FitzPatrick Institute of African Ornithology, **Prof. Andrew McKechnie** of the **Department of Zoology and Entomology** reported a mortality event involving approximately 110 birds and fruit bats in eastern South Africa in early November 2020 when maximum air temperatures reached 43–45°C and relative humidity was between 21 and 23%.

The mortalities included 47 birds of 14 species, all but three of which were passerines (perching birds), and about 60 Wahlberg’s Epauletted fruit bats. The die-off of songbirds occurred at the Phongolo Nature Reserve in northern KwaZulu-Natal while the bat mortalities were recorded in the town of Pongola

and nearby Hluhluwe. This mortality event occurred on a single very hot day preceded by several cooler days and involved weather conditions similar to those associated with at least one recent flying-fox die-off in Australia.

The disproportionately high representation of passerines among the bird mortalities supports recent predictions that songbirds are more vulnerable to lethal hyperthermia on account of the relative inefficiency of panting as an avenue of evaporative heat dissipation in smaller birds. This appears to be the first documented heat-related mortality event involving wild birds and bats in southern Africa. ■

Adapted from an article that first appeared in the journal, Austral Ecology, in March 2021.

Fencing-in of Botswana elephants could explain massive die-off

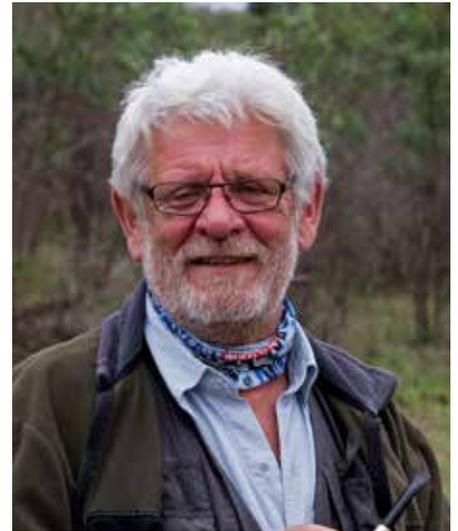
—• Prof. Rudi van Aarde
Emeritus Professor of Zoology and Chair of Conservation Ecology

The death of 350 savannah elephants in May–June 2020 reported by Botswana sparked speculation among conservationists and the public about the cause of their demise.

Carcasses were first found in the Okavango Panhandle region. Samples from the carcasses were tested by scientists in Zimbabwe, the USA, and at the UP Faculty of Veterinary Science.

An international study led by Emeritus Professor of Zoology and Chair of Conservation Ecology, **Prof. Rudi van Aarde**, suggested that the mass die-off could be ascribed to the fencing-in of these animals. While the causes of the deaths are still unknown and will probably

never be known, the fencing-in of these animals in one area, and their relatively high densities, probably explain why the die-off occurred. The study indicates that a re-alignment or removal of fences that restrict elephant movements and limits year-round access to freshwater is required. Restriction of access to freshwater supplies that forces elephants to use pans as a water source possibly polluted by blue-green algae blooms is a possible cause of the deaths; however, as yet this theory is not supported by



evidence. The location where the die-off occurred is not in a conservation area. Moreover, human–elephant conflict is high, leading to elephants avoiding the permanent freshwater sources along which people live. As part of the team’s long-running research programme, which considers regional elephant populations and their management, 10 elephants within an administrative district in northern Botswana, where elephants and people share the land, were tracked using satellite tracking collars fitted on the elephants to map their movements. The elephants in this area are isolated by the Okavango River to the southwest and by fences on the other sides, preventing their dispersal when numbers are high or when conditions become harmful.

The study contends that restricting their movements made this sudden die-off of the elephants much more likely. A team comprising UP and Pakistani scientists, including Prof. Van Aarde, deduced last year that malicious poisoning and poaching are unlikely to have played a role. Other species were unaffected, and the tusks of elephant carcasses were intact. ■

This article is adapted from a piece that first appeared in on the UP website in July of 2021.





UP scientist a member of global team that discovered world's largest fish breeding colony in Antarctica

—• Dr Mia Wege

Department of Zoology and Entomology

Dr Mia Wege of the Department of Zoology and Entomology

was a member of an international research team that made a ground-breaking discovery of the world's largest fish breeding colony in the southern Weddell Sea in Antarctica. Dr Wege was on board the German research vessel Polarstern as a member of a multinational collaborative research team from the Alfred Wegener Institute (AWI) and the Helmholtz Centre for Polar and Marine Research.



The breeding colony of notothenioid icefish discovered by the research team is the highest density of fish nests ever encountered globally. The breeding colony stretches some 240 km².

Using the Ocean Floor Observation and Bathymetry System, a state-of-the-art towed camera system 500 m below the sea surface, thousands of 75 cm-wide nests were discovered near the seafloor, each occupied by a single adult icefish, as well as scores of fish eggs.

Owing to the way the currents flow and the presence of underwater troughs in this area of the Weddell Sea, slightly warmer waters (although still very cold at -1 °C to 0 °C) flow up onto the continental shelf. This creates the perfect breeding spot for the icefish, and vice versa — the fish support many other aspects of the local ecosystem. Fish carcasses contribute nutrients to the system and are most likely a source of food for Weddell seals. Historic and newly collected Weddell satellite tracking data indicated that seals are



spending up to 90% of their time over the fish nests area.

In a separate but related study, Dr Wege, together with colleagues from the US and New Zealand, examined the life-histories of Weddell (WES) and Crabeater (CES) seals and the potential effects that climate change might have on them. The team used a unique data set of the seals' breeding season distribution in the Weddell Sea, determined from satellite imagery using thousands of citizen scientists.

The researchers were able to contrast the theoretical climate effects on both ice-obligate predators who differ in life-history characteristics: CESs are highly specialised Antarctic krill predators and breed in the seasonal pack ice, whereas Weddell

seals (WESs) are generalist predators and breed on comparatively stable fast ice. The team used presence-absence data and a suite of remote sensing environmental variables to build habitat models. Each of the environmental predictors was multiplied by a 'climate change score' based on known responses to climate change to create a 'change importance product'.

The results show that CESs are more sensitive to climate change than WESs. Crabeater seals prefer to breed close to krill, and the compounding effects of changing sea ice concentrations and sea surface temperatures, the proximity to krill and abundance of stable breeding ice, could influence their post-breeding foraging success and ultimately their future breeding success. In contrast to the Ross Sea, here WESs prefer to breed closer to

larger colonies of emperor penguins. This suggests that the Weddell Sea could currently be prey abundant, allowing the only two air-breathing Antarctic silverfish predators (WESs and emperor penguins) to breed closer to each other.

To round off a most productive year, Dr Wege led another first-of-its-kind study that was published in *Frontiers in Marine Science*. Dr Wege and her team provided the first habitat models investigating potential climate change effects on Ross seals in Antarctica. Ross seals are the least studied, smallest and least abundant of all the large Antarctic marine predators. The UP-funded study has collected the most data on Ross seals in a single study ever. ■

This article is adapted from a piece first published on the UP website in Jan 2022





South African bats are losing their trees

—• Dr Mariette Pretorius
Centre for Viral Zoonoses

Research by **Dr Mariette Pretorius**, a postdoctoral researcher at the **Centre for Viral Zoonoses** and the **Mammal Research Institute**, highlights why the current lack of cave-specific conservation in South Africa is significant.

Tree loss results in habitat fragmentation and decreased food availability for bats, whilst agricultural and urban intensification exposes bats to pesticides and other pollutants. These factors could have far-reaching consequences for bat health and survival. In an era where land cover change increases the likelihood of pandemics, this research is an important step towards the formal protection of bat-inhabited caves to safeguard both bats and humans.

Worldwide, tree harvesting is causing the destruction of natural habitat, bringing wild animals like bats into closer contact with humans than ever before. Notably, habitat destruction is the leading cause for new emerging zoonotic diseases. In South Africa, at least two species are being studied for their variety of potentially zoonotic viruses, namely the Natal Long-fingered bat and the Egyptian

Rousette bat. These are cave-dwelling species that are widespread throughout the country. However, current population trends are unknown and no formal conservation actions are being taken to safeguard the bats or their caves.

Dr Pretorius investigated some of the anthropogenic pressures these species face around their caves. Using land-cover datasets from the Department of Environmental Affairs, she determined the extent of land-cover change within five kilometres around 47 bat-inhabited caves between 2014 and 2018. The results show an overall 4% decrease in trees around all caves, whilst agricultural and urban areas increased by 2.13% and 0.96%, respectively. Moreover, most roosts are not located in protected areas, leaving caves vulnerable to disturbance, vandalism and destruction. ■



Cultural transmission of vocal dialect in the naked mole-rat

—• Prof. Nigel Bennett

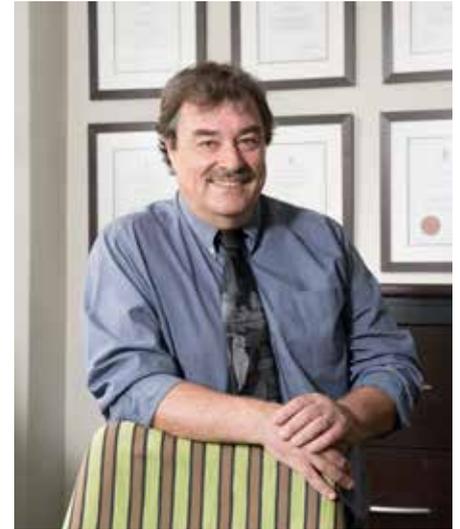
Austin Roberts Chair of African Mammalogy and DST/NRF Research Chair in Mammalian Behavioural Ecology and Physiology

—• Dr Daniel Hart

Postdoctoral researcher in the Department of Zoology and Entomology

Yet, how they maintain this highly organized social structure is unknown. In an international collaboration with colleagues from Germany, **Prof. Nigel Bennett** and **Dr Daniel Hart** showed that the most common naked mole-rat vocalization, the soft chirp, is used to transmit information about group membership — creating distinctive colony dialects. Audio playback experiments demonstrated that individuals make preferential vocal

responses to home colony dialects. Pups fostered in foreign colonies in early postnatal life learn the vocal dialect of their adoptive colonies, which suggests vertical transmission and flexibility of vocal signatures. Dialect integrity is partly controlled by the queen. As a result, dialect cohesiveness decreases when the queen is lost and reemerges only with the ascendance of a new queen. ■



Naked mole-rats form some of the most cooperative groups in the animal kingdom, living in multigenerational colonies under the control of a single breeding queen.





Female Seals that Breed Young Also Enjoy a Slower Rate of Aging

- Dr Chris Oosthuizen
Mammal Research Institute,
Department of Zoology and Entomology
- Prof. Nico de Bruyn
Mammal Research Institute,
Department of Zoology and Entomology



Four decades of research into the breeding habits of Southern Elephant Seals culminated in 2021. The research was conducted by the Marion Island Marine Mammal Programme, headed by Prof. Nico de Bruyn of the Department of Zoology and Entomology.





Unique capture–recapture data of female Southern Elephant Seals were used for the programme. The data were collected over the entire study period for assessing whether the onset and rate of actuarial senescence (the increase in mortality hazards with age) correlated with the age of first reproduction.

The analyses took into account that some breeding attempts and all deaths go undetected. The team found that early reproduction correlated positively with survival in both the short and the long term. Females with an early age of first reproduction had lower rates of senescence and produced more offspring than those that delayed breeding.

The research was led by Dr Chris Oosthuizen and the findings were published in *Ecology* journal in 2021. ■

Adapted from an article that first appeared in the Bulletin of the Ecological Society of America, in April 2021.



Stress levels in bushbabies in the Soutpansberg

—● Channon Long

Department of Paraclinical Sciences, Faculty of Veterinary Science

Global non-human primate populations show dramatic declines owing to climate change, land transformation and other anthropogenic stressors. Therefore, it is imperative to study physiological responses to environmental change to understand primate adaptability and enhance species conservation strategies.



A team of University researchers including **Channon Long** and **Prof. Adrian Tordiffe (Department of Paraclinical Sciences)**, **Prof. Andre Ganswindt (Department of Zoology and Entomology)** and the **Mammal Research Institute** and **Dr Juan Scheun**, a postdoctoral fellow with the **Department of Life and Consumer Sciences**, joined forces with colleagues from the US to examine these responses in thick-tailed greater galagos.

The focus was on the effects of seasonality on faecal glucocorticoid metabolite (fGCM) concentrations of free-ranging galagos in the Soutpansberg Mountains of Limpopo. Analysing fGCM provides a non-invasive method for studying the physiological response of wildlife to various stressors.

Faecal samples were collected each month over the course of a year from free-ranging males and females. Multivariate analyses revealed that the lactation period was a driver of fGCM levels, whereas sex and food availability mainly influenced seasonal fGCM concentrations in the total population. To date, the results of this study show that the drivers of fGCM levels, an indication of increased stress levels in these galagos, are numerous and complex within the natural environment.

The species may be adapted to such conditions and an extreme change to any one component could result in elevated fGCM levels. These results increase the understanding of galago physiology and offers initial insights into species adaptability to a challenging environment. ■



Using standard digital cameras to map how tall structures threaten birds

—• Prof. Nico de Bruyn
Department of Zoology and Entomology

—• Nicolas Prinsloo
Department of Zoology and Entomology

A research group, led by **Prof. Nico de Bruyn** of the **Department of Zoology and Entomology**, is mapping bird flight height in three dimensions (3D), using standard digital cameras. The aim is to improve understanding of how birds fly near tall structures, such as wind turbines.

Birds are regularly struck and killed by wind turbines on local wind farms. Therefore, this research could eventually help protect various vulnerable bird species, including our national bird, the blue crane.

The technology employed is known as stereophotogrammetry. PhD

student, **Nicolas Prinsloo**, used photographs captured from at least three different perspectives and sophisticated software to create a 3D representation of a scene. The team is able to measure the flight heights of birds using affordable camera equipment. This method is cheaper and simpler than previous methods.

To assess the practicality of their photogrammetry method, Prinsloo and his team set up three cameras at the LC de Villiers sports ground of the University of Pretoria. Using photogrammetry, the researchers measured the flight heights of the birds flying over the sports field. The team compared the practicality and accuracy of the method against laser-based rangefinders on rugby poles and floodlights. Photogrammetry can capture numerous birds simultaneously in a wide field of view, whereas a rangefinder has to be manually pointed at one bird at a time. They found that photogrammetry is not only cheaper



and more effective to use than range finders but also the technique is more accurate, particularly for measuring small targets. The bird flight heights were measured precisely to within 10 cm from distances up to 275 m. In contrast, rangefinders are often accurate to within 1m at similar distances.

Prinsloo foresees the technology being used in impact assessments to protect threatened birds such as the blue crane and the vulnerable Cape vulture in areas where wind turbines could be constructed. ■

This article is adapted from a piece that first appeared in on the UP website in July of 2021.



The eating habits of black holes

—● Dr Jack Radcliffe
Department of Physics

The team, which included astronomers from the Netherlands and the United Kingdom, concluded that central black hole growth could occur in many types of galaxies.

The research is important for multiple reasons. It is now well established that an intimate link exists between the creation of new stars and the growth of the central black hole within the same galaxy. However, there must be some interaction or 'feedback' between the two to facilitate the link. This interaction derives from bright radiation emitted by the central black hole.

This is a crucial area of research in astronomy, as the Universe seen today is dependent upon the interaction between these two processes. This research is important, as it shows that new-generation radio telescopes, such as MeerKAT will play

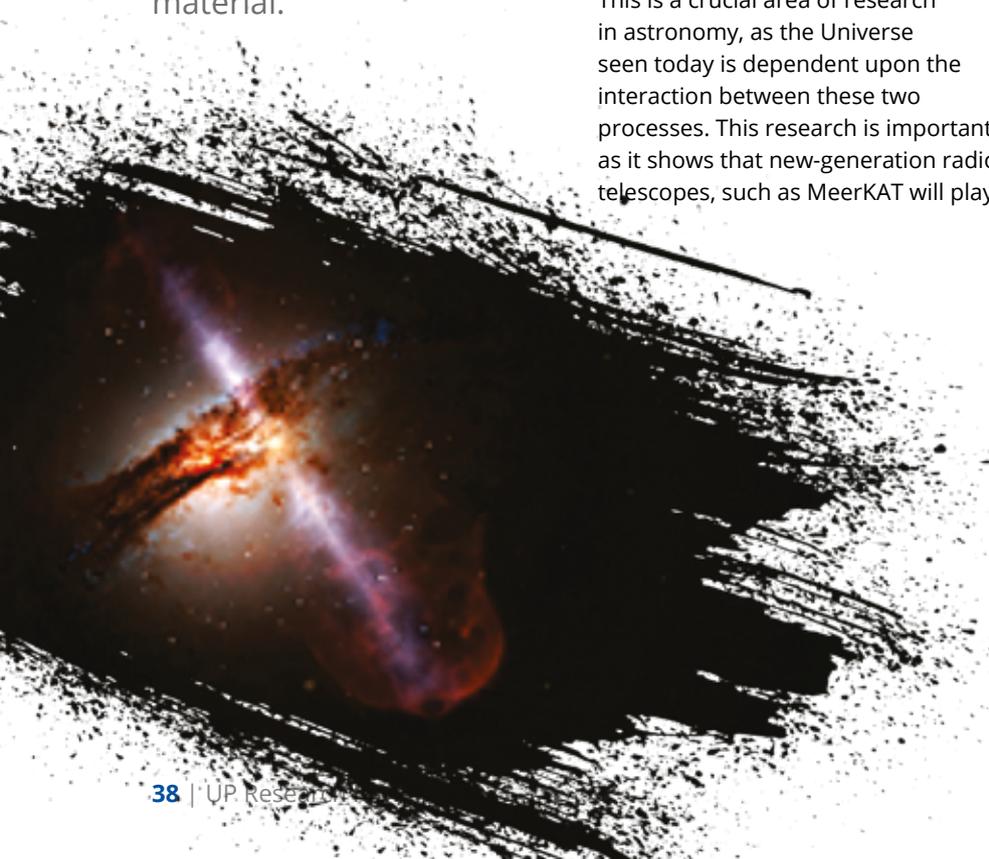
a crucial role in disentangling the link between such processes.

