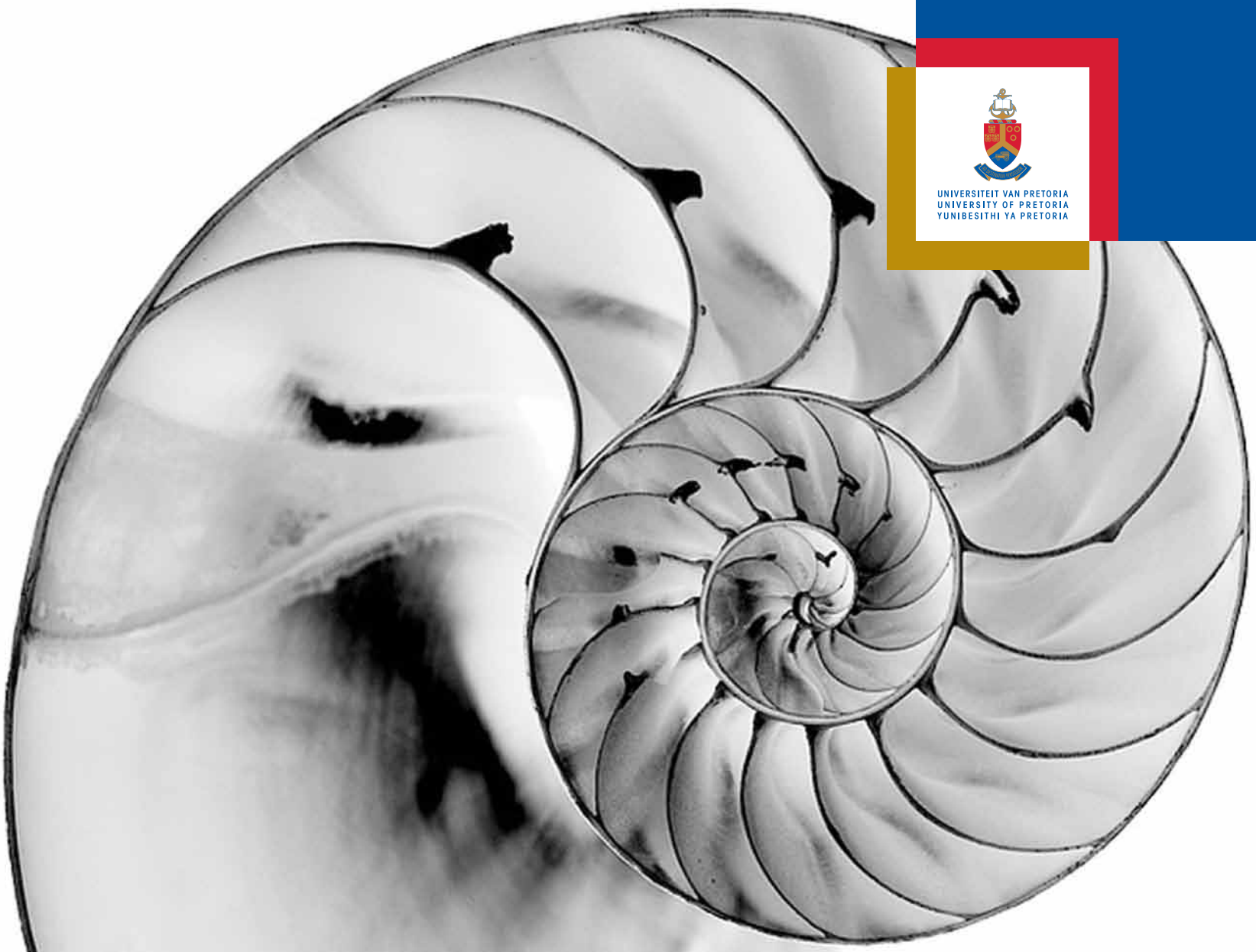

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Research Review 2015

University of Pretoria

A leading research university in Africa

Our vision

To be a leading research university in Africa, recognised internationally for its quality, relevance and impact, and also for developing people, creating knowledge and making a difference locally and globally.

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Spirals in nature tend to follow the Golden Ratio or Fibonacci Sequence in their rates of expansion. These shapes, called logarithmic spirals, are used in a variety of applications, from engineering and architecture, to art.

Nautilus shells are just one example of these spirals.

On this year's cover, a cross-section of the Nautilus shell reveals the cycles of its growth as a series of chambers arranged in a precise Golden Mean spiral.

With each revolution completing a cycle of evolution, the Golden Mean spiral is symbolic of growth, progression and development – qualities that the 2015 Research Review demonstrates by profiling the University's leading and emerging researchers and the impact of their research.

Foreword

Each year the University of Pretoria presents a retrospective Research Review of research productivity and achievements in which different dimensions of the rich and diverse endeavour of our leading researchers, and of young and emerging scholars, are foregrounded.

The UP Research Review 2015 presents under five themes a selection of research ranging across disciplines in the humanities and social sciences, natural and agricultural sciences to engineering, health and veterinary sciences. Five themes were chosen for this Review: *Society, Health, Environment, Resources and Identity*. This approach allows us to illustrate new dimensions to research and its alignment with the needs of the society that the University strives to serve.

The first thematic area relates to UP's identity and location in Africa – from the focus on *Future Africa*, one of the University's programmes that targets mid-career academics in Africa, to the work of an internationally acclaimed artist whose creative output captures 'land as material and metaphor': *Africa Matters–Art Matters–Earth Matters.* Between these two 'bookends' are matters of science diplomacy, big data science, law, economics and the design of regenerative systems towards building a sustainable future.

Each theme similarly casts the spotlight on challenges being addressed through research and innovation. The second thematic focus on health covers lifestyle interventions and the study of non-communicable diseases, food security, and several other research foci - all related to the United Nations Sustainable Development Goals (SDGs), and Goal 3, in particular: 'Ensure healthy lives and promote well-being for all at all ages'. This theme brings to the fore the critical connection among people, animals, organisms and the environment.

We then turn to the environment to cover a broad range of research undertaken in exceptional contexts, beginning with ecology in a changing

world, to studies in extreme environments, and bringing to the fore the link between organism and environmental change in the Age of the Anthropocene.

The fourth theme on resources highlights examples of complex and extensively networked research programmes at UP that seek to find solutions to some of the intractable problems we face regionally and globally related to plants, forests and sustainable livelihoods.

The fifth and final theme on identity is befitting of the contested spaces within higher education in South Africa in this contemporary era of transformation. The introductory research profiled on the craft of biographers concludes, 'You only know where exactly it is that you are bound for once you understand where you are – and you can only know that once you appreciate fully the path already travelled'.

The final section of the Review showcases our A-rated scientists, outstanding research awards, and the many research chairs, institutes, centres and units that constitute a critical mass of research excellence. As a public institution, we take pride in this conscious alignment between the questions and problems that inspire researchers and the contextual realities that demand resolution – therefore also the importance of the claim at UP that *Research Matters*. Research is at the heart of the institutional mission and it is central to positioning the University of Pretoria as a flagship institution in Africa committed to developing people, creating knowledge and finding answers to solve the challenges of our times.

Professor Cheryl de la Rey
Vice-Chancellor and Principal

Introduction

The year under review was one of continuing progress and strengthening research development and, overall, a year of positive change for research at the University of Pretoria. Advancing our existing goals and commitments to building research capacity and productivity, in support of new knowledge for social development and well-being, have continued to be central to our work.

It is with pleasure that I introduce this comprehensive review of the University's growing strengths in research as they continue to provide a foundation for our role as a leading research-intensive African university.

This review showcases the University's research achievements of 2015, presented in five themes, encompassing the breadth and depth of our many research activities.

The qualifications and research skills of our staff members are at the core of the University's research strength. In 2015, the number of academic staff holding doctoral degrees rose to 920 or 62% of the staff – an increase from 54% in 2014. The number of staff members who hold National Research Foundation (NRF) ratings rose by 12% to 438 from 393 in the previous year.

The University's research outputs also increased the publication of international Scopus-listed research papers, increasing from 1 593 in 2014 to 1 705 in 2015. In addition, 79 researchers earned their places as authors of the top 1% of highly cited papers in their fields, in the Web of Science (WoS). These scholars represent a significant critical mass of UP's researchers who have earned recognition for the international impact of their work.

In line with these achievements, the University gained an additional four South African Research Chairs Initiative (SARChI) Chairs for women scientists, while the number of productive international research partnerships grew to 221, with 900 papers (out of 1 909) co-authored with scholars from beyond South Africa's borders.

The University's international standing is further reflected in the 4 375 international students (2 149 of whom are postgraduate students) enrolled in 2015; and 126 international postdoctoral fellows, from 37 countries, who represent 65% of all postdoctoral fellows engaged in UP research programmes.

Just as research productivity and recognition are critical indicators of research activity and excellence, so too is the graduation of postgraduate students. The number of students graduating with higher degrees is a measure of the time

and effort that academic staff devote to supporting new cohorts of talented young people – all of whom will contribute, within and beyond academia, to the social and economic well-being of the country and the greater African region. In 2015 doctoral graduations increased, very significantly, from the 2014 figures by 41% to 333 graduates, and the number of graduates with research master's degrees increased by 16%, totalling 1 023 students.

In addition to improvements in postgraduate student graduation performance, the University supported 28 staff members in the completion of their doctoral degrees, and provided development workshops for some 150 early career researchers – 90 of whom were young women.

While the University invests substantially in its research programmes and projects, additional funding is always critical to the expansion of research activities. This year saw such funding grow by 30% from the R405 million raised in 2014 to R525 million – an amount that reflects not just important research income, but also growing recognition of the University's importance as a centre for research of relevance to the country and the region.

Leading and advancing research and postgraduate education in 2015 is a great privilege. While the Office of the Vice-Principal plays a central role in ensuring the ongoing progress of research at the University of Pretoria, it is the academic staff, the scientists and scholars, who conduct the research. Moreover, it is the Department of Research and Innovation Support (DRIS) whose members have supported research and researchers on a daily basis, under the guidance and leadership of the Director, Dr Carol Nonkwelo. I would like to record my sincere appreciation for the contributions made by all our UP colleagues to the success of research at UP.

Professor Stephanie Burton
Vice-Principal for Research
and Postgraduate Education

Overview of achievements

HIGHLY PRODUCTIVE RESEARCHERS

79
Researchers in the top 1% internationally in their disciplinary fields (*Web of Science*)

1 580
Journal publication units accredited by DHET

30%
Growth in funding to expand research activities

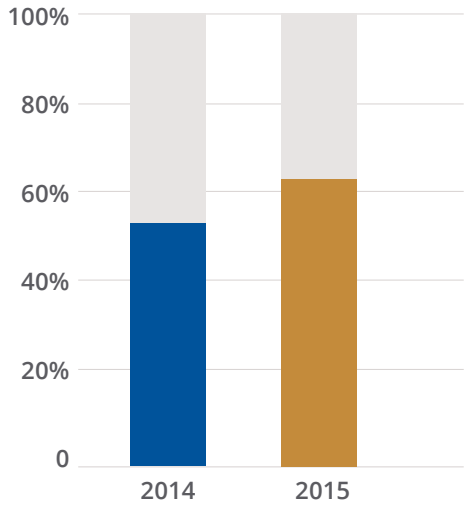
438
NRF-rated researchers

12%
Growth in academic staff who hold NRF ratings

14
A-rated scientists

77
Y-rated young scientists

Academic staff with PhDs



501-550
QS (overall)

501-600
Times Higher Education

77th
Times Higher Education BRICS

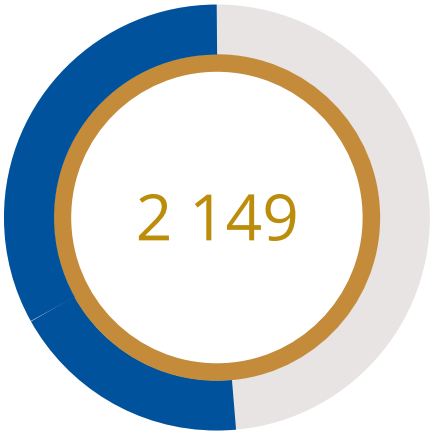
49th
QS BRICS

INTERNATIONAL COLLABORATION AND PARTNERSHIPS

221
Institution-wide international research partnerships

900
Number of papers co-authored with scholars from beyond SA's borders (*WoS Index*)

65%
Percentage of international postdoctoral fellows who are from 37 countries



Postgraduate international students enrolled at UP

53%
Students from SADC countries

UP is one of the 15 founding universities of the African Research Universities Alliance (ARUA)

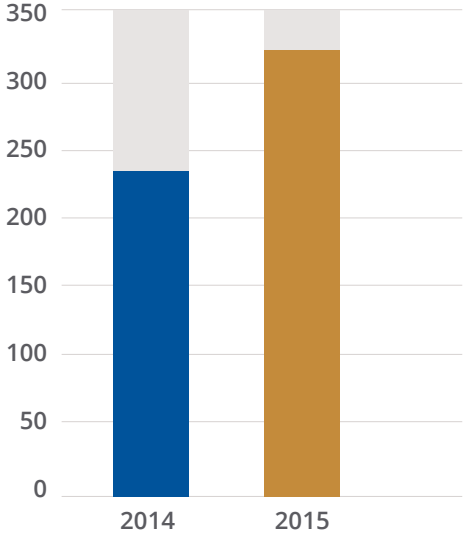
RESEARCH CAPACITY

47
Number of Research Chairs and Centres of Excellence

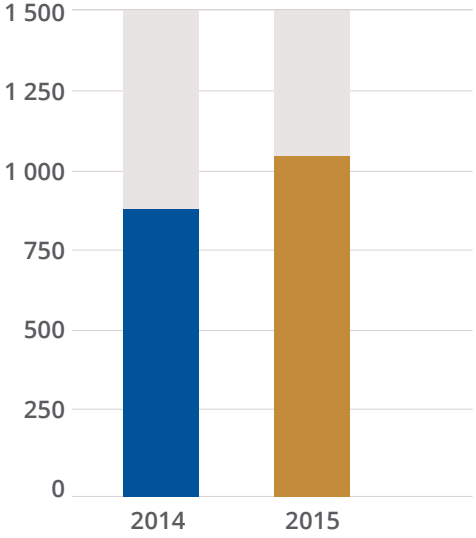
29
Industry and internationally sponsored Chairs

90
Research Institutes, Centres and Units

Increase in doctoral graduates



Increase in research master's graduates



INNOVATION AND IMPACT

224
New agreements with industry and public sector partners

24
New invention disclosures

35
New international patent applications

Don Cowan

A gravel desert in Namibia

PART 2
Research matters

The University of Pretoria's research strategy is built on addressing the very real challenges of the contexts of which we are a part – our place in Africa, and our commitment to knowledge production that speaks to a global world.

The science stories, interviews and short features presented in Part 2 follow five broad themes:

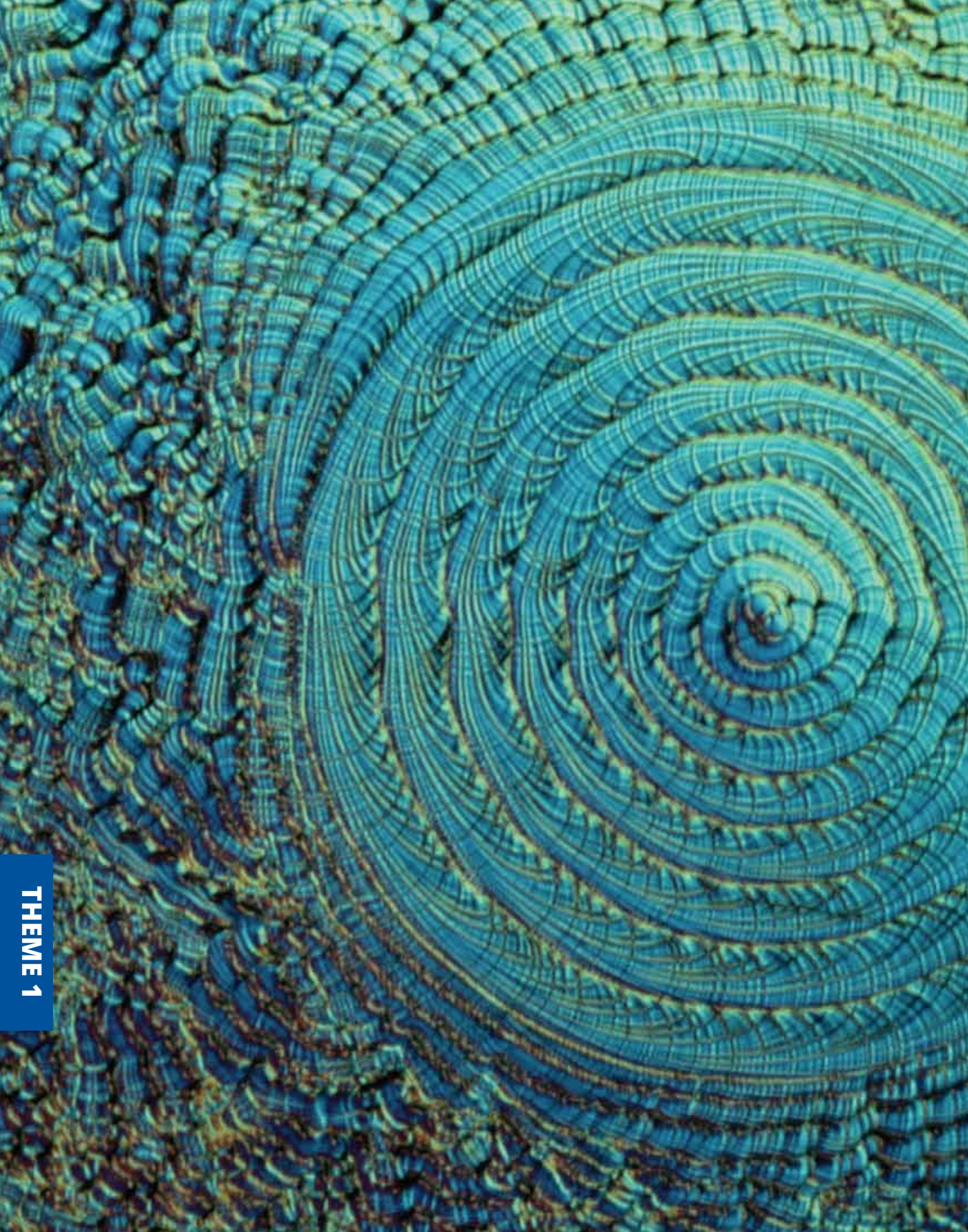
1 – Society

2 – Health

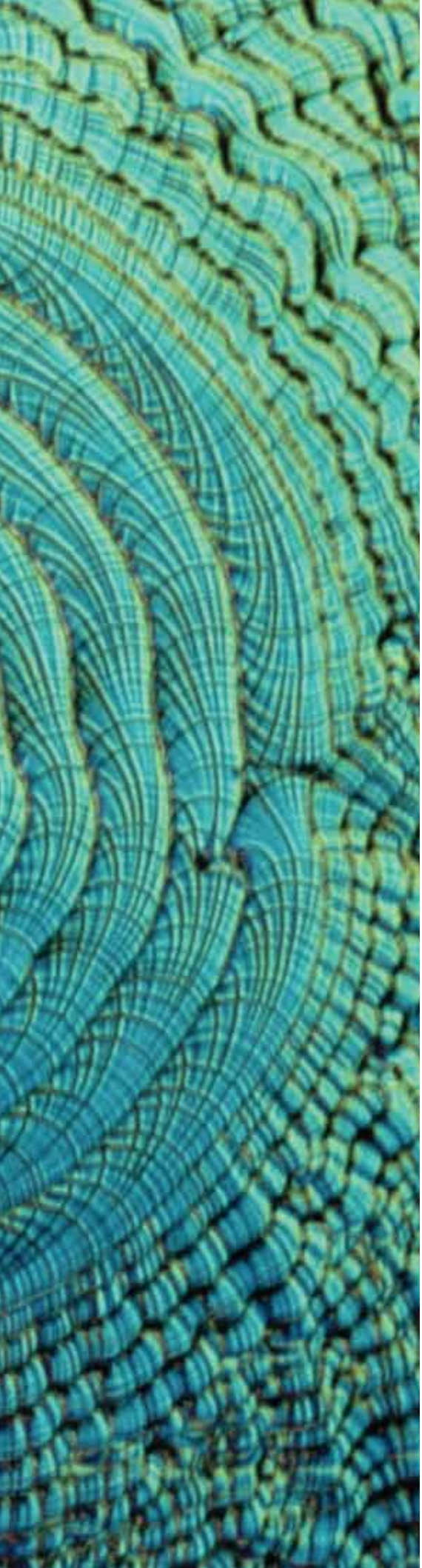
3 – Environment

4 – Resources

5 – Identity



THEME 1



1 Society

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The world, and developing regions in particular, face many challenges that can no longer be addressed by singular and isolated approaches to science. The first theme provides a broad introduction to science in society and firmly locates UP in Africa – from ***Future Africa***, UP's initiative to develop a new generation of science leaders, to *Earth Matters*, the work of an internationally acclaimed artist. This theme, as with the research profiled in this Review, demonstrates what has become widely accepted – that the role of universities is about knowledge production and, equally, about the public good.

Detail of silicon, the most abundant element on Earth, after oxygen.

Future Africa

The world, and Africa in particular, is faced with many grand or 'wicked' challenges that cannot be addressed by the traditional and habitually singular, isolated approaches to science.

Professor Bernard Slippers leads the *Future Africa* project

Professor Bernard Slippers writes that wicked challenges such as poverty, food security, climate change, biodiversity loss and development require the integration of perspectives across disciplines, scales and sectors to understand, let alone address, them.

The United Nations Sustainable Development Goals and African Union Agenda 2063 strategic plan speak to these wicked challenges facing society. They also represent a clarion call to research communities around the world to reconsider how we contribute to the well-being of society. In an age where knowledge is produced at a scale and rate that was unimaginable even a few decades ago, it is an indictment that the world has moved backwards with regards to many of these issues in recent times.

In recognition of these challenges, a new approach to science is emerging. Firstly, convergence science is bringing together different fields of study, allowing for the development of integrated approaches for understanding systems, and opening new pathways and opportunities for providing solutions to problems. Secondly, there is a growing call for such endeavours to be more deeply connected with the society that science is intended to serve, from inception and design, to the 'ownership' and use – what is referred to as transdisciplinary approaches to knowledge production.

To embrace this change, there is an urgent need to develop a new generation of scholars who are equipped to be leaders in addressing the grand challenges we face in Africa through their research and engagement.

"Searching for solutions (to today's global challenges) requires that the scientific community operate in fundamentally new ways... Developing effective solutions requires converging approaches, such as the integration of knowledge from the life, physical, social, and economic sciences and engineering... Research-performing and training institutions, such as universities and research institutes, have critical roles to play... it is essential that they develop appropriate training programs and help stimulate multidisciplinary international collaborations."

Philip Sharp, Nobel Laureate in Medicine, and Alan Leshner, past CEO of AAAS, The American Association for the Advancement of Science.*

The University of Pretoria has established the ***Future Africa*** initiative to foster a new generation of science leaders, and to provide a link for them to research networks across the continent and the world. Future Africa provides a platform where scientists from different fields can meet, work together, exchange ideas and develop new research projects that are specifically aimed at addressing the challenges that constrain change towards a prosperous, equitable and sustainable future for Africa.

*In Sharp PA, Leshner AI. 2014. Meeting global challenges. Science 343: 579

As one of Africa's leading research universities, the University is well placed to develop the future leaders of science in Africa, with programmes that target high-profile African scholars and scholars from further afield, postdoctoral fellows and postgraduate students.

The Africa Science Leadership Programme

The Africa Science Leadership Programme (ASLP) aims to grow excellent mid-career African academics in the areas of collective leadership, team and research development and science-society engagement, with the intention of enabling them to solve the complex issues facing both Africa and the global community.

Two comments from participants at the first ASLP workshop illustrate the value of the programme to young researchers:

"I am delighted to have discovered this network of people. I did not expect the diversity and instant connection we had as Africans and the shared heart in thinking about solutions."

"I have always had ideas about things I want to do beyond my academic discipline, but the Africa Science Leadership Programme was the first time I have had a platform to explore, describe and discuss them with a diverse group of people."

Dr IkeOluwao Oyeneye Ayayi, an ASLP fellow from Nigeria

Tuks Young Research Leader Programme

Similar to the Africa-wide ASLP, the institution-specific Tuks Young Research Leader Programme (TYRLP) is an initiative at the University of Pretoria that targets early career academics. The programme aims to support young academics in the areas of thought leadership, team development, engagement and collaboration. A direct benefit to individual researchers is the community within the University that supports like-minded young researchers in proactively contributing to the research identity of UP. Several of these young academics are featured in this Review.

Dr Darshana Morar, Faculty of Veterinary Science, participant in TYRLP 2015

FUTURE AFRICA

Future Africa will offer the physical infrastructure and space for a dynamic living, learning and research environment, a place where a community of scholars and a range of other actors from across society can meet. Broad scale engagement has already started, with the aim to advance excellence in scholarship, dialogue and social responsibility across disciplines, cultures and sectors on issues of critical relevance to Africa, from sustainable development to good governance, protecting human rights, and advancing innovation for a bio-resource economy.

Science diplomacy in Africa

Since the establishment of the experimental natural sciences in the 17th century, this method of enquiry has not been confined by national borders or citizenship of a particular country. Based on experiments that provide evidence used to understand the natural world, this field of enquiry has always been characterised by the development of international collaborations and the free interchange of ideas.

Diplomacy, on the other hand, writes **Professor Robin Crewe**, is essentially an activity in which national states engage in order to regulate relationships between themselves. The intersection of the interests and activities of the natural scientists with that of the national states in which they live, has resulted in the emergence of an activity that is now called Science Diplomacy. States have recognised that natural scientists (and scholars in general) are driven to form collaborations that arise from their interest in addressing key questions in their disciplines. Hence their primary focus is not on issues of national concern, although if they achieve prestige in a field (e.g. Nobel prizewinners) they will be accorded national honour. States have recognised that encouraging collaboration between their natural scientists may bring significant benefits in terms of relationships between the states and may lead to significant national benefits in terms of the development of ideas, innovations and expertise.

As the cost of undertaking certain forms of research have risen to the point where individual states can no longer afford to fund them, scientists have recognised that they need to form international consortia that would collectively persuade states to co-fund

Photograph courtesy of SKA

the research activities. Good examples of this are CERN in particle physics, the international space station in space exploration, and the SKA in astronomy. In addition, there are a number of issues that arise as a result of the application of the natural sciences to human development that are of global concern. These include the use of genetically modified organisms (GMOs) in agriculture and other industries, and the issue of climate change. In these cases, scientists are involved in advising governments regarding the evidence that provides insights into addressing these problems.

The international role played by scholars was highlighted by a former Foreign Secretary of the Royal Society of London, Lorna Casselton, who said:

*"The Royal Society has a long history of using science to rise above military conflict and political and cultural differences. My post was instituted in 1723, nearly 60 years before the British Government appointed its first Secretary of State for Foreign Affairs."**

Although governments may have been slow in establishing formal structures to make use of science in diplomacy, it is now globally practised.

The challenge for natural scientists engaged at the interface between their disciplinary work and the demands of diplomacy between states is to understand their role in the three dimensions of Science Diplomacy defined in the Royal Society Report on Science Diplomacy:

"The concept of Science Diplomacy ... is still a fluid concept, but can usefully be applied to the role of science, technology and innovation in three related areas:

- informing foreign policy objectives with scientific advice (*science in diplomacy*);
- facilitating international science cooperation (*diplomacy for science*);
- using science cooperation to improve international relations between countries (*science for diplomacy*)."

Thus natural scientists who are encouraged to engage in bilateral or multilateral collaborations by their national governments and funding agencies, or those who advise on the 'wicked' problems that currently confront humanity, need to be aware of the potentially conflicting demands that they may face when they act in a diplomatic role. Most natural scientists who find themselves in these roles are poorly prepared to deal with the environment into which they are thrust, and they need to consider whether they require some mentoring from the University in order to fulfil this role effectively.

Professor Robin Crewe, Director of the Centre for the Advancement of Scholarship (CAS)

**New Frontiers in Science Diplomacy: navigating the changing balance of power*. Report based on evidence gathered at a meeting hosted by The Royal Society of London in partnership with the American Association for the Advancement of Science (AAAS). RS Policy Document 1/10, pp. 32, 2010.

Open data, big data and the future of science

In May 2015, Professor Geoffrey Boulton, Regius Professor of Geology Emeritus and former Vice-Principal of the University of Edinburgh, presented a guest lecture at the invitation of the Vice-Chancellor and Principal, Professor Cheryl de la Rey, an event co-hosted with the International Council for Science (ICSU) and its Committee on Data for Science and Technology (CODATA).

The focus was on the implications of 'open data' and 'big data' for the future of science, and the emergence of data science as a discipline. The 'data revolution' raises important questions for international science and for the science base in Africa, and offers new opportunities for scientific discovery that transcend traditional disciplinary boundaries. It also calls for greater involvement of a wider range of stakeholders and citizens in the co-production of knowledge, and for a deeper democratic engagement with the ways that scientific knowledge is created and used. Science can no longer be a private enterprise that is conducted behind closed laboratory doors.

At the same time, while science is an international activity, it is undertaken in a national cultural setting, which requires national strategies to fit within a common international frame. Professor Boulton's lecture set the scene for discussions about science and science policy for Africa in the age of big data.

The age of big data science

As the cost and complexity of undertaking certain forms of science has led to increasing global science cooperation, so too has the 'data revolution' opened up new research frontiers and brought about new ways of collaborating and of doing research.

Professor Jan Eloff

We have witnessed an unprecedented increase in the volume of data generated in recent decades. Advances in technology have allowed for better storage and speed, and for data to be produced in real-time, without human intervention, through satellites, sensors, drones, digital cameras, machines, phones and many more devices. To illustrate, there are an estimated 26 billion devices connected over the Internet and well over 2 billion people via social media platforms.

