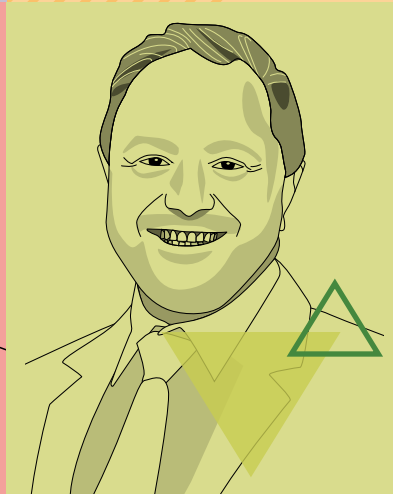
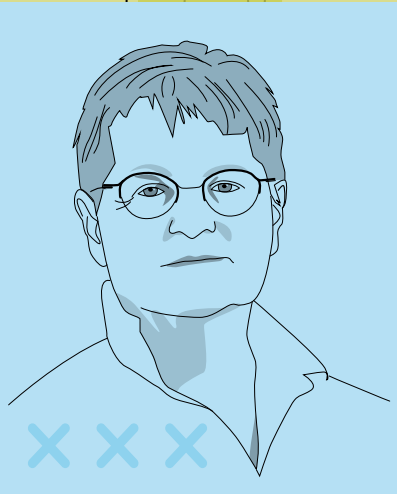
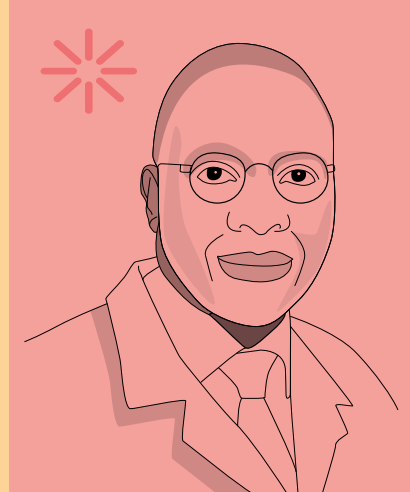




UNIVERSITY OF THE
WITWATERSRAND,
JOHANNESBURG

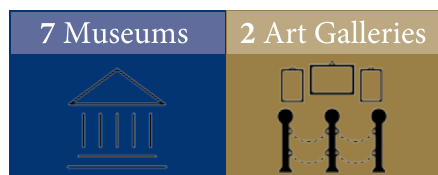


WITS
RESEARCH
WITH IMPACT
2018

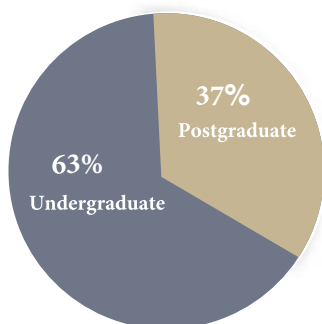
ABOUTWITS

97 YEARS OLD (2019)

11 libraries
17 residences



TOTAL STUDENTS
40259



1125

Number of Full -Time Permanent Academic Staff

25.67% international
64.47% with PhDs

21 Alumni
awarded National
Orders by the
President

9163

TOTAL GRADUATES (2018)

2

COMMERCIAL
COMPANIES

Wits Enterprise & Wits Health Consortium

largest fossil collections in the
southern hemisphere
internationally recognised as a leader in
the palaeosciences

WORLD RANKINGS
2019/2020

Top **1.3%** in the world
#254 (globally)
Centre for World University
Rankings

#1 in Africa
Faculty of Humanities
#400
QS World University Rankings

#40
BRICS Rankings

#194 (globally)
Times Higher Education
Rankings

#201-300 (globally)
Academic Ranking of
World Universities

33
SCHOOLS

28 A-rated researchers

457
NRF-Rated Researchers

3416
COURSES

23 Distinguished Professors

30
SARChI Research Chairs

5
FACULTIES



Science

13.48%



Commerce, Law
& Management

24.44%



Engineering & the
Built Environment

19.93%



Health Sciences

16.44%



Humanities

25.71%

Home to the Bidvest
Wits Football Club



Wits owns the Sterkfontein
Caves (in the Cradle of
Humankind World
Heritage Site)

home to
4 Nobel
laureates

Sir Aaron Klug
Nadine Gordimer
Nelson Mandela
Sydney Brenner

more than
200 000
DEGREES

conferred since the first graduation
ceremony on 4 October 1922, with around
80 000 students graduating since 1994.