Dr Radcliffe's team showed that some of these objects will remain undetectable in such studies. Moreover, the team showed, for the first time, that the radio jets — comprising fast-moving particles travelling near the speed of light from the black hole and a crucial component of this 'feedback' mechanism — are optional. Occasionally an accretion or eating phase occurs simultaneously with stars being created, which is then difficult to detect, and the nuclear accretion process could or could not generate radio jets. These jets are important in the evolution of galaxies because they heat gas, which prevents stars from being formed. On the other hand, the same jets can cause turbulence, which causes gas to collapse to form new stars. Accordingly, these jets can essentially regulate how many stars are formed.

The research was published as a series of two papers in the international journal *Astronomy & Astrophysics*. It entailed a systematic study of the occurrence and nature of nuclear activity in galaxies. The team investigated issues that included: 'Which types of galaxies do the central black holes start eating?'; 'How does this manifest itself?'; and 'What is the best way to detect these eating phases in galaxies?' ■

Based on an article that first appeared on the UP website in April, 2021.

Research by an international team of scientists led by **South African Radio Astronomy Observatory** postdoctoral fellow, **Dr Jack Radcliffe**, has clarified the manner in which massive black holes consume surrounding material.



Using MeerKAT to discover a large group of gas-rich galaxies

—• Prof. Roger Deane
Department of Physics

A study led by **Shilpa Ranchod**, an MSc student in the **Department of Physics** under supervision of **Prof. Roger Deane** of the **Radio Astronomy Research Group**, using South Africa's MeerKAT telescope leads to the discovery of a group of 20 galaxies.

This large galaxy group is likely the most neutral hydrogen gas-rich group ever discovered. This is the first time the group has been identified, despite residing in a well-studied area of the sky.

The distribution of neutral hydrogen gas in these galaxies has revealed interesting disturbed morphologies, suggesting that the galaxies are group members and are being influenced by their cosmic neighbours in the group. For example, an interacting pair of galaxies was found that will potentially merge to form a new galaxy with a completely transformed appearance.

The MeerKAT observations show a galaxy group in its early stages of formation, which is extremely rare. The group was, therefore, able to understand how galaxy groups are assembled and evolve. This galaxy group inhabits an area of sky that has been studied with many other telescopes, but the group structure has been revealed for the first time because of the excellent sensitivity of MeerKAT.

Most galaxies in the Universe reside in groups. However, it is rare to detect a group with such a large number of group members with so much neutral hydrogen. This suggests that the group is still in the process of assembly, as it has not undergone evolutionary processes that would remove the gas from the galaxies.

The galaxy group was discovered by the MeerKAT International Gigahertz Tiered Extragalactic Exploration (MIGHTEE) survey. This is one of the large survey projects in progress using the MeerKAT telescope, and involves a team of South African and international astronomers.

The galaxy group described in this study was found in a survey that produces hundreds of terabytes of data. The data were processed via the cloud computing facility hosted by the inter-university Institute of Data-Intensive Astronomy (IDIA), a partnership between the Universities of Pretoria, Cape Town, and the Western Cape.



Ranchod has subsequently been awarded the prestigious International Max Planck Research School Scholarship to conduct PhD research in Bonn, Germany, at the Max Planck Institute for Radio Astronomy. ■

This piece is adapted from an article that first appeared on the UP website in June 2021.



Increased abundance of secreted hydrolytic enzymes and secondary metabolite gene clusters define the genomes of latent plant pathogens in the *Botryosphaeriaceae*

—● Dr Jan Nagel

Postdoctoral fellow Department of Biochemistry, Genetics and Microbiology, Forestry and Agricultural Biotechnology Institute (FABI)

—● Prof. Mike Wingfield

Founding Director of FABI

—● Prof. Bernard Slippers

Director of FABI

The *Botryosphaeriaceae* are important plant pathogens, but also have the ability to establish asymptomatic infections that persist for extended periods in a latent state.

Dr Jan Nagel, Prof. Mike Wingfield and **Prof. Bernard Slippers**, all of the **Department of Biochemistry, Genetics and Microbiology, Forestry and Agricultural Biotechnology Institute (FABI)** used comparative genome analyses to shed light on the genetic basis of the interactions of these fungi with their plant hosts.

For this purpose, they characterised secreted hydrolytic enzymes,

secondary metabolite biosynthetic gene clusters and general trends in genomic architecture using all available *Botryosphaeriaceae* genomes, and selected *Dothideomycetes* genomes.

The *Botryosphaeriaceae* genomes were rich in carbohydrate-active enzymes (CAZymes), proteases, lipases and secondary metabolic biosynthetic gene clusters (BGCs) compared with other *Dothideomycete* genomes. The genomes of *Botryosphaeria*, *Macrophomina*, *Lasiodiplodia* and *Neofusicoccum*, in particular, had gene expansions of the major

constituents of the secretome, notably CAZymes involved in plant cell wall degradation.

The abundance of secreted hydrolytic enzymes and secondary metabolite BGCs in the various genomes were similar to those in necrotrophic plant pathogens and some endophytes of woody plants. The results provide a foundation for comparative genomic analyses and hypotheses to explore the mechanisms underlying *Botryosphaeriaceae* host-plant interactions. ■

The Welwitschia genome reveals a unique biology underpinning extreme longevity in deserts

—• Prof. Yves de Peer

Centre for Microbial Ecology and Genomics, Department of Biochemistry, Genetics and Microbiology



Welwitschias belong to the ancient, enigmatic gnetophyte lineage that includes plants often found in extremely dry or high-altitude environments. The Welwitschia is a unique desert plant with extreme longevity and two ever-elongating leaves.

Prof. Yves de Peer of the **Centre for Microbial Ecology and Genomics** in the **Department of Biochemistry, Genetics and Microbiology** joined a team of Chinese, European, Namibian and British researchers in presenting a chromosome-level assembly of the Welwitschia genome, together with methylome and transcriptome data for exploring its astonishing biology.

controlling cell growth, differentiation and metabolism underpin the plant's longevity and tolerance to temperature, nutrient and water stress. ■

This piece is adapted from an article that first appeared in Nature Communications in July 2021

They also presented a refined, high-quality assembly of the Asian vine, *Gnetum montanum* to enhance understanding of gnetophyte genome evolution. The Welwitschia genome has been shaped by a lineage-specific ancient, whole genome duplication (~86 million years ago) and more recently (1–2 million years) by bursts of retrotransposon activity. High levels of cytosine methylation (particularly at CHH motifs) are associated with retrotransposons, whilst long-term deamination has resulted in an exceptionally GC-poor genome. Changes in copy number and/or expression of gene families and transcription factors





Flower orientation influences floral temperature, pollinator visits and plant fitness

— Dr Nicky Creux

Forestry and Agricultural Biotechnology Institute (FABI),
Department of Plant and Soil Science



Dr Nicky Creux of the **Forestry and Agricultural Biotechnology Institute (FABI)** in the **Department of Plant and Soil Sciences**, together with a strong team of US researchers investigated how this orientation affects floral microclimate and the consequent effects on plant and pollinator interactions and reproductive fitness.

The team artificially manipulated sunflower capitulum orientation and temperature in both field and controlled conditions, and assessed flower physiology, pollinator visits, seed traits and siring success.

East-facing capitula were found to have earlier style elongation, pollen presentation and pollinator visits compared with capitula manipulated to face west. East-facing capitula also sired more offspring than west-facing capitula and, under some conditions, produced heavier and better-filled seeds. Local ambient temperature change on the capitulum was indicated a key factor regulating the timing of style elongation, pollen emergence and pollinator visits.

These results indicate that eastward capitulum orientation helps to control daily rhythms in floral temperature, with direct

consequences on the timing of style elongation and pollen emergence, pollinator visitation, and plant fitness. ■

This piece is adapted from an article that first appeared in New Phytologist in July 2021

Effective insect pollination requires appropriate responses to internal and external environmental cues in both the plant and the pollinator. Domesticated sunflowers are not fully reliant on outcrossing but benefit greatly from cross pollination and are marked for their uniform eastward orientation of the flower heads (capitula).



Detailed scans of Little Foot

—• Dr Amélie Beaudet
Department of Anatomy

Numerous aspects of early hominin biology remain debated or simply unknown. However, recent developments in high-resolution imaging techniques have opened new avenues in the field of palaeoanthropology.

More specifically, X-ray synchrotron-based analytical imaging techniques can potentially provide crucial details on the ontogeny, physiology, biomechanics, and biological identity of fossil specimens.

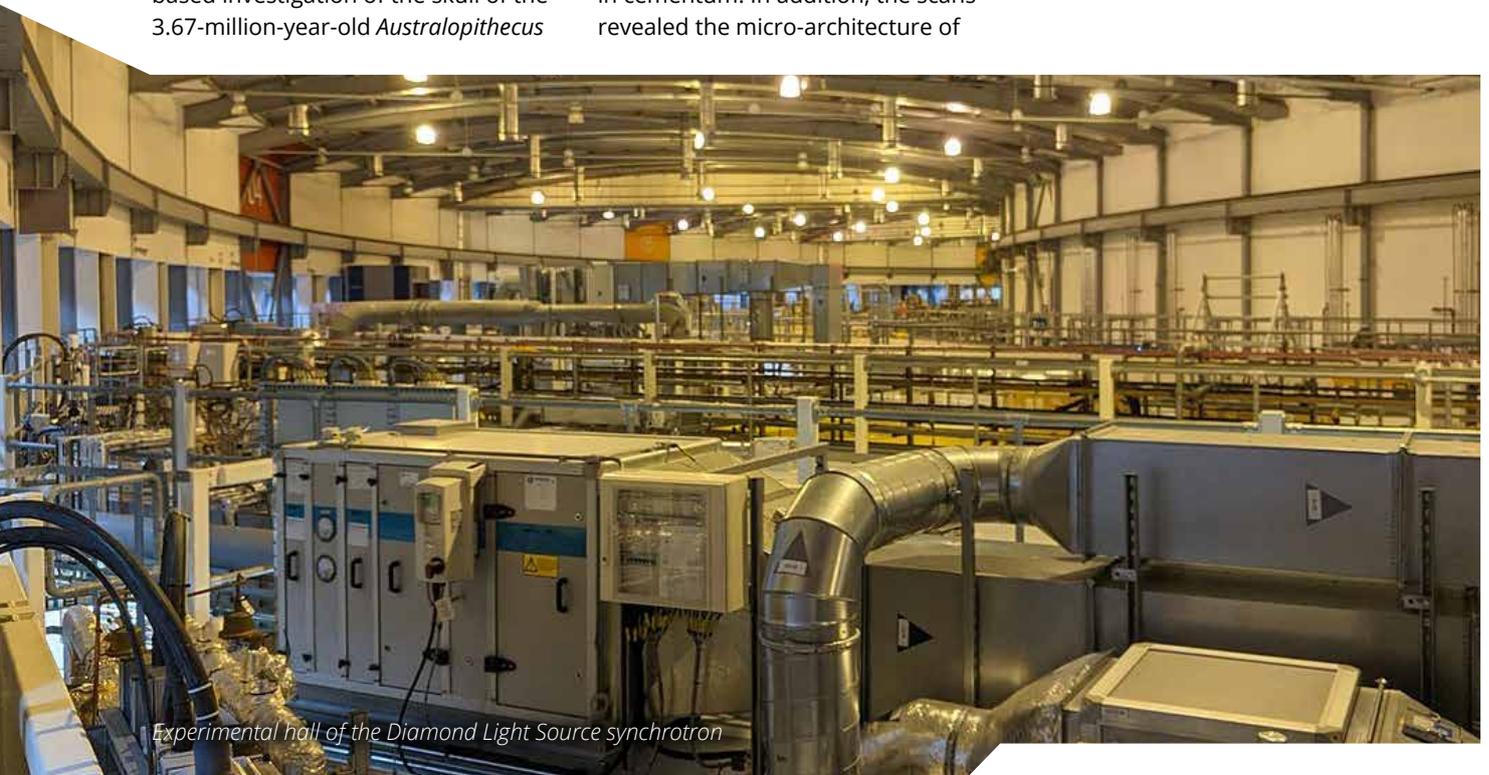
Dr Amélie Beaudet of the **Department of Anatomy** led a team of South African and international researchers in an X-ray synchrotron-based investigation of the skull of the 3.67-million-year-old *Australopithecus*

specimen StW 573 ('Little Foot'). The scans were undertaken using the I12 beamline of the Diamond Light Source at the United Kingdom national synchrotron science facility, located at the Harwell Science and Innovation Campus.

The scans were able to show fine details of the tooth enamel, including evidence of hypoplasia and the incremental lines evident in cementum. In addition, the scans revealed the micro-architecture of

the cranial bone such as the diploic channels. The investigation also revealed for the first time the 3D spatial organisation of the Haversian systems in the mandibular symphysis of an early hominin, allowing sophisticated inference of the soft tissue architecture associated with the bone structures scanned. ■

Adapted from an article that first appeared in eLife in May 2021



Experimental hall of the Diamond Light Source synchrotron



Armillaria root rot fungi host single-stranded RNA viruses

- Prof. Martin Coetzee
Department of Biochemistry, Genetics and Microbiology, Forestry and Agricultural Biotechnology Institute (FABI)
- Dr Tuan Duong
Department of Biochemistry, Genetics and Microbiology, FABI
- Prof. Brenda Wingfield
Department of Biochemistry, Genetics and Microbiology, FABI

Species of the fungus *Armillaria* are distributed globally and include some of the most important pathogens of forest and ornamental trees.

Some of them form large long-living clones that are considered one of the largest organisms on Earth and are capable of long-range spore-mediated transfer, as well as vegetative spread by drought-resistant hyphal cords, similar to plant roots, called rhizomorphs. However, the virus community infecting these species has remained unknown.

Prof. Martin Coetzee, Dr Tuan Duong and Prof. Brenda Wingfield, all of the **Department of Biochemistry, Genetics and Microbiology** in the **Forestry and Agricultural Biotechnology Institute (FABI)** joined researchers from Finland and Russia in using double-stranded RNA (dsRNA) screening and high-throughput sequencing to search for possible virus infections in a collection of *Armillaria* isolates representing three different species, namely *Armillaria mellea* from South Africa, *A. borealis* from Finland and Russia (Siberia) and *A. cepistipes* from Finland.

Their analysis revealed the presence of both negative-sense RNA viruses and positive-sense RNA viruses, whereas no dsRNA viruses were detected. The viruses included putative new members of three virus families and members of a recently discovered virus group tentatively named “ambiviruses”, with ambisense bicistronic genomic organisation. These are viruses that contain at least one RNA segment that is in part of positive and in part of negative polarity and have two loci responsible for generating a protein bicistronic transcription.

The team demonstrated that *Armillaria* isolates could be cured of viruses by thermal treatment, which enables the examination of virus effects on host growth and phenotype using isogenic virus-infected and virus-free strains. ■

Adapted from an article that first appeared in Nature in April 2021

Microbial energy acquisition in the cold desert soils of Antarctica

- Dr Maximiliano Ortiz
Centre for Microbial Ecology and Genomics,
Department of Biochemistry, Genetics and Microbiology
- Prof. Don Cowan
Centre for Microbial Ecology and Genomics
Department of Biochemistry, Genetics and Microbiology

A high diversity of microbial life has been detected in the cold desert soils of Antarctica, once thought to be barren.

Prof. Don Cowan, Dr Max Ortiz and a substantial team from the **Centre for Microbial Ecology and Genomics, Department of Biochemistry, Genetics and Microbiology** joined an international group of researchers to provide metagenomic, biogeochemical and culture-based evidence that Antarctic soil microorganisms are phylogenetically and functionally distinct from those in other soils and adopt various specialised metabolic and ecological strategies.

The team profiled the composition, capabilities, and activities of the microbial communities in 16 physiochemically diverse mountainous and glacial soils. They gathered 451 metagenome-assembled genomes from 18 microbial phyla and inferred that the dominant lineages present are likely native to Antarctica. In support of earlier findings, metagenomic analysis revealed that the most abundant and prevalent microorganisms are metabolically versatile aerobes

that use atmospheric hydrogen to support energy acquisition and drive carbon fixation. Surprisingly, hydrogen oxidation in these microbiomes was catalysed primarily by a phylogenetically and structurally distinct hydrogenase enzyme, encoded by nine bacterial phyla. Metagenomic analyses conducted by Dr Ortiz first identified this new clade of assimilatory hydrogenases.

Using gas chromatography, the team provided clear quantitative evidence that both Antarctic soil communities and an axenic *Bacteroidota* isolate oxidized atmospheric hydrogen using this enzyme. They also calculated that atmospheric hydrogen oxidation was theoretically sufficient for soil communities to meet energy requirements and, through metabolic water production, sustain hydration.