Professor Jan Eloff in the **Department of Computer Science** writes that 'Big Data' are so large and complex that it becomes increasingly difficult, if not impossible, to process and interpret volume. Big Data are typically not only high-volume, but also have high-changing and high-variety characteristics. It is the search for new and novel ways of managing these large volumes of data that gave rise to the concept of Data Science – the behavioural aspects of data that require advanced algorithms to detect the 'hidden' knowledge and behavioural patterns, and predictive analytics to forecast trends:

Big Data Science = Big Data + Machine Learning + Predictive Analytics

Kjell Lindgren

NASA astronaut Kjell Lindgren took this photograph of Earth from the International Space Station, and shared it with his followers on social media. This image was used in the cover design of the publication, *Science International* (2015). *Open Data in a Big Data World* (Paris: ICSU, ISSC, TWAS and IAP).

Big data examples from research profiled in this Review would include, for example, changing market flows, consumer identities and patterns of decision-making, as well as land, water and natural resource use.

Some of the better known examples of Big Data are those gathered by social media platforms. People need to be aware continually that what and who they are dealing with is 'real'. For example, how does a person know that the recipient of information is a real person and not a botnet or a fake person who will misuse such data? How does one know that the email received from a bank was really sent by the bank? Such questions relate to deception and are the focus of the **Cyber-Security and Big Data Science Research Group** in the Department of Computer Science, with researchers leveraging advances in Big Data Science to seek innovative solutions to identity and content deception.

Ambiguity, learning and economic decisions

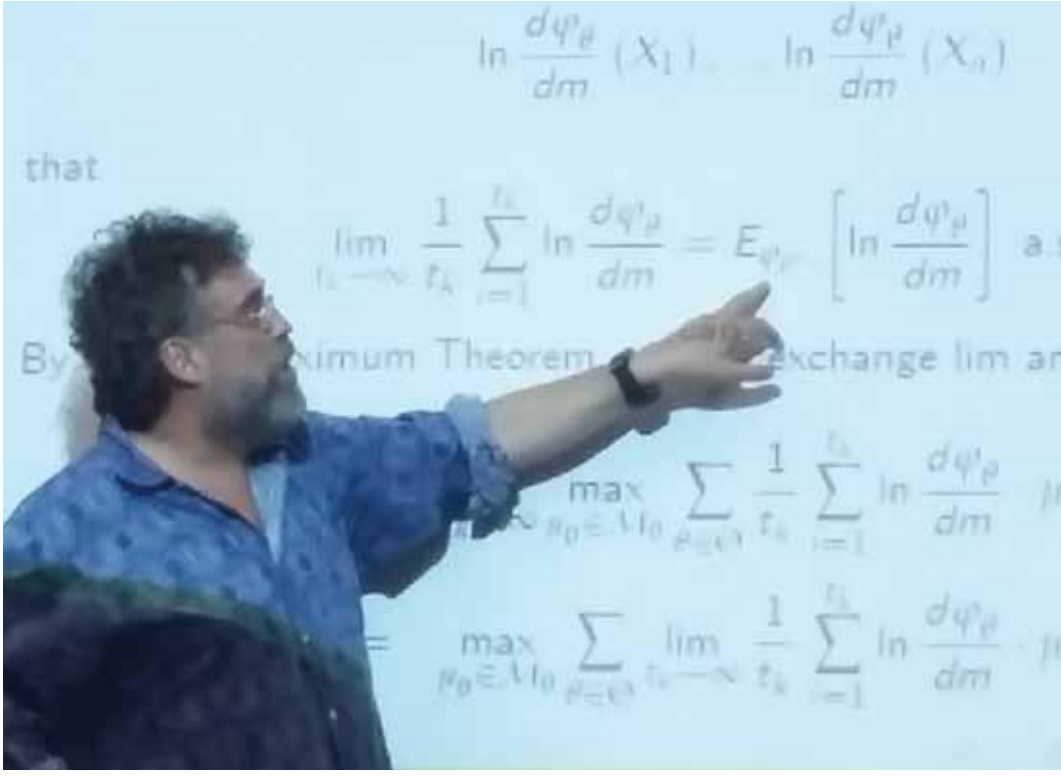
We continually make decisions – about marriage, medical treatment, study opportunities, policies and investments, for example – without knowing the 'true' state of the world. Decisions taken today become the consequences of tomorrow when, out of many possible states, the 'true' state emerges.

Decision theory formalises this state of uncertainty through state-space models. **Professor Alexander Zimper**, from the **Department of Economics**, works in the area of theoretical economics, focusing on behavioural biases and decision theory which are foundational to many of the questions addressed by empirical economists.

Traditional models of decision-making consider a decision-maker who resolves uncertainty about the 'true' state through a subjective probability distribution. Such subjective probabilities should either resemble objective probabilities, or they should converge to objective probabilities through learning. Influenced by insights from psychology, recent theories of decision-making emphasise 'ambiguous' decision situations in which decision-makers cognitively and/or motivationally deviate from this traditional model.

Central to Professor Zimper's research is the question whether such 'ambiguous' decision situations are only short-term phenomena or change through learning. An experiment conducted with collaborating researchers showed that decision-makers' ambiguity does not change through exposure to more information, indicating that in contexts of ambiguity, cognitive learning does not necessarily imply a change in behavioural biases.

In economic applications, he and fellow researchers have developed a model that applies to decisions taken over people's life cycles. For example, the literature has identified age-dependent savings puzzles which show that young people save too little and old people save too much. At the same time, evidence shows that young people underestimate and old people overestimate their objective survival chances. The researchers' calibrated model connects both empirical facts by explaining savings puzzles through ambiguous survival beliefs.



Professor Alexander Zimper

The conflict of obligations

When the Sudanese president Omar Al-Bashir was not arrested while attending the African Union Summit in Johannesburg in June 2015, and was allowed to leave South Africa, major controversy ensued – in the media and in legal circles. As signatory of the International Criminal Court, what were South Africa's obligations?

Professor Dire Tladi

Even before the possibility of Al-Bashir arriving in South Africa arose, **Professor Dire Tladi** had written in a leading international journal, *Journal of International Criminal Justice*, about the conflict of obligations existing in international law with respect to Al-Bashir.

Under general international law, Heads of State are immune from the jurisdiction of foreign States. However, the Rome Statute establishes a duty to arrest and surrender persons, including Heads of State, when such persons are sought by the International Criminal Court. With the arrival of Al-Bashir, this conflict of obligations became real.

On appeal, the Supreme Court of Appeal cited Dire Tladi, and determined, as he had argued in his writings, that there was a conflict of obligations. In addition to advising the government on the subject, and because of his expertise, Professor Tladi had previously been invited to give a keynote address to the annual meeting of the German-speaking Association of International Criminal Lawyers in May 2015. Also, the Japanese Society of International Law requested him in 2014 to write an article for the *Japanese Yearbook of International Law* on the subject, which was published in the 2015 volume of the Yearbook.

Professor Tladi's research on, and personal experience with, international criminal law led him to write a novel – ***Blood in the Sands of Justice*** (2015). It has been described as a riveting crime thriller, built on his extensive knowledge of the workings and machinations of international justice, the relationship between the International Criminal Court, the UN Security Council and the African Union. Those familiar with his political and academic work will recognise his 'insightful analytical hand navigating the sands of fiction'.

The Institute for International and Comparative Law in Africa (ICLA) in the Faculty of Law held a debate on 25 July 2015, shortly after Al-Bashir's non-arrest in South Africa, between Dire Tladi and Johan van der Vyver, IT Cohen Professor of International Law and Human Rights at Emory Law School, Atlanta, Georgia, and Extraordinary Professor in the Department of Private Law at University of Pretoria. The debate was chaired by Christof Heyns, Professor of Human Rights and the Co-Director of ICLA at University of Pretoria, and UN Special Rapporteur on extrajudicial, summary or arbitrary executions.

Dire Tladi is Professor in the **Department of Public Law** and a fellow in the **Institute for International and Comparative Law in Africa** in the Faculty of Law. He is also Advisor to South Africa's Minister of International Relations and Cooperation and the Co-Editor-In-Chief of the *South African Yearbook of International Law*. In 2011 he was appointed to serve on the United Nations International Law Commission (ILC), a subsidiary organ of the General Assembly of the UN. The ILC is made up of international law experts responsible for the codification and progressive development of international law. In May 2015, he was appointed as special Rapporteur responsible for the topic *Jus Cogens* – in layperson's terms, the most important rules of international law. He has been approached to give the prestigious Hague Academy Lectures on International Law in 2020. This is an honour that has only been bestowed on one other South African – John Dugard.

SA Research Chair in International Constitutional Law

Professor Erika de Wet, Co-Director of the **Institute for International and Comparative Law in Africa** (ICLA), was awarded the **DST-NRF SARChI Chair in International Constitutional Law** in 2015. She received an NRF A-rating in 2015 and was also appointed as an Honorary Professor in the Faculty of Law, University of Bonn, Germany.

The South Africa Research Chairs Initiative (SARChI) Chair will focus on examining the legal consequences of the exercise of public power by international organisations, such as the United Nations (UN) and the African Union (AU), for states and for those who live within their territories. This includes the challenges that states face in implementing binding decisions in a manner that gives due effect to their international obligations, while simultaneously protecting principles of fundamental constitutional importance against excessive international influence that can undermine domestic democratic processes.

As with the article published by her colleague, Dire Tladi, her article on the implication of the visit of Al-Bashir to South Africa for international and domestic law, published in the 2015 *Journal of International Criminal Justice*, was also referred to in a subsequent Supreme Court of Appeal judgment on the matter.

Al-Bashir arriving in South Africa for the African Union Summit, June 2015

Biodiversity in areas beyond national jurisdiction

Today's biodiversity is the result of billions of years of evolution. The impact of human activity through use, exploitation and population expansion has been immense with consequences that make all responsible for the preservation and protection of our common terrestrial and marine resources.

In 2015, **Professor Dire Tladi** published two articles on the Law of the Sea that appeared in *The Yearbook of International Environmental Law* and the *International Journal of Marine and Coastal Law*. The articles concerned ongoing negotiations at the United Nations on a possible new treaty to supplement the current UN Convention on the Law of the Sea (1982).

These negotiations have bearing on two issues: the rules relevant to marine genetic resources in areas beyond national jurisdiction, and the protection of biodiversity in those areas. Both issues raise complex questions related to the coherence of international law as a whole. Professor Tladi was also invited to address two meetings at the United Nations, and has advised the South African government and African States on these issues.

Participants from African countries at a workshop on international environmental law, led by Professor Dire Tladi

INTERVIEW: Integrated reporting and sound economic decision-making

"Many still see accountants as the proverbial bean counters who crunch numbers to produce financial statements. This is far from reality. Accounting information is present throughout society. Many important decisions are based on accounting information."

Professor Elmar Venter, Associate Professor in the **Department of Accounting** says there are many misconceptions about accountants. An example is his PhD thesis that shows how the mandatory disaggregation of earnings into components is useful to investors and makes possible the improved pricing of earnings components.

Since 2014 he has been researching the economic consequences of integrated report quality (IRQ) with Professor Mary Barth of Stanford University, and Professor Steven Cahan and Dr Lily Chen of the University of Auckland. They examine whether IRQ is associated with stock liquidity, firm value, expected future cash flow, and the cost of capital. The study is motivated by the global interest shown by firms, investors and regulators in the work of the International Integrated Reporting Council. Their study has already received considerable public attention, and has been featured in the *CFO Magazine* and the Chartered Institute of Management Accountant's global magazine, *Financial Management*. The study was one of the top ten most downloaded papers on the Social Sciences Research Network (SSRN) in the corporate finance and governance category (December 2015-January 2016).

Professor Venter regards networking as key to an academic career. "Research is not something that happens when you are in an office on your own. One has to expose one's work to feedback. At first this is daunting because the peer review system has not been designed to make you feel good, but to improve your work." He is fortunate to have been invited as one of only five globally emerging accounting and finance scholars to join the Deloitte International Association for Accounting Education and Research Scholar Programme, which has enabled him to grow his networks and to present his work to leading accounting and finance scholars at conferences in France, Germany, Italy, Romania and the USA.

INTERVIEW: Environmental law in support of social justice

Melanie Murcott, a senior lecturer in the **Department of Public Law** is an admitted attorney of the High Court of South Africa and a solicitor of England and Wales (non-practising). She is currently reading towards her LLD in environmental law with her thesis on the potential of environmental law to contribute towards social justice in South Africa.

Melanie serves on the executive committee of the Environmental Law Association (ELA) and in August 2015 presented a paper at the ELA's annual conference on "The role of a legal theory of transformative environmental constitutionalism in solving South Africa's acid mine drainage problem".

Internationally, she is part of the IUCN Academy of Environmental Law, which hosts an international colloquium in environmental law each year. At the Academy's 13th annual colloquium held at Atma Jaya University in Jakarta in September 2015, she presented a paper titled "Fighting for the fish, forests and people of Dwesa-Cwebe in pursuit of transformative constitutional environmentalism" to a global audience of environmental scholars.

She envisages a future institute at the University of Pretoria that will engage in activism, research and litigation on environmental rights issues, and as part of this she would include a clinic where law students could advise members of the public on environmental rights violations.

The Africa Tax Institute

Development requires strong and efficient tax revenues, and tax policy and tax administration are therefore high on the agendas of countries in Africa. There is an immense need to strengthen the knowledge base and institutional capacity in this field to handle development challenges.

Professor Riël Franzsen

The African Tax Institute (ATI) has come to be widely recognised as a leading research and educational institution in the field of taxation on the African continent. Under the leadership of **Professor Riël Franzsen**, who also holds the **South African Research Chair in Tax Policy and Governance**, the focus of the ATI is on research and postgraduate education. The multidisciplinary *MPhil: Taxation* degree has attracted students from the public sector of several African countries, with more than 50 graduates to date. The PhD programme in Tax Policy has also attracted African scholars as well as scholars from South America and Europe.

Tax policy and administration are critical at both national and sub-national levels. Rapid urbanisation presents researchers with new opportunities and challenges, such as how to address informality in urban areas, the role of cities as drivers of economic transformation, and innovative ways to provide adequate and predictable finance options for metropolitan and city governments without losing sight of the needs of rural communities. In this context Professor Franzsen's expertise in property tax and local government finance has been used in developing and transitional countries in Africa, Asia, the Caribbean and Europe, where he has been providing policy advice on behalf of international agencies including the United Nations, the International Monetary Fund and the World Bank.

The ATI has had a long-term association with the Lincoln Institute of Land Policy (United States) in the area of land and property taxation, where research undertaken as part of a joint venture is making a significant contribution to strengthening knowledge and providing policy options on property tax issues throughout Africa. More than 30 working papers and a number of journal articles have been published to date, and a scholarly book on property taxation in Africa will be published in 2016 or early in 2017.

The ATI's collaborative comparative research also extends beyond the African continent. Working closely with a team of international collaborators, the Institute focuses on tax policies in other developing and transitional countries. Research projects on property markets and taxation in Central and Eastern Europe, as well as in Central Asia, are under way and outcomes of these projects will benefit policy advisors and public officials, scholars, international funding and donor agencies, valuation agencies, and prospective investors.

In collaboration with Georgia State University (United States) and the City University of Hong Kong (China), the ATI participates in a research partnership focused on city finances in post-depression conditions. Further, in partnership with the Vienna University of Economics and Business in Austria, the ATI is researching good tax governance in Africa as one of the important ways to stem the illicit financial flows from the African continent.

Africans investing in Africa – the case of cement

Cement is an integral part of economic growth and development. As economies grow, so does the demand for this commodity – a direct correlation with infrastructure development, productivity and overall economic performance.

Africa's average cement consumption is 92kg per person; the global average, including China, is 513kg per person per year. With African economic growth rates well above the global average over the past decade, and as the economy and population in Africa continues to grow and urbanise, cement consumption is expected to surge in the next few years. Cement is clearly a key strategic sector on the continent, with significant players and, increasingly, African companies investing and exporting to other African markets.

Professor Lyal White, Director of the **Centre for Dynamic Markets** at the Gordon Institute for Business Science (GIBS), has extensive experience in 'on the ground' research and consulting, specialising in political economy and the business environment in dynamic markets. He also heads the Centre for Dynamic Markets Africa office in Nairobi where he spends time growing the GIBS footprint in Africa.

His case study on cement, published in 2015*, examines the growth of the Dangote Group in Nigeria and its ambitious expansion plans across Africa. This is an example of African capitalism, representing the new and somewhat nuanced style of doing business in Africa, which involves capital-intensive projects; unique methods and management approaches; new technologies and innovations; the ever-present role that the state plays; and the need for local partners or local content in new markets across the continent. Driven by the visionary leadership and energy of Aliko Dangote himself, the rise of Dangote also represents the changing geopolitics of the African region.

Liezl Rees

At the building site of Eko Atlantic City, Lagos, Nigeria. The accropodes line the Great Wall of Lagos and are made on site, weighing 5 tons each.

Nigeria is a good example of how certain protective measures and investment incentives have moved it from a primary cement importer, grossly under-supplied, to a self-sufficient market and ultimately an exporter of cement to other African markets over the relatively short time frame of 10-15 years. The case study shows that building financial markets along with progressive policies aligned to develop the competitive production of cement on the continent will have a direct and immediate impact on reducing the price of cement. This will, in turn, serve as an economic multiplier through infrastructure development and construction towards Africa's urban future.

*White, L. (2015). The case of cement. In T. McNamee, M. Pearson & W. Boer (Eds.), *Africans investing in Africa: understanding business and trade, sector by sector* (pp. 124-146). London: Palgrave Macmillan.

A city centre scene, Lagos, Nigeria

Strategy in Africa is about context

While Africa-wide strategies may start in the boardroom, the real work of establishing which African market to target, and when, begins on the ground, immersed in the market itself.

With this rationale, GIBS has run the Business of Africa programme for five years in succession, taking groups of researchers and industry professionals on a facilitated learning immersion from Johannesburg, South Africa, to Nairobi, Kenya and Lagos, Nigeria. The intensive nine-day programme provides the opportunity for participants to engage with and learn from local and international business executives, policy-makers and entrepreneurs from a range of sectors in these markets.

The debate around 'emerging' Africa has reached a new juncture. With growth rates still well above the global average, the debate is not merely about identifying new markets; it has become more measured and up-to-speed with the rest of the developing world.

The programme demonstrates the critical importance of context in shaping and driving strategy in Africa, and the value of constructive immersion and engagement. Samuel Johnson's old adage carries resonance, while gauging the threats and opportunities beyond the hype and hopes for the continent: "The use of travelling is to regulate imagination by reality, and instead of thinking how things may be, to see them as they are."

INTERVIEW: Leadership – less hero, more team

Anthony Wilson-Prangley lectures at the **Gordon Institute of Business Science** (GIBS). His research area is leading social change with the emphasis on the dynamics of leadership, human behaviour, diversity, change and bridging divides.

He has published on integrative leadership in South Africa's private and public sectors and the nexus between business and society. He explores how business leaders work with government across sector divides to resolve complex social issues, arguing that a shared concept of integrative leadership, located in the African context, could further enhance practice. He identifies three issues that are as yet understudied: own-company buy-in, historical context and 'integrative' conflict.

Wilson-Prangley elaborates: "When we think about what it takes leaders to bridge divides, we instinctively think about how to build a relationship with 'the other side'. My research shows two different dynamics. The first is that as much time needs to be spent working to bring along the people who are on 'your own side'. Union leaders recognise this with the truism that the toughest negotiation is not with management but with selling the deal to fellow workers. Building internal alliances and understanding the limits of one's authority are crucial to maintaining 'own-company buy-in'.

"The second issue is that when we think about working across differences, we think about peace-making and collaborative approaches, but the fluid relationship between conflict and collaboration has not been understood. What is needed is further study and understanding of integrative conflict, where there is a blend of collaboration, alignment, disagreement and synergy. Historical contexts will shape exactly how this takes place."

Complex social challenges, frequently witnessed across the world today, require multi-stakeholder approaches. The relevance of Anthony Wilson-Prangley's work is to broaden an understanding of leadership away from the hero narrative towards a team and more facilitative approach.

Forging consumer identity in a maze of networks

In times of rapid change, notions of who we are and where we belong are being challenged and are in a state of flux. Low-income or 'bottom of the pyramid' consumers are too often viewed in isolation, as are middle-class consumers, as if identity and class structures in a fluid society can be represented as some sort of layer cake – as opposed to a maze of networks.

Kerry Chipp, researcher and senior lecturer at the **Gordon Institute of Business Science** (GIBS), focuses on consumer behaviour, a sub-discipline of marketing, and on consumer value proposition (CVP) development. She seeks to understand consumer transformation through social mobility, or the lack thereof, in a materialistic, heavily marketed, environment. Her book, *E-commerce in Dynamic Markets* (forthcoming), and papers on a resurgence of pride in local identities and identity formation, transformation and assertion on the global stage, seek to understand the landscapes of contemporary consumer identity in emerging markets.

Her research shows that consumer identity is shaped by economic, cultural and technological change, and that the connection between socio-economic states is one of time as opposed to inherited identity. Consumers move up and down the pyramid, maintaining and establishing ties with others across and within their own class structures. Consumer identity in these circumstances is forged through progress and mobility, or plagued with negativity due to a lack of mobility and exclusion. While it is a truism in developing regions of the world that people live and work alongside those from different social classes and circumstances, 'bottom of the pyramid' consumers often feel included or excluded on the basis of their consumer behaviour.

Her paper, "A little respect: CVP development and the low-income consumer", on consumer identities constructed through a maze of networks, won the best paper award at the *Emerging Markets Conference Board* conference held in 2015, an annual conference co-chaired by Professor Naresh Malhotra, one of the world's 'marketing legends'.

Kerry Chipp

Liezl Rees

Why (middle) class (analysis) matters

A few years ago, economists from the World Bank and researchers from the Center for Global Development, the Brookings Institution and the Organisation for Economic Cooperation and Development (OECD) Development Centre spearheaded a discourse, which shifted a pro-poor to a middle-class approach as a new avenue for development.

The United Nations Development Programme's (UNDP) Human Development Report for 2013 identified the middle class as a vehicle for socio-economic change in the global south. The African Development Bank celebrated the growth of an African middle class, estimated at 300 to 500 million people. However, the generous inclusion even of what was termed 'strugglers' or 'floating class' battling to make ends meet seemed rather odd. As an observer remarked, everyone not starving qualified as middle class.

Henning Melber, Extraordinary Professor at the **Department of Political Sciences**, and Editor-in-Chief of the *Strategic Review for Southern Africa*, has focused much of his recent analyses on the African middle classes. He edited and contributed to *The Rise of the African Middle Classes* (Zed Books, forthcoming), and has published several articles on this topic.

A scene from the popular Neighbourgoods Market in Braamfontein, Johannesburg

Christoph Marx

African middle class(es) were considered as torch bearers for promoting good governance. But little research had really been undertaken to explore the extent to which such middle classes are indeed a positive factor influencing policies. Often the beneficiaries of authoritarian regimes, middle classes are anything but, by definition, progressive.

Scholars in African Studies have finally taken more initiative to gain ownership of the middle class debate. South Africa, with its vibrant and dynamic middle class, is a particular case in point. A growing number of in-depth analyses have managed to demystify the notion of middle class. They also bring to the fore (similar to case studies in other African countries) that a middle class is a rather heterogeneous affair – exacerbated in the post-apartheid setting by the racial component.

After all, economistic-reduced number crunching as regards income levels tells little about social status and orientation, while other factors contributing to and shaping identities and political orientations remain ignored. Lifestyle, religion, regional, cultural and ethnic affinities, as well as the urban and rural milieu, all play a role. The debate has often lacked a historical dimension and even more so class analysis. One should also not reduce social analysis to an isolated middle-class focus. The role of the state, policy-makers and bureaucracy alike, remain substantial factors. Not to forget the richest segment of societies. After all, as statistical evidence shows, the rich get richer while the social discrepancies in most countries grow. As the economist Palma reminds us, "it is the share of the rich, stupid!" which might, despite the middle-class debate, remain the most important singular factor.

A future for our past – built heritage and cultural ecosystems

Since its founding, the City of Tshwane (Pretoria) has been the capital city of South Africa for divergent political regimes, each leaving a residue in the built heritage invariably charged with opposing meanings to different sectors of society.

Nicholas Clarke, Research Associate in the **Department of Architecture**, focuses his research on the role of built heritage in social resilience, in which issues of identity of place play a crucial role. In his work, built heritage as a renewable source interfaces with other issues – such as the potential Karoo shale gas development and tourism at World Heritage sites – in assessing impact and the tension between conservation and use.

At the core is an architectural and technical understanding of construction in the retention of authenticity. The city is his laboratory through the Capital Cities Project, an institutional research theme that has arisen through a formal cooperation agreement between the City of Tshwane and the University of Pretoria. In line with the Vision 2055 of the City of Tshwane, his research develops an understanding of the built heritage as a resource that embodies a changing national identity over time. In particular, the focus is on the future development of a shared built heritage, and the influence of Dutch architects and engineers in South Africa during the nineteenth and twentieth centuries.

In 2015 several co-authored publications came from this work, including *Re-centring Tshwane: Urban heritage strategies for a resilient capital*; *Urban planning in Tshwane*; and *Futures for a collective past*, reflecting the central focus on the built heritage as a renewable resource.

Church Square, City of Tshwane

Regenerative systems – *Designing for Hope*

We are living through the end of the world as we knew it. This is not a bad thing. In the breakdown of old systems, we have the opportunity to change – Chrisna du Plessis.

At the core of **Chrisna du Plessis's** research is the question of how a degenerative system can be changed into a regenerative system where catalytic interventions allow different processes to emerge. **Associate Professor** and **Head of Department in Architecture**, her work is situated in the built environment, particularly architecture and urban design and planning, and the complex social-ecological system within which these disciplines are located.

Strategies for regenerative sustainability include the principles of giving back more than what is taken out; creating conditions for emergence and evolution; and making decisions from a value system, based on how nature works. In the built environment, this includes biomimicry, biophilia and bio-based technologies that offer a variety of solutions, from the very simple to the complex.

Her book, *Designing for Hope*, co-authored with Dr Dominique Hes of the University of Melbourne (2015), cites case studies that ground ideas of regenerative development in physical form. Two examples stand out: the Highline in New York City that has transformed a disused railroad spur into an urban park, now a catalyst in the area for small business development, cultural activities and investment in building upgrades. Another is the Koo Teck Puat Hospital in Yishun, Singapore, built on what used to be a community allotment vegetable garden. It is a vivid illustration of the notion of giving back more than what is taken out of the system. The vegetable garden is recreated on the roof and surplus organic food is sold to the hospital canteen. In addition to the use of advanced sustainable built systems, the hospital also offers programmes that teach health and well-being, thus contributing to the health of the community and to social cohesion.*

The book is the only shortlisted entry in the research category of the AfriSam-SAIA (the South African Institute of Architecture) 2015/16 Awards for Sustainable Architecture and Innovation that focuses on the recognition of contributions to sustainable human living environments.

This 'rooted wall' at the Durban International Convention Centre symbolises the symbiotic intertwining of organism and structure in an urban environment.

**Adapted from an article in Earthworks Magazine, Issue 32 (www.earthworksmagazine.co.za)*

Earth Matters – land as material and metaphor

Africa matters–Art matters–Earth matters. This was the sub-title of the E*arth Matters* exhibition that travelled to several international galleries between 2014 and 2015. Organised by the Smithsonian National Museum of African Art, the works of 41 contemporary artists from Africa were chosen to illustrate the conceptually complex and visually rich relationships between individuals and communities, and the land on which they live.

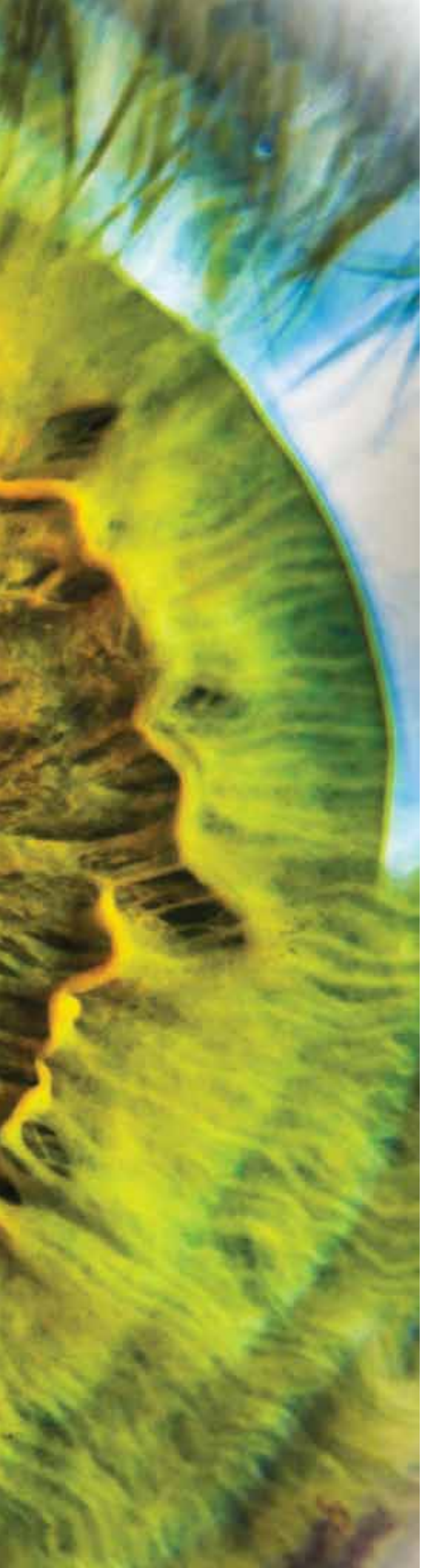
Diane Victor's work, *The Rain Horse*, formed part of this exhibition. Diane teaches in the **Department of Visual Arts** at UP, and comments that working with materials that are normally perceived as redundant and wasted has always interested her.

She uses the by-products of fire, and draws with the smoke and soot from candles, and with the ash obtained from burning and grinding up books. She started using book ash as a medium in drawing elderly and terminally ill people. Asking them to provide a short list of books that had influenced them or made an impression on their lives, she would search in second-hand bookshops for these texts, char the books and grind them up as raw material for her drawings. The motivation behind this was the saying, 'When an old woman dies, it's like an entire library burning down'.

In *The Rain Horse* she used the ash remaining from a number of portraits, mulled together, as her drawing material.

Her interest is in the fragility and vulnerability of both ash and smoke, and in her words, "working with a medium already burned out, extinguished and all used up within the general frame of things.

"I am interested in offering 'second lives' to expended and unwanted materials but am also attracted on a technical level to both materials as they offer alternative solutions and challenges to my drawing process, which I cannot find in more traditional materials."