10 national
centres of
excellence

highest number of government
funded centres of excellence in
South Africa

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RESEARCH THAT **IMPACTS ON** **SOCIETY**

impact: /'ɪmpakt/

noun / verb

a marked effect or influence / have a strong effect on someone or something

Wits is a research-intensive university that impacts on society through its research in multiple ways thanks to the talented researchers, scholars and students who are changing the world for the better.

Committed to the creation of new knowledge, be it traditional, translational (applied) or innovative, our scholars are producing increasing amounts of research with impact. In this context, research with impact is defined to include research that changes disciplinary thinking; research that influences policy and practice; and research that can be taken to the market to generate economic activity.





PROFESSOR ADAM HABIB

Vice-Chancellor and Principal

There are numerous examples of Wits' impact on society, some of which are highlighted in this publication. For example, in 2018, a multidisciplinary team from the Wits Donald Gordon Medical Centre successfully performed the world's first intentional liver transplant from a mother living with HIV to her critically ill HIV negative child, who had end-stage liver disease. This surgery made headlines across the world and offers new hope for families. This is but one visible example of the impact that Wits has on society. Professor Johnny Mahlangu's breakthrough in treating haemophilia, a genetic blood disorder, is set to significantly improve the lives of thousands around the world. Similarly, scientists are one step close in the search to find treatments for Alzheimer's disease.

Our academics and researchers continue to make worthy contributions across all areas be it through informing national policies related to the introduction of a sugar tax, the implementation of the national health insurance programme, the introduction of a national minimum wage, or through tackling gender based harm in society.

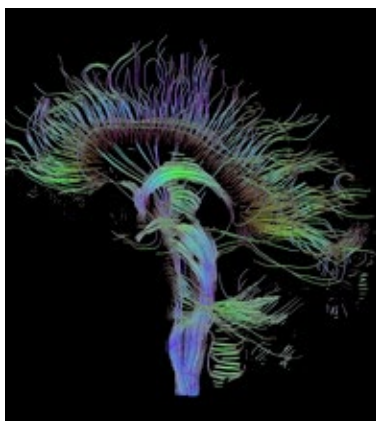
There are several examples in this report of Wits' innovative research that is being commercialised through Wits Enterprise, including affordable, scalable off-grid energy options, green energy from waste water and a new membrane to remove oil from high temperature wastewater.

Looking to the future, we are training scholars to deal with next frontier science and our future economy, and whilst we are focusing on mechanisation, block chain technologies, artificial intelligence, new mining technologies, quantum computing, machine learning and deep science with our industry partners, we are mindful of the impact of these new technologies on humanity, on how we express ourselves, on the future of work, on our morals, ethics and values, and the world as we know it today. Wits is well-placed to find a suitable balance in society, to teach the hard and soft skills required for our future economy but also to ensure that these technologies are beneficial to humanity.

It's been an incredible year for Wits and we are well on our way towards achieving our strategic goals. As we approach our centenary in 2022, we are well positioned to actively lead the frontiers of knowledge creation and to ensure that South Africa, and Africa, are not confined to being passive receptors in a new age. I must emphasise that none of the achievements recorded by Wits University in 2018 would have been accomplished without our academic, professional and administrative staff, who enable greatness and advance the public good. Thank you.

Best

Adam



Read the latest Wits Research News online:
www.wits.ac.za/research

Our theme based research magazine,
Curios.ty is available at www.wits.ac.za/curiosity

[WATCH] the latest Wits Research News on YouTube

Wits. For Good.



PROFESSOR ZBLON VILAKAZI

Deputy Vice-Chancellor: Research and Postgraduate Affairs

“Wits is ranked first by the Academic Ranking of World Universities (which uses objective research indicators) as the leading university in Africa”



A TRAJECTORY OF EXCELLENCE

The year 2018 saw Wits continue on an upward trajectory in terms of producing a record number of research outputs, with over 85% in leading international journals. This resulted in Wits being ranked first by the Academic Ranking of World Universities (which uses objective research indicators) as the leading university in Africa and the only university in this ranking in the top 300 in the world. However, as expected, as our research output plateaus, our indicators demonstrate a slight tapering in the rate of growth. This can be interpreted as a point of strategic inflection anticipated in our research and postgraduate strategy, which will continue to prioritise publication in high impact journals. The implementation of a new strategy will set us on a path towards new growth, leading up to the University's 2022 centennial year.