This study has helped support the concept of a new trophic paradigm for soil microbiomes. Where phototrophs, which capture energy from light, are in low abundance or even absent, it appears that



microbial communities could be sustained by acquiring energy from atmospheric trace gasses, particularly hydrogen and carbon monoxide. Even more exciting is the suggestion that microbial hydrogen oxidation in desert soil communities could actually contribute water to support microbial hydration. Desiccation is the dominant constraint on microbial functionality in desert soils. ■

Adapted from an article that first appeared in PNAS in November 2021



Using bulrush extract to combat parasitic worms

- Dr Moise Ondua
Department of Paraclinical Sciences
- Dr Emmanuel Njoya
Department of Paraclinical Sciences
- Dr Muna Ali Abdalla
Department of Paraclinical Sciences
- Prof. Lyndy McGaw
Department of Paraclinical Sciences

A team from the **Phytomedicine Programme** of the **Department of Paraclinical Sciences**, comprising **Dr Moise Ondua, Dr Emmanuel Njoya, Dr Muna Ali Abdalla** and **Prof. Lindy McGraw** determined in vitro anthelmintic activity of plant extracts of eleven plant species used traditionally in South Africa to treat various disorders, including symptoms related to nematode infections. In addition, they hoped to isolate bioactive compounds from the most active plant extract.

Crude plant extracts were tested at different life-cycle stages of *Haemonchus contortus*, a pathogenic nematode that infects ruminants. The infection, called haemonchosis, causes substantial economic losses for farmers around the world, particularly for those living in warmer climates.

The cytotoxicity of the most active extracts, fractions and compounds

was evaluated on Vero cells, and the most potent extract, fractions and compounds were tested for their ability to kill the parasitic *H. contortus* and the free-living nematode *Caenorhabditis elegans*. Acetone extract from the common bulrush (*Typha capensis*) had the strongest egg hatching inhibitory effect and was also effective in halting larval development of *H. contortus*.

Typha capensis crude extract and its butanol fraction showed promising anthelmintic (anti-parasitic worm) activity against both nematodes studied. The identification of bioactive compounds from the *T. capensis* crude extract supports development of this extract as a complementary or alternative treatment against haemonchosis. ■

Adapted from an article that first appeared in Parasitology Research in August 2021

Examining the anthelmintic, antimycobacterial, antifungal, larvicidal and cytotoxic activities of acetone leaf extracts from the Sneezewood tree

- Dr Thanyani Ramadwa
Department of Paraclinical Sciences
- Prof. Lyndy McGaw
Department of Paraclinical Sciences
- Prof. Mathew Adamu
Department of Paraclinical Sciences
- Dr Balungile Madikizela
Department of Paraclinical Sciences
- Prof. JN Eloff
Founder, Phytomedicine Programme, Department of Paraclinical Sciences

Ptaeroxylon obliquum (the Sneezewood or, in Xhosa, Umthati, the tree for which Umtata is named) is a commonly used medicinal plant in South Africa to treat parasitic infections in animals, tuberculosis (TB) and related symptoms, and other microbial infections.

A team from the **Phytomedicine Programme** of the **Department of Paraclinical Sciences** comprising **Dr Thanyani Ramadwa, Prof. Lyndy**

McGaw, Prof. Mathew Adamu, Dr Balungile Madikizela and Prof. JN Eloff studied the anthelmintic, antifungal, antimycobacterial, larvicidal and cytotoxic activities of the acetone leaf extract of the Sneezewood tree.

The team found that extracts from the plant performed well in activity against parasitic worms and, therefore, could support the ethnoveterinary use of this plant



against animal parasites in South Africa. However, aqueous extracts were not active, which is problematic, as the leaf extract was shown to display cytotoxicity. Cytotoxicity was determined using human liver (C3A) and Vero African green monkey kidney cell lines. *Obliquumol*, isolated from the leaves of the Sneezewood showed promise against opportunistic fungal pathogens. ■

Adapted from an article that first appeared in Journal of Ethnopharmacology in November 2021



Veterinary specialist performs what is believed to be the first neuroprosthesis on a horse in South Africa

—• Dr Juan Muñoz

Department of Companion Animal Clinical Studies

Dr Juan Muñoz in the **Department of Companion Animal Clinical Studies** and **Dr Felipe Corrêa**, the equine surgery resident at the **Faculty of Veterinary Sciences**, performed what is believed to be the first dynamic neuroprosthesis on a horse in South Africa.

The patient, a two-year-old racing filly, suffered from respiratory noise and exercise intolerance secondary to a laryngeal hemiplegia, which is one-sided paralysis of the larynx. The paralysis prevents the cartilage from opening the throat during inspiration. This leads to decreased airflow into the lungs owing to obstruction from the paralysed cartilage, which results in respiratory noise and exercise intolerance. Horses with this disease are called 'roarers' because they make a characteristic respiratory noise that sounds like 'roaring' during exercise.

The patient was brought to us, as she suffered from respiratory noise. An overground dynamic endoscopy was performed at the Onderstepoort Veterinary Academic Hospital that revealed a grade 3/4 left side laryngeal hemiplegia. This procedure is performed by inserting an endoscope into the nasal cavity to visualise the pharynx and larynx area. The horse is subsequently exercised and the data recorded in a computer located underneath the saddle. Playing the video back in slow motion allows visualisation and assessment of the functioning of the pharynx and larynx.



Classically, horses with laryngeal hemiplegia are treated by laryngoplasty and ventriculocordectomy under general anaesthesia. With the laryngoplasty, the paralysed cartilage is 'tied back' into an open position with a suture through an incision in the throat latch area. The suture acts as a 'prosthetic' for the paralysed muscle.

With the ventriculocordectomy, the ventricle and the vocal cord of the larynx are removed to widen the airway and reduce or eliminate the respiratory noise. The laryngoplasty is a nonphysiologic procedure and is associated with complications such

as chronic coughing or dysphagia. In cases diagnosed in the early stage of laryngeal hemiplegia, the cricoarytenoid dorsalis muscle is not paralysed completely and could be reinnervated with other healthy nerves from the neck to restore normal innervation and functionality. This particular filly was in an early stage of the disease and was treated with a combination of the above-mentioned techniques — called 'dynamic neuroprosthesis technique'.

The laryngoplasty (tie-back) was modified by placing a prosthesis with an anchor screw and metallic button, and the reinnervation of

the cricoarytenoid dorsalis muscle was performed with the C1-C2 cervical and accessory nerve. The ventriculocordectomy was performed with laser surgery under endoscopic control, thereby avoiding direct incision into the larynx. The surgery was performed with the patient in a standing position with sedation and local anaesthesia, thereby avoiding the risk and cost associated with general anaesthesia, such as prolonged recovery, orthopaedic injuries, myopathy or neuropathy.

In 2021, several surgical breakthroughs occurred in the **Department of Companion Animal Clinical Studies** that were firsts for South Africa. This included life-saving heart surgery on two dogs by **Dr Adriaan Kitshoff** and **Dr Ross Elliott** who used a ground-breaking approach that entails dilating the opening of a heart valve with a balloon. In addition, **Dr Elge Bester** and Dr Kitshoff conducted the first partial knee replacement on a cat in South Africa. ■

Adapted from an article that first appeared on the UP website in May 2021.





Tracking potentially toxic trace elements in savannah ecosystems

- Dr Andrea Webster
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Department of Zoology and Entomology
- Prof. Andre Ganswindt
Director, Mammal Research Institute,
Department of Zoology and Entomology
- Prof. Nigel Bennett
Austin Roberts Chair of African Mammalogy and DST/NRF
Research Chair in Mammalian Behavioural Ecology and
Physiology

The complex relationships between terrestrial mammals and their habitats make African ecosystems highly interactive environments. Increasing anthropogenic activities have distinctly altered the geochemical cycles and biochemical balance of potentially toxic elements (PTEs) within the environment. Potentially toxic elements have no established biological or physiological function.

Even when concentrations are too low to be individually effective, the combined action of multiple PTEs at low concentrations alone or in combination with other organic and synthetic chemicals could cause adverse physiological effects. **Dr Andrea Webster**, **Prof. Andre Ganswindt** (Director of the **Mammal Research Institute**) and **Prof. Nigel Bennett** (Austin

Roberts Chair of African Mammalogy and DST/NRF Research Chair in Mammalian Behavioural Ecology and Physiology), together with colleagues from Spain and the University of Stellenbosch used faeces collected in the field to non-invasively assess concentrations of PTE in 17 different wildlife species within protected areas of the savannah biome. The team investigated and





compared quantitative differences in PTE concentrations in terrestrial vertebrates occupying different trophic levels within Tswalu Kalahari Reserve (Northern Cape) and the Manyeleti Nature Reserve (Mpumalanga).

The results highlight that concentrations vary widely between individuals, that PTE concentrations

in wildlife are partly linked to underlying geological signatures, but that individual species characteristics, for example water dependence, social grooming or digging for insects affect the risk of toxicity. Overall, measured concentrations for some PTEs were four to six times higher than their respective means in some individuals. Additionally, when measured concentrations

from animal groups at both sites were compared, aluminium, arsenic, cadmium, lead, selenium and vanadium were significantly higher in carnivores than in other trophic groups. In addition to assessing PTE concentrations in wildlife, the team evaluated background concentrations of PTE in the environment. Sediment and corresponding vegetation samples were collected around 48 surface water points at the two reserves for assessment and comparison of 20 trace elements.

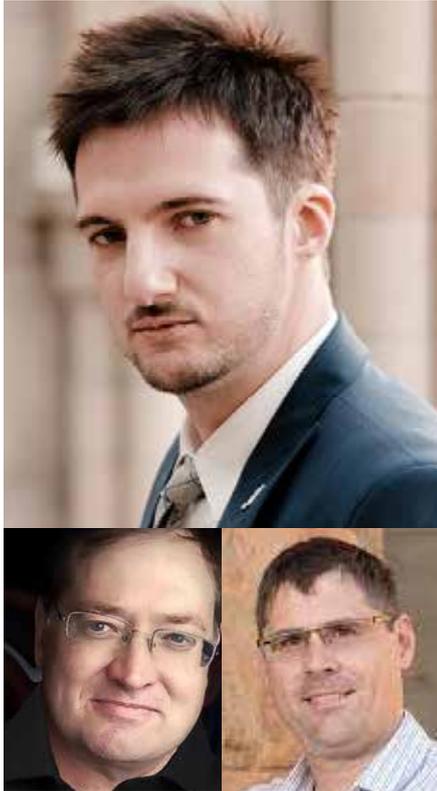
This is the first study to use faeces for non-invasive assessment of PTEs in free-ranging African wildlife. Although faecal analysis cannot tell the full story related to the presence and/or persistence of hazardous pollutants within terrestrial ecosystems, this approach could help identify high risk species and hot spots requiring more intensive monitoring within protected areas, thereby acting as an early warning system to reduce potentially devastating pollution events. ■





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Simulation-based optimisation of the timing of loan recovery across different portfolios

- Dr Arno Botha
Department of Actuarial Science
- Prof. Conrad Beyers
Absa Chair in Actuarial Science, Department of Actuarial Science
- Prof. JP de Villiers
Co-chair: Naspers Research Chair in Machine Learning,
Department of Electrical, Electronic and Computer Engineering

Dr Arno Botha and **Prof. Conrad Beyers** of the **Department of Actuarial Science**, together with **Prof. JP de Villiers** of the **Department of Electrical, Electronic and Computer Engineering** presented a novel procedure for the objective comparison and evaluation of a bank's decision rules for optimising the timing of loan recovery.

The procedure is based on finding a delinquency threshold at which the financial loss of a loan portfolio (or segment therein) is minimised. This is an expert system that incorporates the time value of money, costs, and the fundamental trade-off between accumulating arrears versus forsaking future interest revenue. Moreover, the procedure can be used with different delinquency measures (other than payments in arrears), thereby allowing an indirect comparison of these measures. The team demonstrated the system across a range of credit risk scenarios and portfolio compositions. The

computational results show that threshold optima could exist across all reasonable values of both the payment probability (default risk) and the loss rate (loan collateral). In addition, the procedure reacts positively to portfolios afflicted by either systematic defaults (such as during an economic downturn) or episodic delinquency (i.e. cycles of curing and re-defaulting). In optimising the recovery decision of a portfolio, the procedure better informs the quantitative aspects of a bank's collection policy than relying on arbitrary discretion alone.

In a related paper published in the *Journal of Credit Risk*, the team illustrated a theoretical method to determine the best time to forsake a loan such that the overall credit loss is minimised.

This was achieved by forecasting the future cashflows of a loan portfolio up to the contractual term, as a remedy to the inherent right-censoring of real-world incomplete

portfolios. Two techniques, a simple probabilistic model and an eight-state Markov chain, were used to forecast the cashflows independently. Both techniques were trained on different segments of residential mortgage data, provided by a large South African bank, as part of a comparative experimental framework.

Using their procedure, the authors helped to find a loss-optimal threshold at which loan recovery should ideally occur for a given portfolio. Furthermore, both the portfolio's historical risk profile and the forecasting thereof were shown to influence the timing of the recovery decision. This work is able to inform relevant bank policies or strategies towards optimising the loan collections process. ■

Adapted from articles that first appeared in Expert Systems with Applications in September 2021 and the Journal of Credit Risk in March 2022.

Serving multiple masters: The role of micro- foundations of dynamic capabilities in addressing tensions in for-profit hybrid organizations



—• Prof. Adam Lindgreen
Gordon Institute of Business Science

For-profit companies might claim social and environmental goals beyond their primary economic objectives, but sustainability-driven for-profit hybrids explicitly design and implement their organisational activities to pursue social, environmental and economic goals equivalently, which typically generates tensions, inherent to their hybrid nature.

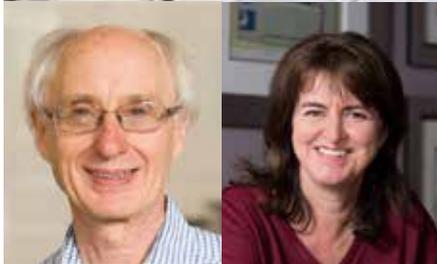
The ability to address these tensions is key to the success of such organisations, yet the manner in which they do so remains poorly understood.

Prof. Adam Lindgreen of the **Gordon Institute of Business Science** together with colleagues from France and Austria undertook a case-based qualitative study, to analyse how specific individual and collective practices continuously contribute to alleviating hybridity-related tensions among for-profit hybrids and allow them to achieve success.

With a micro-foundational perspective on the dynamic capabilities of for-profit hybrids, the authors identified four central, dynamic capabilities of such organisations, supported by respective sets of micro-foundations.

Nine of these micro-foundations specifically contribute to addressing central tensions, to different extents. This study highlights how for-profit hybrids embrace hybridity-related tensions to foster the creation of sustainable value. ■

Adapted from an article that first appeared in Organization Studies in June 2021



Microwave treatment to prolong sorghum flour freshness

- Dr Jimi Adebawale
Department of Consumer and Food Sciences
- Prof. John Taylor
Department of Consumer and Food Sciences
- Prof. Riëtte de Kock
Department of Consumer and Food Sciences

Wholegrain sorghum flour is susceptible to rancid off-flavour development during storage. **Dr Jimi Adebawale, Prof. John Taylor and Prof. Riëtte de Kock** of the **Department of Consumer and Food Sciences** investigated using microwave treatment of whole grain kernels in a pilot-scale commercial microwave oven as a flour stabilisation technology.

Flour from both the microwaved and the untreated kernels was subjected to an accelerated storage test at 50 °C for 6 weeks.

Microwaving resulted in a substantial reduction in the flour fat acidity and the aldehyde levels in the fat, throughout the storage period. Higher levels of microwave energy were more effective in achieving these results.

Sensory indications of porridge rancidity were identified less intensely and much later during the storage of microwave-treated samples. This result indicates that the microwave treatment partially inactivated the flour lipases and, consequently, retarded free fatty acid oxidation, the mechanism that contributes to flour developing rancid, off-flavours over time.

The microwave treatment of the sorghum flour had no substantial adverse effects on the other flour and porridge attributes. Therefore, microwave treatment of wholegrain sorghum kernels could be an effective practical technology to stabilise sorghum flour, thereby enhancing its food product quality.

Research into enhancing the shelf life of sorghum flour, which is made from the drought-resistant and indigenous crop, is one way to potentially address food security on the continent on a large scale. ■



Salmonella Contamination of Chicken Carcasses from Gauteng informal markets

- Dr Thelma Mokgophi
Department of Production Animal Studies, Faculty of Veterinary Science
- Prof. Abiodun Adesiyun
Department of Production Animal Studies, Faculty of Veterinary Science
- Dr. Folorunso Fasina
Department of Veterinary Tropical Diseases, Faculty of Veterinary Sciences



Salmonella has been linked to many food-borne illnesses and epidemics in both humans and animals.

Dr Thelma Mokgophi and **Prof. Abiodun Adesiyun** of the **Department of Production Animal Studies** headed a team that included **Dr Folorunso Fasina** of the **Department of Veterinary Tropical Diseases** to conduct a cross-sectional study to determine the prevalence, serovars, and factors associated with Salmonella contamination of chickens slaughtered in informal market outlets in Gauteng.

A total of 151 chicken carcasses were collected randomly from 47 outlets. Standard bacteriological and molecular methods were used to isolate, identify and determine the serovar of Salmonella isolates. The prevalence of Salmonella ranged from 29% in carcass swabs to 44% in carcass drips.