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South Africa is faced with a heavy burden of disease, which includes both communicable and non-communicable diseases. The theme profiles a broad spectrum of research, starting with lifestyle interventions for chronic disease, diet quality, new ways of studying obesity, and using schools as sites for social change. Research into deafness is also presented, and innovation that makes possible and widely accessible the early identification of hearing loss. A major focus in this theme is human development. In addition, the interface between human and animal health is profiled in a context of anthropogenic impact on the environment and changing climate conditions.

Close-up of a human eye

Sport, exercise medicine and lifestyle research

Sport, exercise medicine, and lifestyle interventions for chronic disease constitute a major strategic research area for the University of Pretoria over the next decade. To this end, the Institute for Sport, Exercise Medicine and Lifestyle Research was established in June 2015, under the directorship of Professor Martin Schwellnus.

The vision of the **Institute for Sport, Exercise Medicine and Lifestyle Research** is to be an international leader in research that promotes health and well-being in the population through lifestyle interventions, a reduction in exercise-related injuries and medical complications, and sporting excellence. The impact and relevance of the research undertaken by the Institute is reflected in its four overarching themes:

- Lifestyle interventions for chronic diseases of lifestyle, or non-communicable diseases (NCD), which present the most important health threat globally.
- The prevention, non-surgical management and rehabilitation of exercise-related (musculoskeletal) and other injuries in sports.
- The prevention and management of medical complications and illness in sport, labelled the 'exercise paradox' because the greatest health benefits of participation in regular physical activity and sport are also evident in populations that are at higher risk of injury and medical complications.
- Excellence in sporting performance.
- Sport and physical activity in society, including economics, governance, management, ethics and education.

At UP there are recognised clinicians and researchers who are already engaged in aspects related to the Institute's five core focus areas. In 2015 research focused on injuries and illness in sport, generating publications investigating the epidemiology of injury and illness in select sports, as well as investigations into the risks of injury. Institute researchers contributed to studies on concussion in sport (in areas such as the diagnosis of concussion and return to play protocols after concussion), as well as the prevention and management of sudden cardiac arrest in sport.

The Institute was represented on a consensus committee convened by the International Olympic Committee (IOC), chaired by Professor Schwellnus. This expert group produced two IOC consensus statements published in a special edition of the *British Journal of Sports Medicine* to coincide with the 2016 Rio Olympic Games. It also reviewed the scientific evidence for the relationship of load (including rapid changes in training and competition load, competition calendar congestion, psychological load and travel) and health outcomes in sport, and provided athletes, coaches and support staff with practical guidelines for appropriate load management to reduce the risk of illness, injury and overtraining.

Professor Martin Schwellnus

Professor Martin Schwellnus is an internationally recognised expert in the field of Sport and Exercise Medicine. He is the Director of one of only nine IOC Research Centres worldwide as well as Director of FIFA Medical Centre of Excellence. He serves as a member of the IOC Medical and Scientific Commission and as a research consultant on the International Paralympic Committee (IPC) Medical committee.

Diet quality and food security in rural households

Severe inadequacies related to the staple diets of most rural households in South Africa highlight the challenges experienced in achieving food security.

Researchers involved in this project:

Dr Mjabuliseni Ngidi, Professor John Annadale, Dr Annemarie Viljoen, Corné van der Merwe, Maria Molokomme, Angela McIntyre, Dr Friede Wenhold, Professor Sheryl Hendriks, Grace Tima Munthali, Mmatlou Kalaba and Dr Diana Marais.

While there may not be much evidence of widespread starvation and extreme undernutrition in South Africa, national and local surveys provide evidence of multiple forms of deprivation related to the experience of hunger, the widespread manifestation of micronutrient deficiencies and increasing rates of overweight and obesity.

A recently study by researchers from the **Institute for Food, Nutrition and Well-being (IFNuW)** investigated the consumption and production patterns of rural households in communities in four selected sites in the poorest local municipalities in South Africa. The study was funded by the Water Research Council and the Department of

Frieda Wenhold

Fieldwork undertaken in the Jozini area by IFNuW researcher, Dr Annemarie Viljoen

Agriculture, Forestry and Fisheries.

It is clear from the findings that most households are food insecure, with inadequate food available to meet the requirements for a diversified diet. Roughly one in four households reported experiencing hunger for most months of the year. In terms of food availability, it seemed that most households were able to purchase enough of the staple maize meal, which is consumed by all households every day. A high proportion of female caregivers were overweight and obese (59%), suggesting that for most households, sufficient dietary energy in the form of the staple food – refined, purchased white maize – is available. Relatively few young children and their female caregivers were underweight, but micronutrient deficiencies (termed 'hidden hunger') were rife.

The high levels of stunting (24%) indicate that the children experienced growth faltering early in life. Of concern also is how many of these stunted children were also overweight (47%). The largely starch-based diet is likely to lead to both growth faltering in young children and overweight in women and children.

The findings show that the diets of poor rural households lack diversity and do not include the frequent consumption of fruit and vegetables necessary to ensure good nutrition, productivity and child development. Seasonality affected the availability of fresh fruit and vegetables in winter, a situation that is exacerbated by a lack of water for the production of nutritious crops. Drought and climate change have further reduced opportunities for diversifying production and the availability of wild foods.

At the same time, a number of households were engaged in agriculture (on average 8 or 9 in 10 households) in the areas where production was possible (Eastern Cape, KwaZulu-Natal and Limpopo). The study found a strong link between engagement in agriculture and improved dietary quality. This resulted in improved household dietary diversity and children's anthropometry scores. Income from farmland production and irrigated agriculture led to the increased intake of fruit and vegetables in general, but also meat, eggs, fish, milk, roots and tubers.

These findings are contrary to research carried out in the late 1990s. This earlier research showed that unless households produced enough food to sell and buy in other essential food (particularly dairy, fruit, fats and oils, meat and vegetables) and non-food items (such as fuel for food preparation and health care), their food security levels did not improve. It would seem that social grants now play a role in providing these essential basic needs, so that any crop production provides a direct improvement in dietary intakes.

Schools as sites for social change

Across the world, nations have been trying to achieve the Millennium Development Goals (MDGs), the target for which was 2015, specifically in relation to the eradication of extreme poverty and hunger (MDG1). Building on the MDGs, the more recent Sustainable Development Goals (SDGs) now aim to address the root causes of poverty and the universal need of supporting the development of all people.

Researchers involved in this project:

Professor Ronél Ferreira (Project leader, Educational Psychology), Professor Peet du Toit (Physiology), Gerda Gericke (Human Nutrition), Karien Botha (Educational Psychology) and Professor William Fraser (Science, Mathematics and Technology Education).

Two research projects in the **Institute for Food, Nutrition and Well-being** (IFNuW) are centred on schools as sites for social change and, in particular, on school-based interventions related to nutrition practices, as well as the physical health and socio-emotional well-being of primary school children in resource-constrained communities. The possibility of enhancing the holistic well-being of primary school children who face vulnerability due to poverty and related risk factors implies the potential secondary outcome of changed lifestyle patterns among children and perhaps their families.

The first project started in 2012 in three township schools in the Bronkhorstspruit area, South Africa, involving a total of 1 465 Grade 4 to 6 learners and the teachers responsible for the Life Skills and Natural Sciences subjects. The second project started in 2014 and built on the first study. It involves a partnership with Fordham University,

Schools are being used as research sites for nutriton-related education and awareness

New York City, USA and an intervention study in two primary schools in the greater Tshwane region with 330 Grade 1 to 3 learners, and 240 learners in the same grades in the Bronx, New York City.

For both projects, an initial assessment of learners' health and well-being was conducted, which provided important baseline data for the development and implementation of the two school-based interventions. Both projects have been developed in a participatory manner, involving teachers and parents of the respective communities. Besides classroom-based activities, the interventions involve home-based activities to include collaboration between child-participants and their parents.

Post-intervention data indicate an increased awareness among the child-participants about healthy eating and dietary patterns. Their knowledge about nutrition, food choice, portion sizes and the food pyramid increased as a result of their participation in the project. Furthermore, preliminary results indicate that children conveyed messages about healthy eating and food consumption practices to their parents. Parents have, as a result, become more aware of healthy eating habits and started questioning the food and nutrition-related choices they have been making.

In terms of physical performance and healthy lifestyles, findings from the project indicate an increase in the levels of fitness of children. In addition, both teachers and parents expressed the view that children had displayed heightened awareness of the importance of exercise and physical fitness after participating in the interventions. According to the teachers, child-participants increasingly started to compare themselves with their peers which, in turn, motivated them to improve their own performance.

INTERVIEW: Sedentary lifestyles can trigger non-communicable chronic diseases

Medical Biochemistry is the research field that sets **Dr Alisa Phulukdaree's** eyes sparkling. It is also of intense personal significance to her.

What interests her most is evaluating the molecular mechanisms involved in chronic inflammatory diseases such as heart disease, diabetes mellitus, Parkinson's and Alzheimer's disease, which are major contributors to the high mortality rate associated with non-communicable diseases in South Africa.

Non-communicable chronic diseases are those that are not caused by infection and that cannot be transmitted from one individual to another. Instead, they result mostly from sedentary lifestyles.

Joining the University of Pretoria as a young researcher has provided Dr Phulukdaree with many opportunities, including an NRF Y-rating in 2015, membership of the Tuks Young Research Leader Programme, and the Dean's Young Research Leader Programme.

"As a young researcher," she says, "the support of colleagues and mentors in my research network has greatly facilitated my progress and success."

Her role model is Professor Anil Chuturgoon who was her lecturer during her undergraduate studies and who supervised her postgraduate degrees – BMedSc Hons (*cum laude*), MMedSc (*summa cum laude*) and her doctorate. "Undoubtedly he has had the greatest influence on me as a passionate researcher, constantly motivating me to publish and contribute to the body of knowledge."

She is in the process of establishing a microRNA analysis molecular laboratory that will complement current research in the Department of Physiology and is creating the protocols and collaboration needed to make the link between clinical research and laboratory-based research. This will allow clinicians access to a research laboratory capable of assessing genetic and epigenetic changes and evaluating pathological mechanisms at the cellular and molecular level.

INTERVIEW: Affordable, non-invasive measures of health and early diagnosis

Dr Vinet Coetzee, lecturer in the **Department of Genetics**, is the principal investigator of the Facial Morphology Research group.

A critical facet of Dr Coetzee's work is a facial screening project, partly sponsored by Canon SA, to help to build a 3D camera for early diagnosis of disorders in children, particularly African children. She also studies the ways in which facial structure and colour can give an indication of measures of health, such as Body Mass Index (BMI), diet, respiratory infections, cardiovascular health, immunity and genetic variation of immune-associated genes in adults.

Dr Coetzee says Africa has many unique health challenges that often require creative solutions. More research is needed to identify the specific facial features associated with disorders such as Down Syndrome in African infants and children. "We need accurate facial photographs of children with and without disorders, and 3D images are ideal because they contain information along a range of dimensions, so we can identify key facial features more accurately."

Her research draws together expertise from a range of fields to identify congenital conditions in young infants and she has built up a network over time, which now consists of over 30 collaborators from 10 different countries. Many African infants with Down Syndrome are only diagnosed at seven months or older, but this research will enable more effective screening of congenital conditions, and will allow health care workers to detect these conditions earlier and more accurately, allowing for better interventions.

Dr Coetzee plans to start a Facial Morphology Research Centre to take full advantage of the interdisciplinary nature of this field. Her goal is to stimulate public engagement with science by developing interactive exhibits that can teach children, and the young at heart, about research, and science more generally.

INTERVIEW: Biochemical shuttle gets closer to cancer satellites

Dr Thomas Ebenhan is a research fellow in the **Department of Nuclear Medicine** and a member of the multidisciplinary, multi-institutional Nuclear Medicine and Molecular Imaging team at the Steve Biko Academic Hospital. Through this work and his involvement with the Preclinical Imaging Facility, he has simplified and operationalised a prostate cancer imaging technique, the first in South Africa. The Preclinical Imaging Facility is a collaboration between UP, the South African Nuclear Energy Corporation and North-West University.

Imaging research is core to the continued global growth of new strategies aimed at improving targeted molecular imaging – the study of biological and biochemical functions or dysfunctions in the body. Cancer is the main application for molecular imaging. Dr Ebenhan's 2015 publications on prostate cancer imaging offer the potential to launch specific radionuclide therapy on a large scale to patients who have not responded to other forms of therapy. This therapy has shown that patients with late-stage cancer – if responsive – improve tremendously without significant side-effects.

Based on Dr Ebenhan's published research, the Steve Biko Academic Hospital can now apply a new form of radiation therapy that makes use of a 'biochemical shuttle' to bring radioactivity in the direct vicinity of the cancer or cancer satellite. The presentation of the latter is known as metastasis, the spread of a cancer from one organ or part of the body to another without being directly connected with it.

Finding new ways to study obesity

Professor Michael Pepper writes that South Africa has the dubious honour of being ranked as one of the most obese nations on the planet. Many factors contribute to obesity and these can broadly be classified as genetic and environmental, epitomising the long-standing nature versus nurture paradigm.

The establishment of models of obesity, or more specifically the formation of fat cells (adipocytes), could potentially lead to the discovery of molecules responsible for different stages of the process, which could then be targeted as part of a novel therapeutic strategy.

In order to address this problem, **Professor Michael Pepper**, Director of the **Institute for Cellular and Molecular Medicine**, and fellow researchers have for several years been isolating stem cells from the fat (adipose tissue) of human donors. These cells have been used to study fat cell formation in great detail in the laboratory, both from a functional and genetic perspective. The group has found new ways of identifying subtle differences between the different stages of the process, and has also identified several molecules, previously undescribed in the context of obesity, that may play a critical role in fat cell formation. These are the most comprehensive studies conducted to date on material of human origin. This is important since most of the work previously described had been done in mice, and since a mouse is not a man (or woman) there is always uncertainty regarding the applicability of these findings in humans.

What are the implications of these findings? First, it will almost certainly lead to an increased understanding of fat cell formation, which will impact on our understanding of the development, physiology and pathology of fat cells and adipose tissue. Second, it provides a means through which to identify new inhibitors of the process which may lead to the development of novel therapeutics. Third, it may contribute to our understanding of the genetics of obesity. And finally, a better understanding of how fat is formed in the human body may also contribute to the development of more effective weight management programmes.

Many diseases are associated with obesity, including diabetes, cardiovascular disease and cancer. Genetic susceptibility to obesity is a well-accepted phenomenon. But so is the contribution of an inappropriate diet and lack of exercise. While the studies from the Pepper group are unlikely to be able to change diets or activity levels, they may lead to the identification of pharmacotherapeutics that inhibit fat cell formation, irrespective of the environmental contribution.

Professor Michael Pepper and researchers at the Institute for Cellular and Molecular Medicine

Advances in deafness gene identification

It is estimated that 1,2 billion people globally suffer hearing loss. While it is a natural part of growing older, hearing loss also occurs as a result of disease, infection, drugs, or damage to the ears and serious head injuries, or it may be hereditary and may remain unidentified in young children. In South Africa, more than 3 million people suffer from permanent, disabling hearing loss.

Dr Rosemary Kabahuma

Hearing loss is believed to be the most prevalent sensory deficit in humans. The cumulative findings of genetic research show that the genes for deafness tend to cluster in specific population groups, and that the majority are still unaccounted for.

Dr Rosemary Kabahuma in the **Department of Otorhinolaryngology** focuses on genomic research into deafness, with the aim of unearthing the genetic bases of hearing loss among sub-Saharan African populations. Her doctoral studies represented a ground-breaking first move into genomic deafness research in sub-Saharan Africa. Her research established that common deafness genes and mutations prevalent in Caucasian and Asian populations are not prevalent among sub-Saharan Africans, findings that have been confirmed in subsequent studies.

Studies worldwide have identified pathogenic variants in over 145 genes, 66 of which have been characterised for nonsyndromic hearing loss, and approximately 150 genetic loci have been mapped. It is estimated that the number of genes could reach 300, equivalent to 1,2% of all human genes. It is this genetic heterogeneity of hearing loss that poses a major challenge to aetiological diagnosis and genetic counselling, especially because most forms exhibit no other identifiable clinical features or signs.

In collaboration with a deafness research team led by Professor XZ Liu at the Miller School of Medicine, University of Miami (USA), Dr Kabahuma has made significant findings in the discovery of the deafness genes prevalent among African population groups from the Limpopo Province of South Africa. They undertook targeted sequencing of 180 genes in a multi-ethnic cohort of 342 mutation-negative deaf probands (the first affected family member) from South Africa, Nigeria, Tunisia, Turkey, Iran, India, Guatemala and the United States (South Florida), detecting causative DNA variants in 25% of multiplex and 7% of simplex families. Further analysis is under way, in which the observed mutations are being screened for and confirmed, in the family members of all the 94 families from South Africa. Overall, the study highlights the importance of family history and the generation of databases for multiple ethnically discrete populations to improve the ability to detect and accurately interpret genetic variants for pathogenicity.

Dr Kabahuma's genomic deafness research approach also highlights the utility of next-generation sequencing techniques which, in combination with functional study analysis tools, provide insights into causative factors in a genetically heterogeneous human disorder such as deafness.

Innovative prosthesis for hearing

One cause of deafness is a condition called otosclerosis. It is commonly believed to be congenital and occurs when abnormal bone material grows around the tiny stirrup bone (stapes) in the middle ear.

Otosclerosis usually originates at the foot of the stapes which, in turn, reduces the intensity of sound that is transferred to the cochlea. Eventually the stapes can become fixed, or fused, with the bone of the cochlea. Hearing aids are usually very effective in the early stages of the disease but eventually a stapedectomy may be required to restore some degree of hearing.

Professor Mashudu Tshifularo, Head of the **Department of Otorhinolaryngology** (ear, nose and throat (ENT)), is widely recognised for his ENT innovations, one of which is the design and patenting of a prosthesis that allows for the surgical replacement of the ossicle (or ossicles) that are not functioning. These are the three tiniest bones in the human body, also called the malleus, incus and stapes, or commonly as the hammer, anvil and stirrup.

Professor Tshifularo's view is that the complete removal of all components may interfere with the delicate amplification and loud sound dampening system of the inner ear. His innovative approach aims to simplify the stapedectomy procedure and increase the chances of success with minimal intrusion trauma via a patent which includes separate replacement prostheses, each shaped and configured to resemble the natural ossicle it represents. Professor Tshifularo received a Gauteng Accelerator Programme (GAP) Medical Special Recognition award for his innovative hearing prosthesis.

Affordable screening for hearing loss and referrals

hearScreen™ turns an ordinary smartphone into an easy-to-use and cost-effective solution for screening children and adults for hearing loss.

Professor De Wet Swanepoel of the **Department of Speech-Language Pathology and Audiology** is the lead inventor in an application that makes widespread systematic hearing testing possible and can be operated by laypersons in primary healthcare contexts. The application makes use of cloud-based data management and a referral system that links schools and patients to services.

The vision of the project is to have an impact on the lives of the 1,2 billion people around the world who suffer hearing difficulties, by providing them with affordable access to screening and linking them to health and hearing services.

In 2015 hearScreen™ received several prestigious awards: the South African Innovation Award in the category of Community Innovation; the Philips Innovation Fellows Competition award, in partnership with the Innovation Hub, for 'The Next Big Idea'; and the Innovation Summit award for social innovation in early childhood development.

Professor Swanepoel was also honoured by the Southern African Association for the Advancement of Science (S2A3) for his academic work and research through the award of the S2A3 British Association Medal (silver) , one of the highest awards for original scientific research in South Africa.

Lightning myths and evidence

There are many myths associated with lightning, and over the ages many cultural beliefs have been handed down about what causes lightning and what happens when a person is struck.

Lightning is dangerous; it is the most consistent weather killer, killing more people than hurricanes, tornadoes or floods. It is estimated that, globally, lightning kills approximately 24 000 people per year, and about ten-fold more are struck or injured.

Dr Ryan Blumenthal, a senior specialist forensic pathologist in the **Department of Forensic Medicine**, is one of the few forensic pathologists in South Africa with a particular interest in lightning. He has contributed to international procedures and guidelines for lightning strike fatality and electrocution victims. He was a finalist in the 2015/2016 National Science and Technology Forum (NSTF) Awards in the category *Communication for Outreach and Creating Awareness* for his substantial contribution to raising public awareness of science, engineering and technology.

Some common misconceptions about lightning are, for example, that:

- if you can see blue sky, there is no danger;
- lightning never strikes twice at the same place;
- lightning victims remain electrified and are dangerous to touch;
- rubber protects against, and metal (such as is found in umbrellas) attracts, lighting;
- it is safe to seek shelter under a tree; and
- grounding a building makes it safe from structural damage.

Lightning can strike directly or indirectly (by contact with an object such as a pole or a tree that is struck directly), from a 'side flash' from a struck object, or from an earth current. Lightning injuries often resemble those found in victims of bomb explosions due to the effects of a 'pressure blast wave' caused by the lightning itself. The impact is similar to that of a 5kg TNT bomb and can injure people within 10m of a lightning flash.

In collaborative research experiments, published in the *South African Journal of Science* in 2015, Blumenthal and fellow researchers reported on some unusual facts about lightning's pressure blast wave. Based on the findings, they were able to estimate the minimum 'overpressure' to which a lightning victim was exposed, and the victim's distance from the lightning channel. They believe that these findings will be of interest to several other disciplines and to those active in the field of lightning physics and lightning protection.

Brain hypoxia/ischemia and its consequences

An adequate supply of oxygen is an absolute requirement for normal development, and this is particularly important in the brain.

The lack of oxygen (hypoxia) affects vital structures in the brain with consequences, depending on the stage in development at which this occurs, varying from mild to moderate to severe. The most dramatic consequences are the development of cerebral palsy, cognitive defects and seizures.

Work is ongoing in several Departments in the **Faculty of Health Sciences** involving the following lead researchers and their teams:

- **Professor Robert Pattinson**, Maternal and Infant Health Care Strategies Research Unit at the South Africa Medical Research Council;
- **Professor Izelle Smuts**, Associate Professor and Head of the Paediatric Neurology Unit at Steve Biko Academic Hospital and University of Pretoria; and
- **Professor Michael Pepper**, Director of the Institute for Cellular and Molecular Medicine, the SAMRC Extramural Unit for Stem Cell Research and Therapy, and a Research Professor in the Department of Immunology in the Faculty of Health Sciences.

Their research foci are three-fold: to establish ways to prevent hypoxia from occurring; to understand the pathophysiological mechanisms that lead to some of the dramatic consequences; and to treat patients who suffer brain injury.

Ideally, babies at risk of developing brain hypoxia should be detected before labour starts. In this regard, the Maternal and Infant Health Care Strategies Research Unit is working with the Council for Scientific and Industrial Research (CSIR) on testing a simple continuous wave Doppler apparatus that measures blood flow in the umbilical cord (Umbiflow). By screening pregnant mothers during pregnancy, foetuses at special risk of dying *in utero* before labour, and those at risk of developing foetal distress in labour, can be detected.

With regard to pathophysiological mechanisms, the contribution of predisposing genetic factors has been greatly understudied in brain injury resulting from hypoxia. If one is to draw an analogy with cerebral palsy, for which a strong genetic component is beginning to emerge, it is quite possible that we will see that those infants who manifest the consequences of brain hypoxia do so as a result of a genetic predisposition, which may render their central nervous systems more susceptible to this kind of injury.

The treatment of infants who manifest the consequences of brain injury possibly due to hypoxia requires a comprehensive approach, from the early neonatal stage and extends throughout their entire lives. They require not only chronic medical intervention, but education and vocational options also need to be addressed.

Apart from the importance of being able to prevent and treat hypoxic brain injury and of expanding our knowledge base in this area, ongoing work also has important medico-legal implications. There is currently a wave of litigation in the country that involves children who apparently have been subjected to hypoxia and who have, for example, developed cerebral palsy. In light of the dearth of knowledge in this area on the pathogenesis of the disease, a detailed and accurate understanding of the consequences of hypoxia will have implications not only for patients, but also for both the medical and legal professions.

Struggling to breathe

Cystic fibrosis (CF) is a genetic disease. In South Africa the life expectancy of CF patients is just over 20 years; elsewhere it could be as high as 50.

Part of the reason that South African CF patients tend to die prematurely is because they are often diagnosed late. Children born with CF tend to have three main symptoms. Their sweat contains elevated levels of chloride and they have many chest infections. They also fail to thrive (which means they are short for their age and underweight).

Diagnosing CF is not straightforward. First, it was assumed that CF could only affect Caucasian patients, which is not the case. However, this idea still lingers, increasing the likelihood that CF patients of other ethnicities may be underdiagnosed. Second, there are other illnesses with symptoms similar to CF that occur more frequently in South Africa, such as tuberculosis (TB). This means that a CF patient may be mistaken for having TB, for example. Third, the 'gold standard' CF test – known as the sweat test – may miss some CF patients.

A genetic test for CF would be a reliable way to identify all true CF patients but this has its own challenges. CF is caused by mutations in the CFTR gene. The current genetic test for CF patients in South Africa was developed based on data obtained from French patients. When this test was performed locally on 171 suspected CF patients, 30% of the genes assessed returned a result of unknown mutation. This could mean either that they did not have CF or that they carried mutations that are not typically seen in France.

In order to test the latter hypothesis, **Professor Michael Pepper** and **Dr Cheryl Stewart** of the **Institute for Cellular and Molecular Medicine** (ICCM) have sequenced the CFTR gene of 50 suspected CF patients on whom an incomplete genetic diagnosis had been made. They found 21 mutations that are not on the current (French) test, four of which had never been identified before anywhere in the world. This supports the fact that CF mutations are population specific. Initially, 59% of the genes in the cohort of 50 patients had a test result of unknown mutation, which they were able to reduce to 26% on the basis of the new mutations they had discovered. They anticipate that the data could be used to refine the current genetic test used to screen South African patients. If a South African test was used to identify patients earlier, it would help CF patients live longer and healthier lives.

Dr Cheryl Stewart

Remote sensing for malaria control

The World Health Organisation (WHO) estimates that in 2015 there were 214 million clinical malaria cases and 438 000 deaths, with most recorded in the African region. South Africa has plans to eliminate malaria by 2018, but changing climate conditions and the movement of people may reintroduce the disease in areas that have been malaria-free due to successful control efforts.

The incidence of imported malaria is growing, particularly in non-endemic areas. Malaria is endemic in the KwaZulu-Natal, Limpopo and Mpumalanga provinces but there is a risk that it may become endemic in other regions. Climate change might also impact on how malaria is transmitted. Elimination is further affected by the cross-border impact of malaria from Mozambique and Zimbabwe.

The University of Pretoria **Centre for Sustainable Malaria Control (UP CSMC)** is a fully integrated, multidisciplinary, interdepartmental and interfaculty initiative. The aim of the Centre is to coordinate and promote collaborative research on safer and sustainable malaria control and management strategies, and to generate knowledge and support new activities pertaining to safe malaria control in Africa through fundamental and applied research. The Centre's collaborative and transdisciplinary approach integrates all aspects of malaria control with research focusing on human health, parasite control and vector control.

The UP CSMC's **Remote Sensing for Malaria Control in Africa** (ReSMaCA) programme is an initiative that makes use of earth observation technologies. The programme is a collaboration between the South African National Space Agency (SANSA) and French partners, the French National Centre for Space Studies (CNES).

By using satellites and remote sensing techniques to monitor epidemics and merge health data with environmental and climatic data on water, air, vegetation and soil gathered by observation satellites, the disease-causing conditions and the mechanisms involved in the spread of disease can be researched. A malaria climate-modelling system may provide early warning on possible outbreaks and will stimulate research on the potential impacts of climate change on malaria. Remote sensing can also be used to monitor the movement of people across borders.

At the UP CSMC it is believed that one single control aspect will not solve the malaria problem and that various initiatives are required for safer and sustainable malaria control. Initiatives, including the ReSMaCA programme, form part of the Centre's approach to the eventual elimination of malaria.

The Director of the Centre for Sustainable Malaria Control is **Professor Tiaan de Jager**, supported by **Dr Taneshka Kruger**, the Senior Project Coordinator, and researchers from six faculties at UP: the Health Sciences, Engineering, Built Environment and Information Technology, Natural and Agricultural Sciences, Veterinary Science, Education and Humanities. The Centre hosts a **DST-NRF SARChI Research Chair on Sustainable Malaria Control**, led by **Professor Lyn-Marie Birkholtz** in the Department of Biochemistry. It is a South African Medical Research Council (SAMRC) Collaborating Centre for malaria research. Collectively the network of collaborating centres provides a multidisciplinary approach to malaria research.

Emerging respiratory and neurological viruses

Over the past decade, mosquito-transmitted zoonotic viruses have caused some of the most important emerging diseases in humans and animals. Despite their origin in Africa, these viruses are not routinely investigated in terms of their roles in neurological disease, possibly due to a lack of clinical awareness of their disease potential.

Professor Marietjie Venter

Scientists in the emerging respiratory and neurological virus group in the **Centre for Viral Zoonoses** in the **Department of Medical Virology** focus on newly described or previously missed viruses transmitted through insect vectors (arboviruses). **Professor Marietjie Venter**, who heads the programme, currently holds a joint appointment between UP and the US Center for Disease Control and Prevention. She works closely with researchers and students in the virus group, and with veterinarians across the country, to establish a surveillance network in animals with neurological or respiratory signs, in collaboration with **Dr June Williams** in the **Faculty of Veterinary Science**. The group also investigates neurological and respiratory cases in humans and undertakes mosquito vector surveillance on farms and wildlife reserves in collaboration with Professor Leo Braack of the Centre for Sustainable Malaria Control and Professor Paulo Almeida, extraordinary Professor from the University of Lisbon.

Centre for Viral Zoonoses

Scientists with a strong focus on zoonotic diseases joined forces to launch the **Centre for Viral Zoonoses (UP-CVZ)** at the end of 2015. The Centre is situated in the Department of Medical Virology where the BSL3 laboratory is based and includes a steering committee of scientists in the Health Sciences (Professor Marietjie Venter), Natural and Agricultural Sciences (Professors Louis Nel and Armanda Bastos), and Veterinary Science (Professor Estelle Venter).

Professor Wanda Markotter joined the Department of Medical Virology in 2015 as the first Director of the Centre for Viral Zoonoses.

In 2015 the group described, in the journal *Emerging Infectious Diseases*, the Old World Alpha, Middelburg and Sindbis viruses as causes of severe neurological disease and fever in horses.