The productivity track record over the last eight years has seen a doubling of the University's overall research output. If one overlooks the small downward step in 2008, the growth streak dates back 14 years to 2004, the year in which the Department of Higher Education and Training (DHET) significantly raised the research output subsidy. Over this period, research productivity increased 2.6 times.

An important reflection is that the escalation in research productivity has not come about at the expense of the quality of our research. One simple measure of this quality is that more than 85% of our research journal articles are published in the Web of Science (ISI) index journals, which are highly regarded globally. Under the new accreditation rules, which include Scopus and other indices, this rate has advanced to just shy of 95%. It is also staggering to recognise that Wits authors have written on average 24 monographs per annum over the last five years. These facts point toward the sustained scholarly contribution made by Wits academics.

This brings me back to the realisation that a research-intensive university such as Wits is only ever as good as its talent base. It is true that functions such as the University's Research Office and the Faculty Research Offices make a significant difference in creating a conducive environment wherein which research can be conducted but without the talent of our incredible researchers, these efforts would be in vain.

In light of these contributions, I sincerely express my deep appreciation to all the research-active academics affiliated to Wits who have contributed to creating new knowledge that ultimately advances the public good. Thank you.





DR ROB DRENNAN

Director: Research Development

“Research income earned amounted to R548.15 million, which is 11% more than in 2017”

RESEARCH - ONWARDS & UPWARDS

It is a privilege to work with some of the most talented researchers, who are curious about the world, deeply inquisitive and committed to their students. These “seekers of the truth” have convinced me that talented scholars make a successful research-intensive university.

In my view, there were three events that shaped proceedings for the year. Firstly, the visit by National Research Foundation (NRF) CEO, Dr Molapo Qhobela and his Deputy, Dr Gansen Pillay heralded the realisation that the NRF is facing severe resource constraints that are beyond its direct control. A simple scan of the South African economy and the higher education sector reflects this reality. In response, the University's Research Office (URO) initiated a campaign titled “Thinking beyond the NRF” for research funding.

The campaign did not downplay the importance of state funding but did herald a significant increase in sourcing funding from international agencies, trusts and foundations. The URO now regularly interacts with more than 23 international funders, each with their own complexities and requirements. This has presented an opportunity for the URO to provide additional assistance and to live up to its motto: *Your Success is our Success*. Research income earned

outside of Wits Enterprise and the Wits Health Consortium through competitive research grants in 2018 amounted to R548.15 million, which is 11% more than in 2017.

Despite the changes to the NRF Incentive Funding Programme, the URO stewarded over 40 new NRF-rating applications and it is clear that the rating still carries value for previously unrated academics. On the other hand, the number of applications for re-evaluations dropped.

Secondly, the administrative processes around the approval of ethical research seemed to occupy an inordinate amount of time. This is clearly a very important component in a research-intensive university designed to comply with the law and to protect the reputation of the University and individuals. A significant amount of time was thus dedicated to streamlining administrative processes without compromising on the substantive decision-making processes.

Finally, 19 major discoveries were reported by Wits scholars in 2018, which have largely been made accessible to multiple audiences in the public sphere. The research communication campaigns that convey the outcomes of research are of great significance and the excitement that they generate cannot be easily measured. Two indicators which do no justice to the impact of making this research visible in the public sphere are the advertising equivalent value of the 19 campaigns which total almost R 10 million and the 63 000 *Eureka!* reads by science journalists globally. They indicate research with impact, a key strategic aspiration for Wits.

Other indicators of the quality and quantity of research are presented overleaf and demonstrate Wits' remarkable productivity in 2018. It is a privilege to serve researchers at Wits along with colleagues in the URO and other professional departments, none of which would be exceptional without Professor Zeblon Vilakazi, whose leadership is inspirational.

RESEARCH BY NUMBERS

HOW DOES DHET COUNT RESEARCH OUTPUT?

The Department of Higher Education and Training (DHET) units are calculated using the fractional author count system for publications. For postgraduate student completions, one unit is awarded to the completion of students with a Masters degree by research or a fraction thereof for a Masters qualification by coursework and research. Three units are awarded for the completion of a PhD degree.