Five factors were determined as statistically significant for Salmonella contamination of carcasses. These are township locations of the outlet, amount of throughput the outlets experience, carcass evisceration, location of the carcass for sale, and sanitation of the outlet.

Nine serovars were identified, of which Bovismorbificans was predominant and present in a third of the samples. The five important factors significantly associated with the isolation of Salmonella at these outlets offer opportunities for reducing Salmonella contamination. However, further investigation is required into the probable causes of the predominant isolation of Salmonella serovar Bovismorbificans in chickens and its potential

implications for human infections in South Africa. It is clear from the results of this research that chickens purchased from informal markets in Gauteng could be a source for salmonellosis in humans if improperly cooked before consumption. ■

Adapted from an article that first appeared in the Journal of Food Protection in January 2021

The history and genetics of our famous Nguni cattle can help conserve them

—• Prof. Este van Marle-Koster
Department of Animal Science



Southern Africa's Nguni, Afrikaner, Drakensberger and Bonsmara cattle are unique and well suited to the climate of southern Africa. **Prof. Este van Marle-Koster**, of the Department of Animal Science, is putting together a detailed picture of the genetics of southern African cattle breeds.

Southern Africa has about 150 recognised indigenous breeds well suited to the region's hot and dry conditions. By identifying which genes code for their most favourable traits, like growth and resilience, researchers can help farmers selectively breed more productive animals while conserving the features that make these breeds special.

As average temperatures rise, so does the need for animals that are adapted to heat, such as the Nguni and the Afrikaner. These indigenous breeds have the potential to grow economies and reduce hunger. Genetic sequencing helps to realise that potential by finding the genes associated with adaptive traits like resilience to heat stress.

Indigenous breeds like the Nguni and Bonsmara have far fewer genotyped animals than more common world breeds. To get a better picture of the genetic potential of these indigenous breeds, Prof. Van Marle-Koster sought to trace their origins by going through over 2 000 years of southern African history.

According to the archaeological record, it took a long time for cattle to be raised in southern Africa's punishing climate. The first traces of cattle in the region date back to around 2 000 years ago, whereas cattle in other parts of Africa were present more than 4 500 years ago.

Prof. Van Marle-Koster hopes that the long history of cattle in the region can also be reflected in their genetic data. For instance, they found that in the 17th century, Dutch settlers used Sanga cattle from the Khoekhoe, and selectively bred them as draught animals, which then brought about the Afrikaner breed.

So far, Prof. Van Marle-Koster and her team have published their review detailing the known breeds and ecotypes of southern Africa, as they put plans in place to do genomic sampling in South Africa, Namibia and Botswana. With this work, the researchers will use the resulting genomic data to help farmers breed more resilient and productive cattle. ■

This piece is adapted from an article that first appeared on the UP website in August 2021.

Linking bacteria in ostriches with bird flu

- Prof. Celia Abolnik
Research Chair in Poultry Health and Production,
Department of Production Animal Studies
- Debbie Landman
Department of Veterinary Tropical Diseases
- Reneé Pieterse
Department of Veterinary Tropical Diseases



Avian influenza surveillance is a requirement for commercial trade in ostrich products, but influenza A viruses (IAVs) have proven difficult to isolate from ostrich tracheal swabs that test positive using molecular methods.

The Research Chair: Poultry Health and Production in the **Department of Production Animal Studies**, Prof. **Celia Abolnik**, led a team including **Debbie Landman** and **Reneé Pieterse**, both of the **Department of Veterinary Tropical Diseases** in hypothesising that microbes unique to the ostrich trachea propagate in the transport medium after sampling, and affect viral viability.

The team cultured tracheal swabs from 50 ostriches on 4 farms in South Africa, and recovered and identified 13 bacterial, 1 yeast, and 2 fungal species. *Dietzia sp.*, a bacterium that infects humans, had not been identified previously in the oropharyngeal tract of a bird. The bacteria were tested for antimicrobial susceptibility, and most aerobic species, except for *Streptococcus sp.* and *Pseudomonas sp.*, were sensitive to enrofloxacin; all were susceptible to sulphonamide.

Virus inhibition experiments determined that ostrich-source *Streptococcus sp.*, *Pantoea sp.*, and *Citrobacter freundii* produced extracellular metabolites that caused a substantial reduction of 99.9% in the IAV titers. *Streptomyces*, *Corynebacterium*, *Staphylococcus*, *Arthrobacter gandavensis*, *Pseudomonas putida*, and *Acinetobacter spp.* similarly reduced the viability of IAV from 77.6% to 24.1%. *Dietzia* appeared to have no effect, but *Rothia dentocariosa*, *Rhodotorula spp.*, and *Clostridium spp.* slightly increased the viability of IAV. ■

Adapted from an article that first appeared in the Journal of Veterinary Diagnostic Investigation in July 2021.





Extracts of indigenous South African plants as ingredients in sunscreen

- Dr Danielle Twilley
Department of Plant and Soil Sciences
- Deveshnee Moodley
Department of Chemical Engineering
- Dr Heidi Rolfes
Department of Chemical Engineering
- Prof. Lyndy McGaw
Phytomedicine Programme, Department of Paraclinical Sciences
- Dr Balungile Madikizela
Phytomedicine Programme, Department of Paraclinical Sciences
- Prof. Namrita Lall
Department of Plant and Soil Sciences

Exposure to solar ultraviolet (UV) radiation is a major contributing factor to the increasing number of skin cancer cases. Interest has grown to use plant extracts as natural ingredients in cosmetic formulations due to their photoprotective effect, antioxidant and anti-inflammatory activity, as well as other biological activities.

A multidisciplinary team headed by **Dr Danielle Twilley** of the **Department of Plant and Soil Sciences** and including **Deveshnee Moodley** and **Dr Heidi Rolfes** of the **Department of Chemical Engineering**, **Prof. Lyndy McGaw** and **Dr Balungile Madikizela** of the **Phytomedicine Programme, Department of Paraclinical Sciences** and **Prof. Namrita Lall** of the **Department of Plant and Soil Sciences**, evaluated the biological activity of two South African plant extracts, *Helichrysum odoratissimum*, the aromatic Imphepho and *Buddleja saligna*, the False Olive tree, successfully incorporating these extracts into sunscreen formulations due to their reported biological activity. The UP team collaborated with various external institutions across South Africa.

Ethanollic extracts were prepared from the leaves and stems of the

plants and evaluated for their antioxidant activity, mutagenic potential and antiproliferative activity against human dermal fibroblasts. The extracts were further characterized using gas chromatography-mass spectrometry. Thereafter, the extracts were incorporated into separate sunscreen formulations to evaluate the in vivo dermal irritancy potential, in vivo sun protection factor, in vitro UVA protection, photostability and long-term stability of the formulation, to confirm that by incorporating the extracts, the stability or photoprotective effect of the sunscreen formulation was not reduced and that these formulations were considered safe for topical application.

The formulations remained stable under normal and extreme conditions and the plant extracts did not affect the photoprotective



effect of the sunscreen formulations and contributed towards the formulations' stability. Additionally, each of the formulations were photostable, whereas the formulations with the addition of the extracts showed an incremental increase in photostability when compared to the base formulation. Both these extracts have been previously reported to display antiproliferative activity against skin cancer cell lines, contributing towards the medicinal benefit of using these extracts as ingredients into sunscreen formulations. As such, both plants could be considered as useful and viable additives to sunscreen formulations due to their reported biological activity. ■



The Dark Side of the Hive

—● Prof. Robin Crewe

Senior Research Fellow, Centre for Advance Scholarship

—● Prof. Robin Moritz

Social Insects Research Group

Honey bees have been described as exceptionally clever, well-organised, mutualistic, collaborative, busy and efficient — in short, a perfect society. The colony is indeed a marvel of harmonious, efficient organisation but it also has a considerable dark side.

colony.

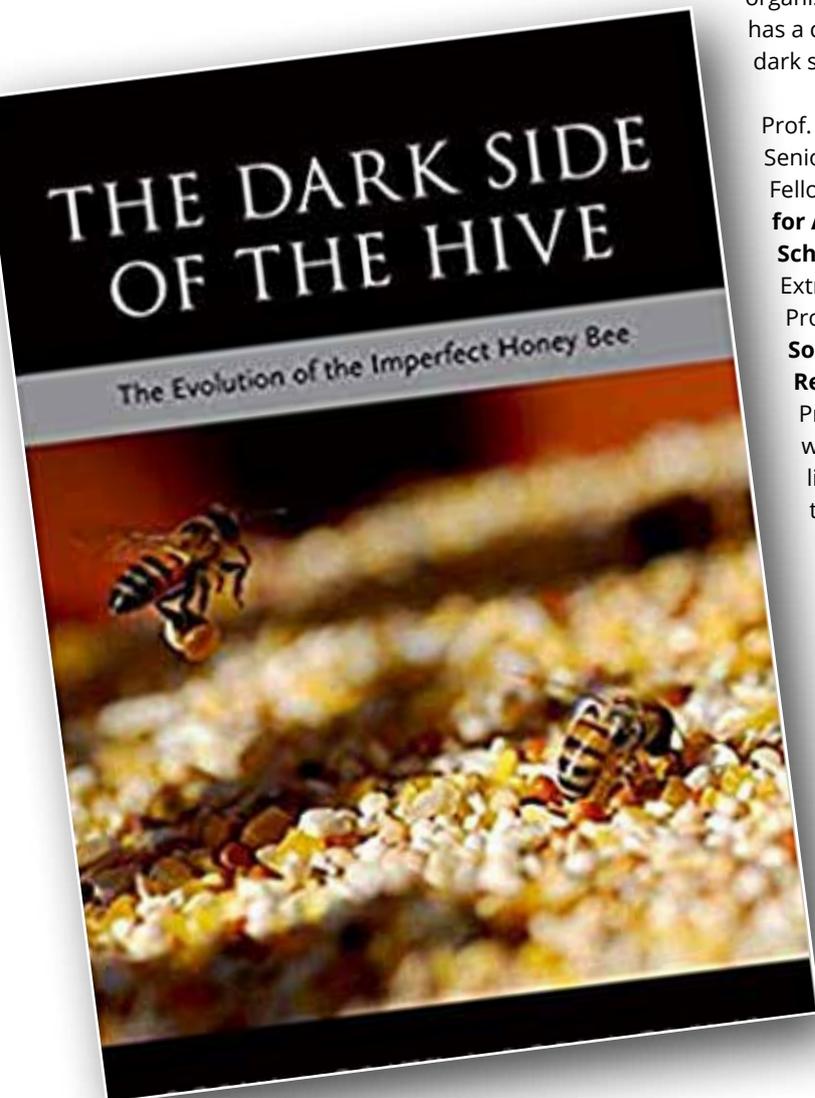
The perceived perfection of the honeybee's social organisation is a function of a focus on the colony as a whole rather than on its individual members and their idiosyncrasies. The Dark Side of the Hive, therefore, focuses on the role of the individual rather than that of the collective.

Prof. Robin Crewe, Senior Research Fellow at the **Centre for Advance Scholarship**, and Extraordinary Professor in the **Social Insects Research Group**,

Prof. Robin Moritz, write about the life history of the honey bee, highlighting conflict rather than harmony, and failure rather than success from the perspective of the individual worker in the

Moritz and Crewe dissect the various careers that individual male and female honey bees can follow and their role in colony organisation. Competition between individuals using both physical and chemical force drives the organisation of the colony.

This book deals with individual mistakes, maladaptations and evolutionary dead-ends that are also part of the bees' life. The story about these dark sides of the colony spans the full range of biological disciplines, ranging from genomics to systems biology. ■



Population diversity and genetic structure for a globally important fungal tree pathogen

—• Prof. Michael Wingfield

Department of Biochemistry, Genetics and Microbiology, Forestry and Agricultural Biotechnology Institute



A team from the **Department of Biochemistry, Genetics and Microbiology, Forestry and Agricultural Biotechnology Institute (FABI)**, including **Prof. ShuaiFei Chen, Dr Irene Barnes and Dr Tuan Duong**, and led by **Prof. Mike Wingfield** partnered with the China Eucalypt Research Centre (CERC) in the Chinese Academy of Forestry (CAF) to genotype species in the *Ceratocystis manginecans* complex.



These species are important fungal pathogens of plantation trees globally. The most important hosts include species of *Eucalyptus*, *Acacia*, *Mangifera* and *Punica*. Despite their relevance and widespread occurrence, little is known regarding their population genetics and how this could relate to their host associations or the geographic regions in which they occur.

A global collection of 491 isolates representing the *C. manginecans* complex, from four different plant hosts and nine countries, were genotyped using microsatellite markers. Population genetic analyses were conducted using numerous tools to interrogate how their genetic diversity and structure could be affected by hosts or areas of occurrence.

The results of genetic diversity studies showed that when grouping isolates into populations based on their host associations, the

population on *Eucalyptus* was most diverse, and it also has a broad global distribution. When considering countries of origin as a basis for defining populations, the gene and genotypic diversity were highest in populations from China, Indonesia, and Brazil. In contrast, populations from Oman and Pakistan collected from cashew trees had the lowest genetic diversity and were clonal.

Molecular variance, population differentiation, and network and structure analyses showed that the genetic structure of isolates in the *C. manginecans* complex is influenced by both host association and geographical isolation. Furthermore, the results reflected the movement of genotypes between plant hosts and geographic regions, which has implications for the broad global distribution of this pathogen. ■

Adapted from an article that first appeared in the Journal of Fungi in August 2021



Host countries' level of development and internationalisation from emerging markets

—• Prof. Helena Barnard
Gordon Institute of Business Science

Host countries' level of development affects internationalisation from emerging markets. The challenges and opportunities firms face, the resources and assets they need, and ultimately how they internationalise are shaped by whether firms internationalise to developing or developed countries, and whether they operate within a single or across multiple levels of host country development.

Prof. Helena Barnard of the **Gordon Institute of Business Science**

proposed a typology of four firm strategies to deal with different host location types. These are local optimisation, global consolidation, brokering and niche filling.

Local optimisation occurs when firms seek out less competitive markets in similar and lower income countries, managing institutional and infrastructural challenges through collective action. Firms seeking global consolidation manage their limited capabilities and legitimacy through mergers and acquisitions as they springboard from low- to high-income host locations. Suppliers in global value chains and the customer-facing partners of advanced multinationals in low-

income countries are arbitrageurs between high- and low-income countries. They use brokering to avoid head-on competition with advanced multinationals. However, to grow, firms must retain their primary relationships while developing non-competing relationships. Niche filling involves firms targeting knowledge-intensive offerings at lucrative high-income markets, managing their smaller resource base vis-à-vis competitors through non-equity or digitally enabled modes of internationalisation. Firms can simultaneously use different strategies for different types of foreign markets. ■

Adapted from an article that first appeared in the Journal of International Management in September 2021

Temporal mediation of uncertainty within entrepreneurial opportunity evaluation

—● Dr Jonathan Marks
Gordon Institute of Business Science

—● Tomislav Batev
Gordon Institute of Business Science



Limited research within entrepreneurship is available on how time affects the decision-making of entrepreneurs. **Dr Jonathan Banks** and **Tomislav Batev** of the **Gordon Institute of Business Science** attempt to bridge this gap by understanding how temporal factors affect opportunity evaluation as well as uncertainty.

The researchers conducted two experiments and found that individuals modify their evaluation of the same opportunity when evaluating a distant future versus a near future event.

Study one employed two within-subject vignettes, showing the same opportunity but varying the temporal distance. Study two used a two-by-two within-subject vignette design, again showing the same opportunity but changing the temporal distance and the perspective of opportunity from first person to third person, with the aim of removing response uncertainty.

The results of the first study showed a significant difference in the evaluation of an opportunity when varying temporal distance. The attractiveness of an opportunity was higher in the near future than in the distant future. Similarly, the

likelihood of exploitation was higher in the near future compared with the distant future.

Findings from the second study reveal that response uncertainty affects the likelihood of exploitation, establishing that uncertainty, indeed, influences the likelihood of opportunity exploitation. In both the third- and the first-person perspective, opportunity evaluation was more attractive in the near future than in the distant future, with the first-person perspective rating it higher in both instances.

While Dr Banks and Batev identified that an opportunity is evaluated differently at different stages, their research does not indicate whether a potentially correct evaluation exists. Is the distant future evaluation or the near future evaluation the 'correct' evaluation? Future research could investigate establishing an anchor in the evaluation and could determine

whether the distant temporal evaluation is undervalued or whether the near temporal distance opportunity is overvalued. ■



HEALTH AND
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Examining the chemicals on our skin to better deter mosquitoes

—• Dr Madelien Wooding
Department of Chemistry

—• Prof. Egmont Rohwer
Department of Chemistry

—• Dr Yvette Naudé
Department of Chemistry

Human skin surface chemical cues comprise a complex mixture of compounds that mosquitoes use to locate and select their human host, based on the inter- and intra-human variation in chemical profiles.

The complexity of the skin surface matrix calls for advanced analytical techniques to enable separation and identification of biomarkers, which may be used as topical attractants and repellents in future mosquito vector control programmes.

Dr Madelien Wooding, Prof. Egmont Rohwer and Dr Yvette Naudé, all of the **Department of Chemistry**, joined with researchers from Australia in investigating the perceived mosquito attractiveness between 20 volunteers, and the preference of mosquitoes to bite certain regions of the body. The preference for ankle versus wrist of the human host was studied by comparing skin surface chemical profiles.