Unlike the New World Alpha viruses found in the Americas, the African Old World Alpha viruses were previously considered to be mild pathogens associated with fever, rash and arthritis in humans, and no cases had been described in horses. The group described outbreaks of the neurological disease of Middelburg and Sindbis viruses that occurred regularly across South Africa in horses between February (late summer) and June (early winter) each year. The researchers sequenced the full genome of a neurological strain of the Middelburg virus and developed an analytical method that can distinguish between the Middelburg virus and the Sindbis virus. These viruses were also identified as the cause of neurological disease in several wildlife species, and were found in mosquito and midge vectors on horse farms in the Gauteng province and in the Mnisi area, a rural community next to the Kruger National Park. The viruses are currently being investigated in cases of human meningitis.

SARChI Chair in Animal Infectious Diseases (Zoonoses)

Professor Wanda Markotter was awarded the DST-NRF South African Research Chairs Initiative (SARChI) Chair in Infectious Diseases (Zoonoses) in 2015. A zoonosis is defined as any disease or infection that is naturally transmissible from vertebrate animals to humans and vice versa, and can be caused by all types of pathogenic agents, including bacteria, parasites, fungi and viruses with both domestic and wild animals acting as reservoirs of infection.

At least 60% of emerging infectious diseases affecting humans are of a zoonotic origin and, in the past 15 years, more than 50% of global emerging infectious diseases originated from Africa.

The central research focus of the Chair will be on zoonotic infectious diseases at the animal-human-ecosystem interface. This includes detection and control of the diseases based on an understanding of, among others, epidemiology, evolution, pathogenicity and mechanisms of infection, and also of ecological factors that determine the transmission between animals and humans. This requires a multidisciplinary approach embodied in the 'One Health' concept, which calls for collaboration between natural, medical and veterinary scientists.

Bovine tuberculosis on the move

Bovine tuberculosis is an infectious disease of mostly domestic cattle but in recent decades it has appeared as an emerging disease of wildlife in South Africa and beyond, potentially threatening endangered and rare species.

Professor Anita Michel

Close on a century ago bovine tuberculosis (BTB) affected a significant percentage of dairy cattle herds and posed a serious public health threat to humans – it is a zoonosis mostly transmitted via milk. While the disease has been eradicated in many developed countries, it is still a major livestock disease in South Africa and in the region, complicated by spill-over to 21 different indigenous wildlife species.

The research conducted by the BTB team in the **Faculty of Veterinary Science**, under the leadership of **Professor Anita Michel**, embraces the challenges posed by this multi-host disease through studies investigating the epidemiology, improving the diagnosis and exploring new control measures of the disease in cattle as well as in wildlife. Because BTB is a player at the wildlife-livestock-human interface, they have made it a priority to employ a 'One Health' approach to determine the impact of BTB on humans and their livestock in the Mnisi community, which borders the Kruger National Park.

Wildlife are translocated in their tens of thousands every year in South Africa. With an increasing number of buffalo, kudu, lions and other species being infected with BTB, such 'stock' movements may introduce the disease to new properties and areas.

As a chronic infectious and progressive disease, the large scale spread to other animals only becomes apparent with time, as demonstrated by the research team's epidemiological investigation of a BTB outbreak in the well-known Madikwe game reserve in the Northwest province.

At the start of the project, **Jolly Musoke**, a PhD student, established effective collaborative links with farmers and the community, and with the Department of Health and the Department of Agriculture, Forestry and Fisheries at both provincial and local levels. The rewards from this effort came in the form of the first evidence from Africa to prove that BTB was transmitted back from infected wildlife to neighbouring communal cattle. The research team was also the first to conduct an investigation of the zoonotic risk of BTB in humans in rural communities, with the good news that it did not appear to affect human health. The interest at this interface has resulted in collaboration and postgraduate supervision beyond national borders, in Mozambique, Tanzania and Eritrea. In early 2016, a second and bigger 'One Health' TB project will be launched in northern Kwazulu-Natal to gather much-needed research data to establish the impact of zoonotic TB on humans and of human TB on cattle.

Other research projects of this group investigate tuberculosis in small mammals (banded mongooses), as well as in African elephants in Zimbabwe and Zambia and buffalo in Botswana. All these projects involve extensive testing of wild animals using new diagnostic tests that require veterinary as well as laboratory expertise. Accomplishment of present research outputs would therefore not have been possible without dedicated and skilled postgraduate students and close partnerships with national and international collaborators.

Bats as reservoirs of zoonotic infectious agents

Bats are potential reservoirs for a wide range of zoonotic infectious agents, many of which are viruses that carry an extreme public health risk.

Many zoonotic infections are mild but some may lead to fatal diseases, for example, rabies, the Nipah (NiV) and Hendra viruses, and in haemorrhagic fevers – the Marburg and Ebola viruses.

A research team, led by **Professor Wanda Markotter** at the **Centre for Viral Zoonoses** (UP-CVZ) conducts surveillance of African bat populations to understand the diversity, distribution and circulation patterns of bat-borne viruses and the potential threat to veterinary and public health. The study of bat infectious agents has been further expanded by the research of a postdoctoral fellow at the Centre, Dr Muriel Dietrich, who combines field sampling in bat caves, molecular work and bioinformatics approaches to investigate bacterial communities in bat populations in South Africa.

Using powerful metagenomic research tools, the researchers have investigated the composition of the bacterial microbiota in bats (a collective term for the bacteria that live in or on the body). They have identified highly diverse and specific bacterial communities in samples that are implicated in pathogen transmission in bats, such as urine, faeces and saliva. In addition to commensal bacteria (part of the normal microflora), the researchers have also found that bats excrete bacteria that may cause disease in humans, such as *Leptospira*, *Rickettsia*, *Bartonella* and *Coxiella*, highlighting the possibility that bats may be the reservoir of human bacterial pathogens.

As the resident microbiota are thought to play a significant role in host susceptibility to pathogens, unravelling the interactions between the microbiota, the host and potential human pathogens will help understand the role of bats as reservoirs of zoonotic infectious agents, and the risk of transmission to humans.

Reducing the risks of wildlife capture and anaesthesia

Since the mid-20th century, the use of veterinary-specific anaesthetic drugs to capture wildlife, via darting, has become common practice. Although this practice has improved over time, a number of animals still succumb or suffer from the side-effects of the drugs or the capture process.

What causes death or the drug-induced side-effects is not entirely known. **Professor Leith Meyer**, in the **Faculty of Veterinary Science**, and his collaborators have embarked on a number of studies to better understand the effects of these drugs and of the capture process.

A highlight of their work has been an improvement in the safety of anaesthesia (chemical immobilisation) of the white rhinoceros. When immobilised via darting, rhino suffer from cardiorespiratory compromise and develop severe hypoxia. Simply administering oxygen to rhino is ineffective; in fact, it compromises them even more. Professor Meyer's team found that combining oxygen with an analgesic drug called butorphanol adequately corrects hypoxia. However, this combination has only worked well in rhino kept in captivity, and was not as effective when animals were darted while being chased by a helicopter in the field.

Their research may not only have benefits for wild animals but also for humans. Humans, like animals, often suffer severely from respiratory depression when the analgesic group of drugs, the opioids, are used. Another noteworthy discovery by Professor Meyer is that opioid drugs, when used in wildlife, cause pulmonary hypertension. Meyer has clearly shown that this hypertension severely exacerbates the hypoxia caused by respiratory depression. Opioids have also been shown to cause pulmonary hypertension in humans, but their link to hypoxia, until now, has not been shown in humans or other animals.

In future studies they will look more closely into the lungs of immobilised rhino to observe how pulmonary pressures and other physiological changes influence gas exchange and hypoxia. These studies are critically important to help develop new anaesthetic approaches to reduce the risks associated with capture and anaesthesia. Their findings are being applied in the field and are already making a difference to this threatened species.

Professor Leith Meyer and colleagues test the cardiorespiratory effects of darting

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The impact of human-induced environment changes on species is a common thread that ties together much of the research profiled here: from understanding species interactions, to microbial ecology research and ancient forms of life providing rich data on local ecosystems, rainfall patterns and climate change. The impact of research under the broad rubric of environment also includes the study of the extensive soil ecosystems across the African continent, and how organisms (including mammals) survive in extreme environments. The theme concludes with threats to the survival of iconic wildlife species.

Peter le Roux and Michelle Greves

The daisy *Senecio rhomboideus* grows on the cushion plant *Euphorbia clavarioides,* the Golden Gate Highlands National Park

Ecology in a changing world

Understanding species interactions is crucial to predicting how human-induced environmental changes impact on the nature and functioning of ecosystems, and improves forecasts of the impact of climate change on the environment.

Dr Michelle Greve and **Dr Peter le Roux** in the Ecology Section of the **Department of Plant and Soil Sciences** are investigating how plants interact with their environment and with other organisms.

Traditionally, climate has been assumed to be the chief determinant of where species occur. However, recent research suggests that sometimes biotic interactions may be more important than abiotic environmental conditions for determining species occurrence patterns, particularly under stressful conditions. Dr Peter le Roux and his students are testing this idea using cushion plants (that is, species with a compact, hemispherical growth form) as model systems to examine if the outcome of interactions between plants changes with environmental conditions.

Rabia Mathakutha collects *Poa cookii* grass on Marion Island

Dr Peter le Roux and Dr Michelle Greve

Dr le Roux's team is focusing on plant interactions and cushion plants in two very different habitats: alpine grasslands in the Drakensberg, and tundra on sub-Antarctic Marion Island. Earlier results have shown that the widespread sub-Antarctic cushion plant *Azorella selago* strongly impacts on other plant species, with the cushion plant having a negative influence in milder environments but a positive effect on co-occurring plants under more stressful conditions. The team's current research is building on this understanding and testing if this pattern holds across an entire ecological community, by examining vascular plants, mosses, lichens, invertebrates and microbial communities and exploring the mechanisms driving the environmental contingency in these interactions.

Preliminary results suggest that the positive impacts of *A. selago* allow some species to grow at higher altitudes than possible in the absence of the cushion plant, highlighting how even fine scale

biotic interactions may affect broad scale biodiversity patterns.

In the Drakensberg the cushion plant *Euphorbia clavarioides* only grows in very rocky or eroding areas. In these stressful habitats the species provides a unique microhabitat, potentially allowing species to survive in areas that would otherwise be inhospitable. The research team is now testing whether, despite considerable differences in climatic and geological conditions and a 20-fold difference in plant species richness, the plant-plant interactions in the Drakensberg follow the same patterns as in the sub-Antarctic. Initial analyses suggest that in both study systems positive interactions are consistent under harsh environmental conditions.

Dr Michelle Greve and her students are also investigating how interactions between species affect their distribution, but over much larger areas. South Africa is home to two wild silk moth species that have high economic potential. These moths rely on a few species of host trees to complete their life cycle. In this study, the research team is investigating how best to incorporate knowledge of the distribution ranges of the host trees to predict where in Africa these moths will occur, and how climate change might affect them in the future. This knowledge can inform commercial harvesting under future climate change scenarios.

Silk worm cocoon

Dr Peter le Roux and Dr Michelle Greve

Mia Momberg surveys for *Euphorbia clavarioides* cushion plants in Echo Ravine at the Golden Gate Highlands National Park

Predicting alien invasions – which plants pose a threat?

Alien species pose a serious threat to biodiversity. Globally, the increasing trend in international travel and trade has resulted in increased numbers of introductions of species into areas to which they are not indigenous. Ecologists in the Department of Plant and Soil Sciences are studying various aspects of plant invasions, including the risks and impact of non-indigenous plant species in South Africa and the sub-Antarctic, and how to prioritise their management. One focus is understanding the likelihood of new plant invasions, using the sub-Antarctic islands as a study system.

Despite their isolation, the islands of the sub-Antarctic seem to be prone to invasions by non-indigenous plant and insect species. To mitigate future invasions, Dr Greve and her team are using a range of tools to predict which alien species might be particularly likely to invade the sub-Antarctic islands by studying the climate requirements of potential invasives and understanding what traits allow existing invasives to become successful in the region. This approach has made it possible to identify a number of species with a high likelihood of establishing in the region and threatening the islands' indigenous inhabitants. By examining alien plant species across the entire sub-Antarctic, their research will allow the governments managing individual islands to focus their efforts on reducing the likelihood of transporting such species to the islands, and to prioritise species on which to focus their eradication efforts.

Microbes and invasive tree species

Islands present intriguing opportunities to study the controls of biological invasions – that is, the introduction, accidentally or incidentally, and establishment of exotic species from one region into another region separated by geographical barriers, such as oceans or mountains.

Legumes are often over-represented among invasive plant taxa with some taxa, such as the Australian acacias, emerging as model systems within invasion biology. One unusual extra-Australian acacia is *Acacia heterophylla*, endemic to Réunion Island in the Indian Ocean. Ecologists have long speculated about the unusual distribution of this tree species, which remains an enigma. The most plausible hypothesis is that *A. heterophylla* was introduced from Hawaii to Réunion (18 000 km apart) by sea birds about 1,4 million years ago.

Traditionally, the success of *A. heterophylla* in invading the island has been attributed to plant species traits (e.g. high seed outputs) and abiotic factors (e.g. similar climate and soil chemistry between the native and the invaded range). It is also likely that microorganisms (bacteria and fungi), such as rhizobia and arbuscular mycorrhiza (AM), play an important role in the establishment and invasion success of acacias. Rhizobia associate with legumes and fix atmospheric nitrogen into plant-available ammonium, whereas AM facilitate plant nutrient uptake, especially phosphorus.

However, no information is available on the diversity of the microbial communities associated with *A. heterophylla*, their role in facilitating the invasion process and how these may impact on regional biodiversity and ecosystem functioning. A better understanding of the microbial communities associated with acacias is important in order accurately to understand, predict and manage biological invasions. With this in mind, **Dr Angel Valverde** (**Centre for Microbial Ecology and Genomics**) was part of a team of researchers who visited Réunion Island in March 2015 and collected *A. heterophylla* rhizosphere soils (the narrow zone that surrounds and is influenced by plant roots) from various locations. The team used high-throughput (Illumina amplicon)

Réunion Island

sequencing to analyse the 16S rRNA gene from the bacterial populations.

Phylogenetic profiling revealed that the bacterial composition of rhizosphere soils was primarily determined by location. A shared core of 94 bacterial taxa was found in all soils, which suggests that common principles underpin *A. heterophylla*-microbe interactions. Several members of this core are known to promote plant growth and confer tolerance to abiotic stress (e.g. *Bradyrhizobium*, *Rhizobium*, *Bulkholderia* species). Controlled experiments to elucidate the role of these microorganisms in *A. heterophylla* invasion are currently in progress.

The team that visited Réunion Island included Dr Angel Valverde (Centre for Microbial Ecology and Genomics, UP), working with Dr Dominique Strasberg (University of Réunion), Professor Pedro Crous (the UP Forestry and Agricultural Biotechnology Institute (FABI) and Centraalbureau voor Schimmelcultures, The Netherlands), Professor David Richardson and Dr Jaco Le Roux (Centre of Excellence for Invasion Biology, University of Stellenbosch), and Professor Mike Wingfield (FABI and the Centre of Excellence in Tree Health and Biotechnology, UP).

This group of internationally recognised biologists represent a formidable combination of global experts in their respective fields.

An ancient and primitive form of life

Welwitschia mirabilis is an uncommon plant found in the western hyper-arid desert regions of Namibia and southern Angola, where it occurs in isolated populations ranging from two to more than 1 000 long-living individuals. It is thought that the older specimens may be more than 1 500 years old.

The plant, named after the Austrian botanist Friedrich Welwitsch who first documented its 'discovery' in 1859, has always fascinated scientists because of its primitive nature. In addition to its scientific significance, *Welwitschia* is of considerable importance to the local ecosystem because it provides refuge, shade, food and water to many species of animals that inhabit the Namib. Although researchers have extensively studied the botany, physiology and ecology of *Welwitschia* plants, very little is known about the microbial communities associated with *Welwitschia*.

Dr Angel Valverde and his colleagues used 454 pyrosequencing to analyse the prokaryotic and fungal communities inhabiting the *Welwitschia* rhizosphere and compared them with those from the bulk soil. What they found was remarkable. The rhizosphere of *Welwitschia* harbours diverse and distinct bacterial and fungal communities compared to the bulk soil. Many of the genera consistently observed in the rhizosphere samples are known to contain strains with plant-growth promoting abilities (*Acinetobacter*, *Sphingomonas*, *Rhizophagus*, an arbuscular mycorrhizal fungus). Current investigations using culture-based approaches will help in elucidating whether or not these microbes interact synergistically to promote *Welwitschia* plant health and productivity.

Baobabs – a 1 000-year record of rainfall patterns and climate change

The primary focus of the Stable Isotope Laboratory at UP is on the analysis of stable isotopes and the reconstruction of past environments, the impact on biodiversity and the response of ecosystems and species to an ever-changing environment.

A key research programme has been the generation of long-term climate records from selected long-lived indigenous tree species (such as the Baobab *Adansonia digitata L.*) from across southern Africa. Ancient Baobab trees, which are predominantly found in summer rainfall areas, are excellent study models as they can live for more than 1 000 years and therefore can provide valuable insight into both the natural and anthropogenic effects of climate change over time.

Stephan Woodborne

Dr Grant Hall coring a Baobab

Dr Stephan Woodborne (iThemba Labs, Johannesburg) and **Dr Grant Hall** (Stable Isotope Laboratory, MRI at UP) are the lead researchers. Based on earlier research carried out on Baobab trees in the Pafuri region of the Kruger National Park and several species in the KwaZulu-Natal region between 2010 and 2013, they realised the potential of providing high-resolution time series analyses of past rainfall based on stable carbon isotope ratios derived from growth rings.

During the lifetime of a tree, carbon is taken up from the atmosphere and incorporated into the wood tissue that forms during the growing season. The stable carbon isotope ratios in each ring vary from year to year and provide a proxy record of each year's rainfall.

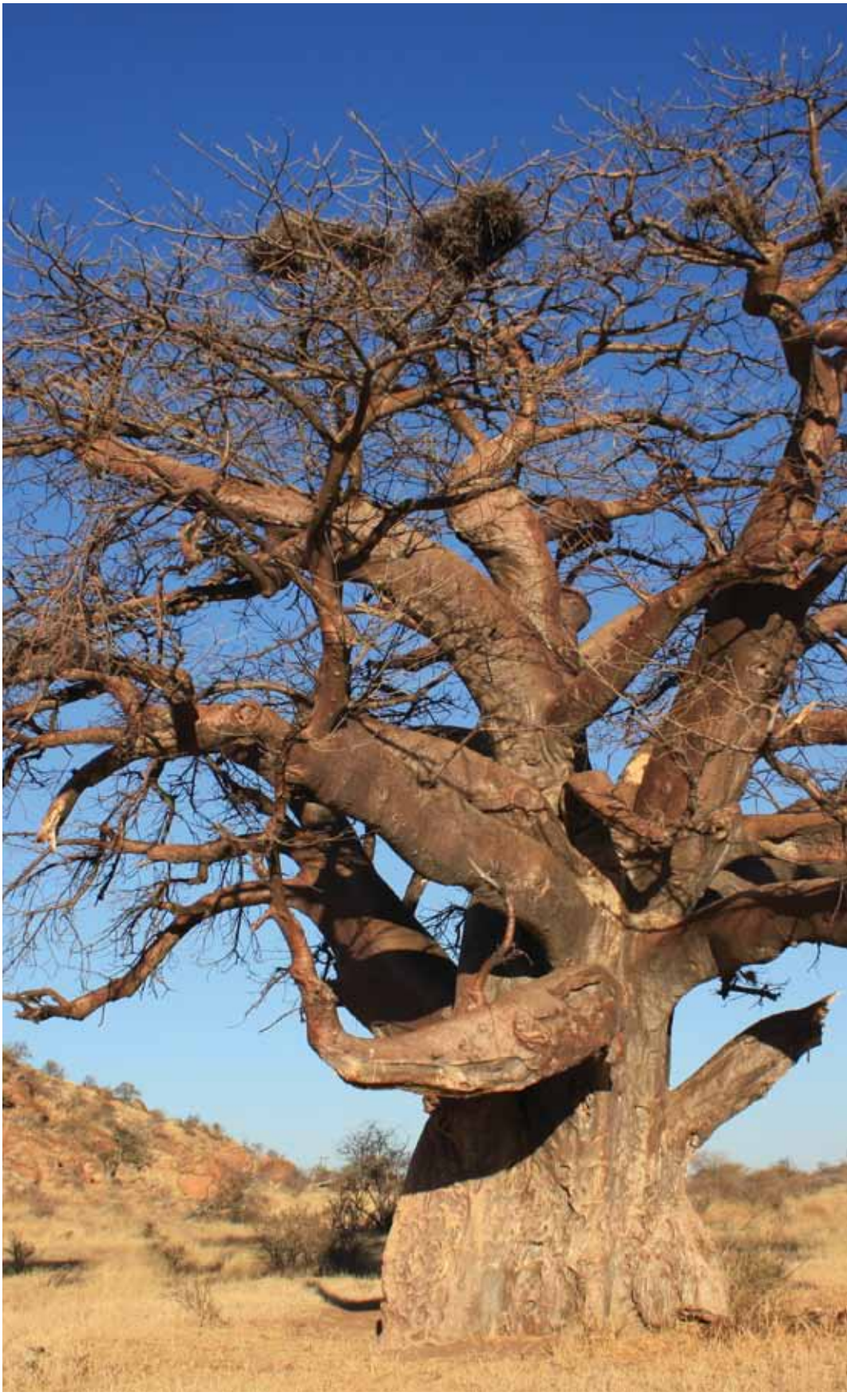
In 2015, Dr Woodborne and Dr Hall carried out two major field trips to collect additional samples of Baobabs from Mapungubwe and Kruger National Parks in South Africa, and from the Epupa Falls in northern Namibia to complement the

existing isotope time series. Baobab core samples and trunk discs from Camel-thorns (*Acacia erioloba*) were also collected along a north-south transect across Botswana. The second field trip was to south-western Madagascar where Dr Hall assisted with the sampling of several Madagascan Baobab species.

Cores up to 1,5 metres in length are taken from living Baobabs using an increment borer. This procedure does not damage the trees and the holes created are sealed as soon as the core is removed. The chemistry of the wood reflects the growing conditions and the periods during which growth occurred (rainfall periods), as well as the periods during which the trees were under water stress (drought periods). As a tree grows, new rings are formed year after year, and the chemistry of each ring gives insight into climate change in that locality.

The processing for stable isotope analysis and high-precision radiocarbon dating started in 2015. By the end of 2016 the project will have produced a 1 000-year record of past rainfall across southern Africa.

A vast amount of data for wide-ranging stable isotope-related projects has been generated. In addition, the facility provides training and analytical services, and collaborates with several institutions in South Africa and internationally. In 2015 Dr Hall and Dr Woodborne worked closely with researchers and students from numerous international institutes as well as locally with SANParks and the universities of Cape Town and KwaZulu-Natal. In addition, datasets have been used by climate modellers from Sweden and the Council for Scientific and Industrial Research (CSIR) to improve the predictive power of global climate models and to mitigate the effects of climate change in southern Africa.



Grant Hall

International teamwork in marine microbial ecology research

In science no man is an island – Thulani Makhalanyane

As Deputy Director of the **Centre for Microbial Ecology and Genomics** (CMEG), **Dr Thulani Makhalanyane** has established several new projects focussing on the microbial ecology of cold desert soils and Southern Ocean habitats, as part of the South African National Antarctic Programme (SANAP).

Dr Makhalanyane is a Young Ambassador for the International Society for Microbial Ecology (ISME), and has spent time at the Pacific Northwest National Laboratory under the mentorship of Professor Janet Jansson, the current ISME President and a world-leading microbial ecologist.

For Dr Makhalanyane, 2015 was a prolific publishing year. His apex paper, co-authored with colleagues from CMEG, was a major synthesis of the microbial ecology of hot desert ecosystems, which was published in *FEMS Microbiology Reviews*, the leading journal of the Federation of European Microbiological Societies.

In 2015 he was one of only two recipients of the TW Kambule-NSTF award for an excellent emerging researcher. "Winning the award was a welcome validation of the importance of our work and our contribution to knowledge generation and capacity development," he says.

Dr Thulani Makhalanyane alongside a transport vehicle – fondly referred to as Ivan, the Terra Bus – that takes researchers from the airstrip where they land in Hercules helicopters to the Dry Valleys of the Antarctic, about an hour's drive.

INTERVIEW: Braving heavy seas, sea-ice, snow and the Roaring Forties in search of science

Back: Ramontsheng Rapolaki, PhD student at UCT, and Sandra Phoma, PhD student at UP. Front: Katherine Moffett, MSc student at UCT, Dr Tshoanelo Miya, Project Investigator at the University of Free State and Mubanga Kabwe, a PhD student at UP.

It was winter time in 2015. **Sandra Phoma** and **Mubanga (Helen) Kabwe** had never seen the sea before. This all changed the moment they boarded the SA Agulhas II, ready to depart on a winter cruise to the Southern Ocean.

At the time both Sandra and Helen had just completed their MSc studies under the supervision of **Professor Don Cowan** of the Centre for Microbial Ecology and Genomics (CMEG) with **Dr Eldie Berger** as co-supervisor. Their research project was part of an NRF-funded Blue Skies programme under Dr Thulani Makhalanyane, also of CMEG, aimed at understanding the composition and role of marine microbial 'dark matter'.

As part of their research, Sandra and Helen were involved in the sampling strategy which aimed to use culture-independent techniques to understand the composition and functional role of the marine micro-environment in atmospheric carbon cycling and its possible impact on climate change. Their task was to obtain a series of varying depth water samples along a north-south transect. To obtain the seawater samples from various depths, they used sophisticated CTD (conductivity, temperature and depth) sampling equipment lowered by winch from the shipside. An excellent set of samples was recovered and returned to the CMEG laboratory, where DNA sequencing to identify the species and gene diversity has been completed.

The SA Agulhas II cruise lasted four weeks during which time the two students collected water samples at different sampling sites. They became skilled winch operators, working long hours in heavy seas, strong winds, sea-ice and snow. It was a physically and mentally exhausting experience, and quite harrowing at times. The nature of the Southern Ocean, especially the "Roaring Forties" (strong westerly winds found in the Southern Hemisphere between the latitudes of 40 and 50 degrees), created much discomfort. The ship sailed all the way to the sea-ice margin at 57 degrees South.

Storme de Scally and Sandra Phoma

Another member of the CMEG research team who collected samples for her Master's studies on board SA Agulhas II on two of its cruises is **Storme de Scally**. Her research focuses on inducing ocean acidification (OA) in the laboratory environment to determine what effect OA will have on the microbial communities and their functionality in Southern Ocean seawater.

Storme recalls her research adventure: "Taking samples during SA Agulhas II's Marion Island Relief Voyage was the most incredible and educationally informative experience of my life. Not only is the ship a fully equipped laboratory facility, it also has extremely friendly staff and scientists. We spent most of our time in the wet laboratory, filtering water samples for later DNA/RNA extraction in the CMEG laboratory, working in shifts over 24-hour periods. At one station we also collected 400 litres of water to use for my OA experiment at CMEG. As the Marion Island Relief Voyage transports over-winterers to and from Marion Island, we were able to leave the ship for a day and hike on this beautiful sub-Antarctic island, which harbours incredible birdlife."

Mathematics and biology – epidemiological modelling and more

We have witnessed enormous growth in biological research spurred on by a technological revolution in mathematical models and methods that has allowed for the generation of vast amounts of previously inaccessible biological data.

Responding to the challenges of working with large quantities of data, the **DST-NRF SARChI Chair in Mathematical Models and Methods in Biosciences and Bioengineering** was established at UP in 2013. The Chair has established a strong research agenda pursued by an active group of principal investigators.

The main focus is on epidemiological modelling of diseases in humans, livestock and plants, with the aim of providing scientific support for knowledge-based policy-making. It is worthwhile emphasising that this would not be possible without the simultaneous development of fundamental aspects of mathematics such as dynamical systems and partial differential equations, as well as numerical methods. Maintaining a healthy balance between pure and applied mathematical research in the research group has contributed to the strength of the Chair.

Professor Jean Lubuma, the first incumbent of the Chair (2013-2015), has been succeeded by **Professor Jacek Banasiak** (above). Professor Banasiak is a B1-rated scientist and applied mathematician specialising in the analysis of dynamical systems modelling processes in technological, physical and natural sciences. His research has covered fragmentation and coagulation processes, network dynamics, as well as structured population dynamics and epidemiology. More recently his work has extended to include multiple scale and network dynamics aiming, in particular, at developing robust techniques to simplify complex dynamical systems based on the existence of different time and space scales.

The work of the Chair is supported by an excellent team of interdisciplinary principal investigators who include Professor R Anguelov, Dr M Chapwanya, Dr S Garba (Department of Mathematics and Applied Mathematics), Dr AA Yusuf (Department of Zoology), together with postdoctoral fellows and postgraduate students.

The microbiology of African soils

Terrestrial soils support life and livelihoods. Until recently, it has been generally assumed that crop productivity, which is so critical to food security, was a function of the plant cultivar, the climate (particularly rainfall) and the soil nutrient status (fertility). However, a growing body of research over the past decade suggests otherwise.

Professor Don Cowan, Director of the **Centre for Microbial Ecology and Genomics** at UP, is heading a series of innovative research projects focusing on the microbiology and microbial ecology of the very extensive soil ecosystems across the African continent.

Their research has shown the associations between plant roots and soil microorganisms (in what is termed the rhizospheric zone) is an important factor in plant growth and productivity.

Soil microorganisms represent a vast and almost completely unexplored genetic resource. As little as a teaspoon of soil may harbour as many as a billion microbial cells from several thousand different species, and different soils may harbour very different microbial communities. The genomes from these organisms represent a huge resource – in providing the information required to understand the function, performance and adaptation of the soil microbial species, but also as a long-term resource for potentially valuable products (such as enzymes, bioactive compounds, antibiotics, and the likes) for a future biotechnology industry.

Professor Cowan's team has been working on the microbial ecology of the Namib Desert for the past six years, and has already published some 25 papers from these studies. More recently, several new project opportunities have allowed the researcher group to extend their interests into other regions of the African continent, through the award of an NRF South Africa-Tunisia bilateral research grant and, most recently, the initiation of a large intra-African collaborative

Professor Don Cowan (second from right) and AADMEN colleagues in Tunisia

research programme funded by USAID. The principal aim of all these studies is to obtain a baseline dataset of the microbial diversity in a very wide range of different soil types and different climatic zones across parts of the African continent. A secondary aim is to compare the soil microbial community fingerprints of 'natural' soils with the soils of areas under intensive farming practices.