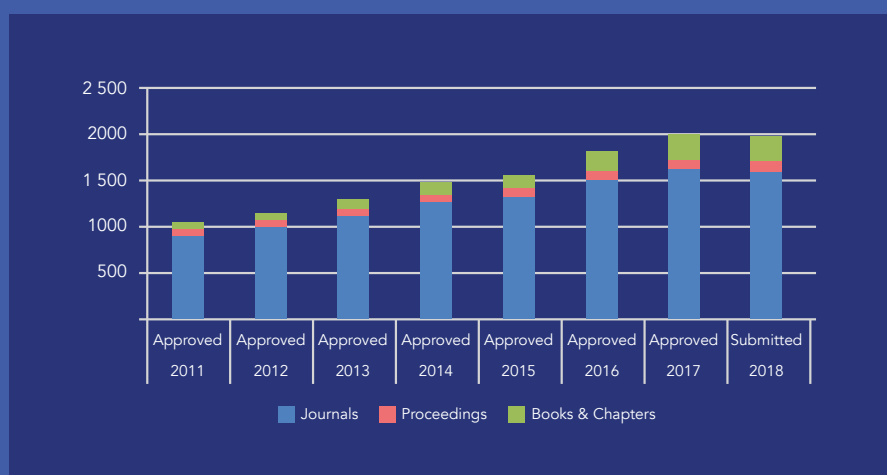


Figure 1: DHET units for research publications

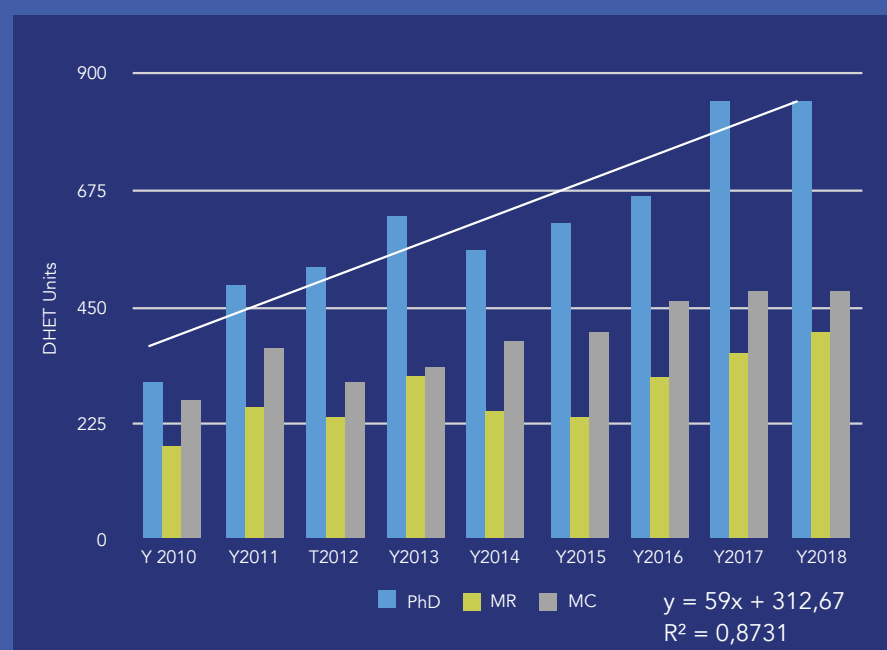
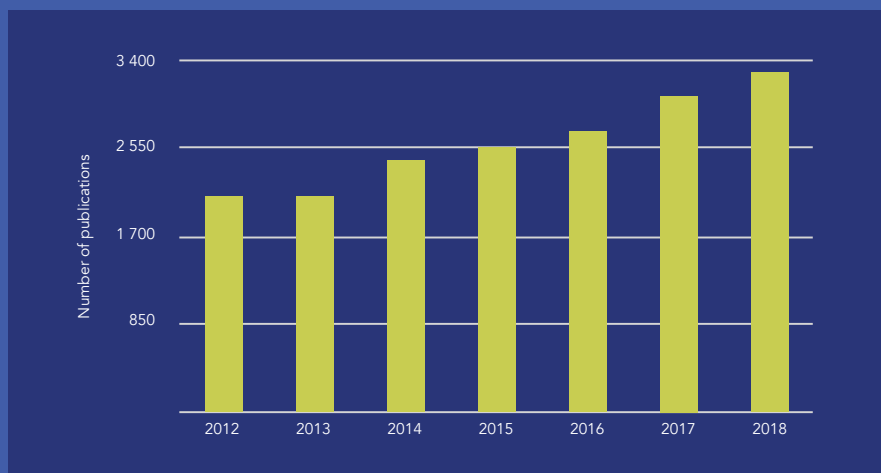


Figure 2: DHET units for postgraduate completions



HOW ELSE IS RESEARCH OUTPUT MEASURED?