Ion mobility was combined with high resolution mass spectrometry to provide additional confidence in biological marker discovery and identification of human skin surface compounds. This study employed a non-intrusive sampling scheme using a polydimethylsiloxane sampler and solvent desorption analysed with ultra-performance liquid chromatography with ion mobility

high-resolution mass spectrometry. Statistical approaches guided the identification of 14 biological markers discerning differences in perceived mosquito attractiveness, and 20 biomarkers associated with the different skin regions sampled. A broad range of chemical compounds was detected from a variety of classes (including sugars, steroids, fatty acids, peptides and peptide derivatives, and compounds of food origin). Ten compounds were unequivocally identified on the human skin surface, and caffeine was reported on the human skin surface for the first time. Furthermore, 77 compounds were detected on the human skin surface, with 64 probably not reported previously, using accurate mass, collision cross section (CCS) values and fragmentation patterns. This approach enabled comprehensive human skin surface chemical profiling and provided an extensive list of tentatively identified skin surface compounds, together with accurate mass values and adducts with their corresponding CCS values. ■

Adapted from an article that first appeared in the Journal of Mass Spectrometry.



Mathematical analysis of the effect of transmission-blocking drugs on the population dynamics of malaria

- Dr Woldegebriel Assefa Woldegerima
Department of Mathematics and Applied Mathematics
- Prof. Rachid Ouifki
Department of Mathematics and Applied Mathematics
- Prof. Jacek Banasiak
Department of Mathematics and Applied Mathematics



Recently, promising clinical advances have been made in developing antimalarial transmission-blocking drugs (TBDs) that prevent parasite transmission, cure the disease and have prophylactic effects.

Dr Woldegebriel Assefa Woldegerima, Prof. Rachid Ouifki and Prof. Jacek Banasiak, all from the **Department of Mathematics and Applied Mathematics**, developed and analysed a population-level compartmental model of human–mosquito interactions that took into account an intervention using TBDs. This was achieved by extending the Susceptible, Exposed, Infected, and Recovered populations in humans and Susceptible, Exposed, and Infected populations in mosquitoes.

The population-level epidemic models belong to a group that analyses malaria transmission by observing the human's progress through the disease from being susceptible, through being infected

and becoming infectious, to recovery, either through classical or transmission-blocking drugs. The model's novelty lies in adding the class of humans who are fully protected after successful treatment with a TBD. It is worth noting that the model was developed as part of research collaboration within the NRF Community of Practice in Malaria Elimination, led by Prof. Lyn-Marie Birkholtz.

Before analysing the model's stability and bifurcation behaviours, the team started by ensuring that the model was well-posed in a biologically feasible domain. Further analysis indicated that the model exhibited forward and backward bifurcation under certain conditions, and found formulae showing in a quantitative

way how the effect of the treatment rate on reducing the reproduction numbers depended on other key parameters such as the efficacy of the drug.

The projections of the validated model showed the benefits of using TBDs in malaria control to prevent new cases and reduce mortality. In particular, the team found that starting treatment of the population of Sub-Saharan Africa with an efficacious TBD from 2021 could potentially eliminate malaria by 2035. ■

Adapted from an article that first appeared in the Journal of Applied Mathematics and Computation in July 2021

Healthcare without borders

- Dr Gerhard Janse van Rensburg
Department of Paediatrics
- Prof. Ute Feucht
Research Centre for Maternal, Fetal, Newborn and Child Health Care Strategies
- Dr Jennifer Makin
Research Centre for Maternal, Fetal, Newborn and Child Health Care Strategies
- Dr Nanya le Clus
Department of Paediatrics
- Prof. Theunis Avenant
Department of Paediatrics

Human migration is a worldwide phenomenon that receives considerable attention from the media and healthcare authorities alike. A significant proportion of children seen at public sector health facilities in South Africa are immigrants, and gaps have been noted previously in their healthcare provision.

A team comprising **Dr Gerhard Janse van Rensburg**, **Dr Nanya le Clus** and **Prof. Theunis Avenant**, all from the **Department of Paediatrics**, and **Prof. Ute Feucht** and **Dr Jennifer Makin** from the **Research Centre for Maternal, Fetal, Newborn and Child Health Care Strategies**, described the characteristics and differences between immigrant and South African children admitted to Kalafong Provincial Tertiary Hospital (KPTH), a large public sector hospital in Gauteng Province.

The cross-sectional study was conducted over a four-month period from 2016 to 2017. Information was obtained through a structured

questionnaire and review of health records. The enrolled study participants included 508 children divided into 2 groups, namely 271 general paediatric patients and 237 neonates. Twenty-five percent of children in the neonatal group and 22.5% in the general paediatric group were immigrants.

In comparison with the South African group, the parents and caregivers of the immigrant group had a lower educational level, lower income, more difficulty communicating in English and were more likely residing in informal settlements. In the neonatal group, there was no difference in the number of antenatal





care (ANC) visits, type of delivery, gestational age, and birth weight. In the general paediatric group, there was no difference in immunisation and vitamin A supplementation coverage. However, when comparing growth, the immigrant group showed more malnutrition compared with the South African group. There was no difference in the prevalence of maternal HIV infection, with equally good prevention of mother-to-child transmission (PMTCT) coverage.

There was also no difference in reported difficulties by immigrants in terms of access to healthcare, although a large proportion (10%) of the neonates of immigrant mothers

were not born inside a medical facility.

Although there were health-related differences between immigrant and South African children in accessing in-hospital care, these were fewer than expected. Differences were found in parental educational level and socioeconomic factors, but these did not significantly affect ANC attendance, delivery outcomes, immunisation coverage, HIV prevalence, or PMTCT coverage.

The immigrant population should be viewed as a high-risk group, with potential problems including suboptimal child growth. Health

workers should advocate for all children in the community they serve, and should promote tolerance, respect, and equal healthcare access.

Adapted from an article that first appeared in PLOS Medicine in March 2021



COVID-19 Delta variants transmitted from humans to animals

—• Prof. Marietjie Venter
Department of Medical Virology

—• Prof. Katja Koepfel
Centre for Veterinary Wildlife Studies



A team led by **Prof. Marietjie Venter, Head of the Zoonotic, Arbo- and Respiratory Virus Programme** at the **Department of Medical Virology**; and **Prof. Katja Koepfel**, Associate Professor of Wildlife Health at the University's **Faculty of Veterinary Science** and including **Dr Adriano Mendes, Dr Amy Strydom, Dr Lia Rotherham** and **Dr Misheck Mulumba** published the only study from Africa that entailed genomic One Health investigations which reveal that Delta variants of COVID-19 were transmitted from humans to animals.

One Health is an approach that recognises that the health of people is closely connected to the health of animals and a shared environment. Close contact with animals and their environment provides opportunities for diseases to spread between animals and people.

The team of transdisciplinary scientists found that reverse zoonotic transmission of COVID-19 from asymptomatic animal handlers at a private zoo in Gauteng posed a risk to big cats kept in captivity. Transmission of the Delta variant to these animals could result in more severe disease. The animals tested PCR positive for up to seven weeks after becoming sick. “

In 2020, the team tested the faeces of two pumas that had previously shown signs of anorexia, diarrhoea and nasal discharge. They tested positive for COVID-19, and exhibited

mild symptoms. They were medicated and made a full recovery after 23 days. Unfortunately, researchers could not carry out an investigation into the source or the specific variant involved in the outbreak. The samples were diagnosed by real-time PCR at the time of the outbreak, but when they tried to sequence the sample a year later, there was insufficient RNA left for genome sequencing.

A year later, during South Africa's third wave of the COVID-19 pandemic, the team conducted a study on three sick lions at the same zoo. The lions had breathing problems as well as runny noses and a dry cough for up to 15 days. A persistent cough was seen between five and 15 days, with two lions experiencing difficulty breathing. One lioness developed pneumonia that did not respond to antibiotics. Respiratory swabs were submitted



to Prof. Venter's programme, where the cases were investigated. Staff and lions were monitored in the weeks that followed for the presence of SARS-CoV-2 and, within 15 to 25 days, all three lions made a full recovery. A One Health investigation into the source of infection was conducted on 12 staff members who had been in direct or indirect contact with the lions.

One staff member who had direct contact with the lions and another who had indirect contact tested PCR positive for SARS-CoV-2 two weeks after the start of the lion disease course. All three lions were PCR positive. This suggested that SARS-CoV-2 was circulating among staff during the time that the lions got sick, and suggests that those with direct contact with the animals were likely responsible for the reverse zoonotic transmission.

Genome sequencing was conducted on the humans and three lions, and tests revealed that each of the infections was a Delta variant. The two pumas and three lions presented with respiratory illness that was similar to COVID-19 in humans. The animals did not respond to antibiotic treatment but recovered after treatment with anti-inflammatory drugs and supportive care.

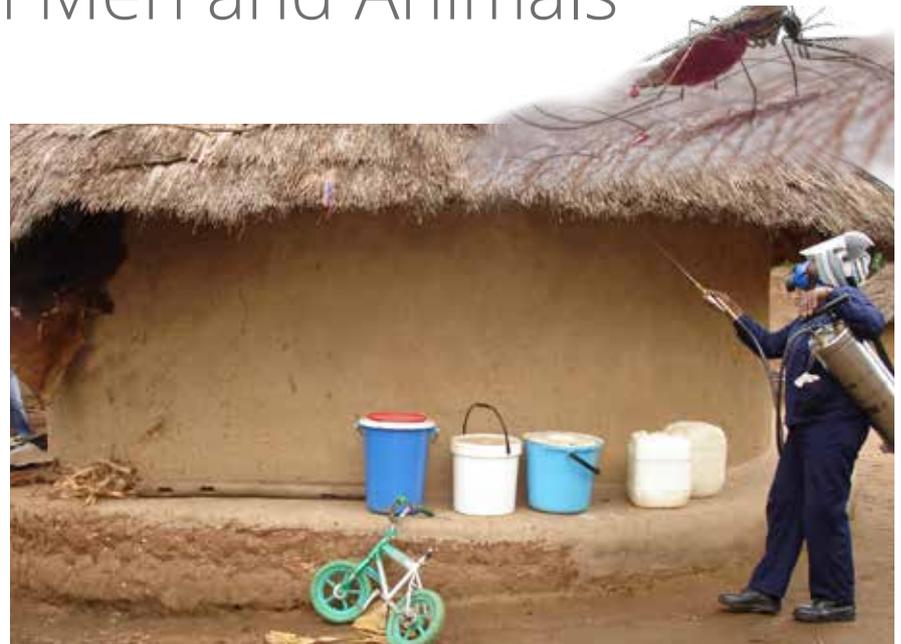
These outbreaks are at least the third and fourth of this kind in which SARS-CoV-2 has been shown to transmit between humans and captive large felines, although the current study is the only one that reports on genomic One Health investigations of Delta variants transmitted from humans to animals, and the only one reported so far in Africa. ■

This piece was adapted from an article first published on the UP website in Jan 2022.

Environmental Toxicants and Sperm Production in Men and Animals

- Prof. Tiaan de Jager
School of Health Systems and Public Health
- Dr Sean Patrick
School of Health Systems and Public Health
- Dr Natalie Aneck-Hahn
School of Health Systems and Public Health
- Prof. Riana Bornman
School of Health Systems and Public Health

In malaria-endemic areas in South Africa, traditional huts are sprayed with DDT, whereas modern structures are sprayed with pyrethroid insecticides. With the modernisation of housing and DDT sourcing costs, spray programmes have changed. Coupled with this factor is an increase in agricultural pesticide use, creating another source of exposure.



However, DDT and pyrethroids are considered endocrine disrupting chemicals (EDCs). Exposure to complex mixtures of EDCs is associated with adverse male reproductive health, including a decline in sperm and semen quality.

Prof. Tiaan de Jager, Dr Sean Patrick, Dr Natalie Aneck-Hahn and Prof. Riana Bornman, all of the **School of Health Systems and Public Health**, the **Environmental Chemical Pollution and Health**

Research Unit and the University of Pretoria Institute for Sustainable Malaria Control, investigated the effects of exposure to a complex mixture of EDCs, DDT, pyrethroids and other agricultural pesticides on seminal parameters, hormonal regulation and sperm chromatin integrity. In a cross-sectional study conducted between 2003 and 2008, and from 2012 to 2017, young males were recruited from a malaria-endemic area in Limpopo Province, where DDT was used in indoor





residual spraying. Exposure levels of DDT (measured in blood plasma), pyrethroids and other pesticides (measured in urine) were determined and a semen analysis was conducted according to WHO standards.

Linear regression models were examined to evaluate DDT/DDE effects on different reproductive outcomes. In sprayed villages, p,p'-DDE exposure levels were significantly lower between 2012 and 2017 than in the 2003–2008 period.

In the non-sprayed villages, p,p'-DDE exposure levels were significantly lower between 2012 and 2017 than in the 2003–2008 period.

Sperm counts were significantly lower in the 2012–2017 period compared with those in 2003–2008. Analysis showed that 3,5,6-trichloro-2-pyridinol (TCPY), 1,2,3-benzotriazine-4-one (BTA), a herbicide, and 3-(2,2-dichlorovinyl)-2,2-dimethyl-cyclopropane-1-carboxylic acid (Trans/DCCA) were

the most common metabolites. Despite the decline in exposure levels over time, seminal parameters and chromatin integrity were still affected. While still dependent on DDT and pyrethroids for malaria vector control, a more sustainable approach is needed towards malaria elimination, involving transdisciplinary approaches. ■

Adapted from an article that first appeared in the proceedings of the XIIIth International Symposium on Spermatology in July 2021





A meta-analysis of meta-analyses: Risk-of-bias assessments in psychology studies

—• Prof. Ding-Geng Chen
SARCHI chair in Biostatistics in South Africa,
Department of Statistics

Prof. Ding-Geng Chen, the SARCHI chair in Biostatistics in South Africa in the Department of Statistics joined with an international team to explore the current practice of risk-of-bias assessment in systematic reviews of behavioral clinical trials published in substance use journals and how assessment results were incorporated into meta-analysis.

The researchers searched for systematic reviews and meta-analyses of behavioural interventions published from 2016 to 2020 in 40 substance use journals. Two team members independently screened and extracted relevant information from each review. Different tools for risk-of-bias assessment and approaches of incorporating the risk-of-bias assessment results into meta-analysis were summarized.

The study identified 35 systematic reviews and meta-analyses of behavioural clinical trials. Among the 35 reviews, 31 (89%) assessed the risk-of-bias of their included studies. Twelve (39%) of the 31 reviews incorporated these assessment findings into their meta-analysis of intervention effects (e.g., conducted

meta-regression or subgroup analysis, sensitivity analysis or limited the synthesis only to the “high quality” studies).

It was found that performing and reporting risk-of-bias assessment remain inconsistent in published systematic reviews. Future systematic reviews and meta-analyses are encouraged to connect their risk-of-bias assessment findings with meta-analysis and follow the most updated PRISMA guidelines in reporting the methods and results of risk-of-bias assessment. ■

Time-Varying Effect of Pandemics on Global Output Growth

—• Prof. Rangan Gupta
Department of Economics

The team investigated the effect on global output growth from the first quarter of 1996 to the first quarter of 2020, using a time-varying parameter structural vector autoregressive (TVPSVAR) model. This is the first attempt to provide a full-fledged time-varying analysis of the effect of uncertainty owing to various pandemics on the real Gross Domestic Product (GDP) growth of the US, other advanced countries barring the US, and emerging economies.

In addition to the index based on the discussion about pandemics that appears in Economist Intelligence Unit (EIU) country reports, the model contained the growth rates of the

three groups of countries. It was found that the negative effect of the coronavirus on the growth rate of output is unprecedented, with the emerging markets being the worst hit. Moreover, since 2016, the co-movement among the growth rates of disparate economies has increased significantly. The results imply that policy-makers would need to undertake vast expansionary policies within their own nations, but it is also important to pursue well-coordinated policy decisions across the economic blocs. ■

Adapted from an article that first appeared in Finance Research Letters in July 2021



Prof. Rangan Gupta
of the **Department of Economics**

collaborated with colleagues from the United Kingdom, Northern Cyprus (under Turkey) and China to analyse the dynamic effect of uncertainty owing to global pandemics, such as those triggered by SARS, H5N1, H1N1, MERS, Ebola, and COVID-19.





How COVID-19 has made life harder for South African women

— Prof. Margaret Chitiga-Mabugu
Dean of the Faculty of Economic and Management Sciences

There is no doubt that the pandemic has had a devastating effect on South Africa and its economy. Women often pay a heavy price during economic crises, and COVID-19 was no exception. As in much of the world, the commerce, catering and personal care sectors faced closure or witnessed their activities severely restricted in the effort to contain the spread of the virus. These sectors employ a large majority of women.

Women are also over-represented in the health sector and are, therefore, more likely to be on the frontline of the epidemic. School closures, meanwhile, led to an increase in women's domestic workloads. Before the crisis, the situation of women in South Africa was already worrying. Women were more likely to be unemployed or in lower-paid jobs than men, and the poverty rate for women is 17 percentage points higher than it is for men. These factors raised the question of whether the pandemic exacerbated existing gender inequalities in the labour market and increased the vulnerability of South African women.

Dean of the Faculty of Economic and Management Sciences, **Prof. Margaret Chitiga-Mabugu**, joined an international team of researchers to examine how the pandemic affected the South African economy and women in particular. They found that women were more affected than men.

This finding conforms to the results of other studies that a pandemic causes more negative effects to sectors that rely on female labour, leading to women earning less than their male counterparts. Accordingly, this pandemic has affected the vulnerability and poverty of female-headed households more than male-headed households.