This research project involves researchers from all the partner nations and will use the latest metagenomic sequencing methods and bioinformatics analyses. The results will be a 'first' for Africa – there is currently no comprehensive (or even cursory) survey of soil microbiology from any African nation, including South Africa.

On the back of this project, Professor Cowan has established a special research focus group, the African-Arabian Desert Microbial Ecology Network (AADMEN). The group met for the first time in April 2015, and established a set of principles to guide future activities involving joint grant applications, future research collaborations and publications.

Surviving in extreme dry deserts

Professor Nigel Bennett holds the Austin Roberts Chair of Mammalogy and the SARChI Chair of Mammalian Behavioural Ecology and Physiology and has an active programme working on African mole-rats and other African small mammals, but he also has another string to his bow.

Professor Nigel Bennett, who is also a Visiting Professor at the King Saud University, with his colleagues Professors Abdulaziz Alagaili and Osama Mohammed, has been investigating various aspects of the physiology of both large and small mammals with the specific aim to investigate how they manage to survive in some of the most extreme dry deserts of Saudi Arabia.

The team have investigated the reproductive biology of the Baluchistan gerbil, the Arabian spiny mouse and the desert hedgehog. Amazingly among these phylogenetically diverse organisms there is a golden thread that links how reproduction is played out in the desert. In males the resurgence of testes growth, spermatogenesis and heightened testosterone concentrations are triggered by rainfall (spring to summer), whereas in the females it is the onset of the restricted rainfall pattern as well as temperature increase (spring to summer) that triggers follicular genesis, ovulation and the subsequent rise in progesterone concentrations. These environmental triggers ensure that young are born at a time that is optimal for the survival of the offspring.

Professor Bennett and his colleagues have established a custom-built temperature- and light-controlled room in Riyadh to investigate the role of the light/dark cycle on the locomotory activity patterns of a number of small rodents including the King jird, the Libyan jird, Yemeni gerbil and Asian dormouse found in the more mountainous western parts of Saudi Arabia. The findings have revealed that activity is restricted to the dark phase of the light/dark cycle. Indeed, under constant dark conditions it is found

Professor Nigel Bennett

Tim Wachner

that the animals still express a distinct innate rhythm of locomotory activity that mirrors that of the pattern on the light/dark cycle, showing that these rodents have endogenous rhythms of locomotory activity that are generated from a distinct region in the brain, the suprachiasmatic nucleus, which is the animal's internal clock. These animals have thus, over time, adapted their patterns of activity to the cooler night time for foraging and reproductive activities.

A large research grant awarded by the Saudi National Programme to Bennett, his Saudi colleagues and Professor Paul Manger from the University of Witwatersrand has enabled the team to investigate the natural body temperature rhythms and activity patterns of the Arabian oryx (a critically endangered ungulate) in the sandy desert of the Rub al Khali or Empty Quarter and the gravel desert of the Mahazat as Seyd (a protected area) using advanced satellite technology. The oryx were fitted with customised satellite collars and a thermal implant linked to the collar placed into the abdominal cavity.

The findings from a calendar year of data have revealed fascinating results that will reshape our understanding of how animals survive in such conditions. In free-ranging oryx at both locations, it was demonstrated that during the cooler winter months the oryx were inactive during the cooler parts of the day showing a night time (nocturnal) inactivity pattern. Conversely, in the warmer summer months, the oryx displayed a bimodal inactivity pattern with major inactivity bouts occurring equally during the coolest part of the night (predawn) and the warmest part of the day (afternoon hours).

The body temperature rhythms from both localities demonstrated that the oryx is an adaptive heterotherm, with body temperature rising through the day, and subsequently dropping during the cool of the night. The most extreme range of heterothermy ever recorded in the oryx (an 8ºC change in body temperature) was found in one free-ranging animal from the Empty Quarter. None of this work would have been possible without the support of the Director of the Saudi Wildlife Authority, Prince Bander bin Saud Al Saud.

INTERVIEW: Giant predators of the southern seas

Dr Cheryl Tosh, a research fellow in the **Department of Zoology and Entomology**, visited the sub-Antarctic Marion Island for the first time in 2005 at the start of her PhD studies. Her PhD project titled "Oceanographic signatures of South Elephant Seals" focused on the environmental correlates of the at-sea behaviour of South Elephant Seals (SESs). In 2015 she received a Y1 rating from the NRF on the basis of her predator research on Marion Island.

Dr Tosh says the ocean-scape is variable and heterogeneous, with changes occurring in three dimensions across space and time. "Something is always changing somewhere. My PhD research enabled me to describe movement responses and find patterns in the data. South Elephant Seals follow a strict seasonal pattern in their annual cycle."

Research on killer whales started as a spin-off from the SES research. Abundant food resources mean that killer whales are always around Marion Island in the summer. Dr Tosh relates how spending so much time on the island allowed her to collect photographic data on killer whales. "It appears that the same individuals are present at Marion Island for large parts of the year. We were able to piece together a preliminary social structure among these individuals. During winter the whales leave the island, and satellite telemetry is used to find out where these animals go during the winter months."

Her work has been published as scientific articles and presented at international conferences. In 2015 she authored a paper about the role of sea surface height anomalies (ssha) on juvenile SESs. Sea-surface temperatures change in these regions according to season. Juvenile SESs tended to change behaviour at the edges of eddies or where the gradients of the ssha were steepest.

INTERVIEW: Monitoring mammal activities in changing times

Dr Trevor McIntyre is a research fellow in the **Department of Zoology and Entomology**. His main research interest lies in understanding how the behaviours of animal species are likely to adapt to human-induced changes in their environment. He seeks to understand what the fitness effects and ultimately the population-level effects of such behavioural changes are.

Most of his research has focused on southern elephant seals on Marion Island in the Southern Ocean. Satellite-linked devices are deployed on elephant seals to record not only their movements when they go on their long foraging migrations of up to eight months at sea, but also data on their dive behaviour and on the physical characteristics of the water masses in which they forage.

The African clawless otter is another animal species that has the potential to provide insight into behavioural adaptations to the environment. These animals are seemingly well adapted to surviving in a broad range of habitats and climatic regions, only requiring a steady supply of freshwater. Dr McIntyre has initiated a research programme aimed at gaining an understanding of the comparative health and behaviour of otter populations. This has resulted in several more applied projects, notably an ongoing study related to the potential impact of otters on the fly-fishing industry.

Predator behaviour and ecology

Effective conservation management of South Africa's wildlife is the ultimate goal of the Centre for Wildlife Management (CWM) at the University of Pretoria, where researchers are actively involved in a range of projects on wildlife species, populations and habitat.

In addition to the devastating impact of poaching and wildlife trafficking, there are several other threats to the survival and well-being of Africa's wildlife. The CWM strives to better understand why changes in wildlife populations are occurring, through research focusing on a range of species, from small mammals to Africa's iconic animals such as elephants and African wild dogs. Much of the research is also aimed at better understanding wildlife-habitat interactions, vegetation and interactions between people and the environment.

The research of **Michael Somers**, Director of the **CWM** and Associate Professor in the **Department of Animal and Wildlife Sciences**, is focused on the management and conservation of carnivores. His main focus is on investigating their behaviour, and how this changes with ecological change and increased human pressure. The research has been done with the use of technologies such as radio or satellite tracking and camera traps.

Professor Somers has had several postgraduate students who have done groundbreaking work. Research conducted in Mozambique, for example, has shown that the presence of poachers alters the natural occupancy of a number of species. The fear of humans in the natural landscape seems to override the fear of other predatory species, and the instinct to be close to food sources. Some research, especially the work undertaken in Botswana by a postdoctoral fellow, **Dr Florien Weise**, has involved local communities in exploring ways of reducing the negative impact of carnivores on people and vice versa. It is anticipated that the outcomes of this study will be adapted and transferred to similar areas once completed.

A recent project has involved collating extensive information, dating back to the 1960s, on the reassembly of the Large Predator Guild in the Hluhluwe-iMfolozi Park in KwaZulu-Natal. This project was accomplished with the assistance of wildlife managers and scientists from around the world, and will be published by Cambridge University Press. The data show the intricate interactions between the many carnivore species and their prey within the Park over time. One of the significant findings was that management in the form of culling or the reintroduction of species has had unforeseen consequences for non-target species, which can take decades to recover, and sometimes never recover. For instance, the brown hyena used to be plentiful in the Park in the 1960s but is now extinct in that locality.

Dr Yolanda Pretorius

Yellow-breasted pipits – are they nearing extinction?

The yellow-breasted pipit is a southern African endemic bird species that is listed as 'vulnerable' on the global and regional Red List of the International Union for Conservation of Nature (IUCN).

Yellow-breasted pipit displaying its bright plumage

Yellow-breasted pipits are one of a handful of vertebrate species that are endemic to the Moist Highland Grasslands of southern Africa. Anecdotal evidence suggests that the population has steadily decreased, with apparent local extinctions in some regions and massive reductions in population size where they used to be plentiful. Yet the causes of these reductions remain largely unknown.

Darren Pietersen, studying towards his doctoral degree in the **Faculty of Veterinary Science**, with **Professor Andrew McKechnie** in the **Department of Zoology** and the Percy FitzPatrick Institute of African Ornithology, Professor Raymond Jansen from the Tshwane University of Technology and Dr Ian Little of the Endangered Wildlife Trust, are examining the habitat requirements of this species in order to better understand what drives their distribution. Although previous studies have investigated the habitat requirements of this species at a local scale, the collaborative research will extend the study across the species' entire range. Furthermore, the researchers are investigating what biological factors may be driving this distribution by making use of environmental niche models to predict and interpret the species' current distribution, while also undertaking a phylogenetic study of all sub-Saharan African pipits and longclaws (both members of the family *Motacillidae*). The latter will allow them to determine how yellow-breasted pipits are related to these two groups, as well as determine whether their taxonomic position might explain why they are such habitat specialists.

During their summer breeding season, when both sexes have diagnostic bright yellow plumage, they are restricted to Moist Highland Grasslands along the Eastern Escarpment of South Africa, marginally entering eastern Lesotho. In winter both sexes lose their bright colouration, becoming rather nondescript, dull brown birds that are difficult to identify. As a result, their non-breeding range is poorly known, although the available evidence suggests that at least some individuals remain on the summer breeding grounds while others drop off either side of the escarpment and can be found as far afield as Suikerbosrand Nature Reserve near Johannesburg.

It is clear that in several areas their habitat is threatened by factors that include open-cast coal mining, conversion of grasslands to crop agriculture, afforestation, human settlements and unfavourable land management. Like many other Moist Highland Grassland endemics, yellow-breasted pipits are extremely sensitive to unfavourable land management practices, such as fire regimes that are either too frequent or infrequent, or over- and under-grazing. This study will document in detail what drives their distribution patterns.

Africa's pangolins in the spotlight

Until a few years ago not many people knew what a pangolin was. Now, thankfully, that trend is changing. Pangolins are the only group of mammals that have an outer covering of scales rather than fur, making them look more like reptiles than mammals.

Pangolins are highly sought-after in the African (and Chinese) traditional medicine trades. In Africa they form an integral component of cultural rituals and also feature prominently in the 'bushmeat' trade. Yet not much is known about pangolins, other than that the current rate of consumption is far exceeding their reproduction rate. This basically means that pangolins are being eaten to extinction!

As part of a multi-organisational research group, which includes the University of Pretoria and colleagues from the Tshwane University of Technology, the National Zoological Gardens of South Africa and the African Pangolin Working Group, efforts are being made better to understand the biology, cultural uses and current trade levels of pangolins.

Darren Pietersen, who as part of his Master's research studied the ecology of pangolins, has teamed up with **Professor Armanda Bastos** of the **Mammal Research Institute** and Honours student **Sean Heighton** to study what diseases pangolins have, and whether any of these may have potentially negative effects on humans or livestock. This is especially pertinent, considering the rapid increase in trade that has been observed over the past five years, and the potential for this trade to transmit bacterial species to regions where they may not be present. The study also has important health implications, as those pangolins that are lucky enough to be rescued from the trade, often spend time in a rehabilitation centre prior to release. Knowing what diseases they may carry will assist rehabilitators to take the necessary precautions to protect themselves, the pangolins and other animals in the centre.

Further research is being undertaken by **Christine Steyn** of the **Faculty of Veterinary Science** who is describing the anatomy of the front limb of the pangolin. This will enable researchers to compare the musculature of pangolins to those of species that are closely related but with a vastly different diet, and those that are distantly related but with a similar diet, to see how both phylogeny and niche drive body functionality. Additional projects being undertaken in association with their collaborators are quantifying the illegal pangolin trade, investigating the cultural uses of pangolins in Africa, and investigating the genetic diversity both within and between the African pangolin species.

Darren Pietersen

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Trees and, in particular, the health of planted forests, define much of the research profiled under this theme. There has been a dramatic reduction in trees due to environmental change and disease, with an estimated 15 billion trees lost globally in a year. One focus is on the impact of tree-infecting fungal pathogens and insect pests, and the need for a global strategy that would involve greater and more effective understanding, surveillance and control of key pests. At the same time, wood from plantations is a renewable feedstock for bioproducts and for several forms of bioenergy. Understanding the genetic makeup of wood, and how wood forms, are therefore research foci of great relevance. Research profiled also includes a focus on rural livelihoods and forest ecosystems, and on food security. Moving away from trees, the final focus is on bulk and nano-carbon materials and technologies research to meet future energy demands.

Cross-section of a tree, showing growth rings

Planted forest health

What would we do without fungi? This is not a question that is often asked by members of the public but is one that is much more important than most people realise.

Professor Brenda Wingfield writes that we would not be here without fungi: apart from being an essential source of antibiotics, they are the world's most important decomposers and nutrient cyclers. We also depend on fungi for our 'daily bread' that would not rise without them and, for those who enjoy the occasional 'tipple' or who frequent pubs, life would be much less jolly without the fungal fermentation that results in most alcoholic beverages.

In addition to their many other crucial roles in our lives, fungi are the world's most important causal agents of plant disease – in fact, the majority of the most devastating diseases of plants are caused by fungi. Importantly, these problems are increasing in number and impact globally, and are now seriously threatening world food security.

Fungi that cause plant diseases are mostly microscopic, yet the diseases that these 'pathogens' cause are much more obvious. Perhaps the most famous plant disease is late blight of potatoes that gave rise to the Irish Potato Famine, resulting in the death of more than 1 million people and a huge migration of Irish people to America (and other

parts of the world) in the mid-1800s. Trees are particularly susceptible to fungal plant diseases. The best example in the Southern Hemisphere involves a species of *Phytophthora* (not strictly a fungus but studied by people who work with fungi and who investigate tree diseases), which causes a root disease that has devastated natural woody ecosystems in Australia and is now also causing substantial damage to native trees and shrubs in South Africa.

The impact of tree-infecting fungi in natural forests and woody ecosystems is huge.

What is the solution to the terrible threat? The most obvious step is to slow down the global spread of fungal pathogens. This is no trivial matter and it is fraught with many logistical problems. The movement of people and products is the major route by which fungal pathogens have moved globally, an increasing trend. It is not possible to stop this movement of people and products as this is closely linked to the world economy. Some countries such as Australia and New Zealand have excellent quarantine mechanisms but they are relatively unique, partially in that they are islands and able more easily to control the movement of people and products into their countries. From a South African perspective, we know from human migration that our borders are incredibly porous. Thus any fungus that arrives somewhere on the continent is probably going to get to us sooner or later.

Identifying the pathways of movement of pathogens is, therefore, thought to be more effective than attempting to produce lists of fungi to be identified at borders. And our ability to identify potential threats is compromised by the fact that while there are some pathogens that we know are highly threatening, there are many that have yet to be described. Even for those that have been described, we do not know whether they really pose a threat outside their native ranges. As a result, we need considerably more research on plant diseases and the fungi that cause them: ultimately, we might be able to provide some solutions. What needs to be understood, however, is that we are literally involved in a host-pathogen 'arms race'. Our only security is in doing research to understand the threats and to contain them.

By studying fungi, and especially those that are pathogenic, we learn about how they grow, what they do, and how we can control them. It is only through studying these pathogens that we can create a body of knowledge that is essentially an insurance policy for the future. In some ways it is a voyage into the unknown – a voyage of discovery.

SA Research Chair in Fungal Genomics

Professor Brenda Wingfield, **Department of Genetics** and the **Forestry and Agricultural Biotechnology Institute** (FABI), holds the DST-NRF SARChI Chair in Fungal Genomics in the Faculty of Natural and Agricultural Sciences at UP. Her research over the past 20 years has focused on the global movement and evolution of fungal pathogens, particularly those that cause tree disease. She is widely recognised as a world leader in her field. She was instrumental in developing the first DNA-based phylogenies for a number of important tree pathogens, and molecular tools to study the population diversity, origins and movements of several tree pathogens. She also led the team that sequenced the first fungal genome in Africa.

The focus of the Chair in Fungal Genomics will be on the application of genome technologies to understand and exploit resources available in the genomes of economically important fungi for industrial purposes, and to resolve problems that arise from the negative aspects of these microorganisms.

In 2015 Professor Wingfield received the Christiaan Hendrik Persoon Medal for her outstanding contributions to plant pathology, the highest award the Southern African Society for Plant Pathology (SASPP) can make to a member.

Mitigating the impact of pests on forests needs a global strategy

There are an estimated three trillion trees in the world. This is 46% less than before the development of agriculture and the expansion of human civilisation over the past 12 000 years. The world loses about 15 billion trees a year.

Professor Mike Wingfield

In 2015 **Professor Mike Wingfield** published a review article in the journal *Science* with co-authors in the Forestry and Agricultural Biotechnology Institute (FABI) – **Professors Brenda Wingfield** and **Bernard Slippers**, and **Dr Eckehard Brockerhoff**, the principal scientist at Scion in New Zealand.*

The authors propose a global strategy that would include several critical actions and focus on an integrated approach to the understanding, surveillance and control of key pests, rather than focussing on single-country strategies.

Why is such a wide-ranging global strategy necessary? Forests and woodland ecosystems worldwide are under threat from insect pests and fungal pathogens (or simply pests), despite the best biosecurity efforts. The article describes that the most rapidly changing of these threats is as a result of anthropogenic influences that directly and indirectly impact on the distribution and patterns of interaction between trees and pests. Without a concerted global effort to understand and control invasive pests, the rising trend in their emergence is expected to continue, threatening the sustainability of forests and forestry.

Planted forests are particularly vulnerable to invasive organisms as they are typically of a single and non-native species. They cover vast areas – currently 7% of global forests – and have become part of the natural resource. An analogy is made with agricultural crops as planted forests now support major industries.

At FABI there are several programmes that address the problem of insect pests and fungal pathogens from different dimensions. This includes research undertaken by several research groups, as well as: The Chair in Forest Genomics and Biotechnology; The Centre of Excellence in Tree Health Biotechnology; The Tree Protection Cooperative Programme; Eucalyptus and Pine Pathogen Interactions.

The Tree Protection Cooperative Programme and the Centre of Excellence in Tree Health Biotechnology have focused on the ecology and evolution of insects and microorganisms that affect tree health, and on the development of tools to mitigate their impact.

*MJ Wingfield, EG Brockerhoff, BD Wingfield, B Slippers (August 20, 2015). Planted forest health: The need for a global strategy, Science. 349 (6250), 832-836.

FABI's pine tree pest biocontrol

Sirex noctilio is a wasp of European origin that poses one of the biggest threats to the multi-billion dollar pine plantation industry in many parts of the world. Research and management of this wasp by researchers in the Forestry and Agricultural Biotechnology Institute (FABI) are prime examples of the power of global collaboration, as well as local academia-industry-government partnerships to manage forest pests.

The wasp and its obligate associate, a mutualistic fungus, was accidentally introduced in New Zealand around 1900 and has since steadily made its way to all continents where pine trees are grown commercially. Unlike in its native range, the wasp kills pine trees within months after attack and has consequently become one of the biggest threats to these pine plantations globally.

Professor Bernard Slippers in **FABI** writes that one of the reasons the wasp has become so deadly outside its native range is because it has no natural enemies in areas where it has been introduced. An important method of control of the wasp is therefore to introduce its natural enemies; a process called biological control. Most prominent is a microsopic worm or nematode called *Deladenus siricidicola*. The nematodes infect wasp larvae and eventually sterilise the developing adult female wasps. The associated fungus is essential for both the development of the wasp larvae and the nematodes that feed and breed on it before infecting the wasp larvae.

The efficiency of the nematode at controlling the wasps' populations is dependent on variable characteristics of the environment, nematode, fungus, wasp and pine trees in which the larvae develop. For this reason, researchers at FABI study all the links in this complex food chain to support the development of a locally effective management programme, together with collaborators from Australia, Japan, New Zealand and various countries in Europe, North and South America.

An important step in this process has been the sequencing of each organism's genome by FABI researchers. These data now provide a blueprint to study various aspects of the life history of these organisms. An understanding of genetics also allows the researchers to develop tools to select the best nematode for the job, to create global maps of the natural distribution of different variants of nematodes, wasps and trees, and to investigate new potential methods of biocontrol, such as creating sterile male wasps.

FABI has close linkages with government and industry through the Tree Protection Cooperative Programme and a national Sirex Control Programme. It is a model partnership between business, policy-makers and scientists. FABI, as a global front-runner in holistic tree health research, recently called on world leaders to tackle similar problems on a global scale through international collaborations and multidisciplinary research.

Sirex wasp female ovipositing

Insects as key constraints to *Eucalyptus* forestry in Africa

Plantation forests provide the basis for one of the most effective employment and empowerment industries in rural areas.

In Africa, the use of productive tree species such as *Eucalyptus* is increasing rapidly in order to bridge the gap between demand and supply of wood. In addition to providing building materials, fuel-wood, poles and farm timber, monetary income from *Eucalyptus* has helped in buffering financial crisis for many poor farmers.

The important socio-economic contribution of *Eucalyptus* plantation forestry in Africa is challenged by disease and insect pests of these trees. This is mostly due to accidental introductions of insect pests and diseases from the native range of *Eucalyptus* to its new environment, and in some cases due to host expansions of pathogens and insects native to areas where *Eucalyptus* is planted as exotic species.

Dr Brett Hurley and colleagues, including **Professors Bernard Slippers** and **Michael Wingfield** at the **Tree Protection Cooperative Programme (TPCP)** in the Forestry and Agricultural Biotechnology Institute (FABI), are developing a regional management strategy to manage these insect pests, using a combination of approaches and tools. In 2015, substantial progress was made in developing molecular tools to accurately identify pest species. Molecular tools are often needed to confirm identifications of insects, especially when collecting the immature stages, but also to distinguish between cryptic species or different genotypes of the same species, which can differ in their virulence, host associations and response to management strategies. Comparing the genetic diversity within and between insect populations can also assist to infer patterns of spread and thus identify potential source areas of introduction.

Biological control is considered one of the most effective and feasible responses to insect invasions and consequently the TPCP has developed much capacity in this area over the years, including the establishment of the **FABI Biocontrol Centre**, consisting of advanced facilities and equipment and highly skilled staff. Research has focused on the development and optimisation of biocontrol agents, and has resulted in the release of agents for all the current major invasive insect pests of *Eucalyptus* in Africa. Most of the releases have been in South Africa, but collaborations with other African countries have been growing.

Going forward, Dr Hurley will be leading a workshop to develop capacity in biological control in sub-Saharan Africa. The workshop will include members from various African countries, with participants being supported to attend by the United Nations Food and Agricultural Organisation (FAO), the Tobacco Research Board of Zimbabwe, the tobacco industry in Malawi, and relevant government departments.

Unravelling *Eucalyptus* genome biology

Wood from fast-growing *Eucalyptus* (commonly known as 'gum') tree plantations is a renewable feedstock for bioproducts such as timber, cellulose, paper, textiles, food additives, pharmaceuticals and various forms of bioenergy. These are renewable alternatives for petroleum-based products and constitute one of the cornerstones of the global bioeconomy.

In a major study funded by the US Department of Energy, researchers from the University of Pretoria, together with an international consortium of scientists from over 30 institutions, decoded the 640 million base-pair genome sequence of the eucalypt species, *E. grandis*. The main findings of the study were reported in the prestigious journal *Nature* in 2014*. Following that, the detailed findings on the biology and evolution of *Eucalyptus* encoded in the genome sequence were published in 2015 in a special issue of the journal *New Phytologist*.

With support from the lead investigator of the project, **Professor Zander Myburg** in the **Department of Genetics** and the **Forestry and Agricultural Biotechnology Institute** (FABI), emerging young researchers **Drs Eshchar Mizrachi** and **Steven Hussey** at UP made major contributions to the companion studies unravelling the eucalypt genome and co-authored several articles in the special issue covering diverse topics such as comparative genomics, carbon allocation, protein evolution and woody biomass production in *Eucalyptus* trees. This set of papers represents a significant advance in the understanding of the biology of the most widely planted hardwood fibre crop in the world and illustrates the value of supporting young science leaders in frontier research fields at UP.

Professor Zander Myburg

*Myburg, ZA. et al (2014). The genome of *Eucalyptus grandis*, Nature, 510, 356-362, doi:10.1038/nature13308.

Understanding how wood forms

Wood is a renewable material that is finding new identity and value in biomaterials, chemical precursors and energy-related products. Understanding the biology of how wood forms is therefore of paramount interest for an innovative and green bioeconomy.

Although traditional uses of wood, such as timber for furniture and especially pulp and paper, make up an important part of the South African economy and job market, new avenues for the use of woody biomass are resulting in significant investment internationally. In addition to value from forestry, much of the research on how wood forms can be applied to other biomass-producing crops, including waste products from food crops such as maize or sugarcane.

The synthesis of wood involves a series of developmental processes that are meticulously coordinated in the genome of the particular tree. Within each of millions of individual living fibre cells, several thousand proteins and small molecules import the necessary carbon in the form of sugars and convert it into polysaccharides such as cellulose and hemicellulose, while some sugars are converted to aromatic molecules which polymerise to form lignin.

Dr Eshchar Mizrachi (middle) and his research team (from left): Desre Pinard (PhD student), Riaan Swanepoel (MSc student), Daniel Harty (BSc honours), Mark Maistry (Postdoctoral fellow), Jonathan Botha, Drew Behrens, and Elodie Ekoka (PhD student). Danielle Roodt (PhD student), is not in the photograph.

Dr Eshchar Mizrachi's group models the formation of wood, from the determination of cell identities to their development, to the allocation and processing of carbon and other small molecules inside to form these valuable biopolymers in the secondary cell walls. This is achieved by measuring and analysing different 'layers' of biology (that is, how genes are expressed, how proteins are synthesised, and how small molecules like sugars and phenolics are made). The integration of this knowledge across various tissues or states of wood formation is called systems biology – a holistic approach that provides a top-level view of the organisation of these small molecules during wood development. Since the variation in the genome of trees contributes to how genes are expressed, an exciting dimension to this research is modelling this process across related individuals in a population, referred to as systems genetics. Here, the integration of data for thousands of genes, hundreds of metabolites, and dozens of industrially important traits across several hundred trees, has led to the reconstruction of a model that shows which parts of the system have an impact on carbon availability, growth, density, and the formation of important biopolymers.

With this new insight and a rich model, the group focuses on two important aspects. Firstly, how is carbon used during wood formation and allocated to form the different biopolymers, particularly in the metabolically active organelles (compartments within the cells) such as plastids and mitochondria? Secondly, since this process is common to most land plants, how has it evolved? Which programmes are common and which genes may contribute to differences in cell wall chemistry observed in, for example, *Eucalyptus* trees, poplar trees, corn stems, sugarcane or even ferns? Testing these genes using synthetic biology can lead to new biotechnology strategies for the use of biomass.

Wood from *Eucalyptus grandis*

In addition to his research in the Department of Genetics and FABI, **Dr Mizrachi** was one of the first fellows of the Africa Science Leadership Programme (ASLP), a Global Young Academy, University of Pretoria and ***Future Africa*** initiative that brings together scientists from Africa with the aim of developing research excellence, visibility and interdisciplinarity in Africa. Following his training in the ASLP in 2015, he co-organised and was a mentor in the first Tuks Young Research Leader Programme (TYRLP) in the same year, led by Professor Bernard Slippers. Through ASLP he is part of a working group with other scientists from Uganda, Mauritius, Ghana and Kenya, focusing on improving uptake of online educational resources in Africa, and methods to disseminate these resources offline for areas with poor internet access. (See pages 12 and 13.)

Seizing control of woody biomass development

Genes are the blueprint of an organism but it is their precise, coordinated regulation that builds cells and tissues. The *Eucalyptus grandis* genome represents the computer code from which any gene sequence (in the tree) can be extracted.

The next great challenge in understanding wood development is to figure out how gene regulation is implemented by its operating system – the molecular machinery of trees that interprets DNA code – to initiate developmental programmes such as making wood. Hundreds of interactions within a densely 'wired' network control the genes involved in forming thickened secondary cell walls, the main component of woody biomass. By understanding these networks, we may be able to re-engineer them to manipulate the cellular structure and biochemistry of wood, thereby tailoring biomass from *Eucalyptus* trees toward specialised biomaterials applications.

Dr Steven Hussey in the **Department of Genetics** and **FABI** is research leader of a project on the genetic and epigenetic regulation of wood formation in trees. Dr Hussey's team, in collaboration with the University of Toulouse, has characterised a family of 189 proteins in the *E. grandis* genome, some of which play critical roles in secondary cell wall regulation and cold stress responses, revealing new candidate genes for the regulation of these processes. They have shown that some control the terminal developmental programmes for the formation of vessel and fibre cells, the two main cell types comprising wood. Dr Hussey's team members are currently exploring the possible roles of other *E. grandis* regulatory genes in wood formation by introducing these genes into poplar trees and studying their effects on growth and wood development in controlled greenhouse trials. The hope is that promising

Dr Steven Hussey, a Mandela Rhodes Scholar, is passionate about developing scarce skills, especially for emerging fields such as synthetic biology. In 2015, he instructed an undergraduate International Genetically Engineered Machines (iGEM) synthetic biology team, *Pretoria_UP*. They presented their Switch-coli project aimed at re-programming bacterial chemotaxis at the prestigious iGEM competition held in Boston (USA), and won a bronze medal.

gene candidates emerging from this research may be deployed in new breeding approaches to enhance the properties of woody biomass for industrial processing.