Note: The growth shown on the left is not paralleled in Figure 1 due to the fractional author method of calculating research units. The more we collaborate, the more we share.

The areas (knowledge fields) in which these publications are located is shown in Figure 4.



Figure 3: Number of Wits-authored publications per year in the Scopus Index

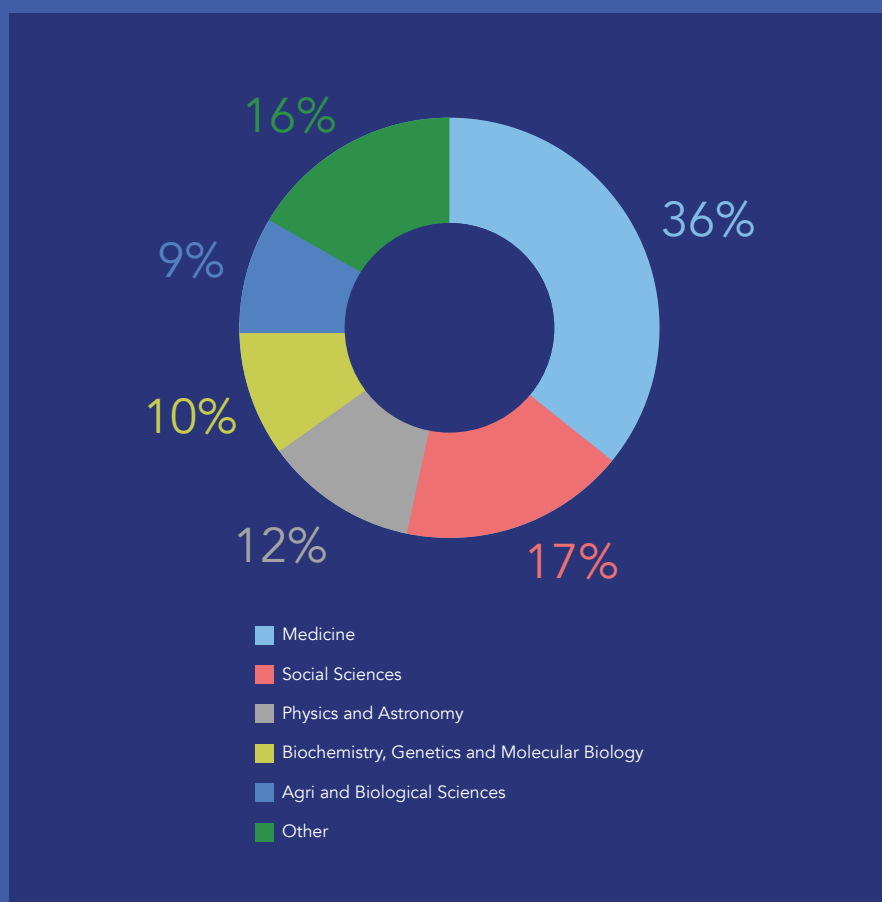


Figure 4: Knowledge fields that make up the 2018 Scopus indexed research

THE JOURNALS IN WHICH WITS AUTHORS PUBLISH MOST ARE LISTED BELOW

79
PLOS ONE

62
SOUTH AFRICAN
MEDICAL JOURNAL

49
JOURNAL OF HIGH
ENERGY PHYSICS

36
PHYSICS
LETTERS B

34
PHYSICAL
REVIEW D

PUBLICATIONS IN THE MOST IMPACTFUL JOURNALS

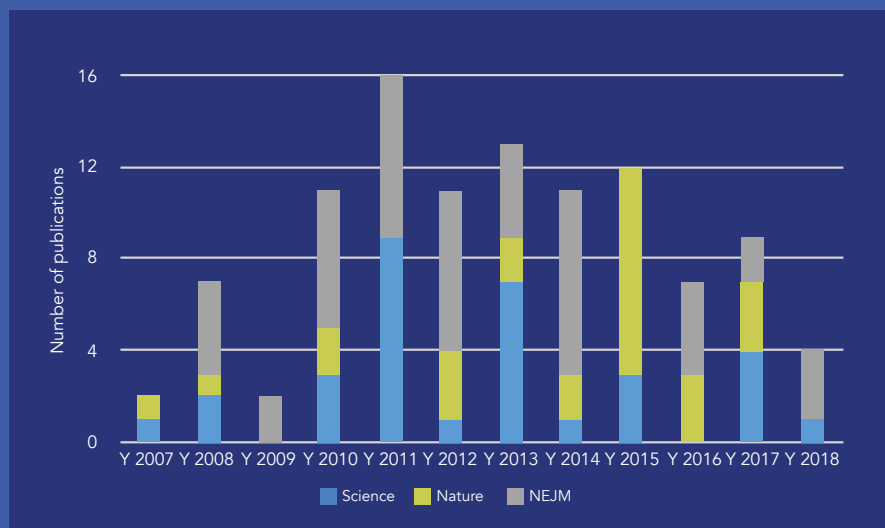


Figure 5: Number of Wits-authored journal articles in high impact factor journals

Wits produced about one third of South Africa's top quality research in 2018. Our fractional author count is much lower showing that this research is as a result of extensive collaboration which we see as a positive achievement.

RESEARCH WITH IMPACT

An analysis of research by numbers only cannot give the full account of its impact. The benefit of the knowledge created in 2018 to society and the economy is the true value of this research. It is also important to recognise that research contributes to the quality of teaching in a university. The impact can be expressed qualitatively through the description of case studies.

OUR PEOPLE

Research is entirely dependent on the calibre of the academic staff of the university. It is their talent, understanding and curiosity that enable research. Wits is proud to recognise many excellent scholars across the campuses, hospitals and research sites that make up the University. There are far too many to name but here are some indicators of the talent that Wits enjoys:

30 SOUTH AFRICAN RESEARCH CHAIR HOLDERS

457 NRF RATED RESEARCHERS, INCLUDING 28 A-RATED SCHOLARS

Wits also enjoys a number of people who are recognised by the ISI index as Highly Cited Authors (authors who are ranked in the top 1% of their field globally by citations). In 2018 Prof. Lee Berger and Prof. Lynn Morris held such an accolade. Both were also recognised in 2017. Others who have been recognised in previous years include Professors Chris Mathew, Christopher Henshilwood, Francesco D'Errico, Lyn Wadley and Rachel Jewkes.