The team identified and modelled the channels through which COVID-19 and lockdown measures were affecting the South African economy. On one side, the economy was affected through international channels, as export from South



Africa became more difficult because other countries have reduced their consumption of South African commodities. On the other side, the economy was affected through national channels owing to lockdown measures, as some workers could not work remotely, only essential sectors were open and other sectors were closed.

Moreover, both supply and demand shocks affected the economy. On the supply side, factories had to close to comply with the lockdown rules. At the same time, there was reduced demand from the rest of the world.

The pandemic did not affect all sectors in the same way, with

the determining factors being whether the sector was declared essential or not and whether it was related to export commodities or not. This unequal economic effect led to a disproportionate rise in unemployment for women, as they are concentrated in the sectors hardest hit by the lockdown measures, including hospitality and personal care.

The decreased demand for workers resulted in a drop in wages, leading to a reduction in household consumption. Female-headed households faced a larger decrease in their real consumption, which declined 4% to 5% more than that of male-headed households. Poverty

among women, therefore, increased more than among men.

Indeed, the losses in income created an increase in the poverty index by one percentage point more for women than for men, resulting in a poverty rate that is 50% to 55% higher for female households than for male-headed households. ■

Adapted from an article that first appeared in The Conversation in December 2021





Global analysis of the effect of COVID-19 stay-at-home restrictions on crime

—• Prof. Gregory Breetzke
Department of Geography, Geoinformatics & Meteorology

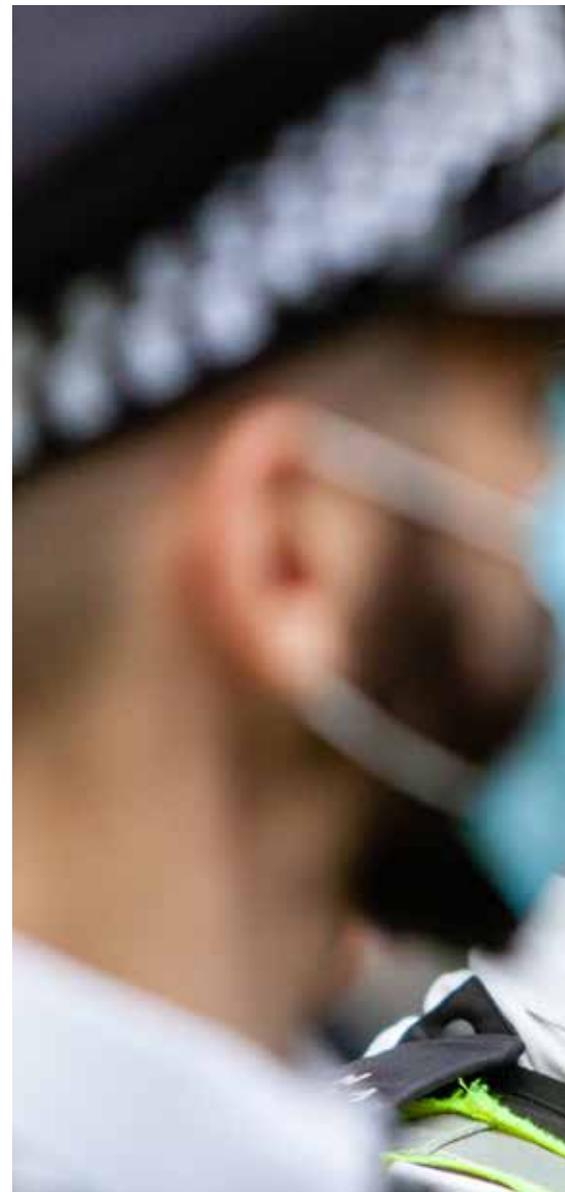
The stay-at-home restrictions to control the spread of COVID-19 led to an unparalleled sudden change in daily life, but it is not clear how these restrictions affected urban crime globally.

Prof. Gregory Breetzke of the **Department of Geography, Geoinformatics & Meteorology** was a member of a multi-national team that collected data on daily counts of crime in 27 cities across 23 countries in the Americas, Europe, the Middle East and Asia.

The team conducted interrupted time series analyses to assess the effect of stay-at-home restrictions on different types of crime in each city. Their findings showed that the stay-at-home policies were associated with a considerable drop in urban crime, but with substantial variation across cities and types of crime. Meta-regression results showed that more stringent restrictions over movement in public space were predictive of larger declines in crime.

The dependent variable in the analyses was police-recorded daily reported crime incidents for six major crime categories, namely assault, theft, burglary, robbery, vehicle theft and homicide.

The results suggested that stay-at-home restrictions were associated with declines in all types of crime, with the exception of homicide. In Barcelona, for example, police-recorded thefts declined from an average of 385.2 to 38.1 per day. However, substantial variation was evident across crime categories and cities in the size and direction of crime trends following the implementation of restrictions. Over time, the mean trend started to return to pre-restriction levels of crime.



The results for homicide suggested an overall marginal decline in the number of daily homicides following the implementation of stay-at-home restrictions (14%, Fig. 2c). However, only three cities (Lima, Cali and Rio de Janeiro) experienced a statistically significant decline in homicides.

Furthermore, it was found that the more stringent stay-at-home restrictions were associated with significantly more negative effect sizes for burglary, robbery, theft and vehicle theft. In essence, this

finding suggested that more severe restrictions on 'non-essential' movement and activities were associated with significantly larger declines in crime.

The smaller decrease in homicide cases could be ascribed to several factors. First, in many societies, a substantial proportion of homicides are committed in domestic contexts and are, therefore, not affected by the reduction in the density of daily encounters in cities. Second, a varying proportion of homicide is associated

with organised crime, conflicts between gangs or conflicts related to drug trafficking. The behaviour of these groups could be less elastic to changes in the daily routines of those not involved in organized crime. In this vein, conventional crimes in Mexico City declined, whereas crimes associated with organised crime (homicide, extortion and kidnappings) did not.

The reduction in burglaries was likely related to increased informal social control, as more dwellings were occupied around the clock; therefore, offering fewer opportunities for burglaries with a low risk of being disturbed. However, we noted that for several cities, it was not possible to distinguish residential and commercial burglaries.

The measures taken by governments globally to control COVID-19 continue to have a profound effect on all aspects of social life. They offer an opportunity to enhance our understanding of social processes, including those involved in the causation of city-wide crime levels. As the crisis progresses, cities and countries continuously adapt their public health strategies. A crucial next step would be to examine longer-term dynamics in more cities globally. ■

Adapted from an article that first appeared in Nature: Human Behaviour in June 2021





Detecting online sexual predators

- Prof. Jan Eloff
Department of Computer Science
- Dr Vukosi Marivate
ABSA Chair of Data Science, Department of Computer Science
- Hombakazi Ngejane
Department of Computer Science



The problem is that digital forensic investigation is mostly manual. This is a daunting task for forensic investigators owing to the sheer volume and variety of data. A research team comprising **Hombakazi Ngejane, Prof. Jan Eloff** and **Dr Vukosi Marivate** (all of the **Department of Computer Science**), together with colleagues from the CSIR proposed a solution by employing a Digital Forensic Process Model supported by machine learning methods to facilitate the automatic discovery of harmful conversations in chat-logs.

Machine learning has already been applied successfully in the domain of text analysis for the discovery of online sexual predatory chats. However, there is a dearth of approaches that indicate how such approach could contribute to a digital forensic investigation. Therefore, the contribution of this work was indicating how the tasks in a digital forensic investigation process could be organised to obtain useable machine learning results during investigation of online predators. ■

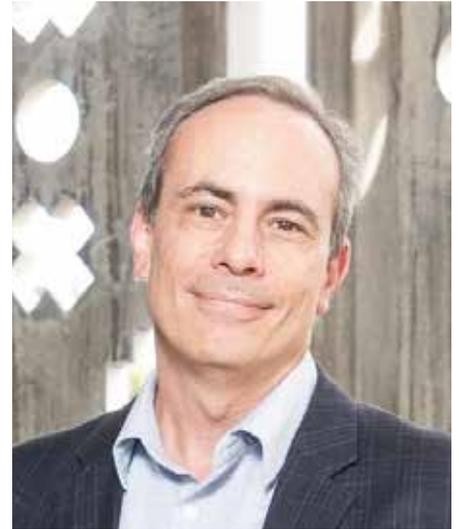
Adapted from an article that first appeared in Forensic Science International: Digital Investigation in March 2021

Chat-logs are informative digital footprints available on Social Media Platforms (SMPs). With the rise of cybercrimes targeting children, chat-logs can be used to discover and flag harmful behaviour for the attention of law enforcement units. In this way, a significant contribution could be made to prevent minors on SMPs being exploited by online predators.



Afro-Communitarianism and the Role of Traditional African Healers in the COVID-19 Pandemic

—• Prof. Thaddeus Metz
Department of Philosophy



The COVID-19 pandemic posed significant challenges to healthcare systems worldwide and, in Africa, given the lack of resources, they were likely even more acute. The usefulness of Traditional African Healers in helping to mitigate the effects of the pandemic has been neglected.

Prof. Thaddeus Metz of the **Department of Philosophy** collaborated with Prof. Luís Cordeiro-Rodrigues of Hunan University, China, in arguing from an ethical perspective that these healers could and should have an important role in informing and guiding local communities in Africa on how to prevent the spread of COVID-19. Particularly, they argued not only that much of the philosophy underlying Traditional African Medicine is adequate and compatible with preventive measures for COVID-19 but also that Traditional African Healers have some unique cultural capital for influencing and enforcing such preventive measures.

The study suggested that given the cultural context of Africa, where Traditional African Healers have a special role, as well as the normative strength of the Afro-communitarian

philosophy that informs it, that good ethical reasons exist to endorse policies that involve Traditional Healers in the fight against COVID-19. The authors also maintained that concerns about Traditional African Healers objectionably violating patient confidentiality or being paternalistic were much weaker in the face of COVID-19.

This article was selected by Oxford University Press as being amongst the 'Best of Philosophy' and the most read content published in their philosophy portfolio in 2021. ■

Adapted from an article that first appeared in Public Health Ethics in April 2021



Evaluating prediction of COVID-19 at provincial level in South Africa: A statistical perspective

—• Prof. Andriëtte Bekker
Department of Statistics

What is the effect of COVID-19 on South Africa? **Prof. Andriëtte Bekker, SARChI Chair in Computational and Methodological Statistics** and a team including **Prof. Mohammad Arashi, Prof. Mahdi Salehi, Prof. Sollie Millard** and **Tanita Botha**, all of the **Department of Statistics**, collaborated to provide the necessary statistical tools, which doctors and policy-makers could use in battling the COVID-19 pandemic, with a focus on South Africa.

The team focused on the spread of the disease by applying a heatmap retrieval of hotspot areas, as well as spatial analysis, conducted using the Moran index, a measure of clustering in spatial correlation.

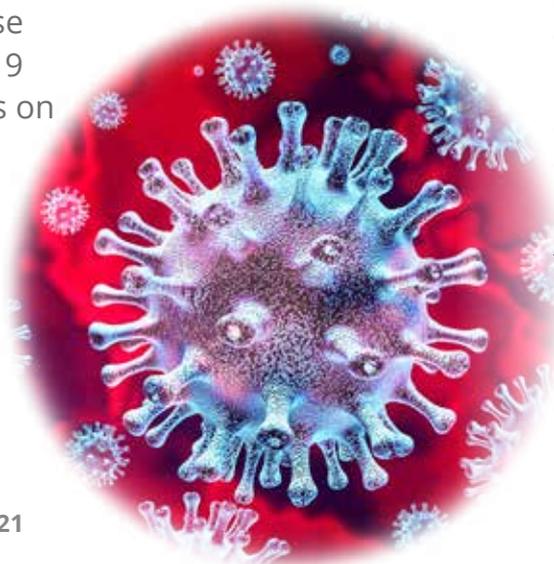
For capturing spatial autocorrelation between the provinces of South Africa, adjacent and geographical distance measures were used as a weight matrix for both absolute and relative counts. Furthermore, generalised logistic growth curve modelling was employed for predicting the spread of COVID-19. The data-driven modelling provided some insights into hotspot identification and allowed for the potential of timeous action in controlling the spread of the virus.

In related work, Prof. Arashi, Prof. Bekker and Prof. Salehi were joined by Iranian colleagues and Prof. **Ding-Geng Chen**, the **SARChI chair in Biostatistics** in South Africa, and **Prof. Johan Ferreira** and **Motala Frances (Department of Statistics)** to develop a useful online interactive dashboard that visualises and follows confirmed cases of COVID-19 in real-time.

The dashboard was made publicly available on 6 April 2020 to illustrate the counts of confirmed cases, deaths, and recoveries of COVID-19 at the level of country or continent, and was formally described in the journal *Frontiers in Public Health* in January 2021.

This dashboard is intended as a user-friendly tool for researchers and the public to track the COVID-19 pandemic. It is generated from trusted data sources and built in open-source R software, ensuring a high sense of transparency and reproducibility. ■

Adapted from articles that first appeared in Environmental Science and Pollution Research in November 2021 and Frontiers in Public Health in January 2021.



Ethics, Politics, Inequality: New directions — State of the Nation

—• Prof. Vasu Reddy
Dean, Faculty of Humanities



Multi-layered inequalities and a sense of insecurity have long been the hallmark of South African life. Recently, however, the attendant uncertainties of Covid-19 have led to greater shared experiences of vulnerability among South Africans.

Prof. Vasu Reddy collaborated with Prof. Narnia Bohler-Muller (HSRC) and Prof. Crain Soudien (UCT) on this volume of *State of the Nation*, which offers perspectives that could help us navigate our way through the 'new normal' in which we find ourselves. Foremost among the unavoidable political and socioeconomic interventions that will be required are interventions based on an ethics of care. Care as an essential attribute must be inserted into all the diverse contexts that structure needs, desires and relations of power.

An ethics of care requires us to reconsider relations of domination, oppression, injustice, inequality or paternalism within the state. In a democratic post-apartheid state that confirms human connectedness, bodies matter and this knowledge must be driven by active citizenship. We are all caught up in webs of power that require of us, as individuals and as communities, the will and understanding to combat and counter poverty and inequality and thereby to improve the state

of the nation. The effects of poverty and inequality are as insidious as Covid-19, and render the most vulnerable even more powerless in the face of this and similar ravages.

Now, more than ever, we need to prioritise an ethics of care. ■





SOCIETAL ISSUES

Societal Issues

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Regional Economic Communities and Integration in Southern Africa: Networks of Civil Society Organisations and Alternative Regionalism

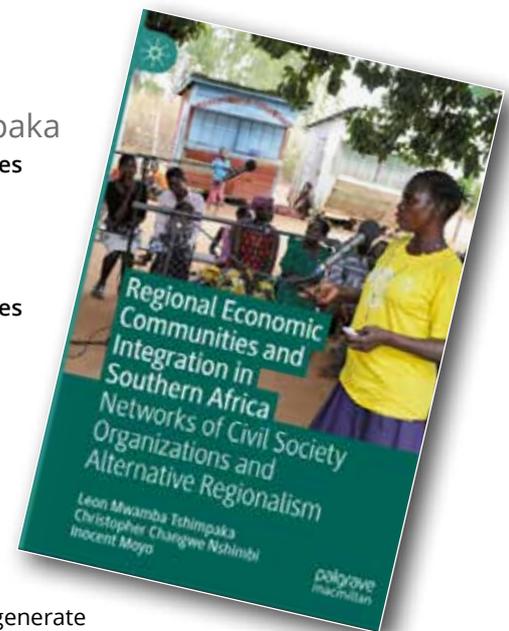
— Dr Leon Mwamba Tshipaka
Department of Political Sciences

— Dr Christopher Changwe Nshimbi
Department of Political Sciences

Dr Leon Mwamba Tshipaka, and Dr Christopher Changwe Nshimbi, both of the Department of Political Sciences, along with Prof. Innocent Moyo (University of Zululand) coauthored *Regional Economic Communities and Integration in Southern Africa*.

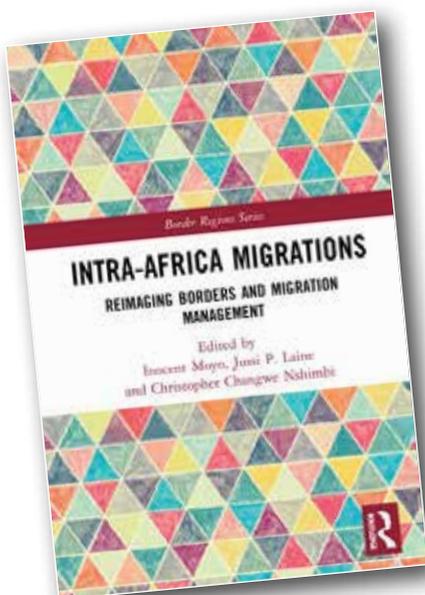
The book offers a significant and innovative contribution to the study of regionalism, bringing a new perspective on issues that are absent from the extant literature.