A plethora of chemical modifications to the genome and associated proteins comprise a poorly understood 'epigenetic' code that profoundly impacts on tree development and may be heritable, much like DNA. Recently, Dr Hussey published the first genome-wide maps of epigenetic markers influencing wood development. He and his co-workers have begun to unravel the effects of activative and repressive epigenetic markers on genes in the earliest stages of wood development, showing that they regulate previously unknown genes and contribute to the evolution of gene expression patterns.

Marius Laubscher (MSc student), Dr Steven Hussey (research leader), and Katrien Brown (BSc honours student)

The nexus of climate change, rural livelihoods and forest ecosystems

Climate change is an increasing reality that affects the environment as well as the livelihoods of rural communities who are reliant on land use and natural resources. It has become imperative to understand rural practices, and the links between climate change, deforestation and land degradation.

Professor Paxie W Chirwa

Professor Paxie W Chirwa is Director of the **SAFCOL Forestry Research Chair** in the Faculty of Natural and Agricultural Sciences. The scientists and postgraduate students in the Chair's group have a range of research projects in remote regions of South Africa, in the Miombo forest ecosystem covering most of the dry forest and woodlands of southern Africa, and in the Sudanian and Sahelian regions of West Africa. The research aims to understand the linkage of people to natural resource governance, resource use and interventions that will succeed in promoting sustainable forest management. This includes a focus on the drivers of land cover change and the modelling of carbon dynamics in natural woodland systems and forest plantations.

Recent research findings show that while agricultural expansion and demand for wood-fuel are identified as major drivers of deforestation, the restoration of degraded dry forests, woodlands and parklands of the Sahel through natural regeneration was the best silvicultural intervention. This is the basis for the promotion of the so-called Farmer Managed Naturally Regenerated Woodlands, with the potential for mitigating climate change. Other research evaluates the impact of participatory forest management on the livelihoods of rural communities and the effect of climate change on forest-based communities.

Researchers and postgraduate students have contributed substantially to the productivity of the SAFCO Research Chair through published work, the preparation of a technical paper for the South African Development Community secretariat on *Measuring Non-Carbon Benefits of Bio-Carbon Projects in Southern Africa*, and presentations at the World Congress held in Africa in September 2015, titled *Forests and People: Investing in a Sustainable Future*.

Food security and the genomics of disease resistance

A project involving the wide field of crop science – field trials at five locations in KwaZulu-Natal over three seasons, glasshouse trials at the UP experimental farm, and genomics experiments in the Plant Sciences Complex laboratories at UP – has generated findings on disease and disease resistance in maize that are of interest to commercial and small-holder farmers.

Professor Dave Berger of the **Department of Plant and Soil Sciences** has led a local consortium made up of PANNAR SEED Pty (Ltd), the University of KwaZulu-Natal, the Centre for Proteomics and Genomics Research (CPGR) at the University of Cape Town, and Forestry and Agricultural Biotechnology (FABI) research groups on the 'Genomics of quantitative disease resistance in African maize varieties', funded by the Technology Innovation Agency and the Genomics Research Institute at UP. Novel sources of quantitative resistance to Grey Leaf Spot (GLS) disease of maize have been identified, and a patent is currently under examination in several countries.

The power of microarray technology was harnessed to generate 4 million datapoints from a single maize population. In collaboration with Professor Zander Myburg of the Department of Genetics, groups of co-expressed genes involved in maize resistance mechanisms, and the strategies that the fungus employs to overcome susceptible maize varieties, were identified.

Professor Berger's research also focuses on the impact and diversity of maize foliar diseases. As leader of the Molecular Plant-Pathogen Interactions group in FABI, this work is conducted in collaboration with fellow researchers **Dr Irene Barnes**, **Dr Bridget**

Crampton and **Professor Terry Aveling**. The team recently completed a population genetics study of *Cercospora zeina*, the fungus that causes GLS, in three provinces of South Africa. Analysis of 350 isolates from commercial farms revealed that the pathogen shows remarkable diversity. In addition, both mating-type genes were found from isolates in all fields, indicating the potential for sexual recombination.

These results challenge a long-held hypothesis that the fungal disease results from a single entry point of the pathogen, and alert maize breeders to the need for diversified resistance breeding. Through a Department of Agriculture, Forestry and Fisheries (DAFF) grant, the team is expanding its research to small-holder maize farms in KwaZulu-Natal and the Eastern Cape, where improved maize hybrids are being tested in farmers' fields. GLS is also widespread in East Africa so a PhD student from Uganda is applying the molecular markers developed in South Africa to the problem in that country.

Professor Dave Berger was awarded the National Science and Technology Forum (NSTF)-South32 Special Theme Award in Crop Science and Food Security. The special theme award for 2015/2016 recognised contributions to crop science and food security in acknowledgement of the United Nations' declaration of 2016 as the International Year of Pulses. Pulses refer to the edible seed of legumes such as beans, lentils and chickpeas. These are highly nutritious, grow in marginal lands and enrich the soil through fixation of nitrogen from the atmosphere and are thus considered important food security crops, which the UN aims to promote.

INTERVIEW: Policies to influence demand and alleviate poverty

Dr Babatunde Abidoye is a senior lecturer in the **Department of Agricultural Economics**.

With a PhD in economics, Dr Abidoye is involved in various international development issues and global projects. He has worked with several international agencies, including the World Bank, the United Nations Development Programme (UNDP) and the European Commission, to aid understanding of how policies can be used to alleviate poverty in Africa and Asia. He provides support to various UNDP projects, including climate change adaptation projects such as the National Adaptation Plan (NAP) for least developed countries (LDCs) and the Ecosystem Based Adaptation (EBA) Project in Nepal, Peru and Uganda.

Closely linked to his focus on poverty alleviation is his research and teaching interest in using advances in econometrics and quantitative techniques to analyse problems related to economic development and welfare. Econometrics is the application of statistical and mathematical techniques in solving problems as well as in testing and demonstrating theories, for example in the food policy and commodity markets area.

Dr Abidoye looks at the role that international commodity prices and changes in technology, such as genetically modified crops in South Africa, play in influencing domestic prices. In the area of environmental economics, he works towards an understanding of how farmers and government can adequately adapt to climate change by evaluating different investments and strategies proposed by farmers and government.

Indigenous plants for medicinal and cosmeceutical use

South Africa is rich in biodiversity with an estimated 25 000 indigenous plant species, some of which are already used in traditional ethno-medicinal practices to treat ailments and disease.

Professor Lall and her fellow researchers follow two approaches in selecting plants: through ethno-botanical selection or phytochemistry. In the ethno-botanical approach, plants used by communities and traditional healers are tested to see if they have medicinal value, while the phytochemistry approach involves the use of existing knowledge about the chemical substances found in specific plants. If a plant is rich in a specific chemical compound that could be of medicinal or cosmeceutical use, it is isolated and trials are run to determine its usability.

The medicinal plant *Ceratonia siliqua*, commonly known as the carob tree or St John's bread, is now being used in one of South Africa's top organic skin-care ranges, Kalahari. Professor Lall has also uncovered a number of other plants that could be used for the effective treatment of skin conditions, ranging from pigmentation abnormalities and wrinkles to acne. Bioprospecting permits have been granted for three types of plants: *Greyia radlkoferi* (for use in skin tone application), *Greyia flanaganii* (for use in sun protection lotions), and *Leucosidea sericea* (as an acne application) – with three more applications in the pipeline.

A distinctive feature of the research undertaken is the technology transfer between knowledge holders and the researchers in terms of sustainable practices, specifically related to the planting and harvesting of medicinal plants. As a result of the research undertaken, and as part of a flagship project of the Department of Science and Technology (DST), Professor Lall and fellow researchers, including postgraduate students, are currently involved in a project in the district of Mamelodi, Tshwane, in helping farmers cultivate plants that can be used for medicinal purposes. The goal is to establish a community-run extraction facility for the supply of natural botanical ingredients.

SA Research Chair in Indigenous Knowledge Systems

Namrita Lall, Professor in the **Department of Plant Science** at UP, was awarded the DST-NRF SARChI Chair in Indigenous Knowledge Systems in 2015. Professor Lall is a medicinal plant scientist and has received several awards for her scientific contributions to advancing science and building the knowledge base in the field of indigenous knowledge systems. In 2014, she received the Order of Mapungubwe Presidential Award for her outstanding contribution to medical sciences. The aim of the SARChI Chair is to combine indigenous knowledge and medicinal practices with scientific evidence and sustainable practices in the harvesting and use of this rich resource in biodiversity.

INTERVIEW: Local raw materials help solve South Africa's energy situation

Dr Hein Badenhorst, senior lecturer in the **Department of Chemical Engineering**, leads the Bulk Carbon Materials Research Group that forms part of the DST-NRF SARChI Chair in Carbon Technology and Materials. This platform is currently being used for research into different aspects of concentrated solar energy.

In 2015, Dr Badenhorst's team won third place in the Innovation Hub's Gauteng Accelerator Programme, or GAP Green competition, for their novel solar concentrator design, which uses off-the-shelf components to reach radiation levels of up to 1 500 suns.

Dr Badenhorst explains that their work is aimed at bringing down the cost of solar energy plants due to the strong focus on local input and content. "Past experience," he says, "has shown that importing overseas technology and hoping it will survive in local conditions is a mistake. We look at using locally available raw materials and tailoring solutions to the South and southern African context. We believe this is the only way to ensure longevity of any solution to South Africa's energy situation."

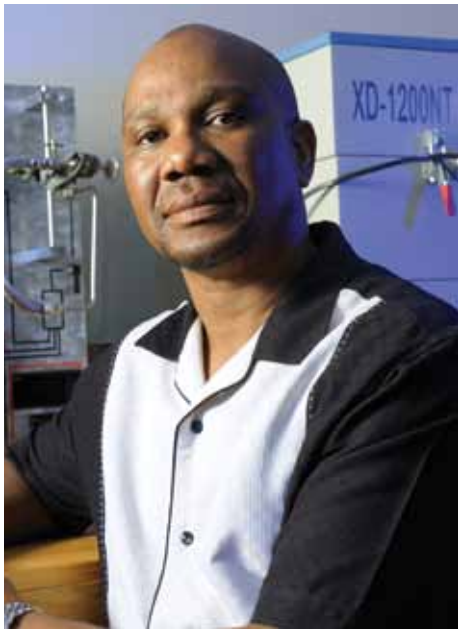
The capability and capacity of solar energy generation companies to store, transmit and distribute captured solar energy, and carbon footprint reduction, are core to the group's work. Thermal storage offers several advantages such as using industrial waste energy in new and efficient ways. The team is looking at innovative techniques to incorporate waste material, in this case recycled rubber tyres, into affordable means of harvesting solar energy.

The team has also designed several applications such as a flash-based desalination technique to recover potable water from seawater and from contaminated or brackish sources.

In 2015 two publications by members of the research group stood out. The first, published in the highly acclaimed international journal, *Carbon*, featured contributions from two young postgraduate students. The second is a publication in the international journal, *Solar Energy*, and featured a novel process for recovering energy from phase change materials, using the high-energy density of latent heat. The concept was developed through the National Research Foundation's Blue Skies funding and Dr Badenhorst hopes that it will develop into a fully-fledged, long-term project.

Carbon materials for renewable energy

The SARChI Chair in Carbon Technology and Materials involves both bulk and nano-carbon materials research and engineering technologies to meet future energy demands and reduce South Africa's carbon footprint.



Professor Ncholu Manyala is the research leader of the Nano-carbon Materials Research Group

Professor Ncholu Manyala holds the Research Chair and is also the research leader of the **Carbon Based Nano-Materials Research Group** at the University of Pretoria. The main focus of Professor Manyala's group is on the use of carbon nano-materials for renewable energy, in particular the application of graphene-based materials in converting solar energy to electricity, and storing it using graphene-based supercapacitors.

The group works on various forms of carbon materials including two- and three-dimensional, nanostructured electrode materials for the next generation of supercapacitor electrodes. The most commonly used material in the laboratory is graphene, a one atom thick material, with the focus on the chemical vapour deposition growth of the material as well as its characterisation, chemical functionality and applications in areas such as energy storage.

The main engineering technology focus is on supercapacitors; that is, electrochemical energy storage devices with different characteristics to those of conventional batteries. While the energy density of supercapacitors is much smaller than that of batteries, the power density can be orders of magnitude higher because they can be charged and discharged rapidly.

Biomass pyrolysis using concentrated sunlight

5 Identity

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The theme profiles three books at the start that capture views and histories 'from the margins' and in several ways frame what follows: the first, elucidating the biographer's craft – and the alchemy of the book; the second, reconstructing culture and politics in dissident intellectual traditions; and the third, an edited collection of black Afrikaans writers. The dominant theme of text, story and identity continues throughout and illustrates how text inscribes identity, and ways of understanding identities. At the intersection of 'space and time' there are the issues of state identity, identities and the politics of space, identity and Africanness. Returning to silent or marginalised identities, the theme concludes with a brief interview text on African refugees – i.e. 'people on the move'.

Close-up of a chameleon's tail

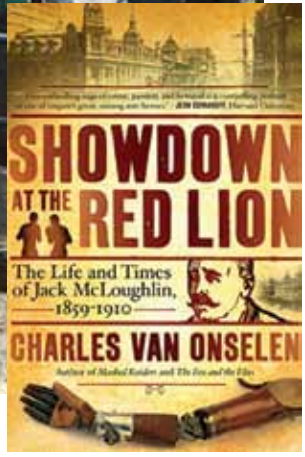
Biographers' craft and the alchemy of the book

Biographers are a strange breed practising a weird, necromantic craft. They shuffle constantly between the dead and the living, lurking in the burial grounds of those long gone, retrieving as much as they possibly can about their subjects from archives, books and graveyards – Charles van Onselen.

Professor van Onselen writes that with minds stuffed with facts and dates, biographers then scurry off to their laboratory-studies where they use the historical imagination, ink and paper to place the dead back in the context of lives lived in times long forgotten. They do this because they know that the alchemy of the book will enable souls seemingly gone to reach out from beyond the confines of the printed page to fascinate, educate and inform the literate about worlds lost. History allows readers settled within the comfort of their favoured retreats to time-travel into dangerous, distant or forbidding places they would otherwise never visit. It is a kind of magic that allows authors to penetrate the consciousness of the living through the dead.

The remains of Jack McLoughlin's skeleton, minus an arm and with the neck broken, now lies lost beneath an unmarked grave in Pretoria's Rebecca Street Cemetery. The Manchester-born Irishman's arm was shattered and then amputated after a failed attempt at escaping from prison in Potchefstroom, in 1890. Dogs roam across the grave, plastic bottles bedeck it and vagrants urinate around there. It was where, back in 1910, the state rid itself of the bodies of those who it had hanged by the neck until they were dead. Nobody loved him then, nobody cares for him now – unless you choose to read about him.

Rebecca Street Cemetery in the City of Tshwane, the site of Jack McLoughlin's unmarked grave



If you want to breathe life into what is left of the man's memory and restore some of his dignity in death, you need first to visit the national archives, that graveyard in-the-making of what should be our well-preserved document-based history, and retrieve the 1909 record of his trial for murder. From the record it is clear that, in the 15 years between the moment that he shot George Stevenson behind the Red Lion in Johannesburg, in 1895, and the day that he was executed in 1910 – and indeed long before that – the condemned man had led an extraordinary life. In an era dominated by ideologies of hyper-masculinity replete with oath-bound notions of honour he had, by his own lights, attempted to retain both his independence and sense of self-worth in countries around the Indian Ocean rim – in Australia, India, New Zealand and southern Africa. It is important because, how can one comprehend fully the struggle for female equality and women's rights in the late 20th and early 21st century unless one understands the codes of masculinity that accompanied the ravages of colonialism and imperialism? *Showdown* is the story of one such man's struggle for life as the state reached across an ocean to try and snuff out his existence in those times.

The delight of biography, properly done, lies in its unparalleled ability to conjure up lives in eras past so as better to understand the deepest sources of the complexities, contradictions, ironies and paradoxes that beset the modern world. Social historical research is rewarding because it provides curious, literate men and women with the opportunity to position themselves more intelligently for the journeys that lie ahead. You only know where exactly it is that you are bound for once you understand where you are – and you can only know that once you appreciate fully the path already travelled.

Professor Charles van Onselen

Charles van Onselen, Research Professor at the **Centre for the Advancement of Scholarship**, is an A-rated scientist and author of articles in leading international journals, and several books on southern African history.

His latest book, *Showdown at the Red Lion: The Life and Times of Jack McLoughlin, 1859-1910* (Jonathan Ball, 2015), formed the basis of an expert lecture delivered at UP: 'Sunny Places for Shady Characters – The Making of Working Class Cultures in Southern Africa's Mining Revolution, c.1886-1914'.

In his lecture he elaborated on South Africa's industrial revolution occurring in a Calvinist-dominated and labour-repressive state linked via a strategic corridor to a Catholic regime in Mozambique that was markedly less morally repressive. Third parties used these disparities in state power to exploit the legitimate or illegitimate demand for certain products or services for private or public financial gain. He suggests that the resulting patterns of social control and collective working class behaviour are best understood as liminal phenomena operating from within this Calvinist-Catholic nexus. By tracing the historical links between Johannesburg and Lourenço Marques, the rise and decline of the trade in alcohol and opium, or the provision of outlets for gambling and prostitution, his lecture (and book) illuminate the dark underside of southern Africa's industrial revolution in new ways.

Culture and politics in dissident intellectual traditions

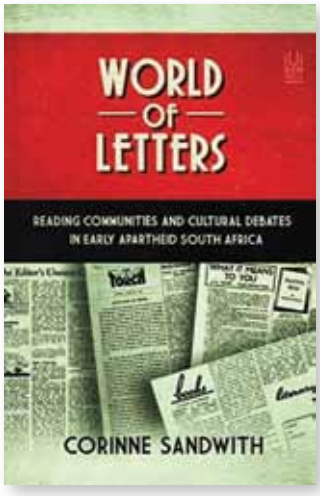
A rich history of public debate about literature and culture in South Africa is to be found in the dissident intellectual traditions of periodical reviews, 'little magazines', oppositional newspapers, debating societies and theatre groups.

Professor Corinne Sandwith

In reconstructing a fragmented history, **Corinne Sandwith's** book *World of Letters: Reading Communities and Cultural Debates in Early Apartheid South Africa* (2015) makes an important contribution to the understanding of South African social and intellectual history in the early twentieth century. She is Professor in the **Department of English** at UP and in 2015/2016 received the Vice-Chancellor's Book Award for *World of Letters*.

The study retrieves a hidden or neglected history of public intellectual engagement from the margins, thus moving away from a conventional emphasis on high culture and elite intellectual activity. In this reframed perspective, new voices and positions emerge – such as early Marxist critic Dora Taylor writing in *Trek* magazine, Es'kia Mphahlele writing in the guise of his alter ego 'Rabelais' in *The Voice of Africa* and Ben Kies' dissident polemics in the *New Era Fellowship*. Her fine-grained and richly detailed analysis traces an important but little known intellectual and political genealogy, thus providing us with both a more nuanced and a more accurate sense of our intellectual present. It also restores a vibrant parallel stream of dissident engagement in early apartheid South Africa to its rightful position in South African social and intellectual history.

A major insight of the study is the extent to which, in South African letters, culture and politics are intertwined and entangled. More specifically, what is powerfully suggested are the ways in which arguments about culture became a means of making political claims – claims to full citizenship, claims to modernity and claims to a complex and creolised cultural identity. It also reveals the centrality of the modes of satire, irony and irreverence in the staging of oppositional views.



Professor Sandwith's research continues to engage with the rich South African cultural archive, this time by extending the focus to include the cultural debates and intellectual traditions to be found in examples of the mainstream and commercial black press such as *Bantu World*, *Ilanga lase Natal* and *Umteteli wa Bantu*. The research gathers insights into black reading cultures and the world of the book in African intellectual life in early twentieth-century South Africa.

The hidden histories of Afrikaans

Afrikaans is an African language. It is a southern African language. It is a creole language. Today six in ten Afrikaans speakers are estimated to be black. Although Afrikaans is spoken across all social indices, by the poor and the rich, by rural and urban people, by the undereducated and the educated, the majority of Afrikaans speakers are poor, marginalised and black people. 'Black' in the generic sense of the word. It is something we often forget.

Professor Hein Willemse of the **Department of Afrikaans** in the Humanities at UP opened a recent paper on the hidden histories of Afrikaans with these words. He has been researching literature and culture among black Afrikaans speakers for close on 40 years – unknown texts, written about marginalised black Afrikaans writers, and doing oral culture fieldwork among the Afrikaans poor of Namakwaland and Namibia.

He writes that one of the undoubted successes of Afrikaner Christian nationalist hegemony was the creation of the myth that the nationalists, and only they, spoke for those identified as 'Afrikaners', and that their worldview was the only significant expression of being Afrikaans-speaking. In all of this, language historians, nationalist politicians, the media and school curricula have chosen to tell one story. It was this story that non-Afrikaans speakers – individuals, communities and institutions outside the Afrikaans speech community – have accepted as the only story. Afrikaans became indelibly identified with Afrikaner nationalism.

Not only did nationalist functionaries and culture brokers suppress oppositional and alternative thought within the Afrikaner community, they also minimised the role and place of black Afrikaans speakers in the broader speech community.

In the late 1970s academics – and black Afrikaans-speaking academics especially – understood that a different story needed to be told. At the very least, one that tells of a more encompassing history, a history that explored the life and culture of those marginalised.

Along with colleagues at the University of the Western Cape, Professor Willemse had organised and participated in the Black Afrikaans Writers' Symposium and over the years they have published three volumes of collected papers: *Swart Afrikaanse skrywers* (1986), *Die reis na Paternoster* (1997) and most recently *'n Vlag aan die tong* (2015). The latest collection brings together the voices of a variety of writers and the peer-reviewed papers of literary scholars on significant black Afrikaans writers.

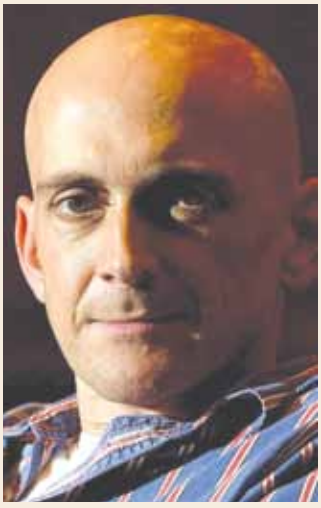
Professor Hein Willemse

In 2007 Willemse published a book on selected black Afrikaans writers, called *Aan die anderkant. Swart Afrikaanse skrywers in die Afrikaanse letterkunde*. In 2011, he and a colleague at the University of KwaZulu-Natal, Suleman E Dangor, edited Achmat Davids' book *The Afrikaans of the Cape Muslims*, which deals with the rich history of the people who were among the first to write their religious texts in Cape Dutch and named their language 'Afrikaa'.

On the impact of these texts and his writings on the development of knowledge of the 'hidden histories' of Afrikaans, Willemse says that primary research takes time, and that will take time to filter through to the broader public. His colleagues in the Department of Afrikaans at UP have done research on black Afrikaans communities around Pretoria and parts of northern Limpopo in the 1980s and that research has now found its way into the specialist literature.

Recently, Professor Willemse delivered the keynote address at the unveiling of a bust of the writer Arthur Fula at the National Afrikaans Literature Research Centre in Bloemfontein. Fula, whose mother tongue was Sesotho, wrote his Afrikaans language novels in the 1950s. "This recognition of Fula comes late but at least it tells us that there is a wider understanding of the multiplicity of stories and voices and a recognition of the diversity of people who speak, live and write Afrikaans. However, the greatest challenge remains the persistence of the old nationalist myths on Afrikaans. Quite often those myths speak of ignorance and today people keep them alive for their own political ends."

INTERVIEW: Music, a universal language



Professor Alexander Johnson, Head of the **Department of Music** in the Humanities, has published more than 50 compositions to date that have been performed and broadcast all over the world – in the UK, USA, France, Corsica, Serbia, Croatia, Russia, Canada, Germany, the Netherlands, Italy, Switzerland, China, Poland, Trinidad, Tobago, Portugal, and in South Africa.

His areas of research are composition and orchestration, music theory and music analysis.

Professor Johnson's 2015 composition, *Afro Dizzy*, for Soprano and Alto Saxophone, Piano, String Quintet and Drumkit – commissioned by the SAMRO Foundation – has been performed by Karendra Devroop and Matthew Lombardt, and the Evolution String Quartet, and broadcast live by Classic FM (South Africa). His *Twee Al Galidi Liederen, Mijn bestaan* and *Vredesbespreking van het hart van Zorro met de rust*, were performed by Hanli Stapela (soprano) and Jannie le Roux (piano) in the Musaion in March 2015. This work was commissioned by the Colloquium Neerlandistiek in collaboration with the Nederlandse Taalunie, the Ambassade van het Koninkrijk der Nederlanden and the Algemene Afvaardiging van de Vlaamse Regering.

His work, *Colour-keys for Solo Clarinet* (B-flat), was commissioned by the SAMRO Foundation for the Creative Arts for the 2014 Unisa International Flute and Clarinet Competition in Pretoria. It was performed by eight of the nine competitors, and has since been performed internationally in Kraków, Venice and Naples.

Professor Johnson's *Music for Children* has been performed in Russia, Poland, the UK and USA. His *Two Afro-disiacs for String Orchestra* was commissioned by the esteemed Zürich Camerata String Orchestra, and performed by the same orchestra in the Tonhalle and at the Hochschule für Musik, both in Zürich. His *Jazz Impromptu No 1* has been performed globally and is currently prescribed for the London Trinity College Licenciate (LTCL) examination. The Trinity College of Music in London has solicited a second piano piece from Professor Johnson for publication in their globally distributed piano examination albums. One of his works is published in the *International Journal of Contemporary Compositions*.

Professor Johnson is a founding board member of the Composers' National Collegium and the founder and director of the Stefans Grové National Composition Competition which has, as its main focus, the promotion and upliftment of the classical music arts in South Africa.

The Child and the Story

It is generally accepted that South Africa is experiencing a literacy crisis and there are numerous current initiatives seeking to address this by focusing on improving the process by which learners are taught to decode simple words and sentences.

Unlike these efforts, The Child and the Story project led by **Professor Molly Brown**, Head of the **Department of English**, does not focus primarily on how children learn to read, but rather on what it is they are given to read and how this impacts on the acquisition of reading fluency, and on the social and psychological development of young readers.

The work of the researchers affiliated to this project is informed by Maria Tatar's idea that children's literature is 'a contact zone' in which the child's developing mind can interact with and crucially select from an enormous range of possible ideas originating in adult minds. This concept becomes especially pertinent in the light of Ricoeur's complementary suggestion that the various incarnations of story deploy 'an imaginary space for thought experiments in which moral judgement operates in a hypothetical mode'.

The formative impact of interactions with such imaginary spaces has also been confirmed by recent research in neurobiology, which has demonstrated that when children read or hear of others' experiences, the firing of neurons in the brain mimic that which would occur were the child to undergo the experience herself.

Such ideas force a revaluation of various aspects of children's reading in South Africa, including the withdrawal of state subsidy for the publication of fiction in indigenous languages for older children on the grounds that they have already learned to read. Further attention also needs to be paid to the implications of the fact that most local children's book authors are white women and to the complex roles which reading fiction and listening to oral stories can and should be playing in homes, clinics and classrooms. Under the umbrella of this research theme, issues of this kind have been explored in a range of articles and are currently shaping the content of a forthcoming textbook on reading in South African classrooms.

The research affirms that children's literature merits academic scrutiny and that countries where this is neglected do not merely risk economic stagnation, but may effectively be trapping their young in imaginative straitjackets that hamper the development of both empathy and creative engagement with the world.

Professor Molly Brown

Social justice and human dignity

A just society treats all people equally and with dignity. There is no social justice in the face of inequality and poverty, and where redistributive justice is restricted by a lack of resources and opportunity for all.

Professor Antoinette Lombard

The Global Agenda for Social Work and Social Development, established in 2012, is a commitment of social work and social development educators, practitioners and international, national and local organisations throughout the world to action for a more just and inclusive society. The Global Agenda is committed to four themes that are respectively researched and promoted in cycles of two years per theme.

Representing the social work educators in the capacity as Chair of the Global Agenda for the International Association for Schools of Social Work, and coordinator of the Global Agenda in Africa, **Professor Antoinette Lombard** of the **Department of Social Work and Criminology** at UP leads the research on these themes. In its third year of implementation, 2015, the focus was on the theme: *Promoting human dignity and worth of all peoples.*

The resilience that people show despite their adversities make them critical partners in finding innovative social and economic models. Research findings indicate that central to ensuring that people would want to participate in social change efforts is that they first and foremost must experience being valued. It is important, therefore, that through the lens of human dignity, people and groups who are vulnerable are not viewed as powerless victims, but rights holders with strengths, voice and agency.

Serving a broader social justice agenda, forums for open dialogue among educators, practitioners and students on themes related to human dignity are critical to identifying areas for joint advocacy and awareness raising. No resources or time limits are required to show respect – it is in the moment, in the opportunity, and it is either immediately experienced or a missed chance.

The Africa region's themed reports are included in the Global Agenda Report, which is released bi-annually at the joint World Conference on Social Work, Education and Social Development. The Global Agenda's next theme for research towards a just and inclusive society is: *Promoting environmental and community sustainability.*

Liezl Rees

The ritual expression of anger

South Africa is raging. All over the country there are signs of public anger, also at our universities. While this is a South African reality at present, the expression and public outpouring of anger is also rife in countries like the United States.

Professor Cas Wepener in the **Department of Practical Theology** has done research on the theme of ritual and religion, and justice and reconciliation in the South African context for more than a decade and sees these expressions of anger and rage as part of the ongoing journey towards national reconciliation.

In his research, both theological and cultural anthropological notions are combined with extensive qualitative ethnographic research in order better to understand the actual performed ritual expressions in their multiple contexts. It is clear that South Africa is in a different phase now, as a country, from where it was in 1994, during the Truth and Reconciliation Commission hearings, or even just as recently as five years ago.

With this unique new context in mind, Professor Wepener published in 2015 an article on anger in the South African context, entitled 'Bliksem!' / Damn it!: ritual-liturgical appreciation of a deadly sin' and a book in both English and Afrikaans, entitled *Boiling point! A faithful reaction of a disillusioned nation*. Wepener argues that however dangerous these expressions of anger potentially are, they are also signs that as a nation we care. As a practical theologian he explores creative ways in which faith communities can embrace anger as an emotion and thereby assist on the road towards reconciliation.

He is currently working on an edited volume with three international scholars on the theme of religious rituals and social capital in poor communities in South Africa, entitled *Bread and Wine and Kentucky Fried Chicken. A ritual lens on social capital formation in South Africa*. In November 2015 he delivered his inaugural lecture as Professor and Head of Department, entitled "The Department of Faith Practices at the University of Pretoria. A Spacious House Accommodating a Postcolonial African Pneumapraxis where an Academic Spirituality of Liminality is fostered".

He has received a visiting scholarship to Princeton University where he will continue his research on the ritual expression of anger.

Student protests during #FeesMustFall

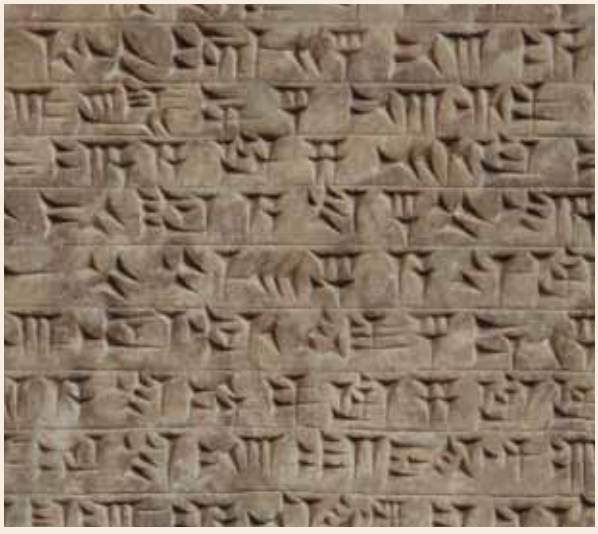
Professor Cas Wepener

INTERVIEW: The reception of biblical texts in late antiquity

Dr Ronald van der Bergh in the **Department of Ancient Languages and Cultures** is an acclaimed expert in ancient Mediterranean scripts. He received a Y1 rating from the National Research Foundation in 2015 and is currently the co-chair of the steering committee of the Working with Biblical Manuscripts (Textual Criticism) Programme Unit of the International Meeting of the Society of Biblical Literature.

Dr Van der Bergh's research interest is in textual criticism of the New Testament, narratology (the study of narrative and narrative structure), and the writings of the early church. His research focuses on how scribal practices influenced the transmission of ancient Mediterranean texts, especially the use and reuse of texts from the Hebrew Bible in the New Testament, with a narrower focus on the Acts of the Apostles. An intersecting point of his research interests is the study of the reception of biblical texts as they are found in the New Testament manuscripts. These manuscripts provide physical evidence of how biblical texts were received in late antiquity. The investigation of scribal practices includes analyses of manuscripts, specifically how the narratives contained in these manuscripts were interpreted and read by the scribes who produced them. The way in which these narratives were read can be seen in the physical attributes of the manuscripts, for example in the paragraph divisions or notes in margins.

The subject of his doctorate was the textual tradition of Old Testament quotations in the Acts of the Apostles in a specific New Testament manuscript, *Codex Bezae Cantabrigiensis*. His article on explicit quotations of Isaiah in the Acts of the Apostles as they are found in this manuscript was published in *Novum Testamentum* in 2015, an international quarterly for New Testament and related studies published by Brill in the Netherlands. The article investigates the textual history of the quotations and the degree of 'Old Testament awareness' shown in these quotations. He defines the concept of 'Old Testament awareness' as the degree to which a New Testament tradition, at any stage of its transmission history, is aware of a quotation stemming from the Old Testament.



Southern African rock art studies

Since the 1700s, southern African rock art studies have attracted immense local and international interest. Several studies have attempted to provide insight into the meaning of what is portrayed in rock art, as well as the authorship of this significant heritage resource.

Dr Ndukuyakhe Ndlovu in the **Department of Anthropology and Archaeology** has spent most of his research career studying rock art and, in particular, variations in the portrayal of animals at different geographic locations. His interest is also in the analysis of the cosmological models that have defined rock art studies, especially in recent decades, and the link between rock art and the environmental conditions prevailing at the time.

Dr Ndlovu's research has identified a particular challenge in southern African rock art studies, whereby understanding derived from very few geographical locations and a limited number of animals is used to make deductions about the significance of animals in rock art in general. His research addresses this deficiency by investigating regional

In 2015 **Dr Ndlovu** received a three-year National Research Foundation grant under the African Origins Platform, which will significantly enhance the scope of current research projects through the fieldwork involved in collecting primary data and research opportunities for postgraduate students.

He has also been appointed as Editor-in-Chief of the *South African Archaeological Bulletin* (SAAB) by the Association of Southern African Professional Archaeologists (ASAPA) Council.

At UP he was one of the 2015 Inaugural TYRLP (Tuks Young Research Leader Programme) Fellows, a programme that aims to grow early career academics in the areas of thought leadership, team development, engagement and collaboration to enable them to address and contribute to solving the complex issues faced by society.

variation in the portrayal of animals and, in particular, in the patterns in animal imagery across the least studied hunter-gatherer rock art areas in southern Africa.

Researchers have studied rock art to improve their understanding of its origins and to develop insights into the people whose art they study. Dr Ndlovu has shown in his published research the importance of providing reasons for the existence of differences in the archaeological record, and thereby to transcend chronologies and mere description that has come to define the discipline.

Polychrome images of eland, considered the most spirituality significant animal in southern African rock art studies. The black colour of one eland is charcoal, probably done by boys herding livestock in the area.

Justice and reconciliation – the recovery of Ubuntu

With its focus on foregrounding traditional value systems mobilised for forms of transitional justice, the Ubuntu project at UP has concentrated on the recovery and meaning of Ubuntu, its value in promoting peace and reconciliation, as well as elevating it from a theoretical realm to a lived principle.

Professor James Ogude

Recent scholarship in Africa points to the significance of the politics of the ordinary and the fact that people in Africa often endeavour to deal with issues of alienation and trauma by turning to African spiritual and cultural rites and epistemologies. Nowhere is this more visible than in communal initiatives towards healing and reconciliation in post-conflict situations in Africa. In the wake of violent conflict that returns to riddle African states such as Rwanda, Uganda and Kenya, and at the dawn of democracy in post-apartheid South Africa, reconciliation again emerged at the centre of the agenda.

Through a series of colloquia and workshops with a team of scholars and experts from the University of Pretoria and East Africa, **Professor James Ogude** at the **Centre for the Advancement of Scholarship** led a conversation on the theme of Ubuntu and Personhood. Inserting the concept of Ubuntu within the broader intellectual debate on self and community, the project produced key contributions that demonstrate the value of Ubuntu in recovering and developing a language of reconciliation drawn from principles underpinned by Ubuntu.

One of the results of this discussion was an article by James Ogude and Unifier Dyer which grapples with the illusive search for justice and reconciliation in the aftermath of the 2007 post-election violence in Kenya. Through engagement with post-conflict narratives of affected communities, the article asks whether indigenous forms of reconciliation such as Ubuntu/Utu have a role in processes of transitional justice. Similarly, one of their research associates, Professor Dominic Dipio from Makerere University, has been doing extensive research on rituals of reconciliation in Uganda with a specialised focus on the Acoli community in Northern Uganda. The two papers were presented, alongside others, in one of the two panels that were dedicated to the theme of Ubuntu at the international conference on Literary and Cultural Studies at Makerere University in August 2015.

The article by Ogude and Dyer was presented by Professor Ogude at the 5th Intercultural Interdisciplinary Colloquium on Reconciliation and Justice held in Vienna from 20-22 May 2015 in conversation with critical reflections on parallel value systems on the continent, such as Utu. Its publication in one of the leading German philosophical journals *Polylog: Journal on Inter-cultural Philosophy*, inserts scholarship and debate on Ubuntu beyond its local confines, placing it alongside the study of other indigenous concepts used in mediating and facilitating transitional justice globally.

Ubuntu feminism – tentative reflections

A paper on the possibility of Ubuntu feminism recalls the history of a project that started in 2003 in Kayamandi, and involved a group of young black South Africans who conducted interviews rooted in five questions about the importance of Ubuntu in the new South Africa.

Professors Drucilla Cornell and **Karin van Marle** in the **Department of Jurisprudence** write about the possible contribution of the philosophy of Ubuntu feminism to contemporary debates.

Some academic writing has questioned whether Ubuntu plays a role in the daily lives of black South Africans. Yet, from conversations with this group of young black South Africans, an understanding of Ubuntu emerged as a way of thinking about our fundamental interconnectedness and as a way of living. Ubuntu was at the heart of the way in which this group and community thought people should live. Ubuntu was conceived as an African principle encapsulating what it means to be human and how all social relationships are embedded in an ethical entanglement beginning at birth.

Another critique has been the view that Ubuntu is patriarchal in the worst sense of the word, insisting on the authority of men over women. The interviews left the authors with the sense that to view Ubuntu as either conservative or fundamentally patriarchal misses its complexity and transformative potential. This was not to deny that Ubuntu has been deployed for conservative purposes.

Turning to the philosophy of Ubuntu, the authors suggest that Ubuntu can be reduced to neither ontology nor epistemology nor an ethical value system, but encompasses all three. It is a philosophy of the way in which human beings are intertwined in a world of ethical relations from birth, born into a language, kinship group, tribe, nation and family. We come into a world obligated to others, and those others are obligated to us. We are mutually obligated to support one another to become unique and singular persons. This understanding is important not only for Ubuntu's contribution to views on the state, politics and the possibility of challenging the status quo, but also for its engagement with Western feminism.

Liezl Rees

Ubuntu feminism, based on the notion of interconnectedness as a source of becoming, profoundly challenges Western feminist thinking on the self, family and community and has the potential to steer the divergent views on an ethics of justice and an ethics of care in alternative directions. What enhances the possibility of the impact of Ubuntu feminism on the present state of the world is its deep commitment to anti-racism and its contestation of neo-liberal capitalism. The authors further contemplate if and how Ubuntu could be understood in terms of spatiality and how, if understood in this way, it could provide new angles from which to think about spatial and distributive justice, and about deep systemic and structural inequalities and injustices, by bringing into focus African knowledge and experience.

State identity

The question of identity is not only pertinent to people as individuals or groups: states, too, in their foreign policies and interactions at a global level, project certain postures and play particular roles, based on their self-ascribed or ascribed identities.

Professor Maxi Schoeman

The identity claims of states are closely linked to their international status which, in turn, acts as one of the determinants of the ability to project power in the international political system of exchange. As part of the involvement of the **Department of Political Sciences** in the **UP Templeton-funded Ubuntu Project**, researchers are analysing and evaluating South Africa's foreign policy in relation to various identity claims, one of which is that of being an emerging power, aiming to promote the interests of the African continent internationally.

In an article titled, 'South Africa as an emerging power: from label to status consistency?', published in the *South African Journal of International Affairs* (2015), **Professor Maxi Schoeman** interrogates the status of South Africa as a significant emerging power. The question is whether this status – both ascribed and self-ascribed – implies a certain amount of space for South Africa to exercise influence in the global arena, and whether it is effectively used to realise foreign policy objectives. In short: is South Africa evolving into a 'power that has power'?

Her research pays specific attention to the domestic constraints on South Africa's ability and capacity to act globally. For example, a key challenge is to mobilise resources that would allow an emerging power to exercise its international duties and responsibilities. Moving up the ladder of influence requires of a state to look beyond its narrow national interest and to take on global leadership burdens. Further, domestic stability and a strong economic basis are core requirements for becoming a global player, as is so well illustrated by China's rise as a Global South power. Other resources are also critical – such as location, geography, size (also of population) and levels of education and development. But more important is the ability of a country to 'make resources operational' to ensure the credibility and viability of those instruments available to them in the process of policy implementation.

Professor Schoeman argues that domestic factors seriously constrain South Africa's efforts to act internationally as an emerging power. Sluggish economic growth, high levels of unemployment and inequality, and the crises related to factionalism within the governing party seem to inhibit the country's ability to project itself as a rising power on the international stage. In fact, these problems may increasingly force the country to turn inward and to lose its status as an emerging power.

Identity, therefore, rests not only on an ascribed or projected status, the latter encapsulated in public statements and policies: it requires access to resources and the capacity and ability to turn those resources into policy instruments in order to consolidate the state's ability to prove its international standing, and to exercise a level of influence that is credible and realistic in relation to its foreign policy values, ideals and objectives.

Identities and the politics of space

Post-colonial theory has contributed to new approaches which (re-)claim centre stage in historical processes. New discourses (re-)position those forced to the margins before. Mainly located in the critique of hitherto dominant theories, a deeper understanding of complex dynamics requires further explorations into representational practices. This includes analyses of 'othering' at the intersection of space and time.

Postcolonial scholars have laid the groundwork for insights into the notion of othering, voice and silences. Space and (local) place remain fundamental sources from which ordinary people and states draw their identity, while governments continue to use the notion of nation and national(istic) discourse in their rhetoric and policies. Space as both a construction and a practice is always tied to historicised experiences of power and systems of inclusion and exclusion. In times of shifting boundaries in a context of increasingly multiple identities, this is a contested sphere. Since place plays a key role in the shaping of ordinary people's collective experiences of identity, this leads to contestations and the rejection of others' claims of belonging to that particular space. Difference, and its construction, is intertwined with spatial politics and its meaning for identity as well as claims of ownership. Often the seemingly non-violent forms of exclusion of minorities and so-called deviants (including other forms of religious orientation) are more salient and harmful. The 'othering' of lesbian, gay, bi- and trans-sexual (LGBT) groups, ethnic and religious minorities, as well as immigrants and refugees, is a case in point.

A deeper understanding of complex social dynamics necessitates thorough scrutiny of representational practices in context. The forms of othering created and imposed in what has at times been dubbed as patriotic history or post-colonial heroic narrative is also a reference point. While new forms of power have created seemingly new discourses, they often reproduce old concepts of power. Despite appearing and claiming to be a post-colonial alternative, these narratives often reproduce similar characters and traits as those of the past, given the (at best) limited change in power relations and concepts of power and domination.

Professor Henning Melber from the **Department of Political Sciences** at UP with Professor Heidi Hudson from the Centre for Africa Studies, University of the Free State, has been the guest editor of a Special Issue of *Africa Insight* (vol. 44, no. 1) on 'African Identities and the Politics of Space and Othering'. The contributors (including **Dr Cori Wielenga** from the Department of Political Sciences) examined a range of African cases of 'othering', including a focus on 'micro-otherings', namely the violence from within, such as xenophobia, homophobia and misogyny. Articles offered comprehensive coverage of a variety of academic disciplines in their synthesis of insights pertaining to the interdisciplinary or trans-disciplinary through the eyes of power and space. This revisits debates on alterity and the African knowledge project and gives it a current feel through a holistic linking of space, power, identity and knowledge.

Professor Henning Melber

Identity and Africanness

What is Africanness (to me)? This question is central to Professor Charles Ngwena's research that seeks to develop a way of knowing and constructing contemporary 'Africannness' which is an outgrowth of his earlier work in the fields of reproductive health and disability, and in these contexts, the focus on developing theoretical frameworks for implicating and overcoming status subordination.

Map of the African continent published in 1904. (Source: Wikimedia.org)

Charles Ngwena is Professor in the **Centre for Human Rights** at UP. His work interrogates the making of Africa and the African race(s), culture(s) and sexuality(ies) in ways that are not just historically conscious but also contest nativism from the outside as well as from within. His research has relevance to the debate and polemics around what is African identity and to the construction of African citizenship in a broader philosophical sense, and contributes towards developing a conceptual framework for, and ways of, understanding inclusive Africanness.

In 1996, Thabo Mbeki's 'I am an African' speech to the South African Parliament marked an important point in the debate and polemics when he articulated an ontology of Africanness in which race was decentred. Twenty years later, Professor Ngwena's research highlights that we are never quite finished constructing our African identities *for our own selves*, or having identities constructed *for us*. His book, *What is Africanness to Me? Contesting nativism in race, culture and sexualities* (forthcoming), is a timely addition to the debates on identity and understanding of self and others.

Identitarian approaches that seem obvious or natural – and command an easy claim to legitimacy and veracity when signifying our collective African selves as completed unities – are in fact

partial and situated unities. They have been constructed in the play of power and exclusion. The homogeneities and affiliations they proclaim are neither natural nor inevitable as they are the outcome of knowledge, power and positionality. His research draws from the work of antifoundational theorists to argue that when thinking about Africanness, dichotomous foundational categories do not serve us well and, for that matter, any identity category. Africannness is extraordinarily diverse precisely because it is situated in a multiplicity of histories, cultures and subjectivities that speak less to African identity in the way it has been espoused in colonial discourses and by ideologues of identity, and more to African *identifications* in the sense intended by Stuart Hall, the late sociologist and cultural theorist.

The work cautions against past and present efforts to reconstitute Africanness in order to retrieve, rediscover, or develop a pristine authentic African episteme or an *uncontaminated* African *Weltanschauung*. Such a project is fraught with the dangers of inclining us towards the very outcome we wish to avoid – the essentialisation or even petrification of Africanness shorn of the temporal present and its historical entanglements. We need to be able to imagine Africanness not only along an axis of similarity and continuity but also along an axis of difference and rupture.

INTERVIEW: Learn from the voices of the past

Dr Thula Simpson has spent a decade researching and writing on the history of the ANC's liberation struggle. His research took him to Zimbabwe, Zambia, Botswana, Swaziland the United Kingdom – and all over South Africa.

The results of Dr Simpson's work have been published in a number of scholarly journals, including the *Journal of Southern African Studies*, *African Studies*, the *South African Historical Journal*, *Social Dynamics* and the *African Historical Review*, as well as in edited book collections published by Wits University Press, and the University of Cape Town Press. He is currently working on his first single-authored book, *Umkhonto we Sizwe: The ANC's Armed Struggle*, which he says reflects the influences that first inspired him to be a historian. What he found interesting and worth studying was a passage in the MK Manifesto of 1961 that conveyed the idea of an insurgency that was launched in part to avoid civil war. He started to explore what it actually entailed. Although it clearly was not non-violent, it was not quite the type of insurgency so typical in other parts of the world. "The limits of violence and how far one can push those limits before the method becomes self-defeating is, if anything, more relevant now than then," he says.

Towards the end of his doctorate research in 2007 he applied for and received the postdoctoral fellowship at the University of Pretoria. The fellowship, and a subsequent three-year period when he received the University's Research and Development Programme grant, provided the resources to do research on a much larger scale than was possible during his doctorate.

It was the richness of the source material that led to the actual writing of *Umkhonto we Sizwe: The ANC's Armed Struggle*. The book deals with the armed, military dimension of the struggle against apartheid. It begins in the 1950s with the ANC's shift from non-violence towards armed struggle, and it continues up to the political settlement of the 1990s that laid the foundations for the new South Africa. The narrative consists of the stories of individuals on all sides of the conflict – whether insurgents, counter-insurgents or civilians – and the ways in which their lives interweave, and often clash, with the collisions occurring in major events in South African history.

"One sees the South Africa that we know begin to take shape ... Most of the leaders of the new South Africa took their first steps onto the pages of history during the armed struggle. It is important to revisit the history of why certain outcomes were achieved while others were not. We have to listen to the voices of the past and learn, without having to repeat their experiences – in fact, precisely so as not to have to follow the same road – the lessons that were earned at a very high price regarding which paths, violent and non-violent, have proven to be fruitful, versus those that have been proven to be disastrous."

Bodies without identity

Forensic pathology services receive numerous bodies without a known identity, many of whom may be illegal immigrants or migrant labourers. Many rural migrants are unlikely to have access to dental care or to return to a hospital for follow-up treatment, which makes the task of identifying an unknown body discovered in the veldt difficult and, at times, impossible.

Professor Ericka L'Abbé

Ericka L'Abbé is a Professor in the **Department of Anatomy** and Head of the **Forensic Anthropology Research Centre** in the Faculty of Health Sciences. Researchers in the unit are leaders in the study of human variation, forensic anthropological techniques and bone trauma analysis in sub-Saharan Africa. They specialise in research on human variation of South African groups, with the intention of creating accurate and reliable biological profiles from skeletal remains. A biological profile, with assistance from the South African Police Services (SAPS), provides basic information to family members who are seeking a missing relative. Other aspects of the body can be used to formulate a positive identification – such as *ante mortem* dental records, fingerprints and DNA.

This research addresses social and biological knowledge gaps on human skeletal remains and its application in medico-legal investigations in South Africa. Information on sexual dimorphism, juvenile age estimation, and ancestry is used directly to establish a more accurate, plausible identification of an unknown person. For example, research into sexual dimorphism and ancestry among socially defined South African groups has improved the reliability and validity of the techniques used to interpret these biological parameters from an unknown person. Additionally, publication of this work and the education of students at a tertiary level has contributed to removing the 20th century race typology stigma in South Africa.

Forensic facial reconstruction sculpture

The researchers in the Forensic Anthropology Research Centre are recognised internationally for their work in this field and have made significant advances in the technology and statistical analyses used on their research material. Many graduates go on to work in academia or the SAPS. In addition, the use of new analytical techniques has contributed to enhancing work in forensic anthropology in general. In future, research will focus on exploring human variation within the South African population and subsequent comparison with other populations, with an emphasis on countries that contributed to the genetic composition of South Africans.

INTERVIEW: African refugees move within Africa rather than from Africa

Dr Cristiano d'Orsi is a postdoctoral fellow in the **Centre for Human Rights**. His research focuses on the plight and legal position of what he calls 'people on the move' in Africa – migrants, refugees and asylum-seekers.

His first encounter with migrants from Africa was when he was still at university in Italy and started interning for a small NGO in his home town, Perugia. His internship began in the early 2000s when there was an influx of asylum-seekers from Rwanda, Liberia, Sierra Leone and Angola. Faced with this situation, he and his colleagues realised that they did not know what the legal position of these forced migrants was. This triggered his interest in the area of public international law.

Dr d'Orsi's paper on the legal protection of refugees in Africa, published in the ZaöeRV of the Max Planck Institute for Comparative Public Law and International Law, opened the door for him to become known among refugee law academics. Apart from Italian, which is his mother tongue, he speaks French fluently. This enabled him to publish articles in French on the conflict in Casamance, Senegal, focusing on the legal situation of the *Mouvement des Forces Démocratiques* (Democratic Forces Movement), and on International Migration through The Hague Academy of International Law. He has also been invited to teach in French at the International Relations Institute of Cameroon (IRIC) at the University of Yaoundé.

His monograph, entitled *Asylum-Seeker and Refugee Protection in Sub-Saharan Africa: The Peregrination of a Persecuted Human Being in Search of a Safe Haven*, was published in August 2015 by Routledge. He says it is not often acknowledged that the great majority of African refugee movement happens within Africa rather than from Africa to the West. His book examines the characteristics and challenges of the refugee situation in sub-Saharan Africa, offering a new and critical vision about the plight of asylum-seekers and refugees in Africa.

Liezl Rees

Peter le Roux and Michelle Greves

PART 3
Researchers and research capacity

Three dimensions are presented in this final part of the Review that underscore the contribution of exceptional researchers to the University's research identity and capacity:

1 – Research awards and recognition

2 – UP's A-rated scientists

3 – Faculties and research entities

Research awards and recognition highlight some of the notable achievements of young and established researchers in 2015. The research interests of lead researchers at UP are briefly profiled and their National Research Foundation (NRF) A-rating acknowledged.

Finally, the University has 47 Research Chairs and Centres of Excellence, and a total of 90 Institutes, Centres and Units. Taken together, this gives some indication of the scope and critical mass of researchers, with research entities grouped under the broad knowledge fields represented by faculties at UP:

- Engineering, Built Environment and Information Technology
- Economics and Management Sciences
- Education
- Health Sciences
- Humanities
- Law
- Theology
- Natural and Agricultural Sciences
- Veterinary Science
- Gordon Institute of Business Sciences (GIBS)

Desert plants in quartz rock

Research Awards

Internal Awards

Each year the University honours and celebrates researchers and academic achievers for their contribution to UP. There are four categories of awards: exceptional academic achievers; exceptional young researchers; National Research Foundation (NRF)-rated researchers; and the Chancellor's award.

The Chancellor's Award: Research

Professor Bernard Slippers was the recipient of this prestigious award for 2015, in recognition of exceptional achievement in the field of research aimed at the advancement of science and the associated promotion of the interests of UP.

Professor Bernard Slippers

The Vice-Chancellor's Book Awards

The Vice-Chancellor's Book Awards recognise and reward authors of scholarly books, monographs and collections. The prizes are awarded annually in two categories: the humanities and social sciences, and natural and applied sciences. For 2015 one award, in the humanities and social sciences, was made to **Professor Corinne Sandwith** for her book, *World of Letters: reading communities and cultural debates in early apartheid South Africa*, published by the UKZN Press.

Her research constructs a rich historical analysis from fragments of cultural and intellectual spaces, contributing significantly to our present-day understanding of literature and culture.

Professor Erika de Wet (UP), Dr Gansen Pillay (Deputy CEO, NRF), Professor Xiaohua Xia (UP), Professor Wiseman Nkuhlu (UP Chancellor), Professor Cheryl de la Rey (UP Vice-Chancellor and Principal), Dr Molapo Qhobela (CEO, NRF), Dr Rocky Skeef (Executive Director, NRF) and Professor Pedro Crous (UP).

Exceptional Academic Achievers Awards

These awards recognise senior academics who are regarded highly by their peers and have consistently excelled in the areas of under- and postgraduate teaching and learning, research, community service and administration. Any academic who has been awarded an A-rating by the NRF in the year under consideration automatically qualifies as an Exceptional Achiever for as long as he or she remains an A-rated researcher. For the year 2015, eight awards were made:

Professor Frans Viljoen (Centre for Human Rights, Faculty of Law)
Professor Liesel Ebersohn (Centre for the Study of Resilience, Faculty of Education)
Professor Jean Lubuma (Dean of the Faculty of Natural and Agricultural Sciences)
Professor Andrew McKechnie (Zoology and Entomology, Faculty of Natural and Agricultural Sciences)
Professor Teresa Coutinho (Microbiology, Faculty of Natural and Agricultural Sciences)
Professor Johan Kirsten (Agricultural Economics, Extension and Rural Development, Faculty of Natural and Agricultural Sciences)
Professor Louis Nel (Microbiology and Plant Pathology, Faculty of Natural and Agricultural Sciences)
Professor John Taylor (Food Science, Faculty of Natural and Agricultural Sciences).

Dr Nico de Bruyn

Exceptional Young Researchers

This award is given to exceptional young researchers. Any person who has been evaluated by the NRF as a P-rated researcher automatically enjoys Exceptional Young Researcher status. Two awards were made for the year 2015:

Dr Nico de Bruyn (Zoology and Entomology, Faculty of Natural and Agricultural Sciences)
Dr Peter le Roux (Plant Science, Faculty of Natural and Agricultural Sciences).

Dr Peter le Roux

External Awards

External awards demonstrate recognition of UP's academics and their achievements. In 2015, several UP researchers received such awards as the following summary of highlights shows.

The DST-NRF SARChI Chair Awards

UP was awarded four of the new DST-NRF SARChI Research Chairs for women scientists announced by the Minister of Science and Technology, Ms Naledi Pandor, in 2015. The recipients were:

Professor Erika de Wet: SA Research Chair in International Constitutional Law
Professor Brenda Wingfield: SARChI Chair in Fungal Genomics
Professor Wanda Markotter: SARChI Chair in Animal Infectious Diseases (zoonoses)
Professor Namrita Lall: SARChI Chair in Indigenous Knowledge Systems.
The four Chairs are profiled in this Review.

Dr Thulani Makhalanyane

NSTF-BHP Billiton Awards

These annual awards recognise outstanding contributions by individuals and teams to science, engineering, technology and innovation (SETI). Under the patronage of the Minister of Science and Technology, the awards have grown to be among the most prestigious public SETI awards in South Africa. In 2015, UP had three winners, with research interests ranging from the mole-rat queens of the Kalahari, to life under rocks in Antarctica, and the genetic improvement of forest trees:

Professor Nigel Bennett, Department of Zoology, SARChI Chair of Mammalian Behavioural Ecology and Physiology, and the Austin Roberts Chair of African Mammalogy.

Dr Thulani Makhalanyane, Centre for Microbial Ecology and Genomics, Department of Genetics.

Professor Zander Myburg, Forest Molecular Genetics Programme, Department of Genetics, and Chair in Forest Genomics and Biotechnology in FABI.

Other prestigious external recognition

Several prestigious national and international awards were won by UP researchers, including:

Professor Brenda Wingfield, Deputy Dean of the Faculty of Natural and Agricultural Sciences, was awarded the Christiaan Hendrik Persoon medal, the highest award of the Southern African Society for Plant Pathology (SASPP) recognising outstanding research achievements in Plant Pathology. Professor Wingfield is only the sixth person and the first woman scientist to receive this award in the 53-year history of the SASPP.

Professor Michael Pepper, Director of the Institute for Cellular and Molecular Medicine at UP, and his team of researchers were awarded a Medical Research Council (MRC) Extramural Research Unit for Stem Cell Research and Therapy.

Professor De Wet Swanepoel (Speech-Language Pathology and Audiology) was awarded the Southern African Association for the Advancement of Science (S2A3) British Association Medal (Silver), one of the highest awards for original scientific research in South Africa, for his innovative smartphone application hearScreen™.

The John FW Herschel Medal, the senior medal of the Royal Society of South Africa, was awarded to **Professor Robert Millar** for 2016**,** Director of UP's Mammal Research Institute and the MRC's Receptor Biology Unit, for his exceptional contribution to science in South Africa. He was also elected as President of the International Neuroendocrinology Federation (INF).

Professor Josua Meyer of the Department of Mechanical and Aeronautical Engineering received the Chairman's Award of the South African Institute of Refrigeration and Airconditioning for seminal research contributions over the past 25 years.

Professor Sunil Maharaj, Dean of the Faculty of Engineering, Built Environment and Information Technology, was awarded the South African Institute of Electrial Engineers (SAIEE) 2015 Engineering Excellence Award for his outstanding contribution to furthering the growth and development of the community and the SAIEE in supporting the elecrical engineering profession.