Dr Nshimbi together with Prof. Moyo and Prof. Jussi Laine (University of Eastern Finland) wrote *Borders, Sociocultural Encounters and Contestations: Southern African Experiences in Global View*. This book examines the enduring significance of borders in southern Africa, covering encounters between people, ideas and matter, and the new spatialities and transformations they



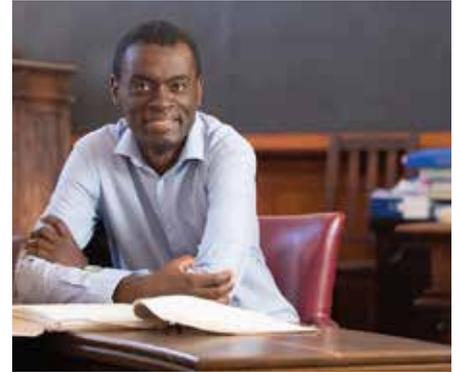
generate in their historical, social, economic and cultural contexts.

The three authors also co-edited *Intra-Africa Migrations: Reimagining Borders and Migration Management*, which discusses regional and continental integration in Africa by examining the management of migration across the continent. It examines borders and securitisation of migration and the challenges and opportunities that arise out of reconfigured continental demographics. ■



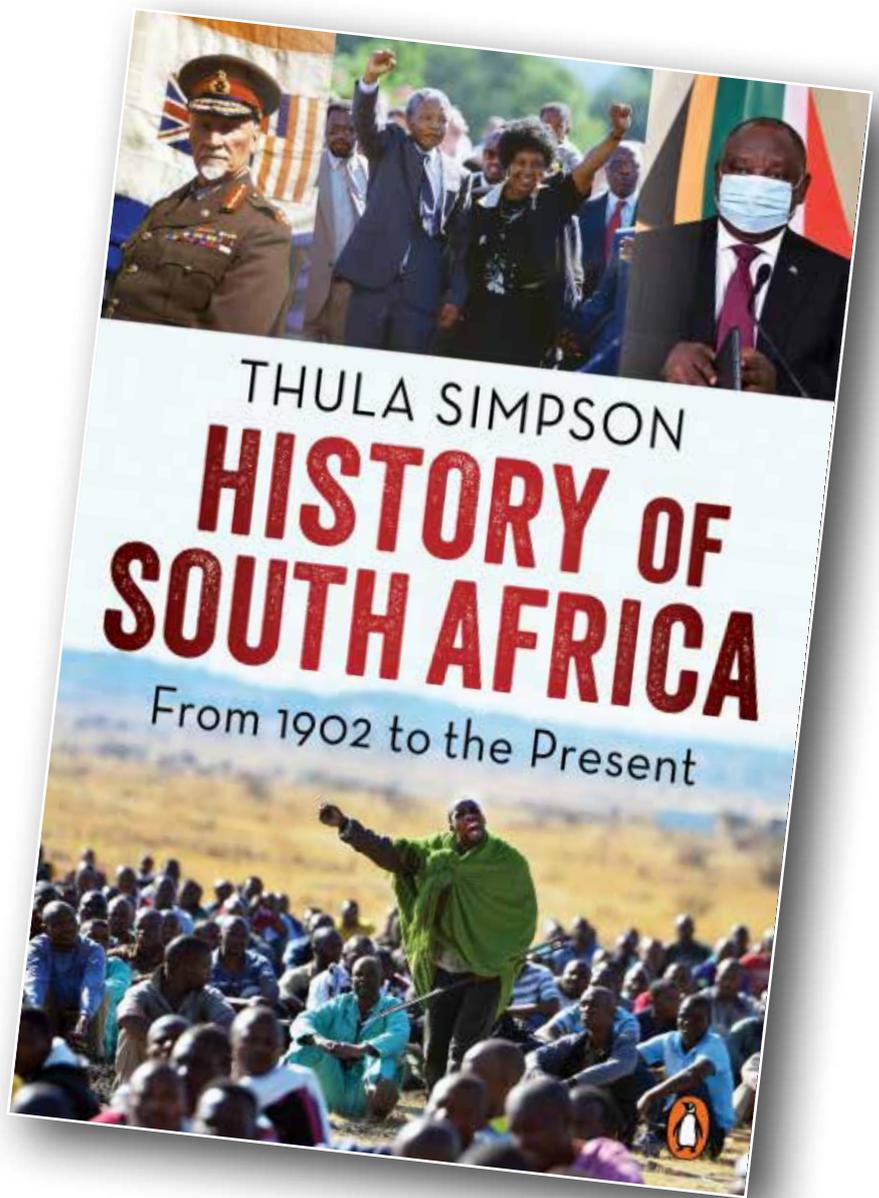
History of South Africa: From 1902 to the Present

—• Prof. Thula Simpson
Department of Historical and Heritage Studies



Prof. Thula Simpson of the **Department of Historical and Heritage Studies** produced a fascinating account of South Africa's 120-year journey through war, crisis and division, which now looks set to come full circle. *History of South Africa: From 1902 to the Present* explores the country's tumultuous journey from the Second Anglo-Boer War to 2021. Drawing on diaries, letters, oral testimony and diplomatic reports, Prof. Simpson follows the South African people through the battles, elections, repression, resistance, strikes, insurrections, massacres, crashes and epidemics that have shaped the nation.

Tracking South Africa's path from colony to Union and from apartheid to democracy, Simpson documents the influence of key figures including Jan Smuts, Nelson Mandela, Steve Biko, P.W. Botha, Thabo Mbeki and Cyril Ramaphosa. He offers detailed accounts of watershed events like the 1922 Rand Revolt, the Defiance Campaign, Sharpeville, the Soweto uprising and the Marikana massacre. He sheds light on the roles of Gandhi, Churchill, Castro and Thatcher, and explores the effect of the two World Wars, the armed struggle and the Border War. Simpson's history charts the post-apartheid transition and the phases of ANC rule, from Rainbow Nation to transformation, from state capture to 'New Dawn'. Along the way, the book reveals the divisions



and solidarities of sport, the nation's economic travails, and painful pandemics — from the Spanish flu to AIDS and COVID-19. ■

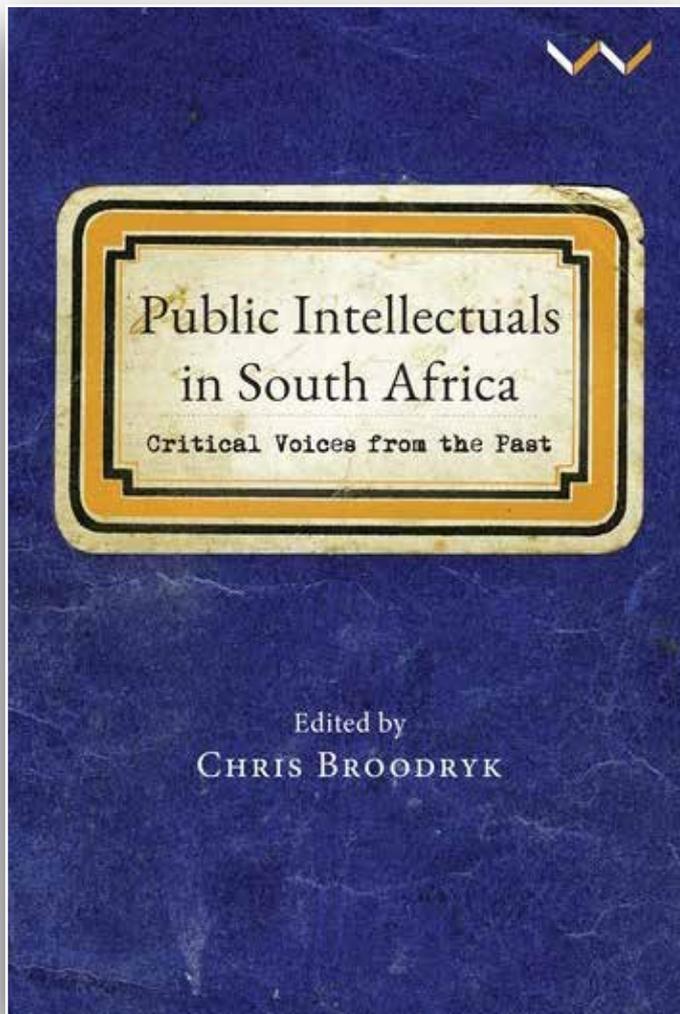


Public Intellectuals in South Africa: Critical Voices from the Past

—• Dr Chris Broodryk
School of the Arts: Drama

Dr Chris Broodryk of the **School of the Arts: Drama** edited a collection of essays in *Public Intellectuals in*

South Africa, which tells the stories of well-known figures and some who may have been mostly forgotten. They include Magera Fuze, John Dube, Aggrey Klaaste, Mewa Ramgobin and Koos Roets, along with marginalised figures, such as Elijah Makiwane, Mandisi Sindo, William Pretorius and Dr Thomas Duncan Greenlees.



The essays capture the thoughts and opinions of these historical figures. The contributors contend that these were public intellectuals who spoke out against the corruption of power, promoted progressive politics that challenged the colonial project and its legacies, and encouraged a sustained dissent of the political status quo. Offering fascinating accounts of the life and work of these writers, critics and activists across a range of historical contexts and disciplines, from journalism and arts criticism to history and politics, this contribution enriches the historical record of South African public intellectual life. ■

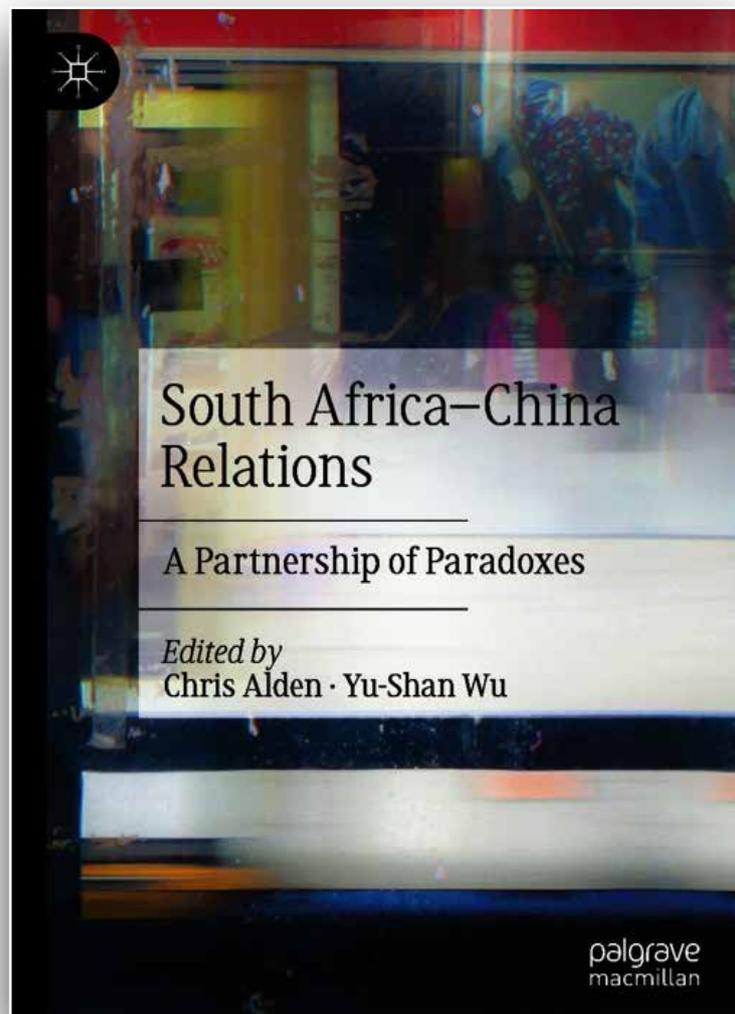
South Africa–China Relations: A Partnership of Paradoxes

—• Dr Yu-Shan Wu
Department of Political Sciences



Dr Yu-Shan Wu of the **Department of Political Sciences** collaborated with Prof. Chris Alden (London School of Economics) to compile *South Africa–China Relations: A Partnership of Paradoxes*. The book involves predominantly South African authors with knowledge and expertise on the topic of relations with China, allowing them to better interact with a local and African audience, linking societal and economic levels and seeking to merge the policy-making space with concerns of everyday citizens.

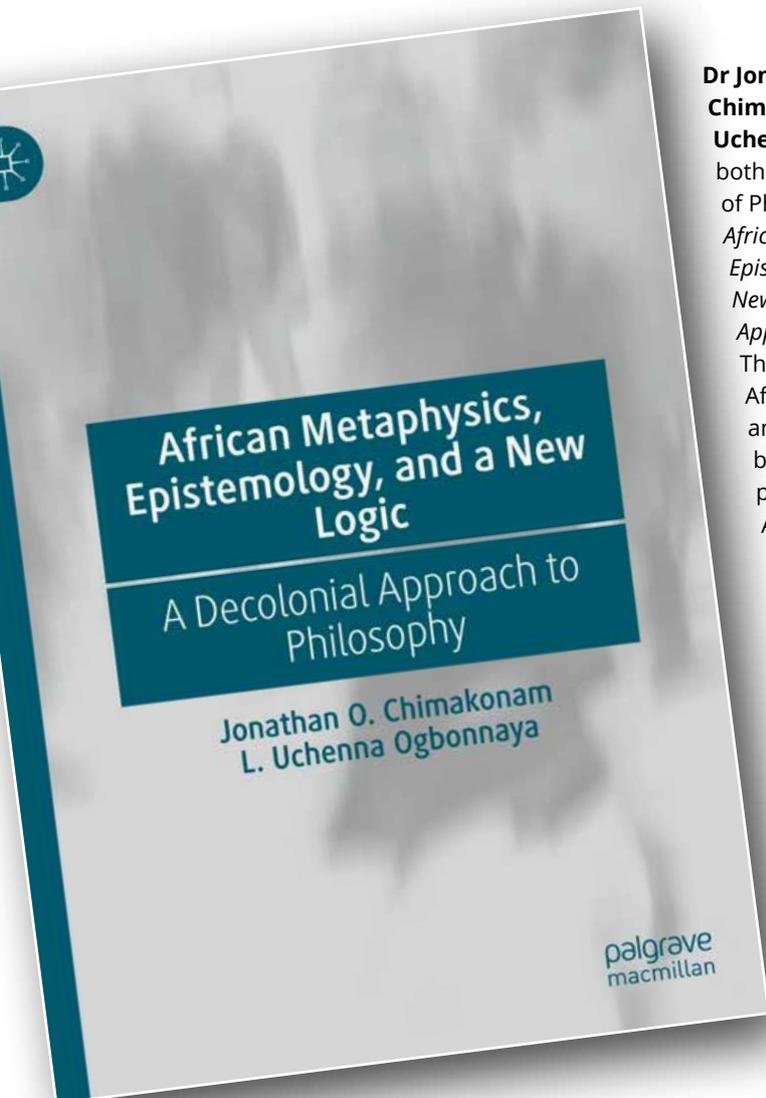
They consider contemporary debates, trends and questions, such as the 2018 launch of the suspension bridge between South Africa and Mozambique built and funded by Chinese investment. With the pace of trade and investment picking up, coupled with closer international cooperation with Beijing through the G20, FOCAC and BRICS grouping, South Africa–China ties are assuming a significant position in continental and even global affairs. At the same time, it is a relationship of paradoxes, breaking with many of the assumptions that underpin contemporary analyses of ‘China–Africa’ ties. The book examines the South Africa–China relationship through a survey of its diplomatic partnership, economic ties and broader community relations. ■





African Metaphysics, Epistemology and a New Logic: A Decolonial Approach to Philosophy

- Dr Jonathan Okeke Chimakonam
Department of Philosophy
- Dr L Uchenna Ogbonnaya
Department of Philosophy



Dr Jonathan Okeke Chimakonam and **Dr L Uchenna Ogbonnaya**, both of the Department of Philosophy, co-wrote *African Metaphysics, Epistemology and a New Logic: A Decolonial Approach to Philosophy*. The book explores African metaphysics and epistemology as branches of African philosophy, from the African perspective.

The authors describe their approach to 'decoloniality' as an intellectual repudiation of 'coloniality', using the method of conversational thinking grounded in Ezumezu logic. Focusing specifically on

both African metaphysics and African epistemology, Dr Chimakonam and Dr Ogbonnaya put forward theories formulated to stimulate fresh debates and extend the frontiers of learning in the field. They emphasise that this book is not a project in comparative philosophy, neither is it geared towards making Africa/ns the object/subjects of philosophy. Instead, the book highlights and discusses philosophical insights that have been produced from the African perspective, which, they contend, must be developed further to achieve decoloniality in the field of philosophy more broadly. ■



Writing Ocean Worlds: Indian Ocean Fiction in English

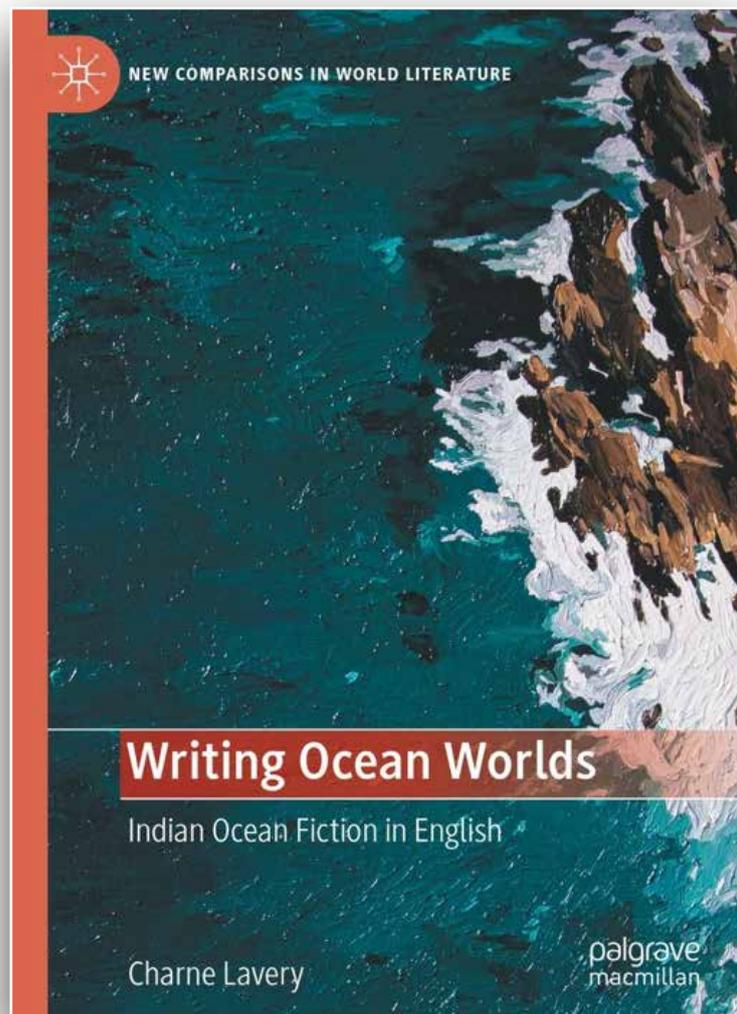
—• Dr Charne Lavery
Department of English

Dr Charne Lavery's book, *Writing Ocean Worlds: Indian Ocean Fiction in English* is the first full-length study to explore the question of broad literary Indian Ocean continuities and differences.

The book analyses the work of three contemporary authors who write about the Indian Ocean as a region and world, namely Amitav Ghosh, Abdulrazak Gurnah, and Lindsey Collen, alongside the imperial-maritime precursor Joseph Conrad. If postcolonial literatures are sometimes read as national allegories, this book presents an account of a different and significant strand of postcolonial fiction of which the geography, in contrast, is coastal and transoceanic.

The work imaginatively links east Africa, south Asia and the Arab world via a network of south-south connections that precedes and survives European imperialism. The novels and stories provide a vivid,

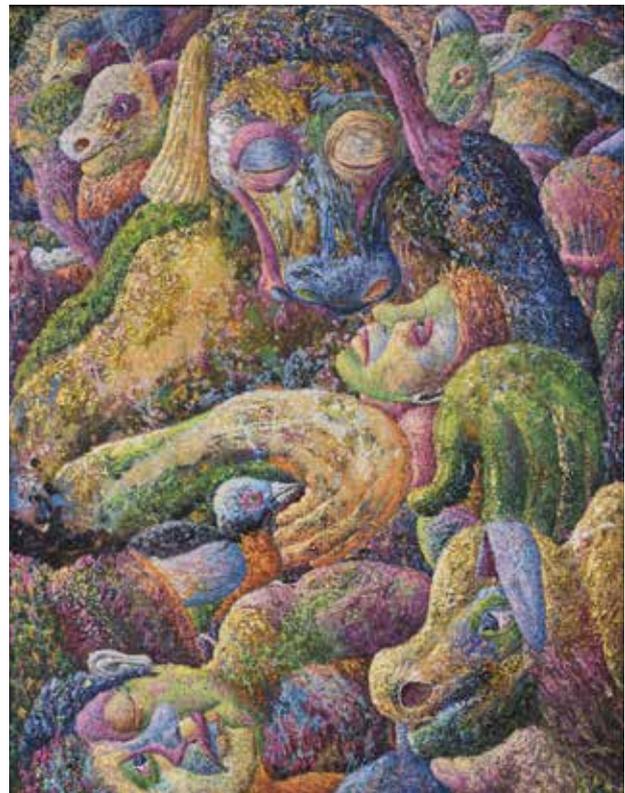
storied sense of place on both a local and an oceanic scale and, in so doing, remap the world as having its centre in the ocean and the south. ■



UP Science Leaders

A-rated scientists

Prof. Nigel Bennett	Zoology & Entomology, Faculty of Natural and Agricultural Sciences	Prof. Charles van Onselen	Centre for the Advancement of Scholarship, Faculty of Humanities
Prof. Michael Bruford	Biochemistry, Genetics and Microbiology, Faculty of Natural and Agricultural Sciences	Prof. Hans van Oort	Science of Religion & Missiology, Faculty of Theology and Religion
Prof. Don Cowan	Centre for Microbial Ecology, Faculty of Natural and Agricultural Sciences	Prof. Brenda Wingfield	Biochemistry, Genetics and Microbiology, Faculty of Natural and Agricultural Sciences
Prof. Pedro Crous	Microbiology & Plant Pathology (FABI), Faculty of Natural and Agricultural Sciences	Prof. Michael Wingfield	FABI, Faculty of Natural and Agricultural Sciences
Prof. Erika De Wet	Public Law, Faculty of Law	Prof. Xiaohua Xia	Electrical, Electronic & Computer Engineering, Faculty of Engineering, Built Environment & IT
Prof. Jean Lubuma	Mathematics & Applied Mathematics, Faculty of Natural and Agricultural Sciences	Prof. Thaddeus Metz	Philosophy, Faculty of Humanities
Prof. Josua Meyer	Mechanical & Aeronautical Engineering, Faculty of Engineering, Built Environment & IT		
Prof. Robert Millar	Physiology, Faculty of Health		
Prof. Stella Nkomo	Human Resources Management & Dean's Office, Faculty of Economic and Management Sciences		
Prof. James Ogude	Centre for Advancement of Scholarship, Faculty of Humanities		
Prof. James Raftery	Mathematics & Applied Mathematics, Faculty of Natural and Agricultural Sciences		
Prof. Yves van de Peer	Genetics, Faculty of Natural and Agricultural Sciences		



Awards and Recognition

Internal research awards

Chancellor's Award for Research

- **Prof. Charles Fombad**, *Centre for Human Rights, Faculty of Law*

Chancellor's Award for Teaching and Learning:

- **Prof. Karen Harris**, *Department of Historical & Heritage Studies, Faculty of Humanities*

Vice-Chancellor's Book Award

African Metaphysics, Epistemology and a New Logic: A Decolonial Approach to Philosophy

- **Dr Jonathan Okeke Chimakonam and Dr Uchenna Ogbonnaya**, *Department of Philosophy, Faculty of Humanities*

Exceptional Academic Achievers

- **Prof. Steve Cornelius**, *Centre for Intellectual Property Law, Department of Private Law, Faculty of Law*
- **Prof. André Ganswindt**, *Mammal Research Institute, Department of Zoology and Entomology, Faculty of Natural and Agricultural Sciences*
- **Prof. Christian Pirk**, *Social Insects Research Group, Department of Zoology and Entomology, Faculty of Natural and Agricultural Sciences*
- **Prof. Vasu Reddy**, *Faculty of Humanities*
- **Prof. Ann Skelton**, *UNESCO Chair in Education Law in Africa, Faculty of Law*
- **Prof. Alta van der Merwe**, *Faculty of Engineering, Built Environment and Information Technology*

Exceptional Young Researchers

- **Prof. Thulani Hlatshwayo**, *Faculty of Natural and Agricultural Sciences*
- **Prof. Nedine Moonsamy**, *Department of English, Faculty of Humanities*
- **Prof. Joel Modiri**, *Department of Jurisprudence, Faculty of Law*

- **Prof. Gustav Muller**, *Department of Private Law, Faculty of Law*
- **Dr Edward Snelling**, *Centre for Veterinary Wildlife Research, Department of Anatomy and Physiology, Faculty of Veterinary Science*

Vice-Chancellor's Award for Excellent Supervision

- **Prof. Johan Olivier**, *Gordon Institute of Business Science*

Teaching Excellence Award

GROUP AWARD

- **Prof. Hanneke du Preez and Mrs Tanya Hill**, *Department of Taxation, Faculty of Economic and Management Sciences*

INDIVIDUAL AWARD

- **Prof. Adrian Shrader**, *Department of Zoology and Entomology, Faculty of Natural and Agricultural Sciences*

COMMUNITY ENGAGEMENT AWARD

- **Dr Renata Eccles**, *Department of Speech-Language Pathology and Audiology, Faculty of Humanities*
- **Dr Esedra Krüger**, *Department of Speech-Language Pathology and Audiology, Faculty of Humanities*

The Conversation Africa awards for Communication Excellence

AWARD FOR THE SINGLE MOST READ ARTICLE

- **Prof. Marietjie Venter**, *The Genomics Research Institute, Department Medical Virology, Faculty of Natural and Agricultural Sciences*
- **Dr Madelien Wooding and Dr Yvette Naudé**, *Department of Chemistry, Faculty of Natural and Agricultural Sciences*

AWARD FOR THE AUTHORS WITH THE MOST ARTICLES PUBLISHED UNDER THE PERIOD IN REVIEW

- **Prof. Daniel Bradlow**, *Centre for Human Rights, Faculty of Law*
- **Mrs Gwen Ansell**, *Gordon Institute of Business Science*

Awards and Recognition

External research awards

- **Prof. Emma Hooijberg**, specialist veterinary clinical pathologist in the **Department of Companion Animal Clinical Studies, Faculty of Veterinary Science**, received the Research Award of the South African Veterinary Association (SAVA).
- **Dr Hendrik Swanepoel**, a master's student in the **Faculty of Veterinary Science**, won the 2021 Prize for Global Research of the Province of Antwerp for his thesis on viral diseases in African ungulates.
- **Prof. Gareth Bath**, Emeritus Professor of the **Faculty of Veterinary Science** received the 2021 Agricultural Writers SA Agriculturalist of the Year award.
- **The Faculty of Veterinary Science's** Onderstepoort Veterinary Academic Hospital (OVAH), was selected by Beeld and Netwerk24 readers as their winner (platinum) in the veterinary category of the 2021 Beeld Reader's Choice competition.
- Postdoctoral research fellow **Dr Ezzette du Rand** of the **Department of Zoology and Entomology** in the **Faculty of Natural and Agricultural Sciences** won the Postdoctoral category in the L'Oréal-UNESCO Women in Science South African National Young Talents Programme 2021 for her work focusing on the seminal fluid of honeybees.
- **Agil Katumanyane**, a PhD student in the **Forestry and Agricultural Biotechnology Institute (FABI)**, received the Women in Science award for Sub-Saharan Africa Young Talents for her work focusing on the potential for the biological control of white grubs in South Africa, using locally isolated entomopathogenic nematodes.
- **Prof. John Taylor**, a Senior Research Fellow in the **Department of Consumer and Food Sciences** and the Institute for **Food, Nutrition and Well-being** was awarded the TB Osborne Medal by the Cereal and Grains Association. His research has concerned sorghum's kafirin prolamin proteins. His team has made significant innovations in utilising kafirin as a bioplastic polymer and as a functional replacement for gluten in non-wheat types of bread.
- **Prof. Stephanie Burton** won the Management Award at the 2020/2021 National Science and Technology Forum (NSTF) NSTF-South32 Awards.
- **Prof. Charles van Onselen**, Research Professor in the **Faculty of Humanities** and affiliated to the **Department of Historical and Heritage Studies**, was awarded the Academy of Science of South Africa (ASSAf) Humanities Book Prize for his highly acclaimed book, *The Night Trains: Moving Mozambican Miners to and from South Africa, circa 1902-1955*.
- **Prof. Elsabe Kearsley**, an experienced lecturer and researcher in the **Faculty of Engineering, Built Environment and Information Technology**, was appointed as President of the South African Academy of Engineering (SAAE).
- **Prof. Vukosi Marivate**, ABSA Chair of Data Science in the **Faculty of Engineering, Built Environment and Information Technology**, as part of a research team, has been named a joint winner of the inaugural 2021 Wikimedia Foundation Research Award of the Year for the Masakhane Natural Language Processing (NLP) research project.
- **Dr Karen Botes**, a lecturer in the **Faculty of Engineering, Built Environment and Information Technology**, won the World Building Congress (WBC) 2022 abstract-writing competition.

Awards and Recognition

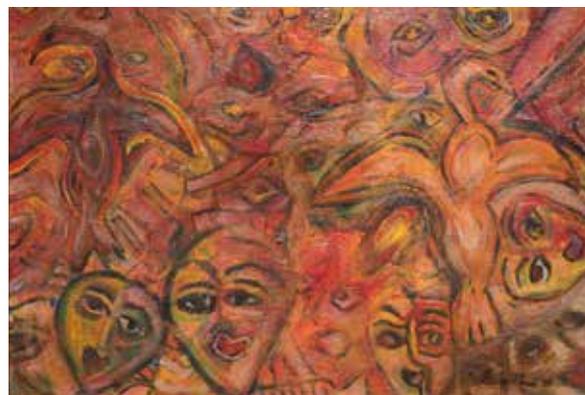
External research awards

- **Dr Marco van Dijk**, a researcher in the **Faculty of Engineering, Built Environment and Information Technology**, was named the winner in the Empowering Communities category for the Knowledge Tree Awards of the Water Research Commission.
- **Prof. Evans Chirwa**, incumbent of the Rand Water and Sedibeng Water Research Chairs in Water Utilisation Engineering in the **Faculty of Engineering, Built Environment and Information Technology** has been elected by the Board of Water Institute of South Africa as a Senior Fellow.
- **Prof. Gareth Bath**, Emeritus Professor of the **Faculty of Veterinary Science** was honoured by the World Veterinary Association (WVA) as one of the recipients of its Global Animal Welfare Award.
- **Prof. Patricia Forbes**, incumbent of the Rand Water Chemistry Research Chair in the **Department of Chemistry**, was elected to the Professional Standards Board of the Royal Society of Chemistry and was made a Fellow of the South African Chemical Institute.
- **Bianca Gevers** (a PhD student in the **Faculty of Engineering, Built Environment and Information Technology**, under supervision of **Prof. Johan Labuschagne**) was runner up (and first in South Africa) in the IOM3 Young Persons' World Lecture Competition 2020 for presentation skills in her lecture on 'Engineering photo-active materials for renewable energy generation'. She was also one of the recipients of the L'Oréal-UNESCO Award for Women in Science South African Young National Talents.
- Postdoctoral student, **Dr Ismaheel Lawal** in the **Faculty of Health Sciences**, was awarded the 2020 International Best Abstract Award by the Society of Nuclear Medicine and Molecular Imaging (SNMI) for the study "Predictors of residual metabolic activity on FDG PET/CT in patients treated for pulmonary tuberculosis".
- **Prof. Sunil Maharaj**, Dean of the **Faculty of Engineering, Built Environment and Information Technology**, was elected in 2020 as Chair for the Global Engineering Deans Council (GEDC).
- **Prof. Wanda Markotter** who is the Department of Science and Innovation/NRF SARChI Chair: Infectious Diseases in Animals (Zoonoses) and director of the **Centre for Viral Zoonoses** in the **Department of Medical Virology, Faculty of Health Sciences** was a finalist in the 2019/2020 National Science and Technology Forum's (NSTF) prestigious NSTF-South32 Awards, in the TW Kambule-NSTF Researcher category.
- **Prof. Josua Meyer**, Head of the **Department of Mechanical and Aeronautical Engineering**, and Chair of UP's School of Engineering in the **Faculty of Engineering, Built Environment and Information Technology**, won the male category of the Engineering Research Capacity Development Award at the National Science and Technology Forum (NSTF)-South32 Awards.
- **Prof. Emily Mitchell**, a veterinary pathologist in the **Faculty of Veterinary Science's Department of Paraclinical Sciences**, was honoured by the South African Veterinary Association (SAVA) Wildlife Group with the Lycaon Award.
- **Prof. Clifford Mutero**, an Extraordinary Professor appointed in the University's **Institute of Sustainable Malaria Control**, hosted in the **Faculty of Health Sciences** received an award for the best publication: Education / Health System in the Faculty of Health Sciences for an article published in *Malaria Journal*, "Integrated vector management for Uganda: knowledge, perceptions and policy development".
- **Dr Chris Oosthuizen**, an alumnus of the **Department of Zoology and Entomology** in the **Faculty of Natural and Agricultural Sciences**, and a research associate with the **Marion Island Marine Mammal Programme**, was recently awarded the Population Ecology Young Author Award.

Awards and Recognition

External research awards

- **Dr Juergen A Richt** from the Kansas State University College of Veterinary Medicine, and Extraordinary Lecturer in the **Faculty of Veterinary Science's Department of Veterinary Tropical Diseases** (DVTD) was awarded the 2021 Association of American Medical Colleges (AAVMC) Excellence in Research Award.
- **Prof. Mike Sathekge**, Head of Nuclear Medicine in the **Faculty of Health Sciences** was awarded the Presidential Award at the seventh South African Medical Research Council (SAMRC) Scientific Merit Awards.
- **LaToya Seoke**, a PhD student in the Faculty of Veterinary Science's Department of Production Animal Studies at the University of Pretoria (UP), was one of only 20 women researchers to receive the Sub-Saharan Africa Young Talent Award for academic excellence under the auspices of L'Oréal-UNESCO for Women in Science.
- **Prof. Daniël Christiaan de Wet Swanepoel** of the **Department of Speech-Language Pathology and Audiology** in the **Faculty of the Humanities** was awarded the African Academy of Sciences' (AAS) science prize for his innovative research in tele-health and mobile health, specifically in the field of audiology.



Editorial panel

Professors Don Cowan, Robin Crewe, Jan Eloff, Vasu Reddy, Bernard Slippers and Brenda Wingfield

Writer and editor

Simon Gear



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