Emeritus Professor of Public Health Medicine, **Maila John Matjila**, and Professor of Health Policy and Management and Dean of the Faculty of Health Sciences, **Professor Eric Buch**, were both awarded a Lifetime Achievement Award from the Public Health Association of South Africa for their exceptional contribution to public health.

Professor Terry Aveling from the Department of Plant Science received the 2015 SANSOR-Bayer Science for a Better Life Award. The prize is awarded by the South African National Seed Organisation and Bayer CropScience in recognition of leadership, innovation and positive contributions to the seed industry and agriculture.

UP's A-rated scientists

Nigel C Bennett

Professor Bennett's research investigates the ecological and physiological factors that affect the control of reproduction and the evolution of sociality. Molecular approaches, together with innovative laboratory and field methods, are used to unravel the mechanisms by which evolution can shape change in socially occurring vertebrate species. The family *Bathyergidae* has turned out to be an ideal model group for investigating the evolution of sociality and, as a consequence, contributes to the interdisciplinary efforts in the study of the causes and consequences of sociality.

www.up.ac.za/zoology-entomology

Professor Nigel Bennett in the Department of Zoology and Entomology holds the UP Austin Roberts Chair of African Mammalogy and the DST-NRF SARChI Chair of Mammalian Behavioural Ecology and Physiology.

Drucilla LC Cornell

Professor Cornell's work has looked at areas such as ethical humanism aimed at reviving black existentialism and radical constitutionalism to counter dominating historicism, imperialism and neo-colonialism. She has also researched female and racial subordination and liberalism post-9/11, particularly in the face of wars in regions such as Afghanistan and Iraq. Of importance too is her work with the Ubuntu project at UP. Established in 2012, the project promotes the status and importance of indigenous values and ideals across various areas of society.

www.polisci.rutgers.edu/cb-profile/userprofile/dcornell

Drucilla Cornell is Extraordinary Professor in the Department of Jurisprudence at UP and Professor in Political Science at Rutgers University, US.

Don A Cowan

Professor Cowan has a primary interest in the microbial ecology of soil habitats, including hot and cold desert soils. For the past decade and a half he has worked at both ends of the biological temperature scale, studying *psychrophilic* microbiology of the Dry Valleys of Eastern Antarctica, and the *thermophilic* microbiology of the Namib Desert. He collaborates with local, national and international researchers on many other metagenomic projects, ranging from studies of the roles of microbial communities on agricultural crop productivity, in sub-Antarctic peat bogs, to the development of human prostate cancers. His newest research programme is the development of a large consortium of researchers to undertake a landscape-scale survey (for the first time) of the microbial diversity of southern African soils.

www.up.ac.za/CMEG

Professor Don Cowan is the Director of the Genomics Research Institute and the Centre for Microbial Ecology and Genomics in the Faculty of Natural and Agricultural Sciences.

Pedro Crous

As a phytomycologist Professor Crous's main interest lies in the evolution and phylogeny of plant pathogenic fungi, especially *Dothideomycetes*, *Diaporthales* and *Hypocreales*. Understanding and defining species means that the importance of sex (recombination) cannot be ignored. His research has shown that many plant pathogens have both mating type genes, and may be having cryptic sex, which also has serious implications for disease control and rates of evolution. He is interested in intra- and interspecies variation, and how this relates to host specificity and speciation. Professor Crous actively pursues integrating DNA data with morphology and ecology. In this regard he initiated MycoBank to capture all fungal names, and now links taxa to their DNA data, cultures, specimens and ecology.

www.cbs.knaw.nl

Professor Pedro Crous is an Associate Professor in FABI, linked to the DST-NRF Centre of Excellence in Tree Health Biotechnology and the Tree Protection Cooperative Programme. He is currently Director of the CBS-KNAW Fungal Biodiversity Centre in Utrecht, The Netherlands.

Erika de Wet

Professor De Wet's research examines the legal consequences that the exercising of public power by international organisations such as the United Nations and the African Union have for states and for those living in their territories. This includes the problems states face in implementing binding decisions of international organisations while giving due effect to other international obligations and constitutional principles of fundamental importance. She was the founding Co-Director of the Institute for International and Comparative Law in Africa (ICLA) at UP. Since October 2015 she has been a fellow at the Käte Hamburger Centre for Advanced Study ('Law as Culture') in Bonn (until July 2016). She has held various national and international editorial positions and is a member of the Scientific Advisory Board for Development Policy of the Max Planck Foundation for International Peace and the Rule of Law, as well as of the General Council of the International Society of Public Law (ICON-S). Professor De Wet is a Honorary Professor in the Faculty of Law of Bonn University.

www.icla.up.ac.za/

Professor Erika de Wet is Professor of International Law in the Faculty of Law and holds the DST-NRF SARChI Chair in International Constitutional Law in the Faculty of Law.

Andries P Engelbrecht

Professor Engelbrecht's main research focus is artificial intelligence with a specific focus on computational intelligence, particularly computational swarm intelligence, learning from zero knowledge using competitive coevolution, evolutionary algorithms, artificial neural networks and image and data analytics. His research team developed an open source library of computational intelligence algorithms, which is increasingly being used internationally. They were the first to provide convergence proofs of particle swarm optimisers (PSO), to develop PSO algorithms to find multiple solutions to optimisation problems, to solve optimisation problems where solutions are represented as sets, to develop PSO-based hyper-heuristics, to use PSO for secondary RNA structure prediction, to use PSO for image segmentation, and they have developed PSO and differential evolution algorithms to cluster non-stationary data. They have also developed new measures to characterise fitness landscapes of continuous-valued optimisation problems.

www.cs.up.ac.za/research

Professor Andries Engelbrecht is Head of the Department Computer Science in the Faculty of Engineering, Built Environment and Information Technology. He is the current incumbent of the DST-NRF SARChI Chair in Artificial Intelligence.

Robert P Millar

Professor Millar's work has made major impacts in areas of human reproduction, hormone replacement and the treatment of disease such as cancer. His recent research has focused on gonadotropin-releasing hormones (GnRH), pioneering the discovery of GnRH prohormones and novel GnRHs. His group participated in a collaborative effort for the first cloning of the GnRH receptor and the discovery of GnRH subtypes. As a result, great strides have been made in the development of anti-cancer drugs. Furthermore, he has been involved in successfully taking eight drugs into the clinic for treating diseases such as prostatic cancer, endometriosis, infertility, and polycystic ovarian syndrome. Most recently his group discovered molecules that can rescue function of mutant human receptors, which has implications for conditions such as retinitis pigmentosa causing blindness. In 2015, it was announced that Professor Millar was awarded the John FW Herschel Medal for 2016, the Royal Society of South Africa's most prestigious medal, for his exceptional contribution to science in South Africa..

www.up.ac.za/en/institute-for-cellular-and-molecular-medicine/

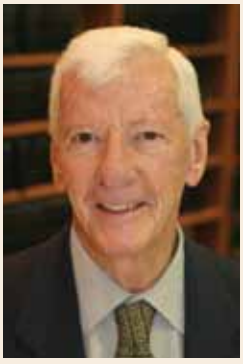
Professor Robert Millar is Director of the Centre for Neuroendocrinology in the Faculty of Health Sciences.

Yves Van de Peer

Professor Van de Peer was the first to suggest a correlation between whole genome duplication events in different plant lineages and the Cretaceous-Paleogene boundary, caused by the Cretaceous-Paleogene extinction event that wiped out about 70% of all organisms, including dinosaurs. Although whole genome duplications are usually an evolutionary dead end, research in Professor Van de Peer's laboratory suggested that, during periods of environmental upheaval, entire genome duplications can provide organisms with a selective advantage so that polyploids can out-compete their diploid progenitors. The research group of Yves Van de Peer is widely recognised for its expertise in gene prediction and genome annotation and comparative and evolutionary genomics, and is involved in several international genome projects.

www.up.ac.za/the-genomics-research-institute
http://bioinformatics.psb.ugent.be

Professor Yves Van de Peer is in the Department of Genetics at UP and Professor in Bioinformatics and Genome Biology in the Department of Plant Biotechnology and Bioinformatics, Ghent University, and the Department of Plant Systems Biology, VIB.



Johan van der Vyver

Professor Van der Vyver is an expert in human rights jurisprudence and the international criminal court, and actively participated in efforts to end apartheid and bring constitutional reform to his native South Africa. He has also served as a fellow in the Human Rights Program of The Carter Center in Atlanta. His research interests and publications include human rights, public international law, international criminal law, humanitarian law, and a great variety of other subject-matters.

http://cslr.law.emory.edu/

Professor Johan van der Vyver is Extraordinary Professor in the Department of Private Law, University of Pretoria.

Charles van Onselen

Professor van Onselen's particular interest lies in the phenomena of crime-as-politics, as exemplified by issues of social banditry, and politics-as-crime, as manifested in the ways in which members of the political elite engage in criminal activities in order to facilitate the accumulation of corporate or personal wealth, as enabled through the processes of corruption. Although these historically rooted problems occur in many parts of the world, they are particularly prominent themes in contemporary South African history. His latest book, *Showdown at the Red Lion: The Life and Times of Jack McLoughlin, 1859-1910*, vividly illustrates the biographer's craft in his tracing of South Africa's industrial revolution and patterns of social control and collective working class behaviour.

www.up.ac.za/centre-for-the-advancement-of-scholarship

Professor Charles van Onselen is Research Professor in the Centre for the Advancement of Scholarship.

Johannes van Oort

Professor Van Oort's areas of research are the rise of Christianity in the Jewish, Greek and Roman contexts; the history of the Early Church, with particular emphasis on Gnostic movements; and the theology, sources and influence of Augustine of Hippo.

https://up-za.academia.edu/JohannesvanOort

Professor Johannes van Oort is Extraordinary Professor in the Department of Church History in the Faculty of Theology.

Brenda Wingfield

Professor Brenda Wingfield's research focus is on speciation and evolution of fungi, predominantly non-model *Ascomycetes*. This includes research on genetic variation within as well as between species. The group enjoys substantial international recognition with respect to research on the molecular systematics and population genetics of fungal pathogens, and is considered as one of the leading teams worldwide that is involved in the development of molecular diagnostic techniques for the identification and classification of pathogenic fungi. Professor Wingfield also has an interest in basic evolutionary biology based on ribosomal RNA-genes which extends beyond fungi, and has a variety of collaborations with research groups working on a range of organisms. Much of this collaboration is in association with the tree pathology research group and the DST-NRF Centre of Excellence in Tree Health Biotechnology in FABI.

www.fabinet.up.ac.za

Professor Brenda Wingfield is the Deputy Dean (Research) in the Faculty of Natural and Agricultural Sciences and Professor in the Department of Genetics. She holds the SARChI Chair in Fungal Genomics.

Michael J Wingfield

Professor Mike Wingfield's research focuses on fungal diseases that threaten forests and forestry globally. Using a broad range of approaches (especially molecular genetic techniques), pests and pathogens arising in many different countries of the world are identified – often for the first time. Research efforts seek to understand the drivers of tree pest invasions and to find methods to reduce the damage that they cause. His research programme falls under the umbrella of two major programmes: The Tree Protection Cooperative Programme, a cooperative venture between the University of Pretoria, all forestry companies in South Africa, the industry body Forestry South Africa (FSA), and the government Department of Agriculture, Forestry and Fisheries (DAFF). The second major programme is the DST-NRF Centre of Excellence in Tree Health Biotechnology where the research focus is on the health of native trees and native woody ecosystems in South Africa, and particularly how pests and pathogens move between this environment and non-native trees planted for commercial purposes for forestry, fruit production and as ornamentals. As IUFRO President, he actively promotes efforts to enhance evidence-based policy formulation on which the future of forests and the associated ecosystem services and global food security depend.

www.fabinet.up.ac.za/mwingfield

Professor Mike Wingfield is the founding Director of the Forestry and Agricultural Biotechnology Institute (FABI) at UP. He is also President of the International Union of Forest Research Organisations (IUFRO), one the largest and oldest scientific unions representing more than 15 000 forestry scientists globally.

Xiaohua Xia

Professor Xia heads the South African National Hub for the Postgraduate Programme in Energy Efficiency and Demand-side Management hosted by CNES. His research interests are control systems and automation, and more recently, the modelling and optimisation of energy systems. This includes non-linear feedback control, observer design, time-delay systems, hybrid systems, modelling and control of HIV/Aids, control and handling of heavy-haul trains and energy modelling and optimisation. In March 2015 he presented a lecture as part of the UP Expert Lecture Series titled: "Energy efficiency and demand side management: do they still come to the rescue?" The central question addressed was whether energy efficiency and demand side management can still rescue the country from its energy predicament.

www.ee.up.ac.za/~xxia

Professor Xiaohua Xia is Director of the Centre of New Energy Systems (CNES) and holds the Exxaro Chair in Energy Efficiency.

Faculties and research entities

Dean: Professor Sunil Maharaj

Engineering, Built Environment and Information Technology (EBIT)

EBIT is organised into four schools: Engineering, the Built Environment, Information Technology and the Graduate School of Technology Management. Engineering is ranked in the top 1% of engineering schools in the world, based on research citations. Research in the Graduate School of Technology Management closely aligns its priorities to this evolving knowledge field. The Built Environment offers an entire spectrum of programmes, with close ties to the building industry. Information Technology is one of the forerunners in South Africa, with research programmes in computer science, informatics and information science.

There are 32 Research Chairs, Institutes and Centres located in the Faculty.

www.up.ac.za/faculty-of-engineering-built-environment-it

DST-NRF SARChI Chairs

Chair in Advanced Sensor Networks
Chair in Artificial Intelligence
Chair in Fluoro-Material Science and Process Integration
Chair for Carbon Material and Technology (jointly with NAS)

Industry Chairs

Anglo American Chair in Pyrometallurgy
CSIR Chair in Aeronautics
Exxaro Chair in Energy Efficiency
WEIR Minerals and Exxaro Chair in Maintenance Engineering
Glencore Chair in Modelling of Pyrometallurgical Modelling
Harmony Chair in Rock Engineering and Numerical Modelling
Rand Water Chair in Civil Engineering
Rand Water Chair in Mechanical Engineering
Sasol Chair in Safety, Health and the Environment
Sedibeng Chair in Water Utilisation Engineering
Sentech Chair in Broadband Wireless Multimedia Communication
Transnet Freight Rail Chair in Railway Engineering

Institutes

Institute of Applied Materials (jointly with NAS)
Carl and Emily Fuchs Institute for Micro-Electronics (CEFIM)
Eskom Power Plant Engineering Institute (EPPEI)
Industrial Metals and Minerals Research Institute (IMMR)
Institute for Technological Innovation (ITI)
Mining Resilience Research Institute

Centres

African Centre of Excellence in Information Ethics
Centre for Advanced Sensor Networks
Centre for Asset Integrity Management
Centre for Electromagnetism
Centre of New Energy Systems (CNES)
Specialist Centre in Plant Asset Management
Centre for Telecommunications Engineering for the Information Society (CeTEIS)
The Centre of Transport Development
SAIW Centre for Welding Engineering

Other

National Hub for Demand-side Management and Energy Efficiency

Education

The Faculty of Education has established itself as one of the premier facilities for education research, capacity development and productivity in southern Africa. The consistent growth in the volume and quality of research outputs, and the international recognition of the Faculty and its academic staff, bear testimony to a vibrant research community. The focus is on building clusters of research excellence, and making a substantial contribution to research that has direct application to local problems.

There are seven Centres and Units located in the Faculty.

www.up.ac.za/faculty-of-education

Dean: Professor Irma Eloff

Centres

Centre for Evaluation and Assessment (CEA)
Inter-University Centre for Education Law and Policy (CELP)
Centre for Mathematics, Science and Technology Education (JCMSTE) – jointly with NAS
Centre for the Study of Resilience (CSR)

Units

Unit for Education Research in AIDS (ERA)
Unit for Distance Education
Living Lab for Innovative Teaching Research at UP (LLITUP)

Economic and Management Sciences (EMS)

EMS aims continuously to strengthen its position as a leader in the fields of economic, financial and management sciences through its academic and research excellence. At the same time, it remains committed to delivering competent, creative, responsible and productive citizens – the 'thought leaders' of the University of Pretoria and South Africa's future business leaders.

There are five Research Chairs, Institutes and Centres in EMS.

www.up.ac.za/faculty-of-economic-and-management-sciences

Dean: Professor Elsabé Loots and Deputy Dean, Research and Postgraduate Studies: Professor Stella Nkomo

DST-NRF SARChI Chair

Chair in Tax Policy and Governance

Industry Chair

South African Reserve Bank Chair in Monetary Economics

Institute

African Tax Institute

Centres

Albert Luthuli Centre for Responsible Leadership
Centre for Communication and Reputation Management

Dean:
Professor Eric Buch

Deputy Dean, Research and Postgraduate Studies:
Professor Tiaan de Jager

Health Sciences

The Faculty of Health Sciences is recognised nationally and internationally as an outstanding institution in terms of its education of health professionals, its research and its clinical service. The Faculty demonstrates a deep commitment to the need for constant innovation in meeting the health sciences challenges that South African society faces, with a strong emphasis on multidisciplinary approaches.

There is a total of 19 Research Chairs, Institutes, Centres and Units – with three Medical Research Council (MRC) Units hosted by the Faculty.

www.up.ac.za/faculty-of-health-sciences

DST-NRF SARChI Chair

Chair in Animal Infectious Diseases (Zoonoses)

Industry Chairs

Chair in Philosophy and Ethics of Mental Health
Rand Water Chair in Water and Public Health

Institutes

Institute for Cellular and Molecular Medicine
Institute for Sports, Exercise, Medicine and Lifestyle Research (approved in 2015)
Institute for Sport Research (pre-existing – established 1979)

Centres

Applied Morphology Research Centre
Centre for Ethics and Philosophy of Health Sciences
Forensic Anthropology Research Centre
Centre for Neuroendocrinology and Brain/Body Dialogues
Comprehensive Physical Rehabilitation Centre
UP Centre for Sustainable Malaria Control (designated as an MRC Collaborating Centre for Malaria Research)
Centre for Viral Zoonoses

Units

Environmental Chemical Pollution and Health Research Unit
MRC Unit for Maternal and Infant Health Care Strategies
MRC Unit for Stem Cell Research and Therapy
UP Community Orientated Primary Care (UP COPC) Research Unit

Dean:
Professor Vasu Reddy (from August 2015)

Acting Dean:
Professor Hennie Stander (August 2014 – July 2015)

Humanities

In a rapidly changing and globalising world we are confronted with many social, political, environmental and economic problems, some which are more intractable than others. It is increasingly acknowledged that the humanities are well suited to producing the types of research that can generate appropriate solutions to many of these problems.

Research capacity is enhanced through its 11 Research Chairs, Institutes, Centres and Units, international partners, and faculty research themes.

www.up.ac.za/faculty-of-humanities

Research Chairs

Jean Monnet Chair in Regional Integration and Governance Studies
Chair in Regional Integration, Migration and Free Movement of People

Institute

Institute for Strategic and Political Affairs (ISPA)

Centres

Centre for Augmentative and Alternative Communication (CAAC)
Centre for Japanese Studies
Centre for Mediation in Africa (CMA)
Centre for Sexuality, AIDS and Gender (CSAG)
Centre for the Study of Governance Innovation (Gov Inn)

Units

Unit for Academic Literacy (UAL)
Unit for Creative Writing (UCW)
UP Cochlear Implant Unit (UP-CIU)

Other

Itsoseng Clinic

Dean:
Professor Johan Buitendag

Theology

The Faculty's overarching research theme is entitled Oikodome – Life in its fullness. In order to combine interdisciplinary and transdisciplinary perspectives, the theme is approached from three cluster perspectives: the so-called basics (Old and New Testament Studies), beliefs (Dogmatics and Christian Ethics with Church History and Church Polity), and practices (Science of Religion and Missiology with Practical Theology). Important foci include aspects of social justice, human dignity, reconciliation, moral formation and responsible citizenship.

There are three Centres in the Faculty.

www.up.ac.za/faculty-of-theology

Centres

Centre for Contextual Ministry (CCM)
Centre for Public Theology (CPT)
Centre for Sustainable Communities (SSC)

Partner liaising offices

Excelsus (Dutch Reformed Church: Centre for Continuing Ministerial Development)
Hervormde Teologiese Kollege (HTK: Netherdutch Reformed Church College)

Dean:
Professor André Boraine

Law

The Faculty of Law's vision is to be an internationally-recognised leader in socially-relevant legal research and education in South Africa and in Africa. It represents the idea of a society governed by the rule of law, and pursues this idea by focusing on excellence in all divisions of jurisprudence. The full spectrum of legal research is undertaken by esteemed scholars, students and lecturers alike.

There is a total of five Research Chairs and eight Institutes, Centres and Units located in the Faculty.

www.up.ac.za/faculty-of-law

DST-NRF SARChI Chairs

Chair in International Constitutional Law
Chair in International Development Law and African Economic Relations

Industry Chairs

Barclays Chair in Banking Law in Africa
UNESCO Chair in Education Law in Africa

Institute

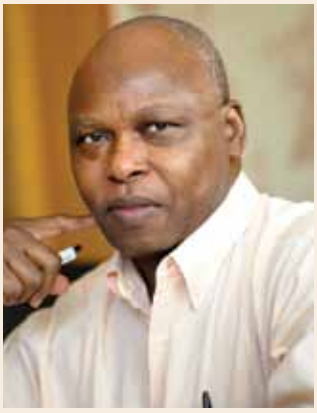
Institute for International and Comparative Law in Africa (ICLA)

Centres

Centre for Advanced Corporate and Insolvency Law
Centre for Child Law
Centre for Human Rights
Centre for Intellectual Property Law
Centre for Law and Medicine
Centre for Sports Law in Africa

Unit

International Development Law Unit (IDLU)



Dean:
Jean Lubuma
(from March 2015)

Acting Dean:
Professor Brenda Wingfield
(August 2014 – February 2015

Natural and Agricultural Sciences (NAS)

NAS strives to be the leading science faculty on the African continent. It has a strong research-intensive identity and pursues active partnerships with key international institutions in all recognised fields of research in natural and agricultural sciences. In terms of the volume and research impact, the strongest performance is in the knowledge fields of Plant and Animal Sciences, Environment and Ecology, and Agriculture.

The depth and range of research endeavour is reflected in the 15 Research Chairs hosted by the Faculty and the 27 Institutes, Centres and Units.

www.up.ac.za/faculty-of-natural-agricultural-sciences

DST-NRF SARChI Chairs

Chair in Carbon Technology and Materials
Chair in Complex Systems
Chair in Fungal Genomics
Chair in Indigenous Knowledge Systems
Chair of Mammalian Behavioural Ecology and Physiology
Chair in Mathematical Models and Methods in Bioengineering and Biosciences
Chair in Statistics
Chair in Sustainable Malaria Control

Centres of Excellence

DST-NRF Centre of Excellence for Food Security (co-hosted with University of the Western Cape)
DST-NRF Centre of Excellence for Tree Health Biotechnology

Industry Chairs

Barclays Chair in Actuarial Sciences
Barclays Chair in Agribusiness Management
Exxaro Kumba Chair in Geodynamics
Mondi Chair in Tree Pathology
Rand Water Chair in Water Microbiology
SAFCOL Chair in Forestry
Sappi and Mondi Chair in Forest Genomics and Biotechnology

Institutes

Institute of Applied Materials (jointly with EBIT)
Forestry and Agricultural Biotechnology Institute (FABI)
Institute for Food, Nutrition and Well-being (IFNuW)
Genomics Research Institute
Mammal Research Institute (MRI)
UP Water Institute

Centres

African Centre for Gene Technologies (ACGT with CSIR and WITS)
Centre for Bioinformatics and Computational Biology
Centre for Environmental Economics and Policy in Africa (CEEPA)
Centre for Environmental Studies (CFES)
Centre for Geo-Information Sciences (CGIS)
Centre for Maths, Science and Technology Education (JCMSTE) – jointly with Education
Centre for Microbial Ecology and Genomics (CMEG)
UP Natural Hazard Centre, Africa
Centre for Wildlife Management

Units

Bioinformatics and Computational Biology Unit
Conservation Ecology Research Unit (CERU)

Bureau

STATOMET (Bureau for Statistical and Survey Methodology)

Other

Biomath Forum
Botanical Garden
Experimental Farms
Herbarium
Laboratory for Microscopy and Micro-analysis
Postgraduate School of Agriculture and Rural Development
Sci-Enza

Dean:
Professor Darrell Abernethy

Deputy Dean: Research and Postgraduate Studies:
Professor Vinny Naidoo

Veterinary Sciences

The Faculty aims to be an internationally accredited seat of veterinary excellence that is locally relevant and provides an effective veterinary interface with the rest of Africa. Research niche areas serve as the driving force behind all research and postgraduate programmes, and are chosen to establish, achieve and project an African uniqueness which complements expertise and knowledge advances.

The Faculty hosts two Research Chairs and is home to four Research Centres, a Genetics Laboratory and Phytomedicine Programme.

www.up.ac.za/faculty-of-veterinary-science

Research Chairs

Chair in Poultry Health and Production
Chair in Primary Animal Healthcare (PAHC)

Centres

Equine Research Centre
Exotic Leather Centre
Centre for Veterinary Wildlife Studies
UP Biomedical Research Centre

Other

Onderstepoort Veterinary Genetics Laboratory
Phytomedicine Programme

Dean:
Professor Nick Binedell (until March 2015)

Dean:
Professor Nicola Kleyn (from April 2015)

Gordon Institute of Business Science (GIBS)

GIBS is based in Johannesburg and is the 'business school for business'. Its focus is on dynamic markets in South Africa and the broader African environment through the provision of high-quality business and management education. In May 2015, the annual UK *Financial Times* Executive Education rankings again ranked GIBS as the top South African and African business school – this was the 12th year running that GIBS was ranked among the top business schools worldwide. In October 2015, its MBA degree was ranked among the top 100 business schools globally in the prestigious Financial Times Executive MBA Rankings.

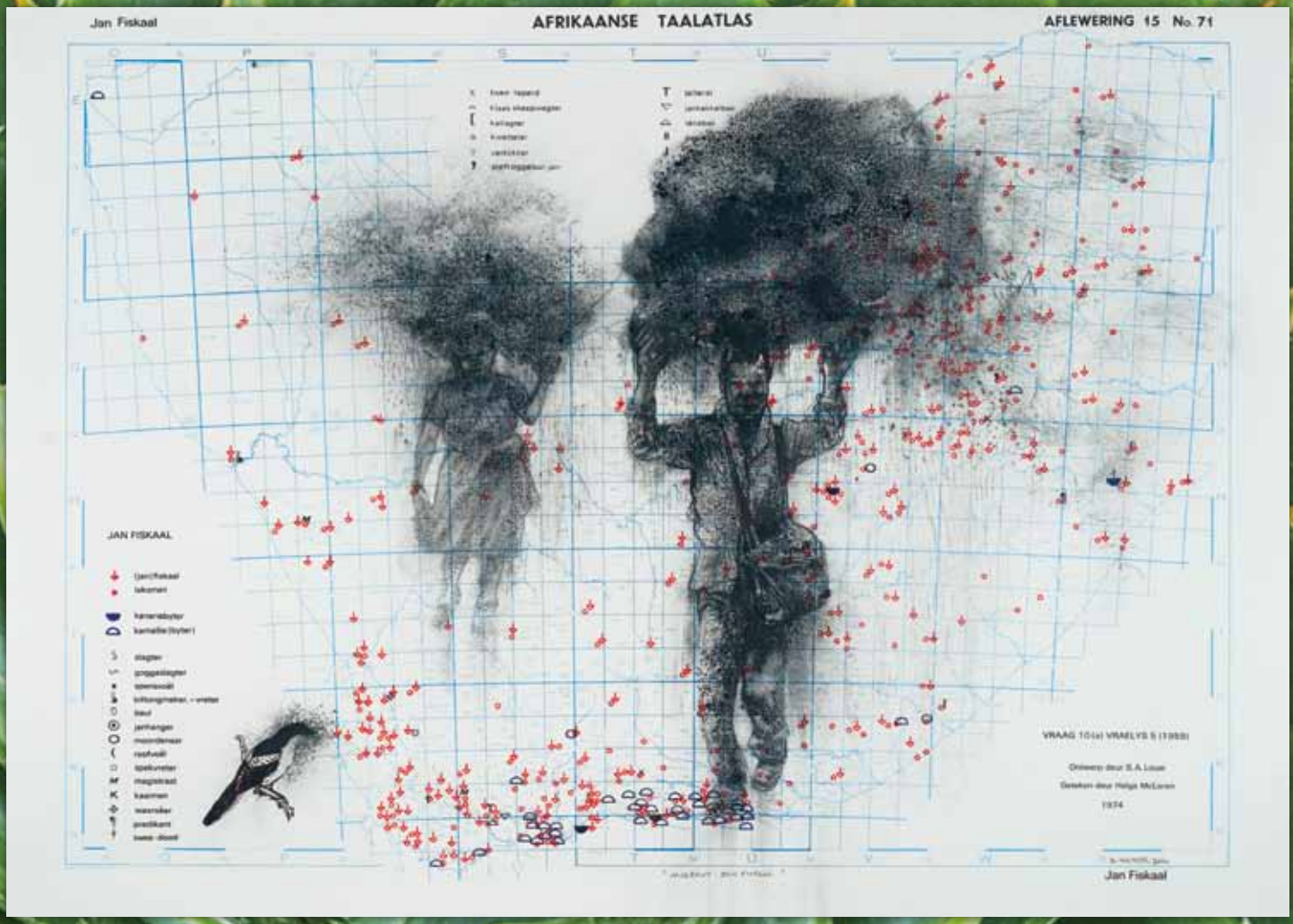
www.up.ac.za/gibs-business-school

Centres

Centre for Business Analysis and Research (CBAR)
Centre for Dynamic Markets (CDM)
Centre for Leadership and Dialogue

Other

Enterprise Development Academy



Jan Fiskaal – *Charcoal dust drawing 2014 by Diane Victor*

This artwork forms part of a series of three works made on the pages of a discarded Afrikaans language atlas. It was exhibited in Antwerp in 2014 as part of a curated show, *Nomad Bodies.*

Over this maze of symbols float the fragmented charcoal dust drawings of a man and a woman carrying large burdens; migrants perhaps, informal traders, refugees, urban walkers moving through a city and its places. The work responds to the idea of a transient society, flexible identities and of belonging.

Acknowledgements

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