YEAR	NAME 1	NAME 2	NAME 3
2018	Lee R Berger	Lynn Morris	
2017	Lee R Berger	Lynn Morris	
2016	Chris Mathew	Christopher Henshilwood	Lynn Morris
2015	Chris Mathew	Francesco D'Errico	Lynn Morris
2014	Lyn Wadley	Rachel Jewkes	Christopher Henshilwood

The Nature Index is a way of assessing the quality of publications. It uses a list of journals from different knowledge fields and counts the number of publications and the fractional author count. The 2018 statistics are reflected below.

UNIVERSITY OF CAPE TOWN



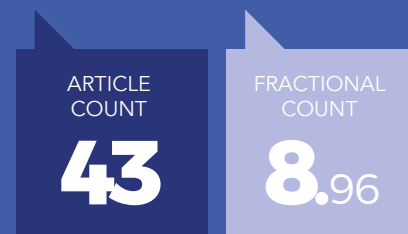
UNIVERSITY OF THE WITWATERSRAND



STELLENBOSCH UNIVERSITY



UNIVERSITY OF KWAZULU-NATAL



UNIVERSITY OF PRETORIA





PROFESSOR ROBERT MUPONDE

Director: Postgraduate Affairs

"The University seeks to become 45% postgraduate by 2025."



BUILDING WITS' POSTGRADUATE CAPACITY

The Postgraduate Affairs Office has developed several new ground-breaking projects which are set to propel the University as it seeks to become 45% postgraduate by 2025.

One such project was to support students from the Postgraduate Association who wanted to develop postgraduate networks and collaborations in the Southern African Development Community and beyond. The students who pioneered this idea built significant relationships with their counterparts at the University of Botswana, the Botswana International University of Science and Technology, and other universities, which led to the establishment of the Postgraduate Network. The Network is now run by innovative and courageous postgraduate students who exude a positive, ambassadorial role for Wits and who are keen on showcasing the best of Wits. It is likely to become a sub-Saharan Project.

The ninth postgraduate cross faculty symposium was held in October 2018 at which incredible research from across all faculties was showcased by Masters and PhD students.

Due to its popularity and immense success, the Office will now introduce new aspects such as the one-minute video presentation competition, where students have to show technical and imaginative prowess by presenting their research in video-form in 60 seconds.

The Office also partially funded writing retreats with measurable outcomes in one faculty. It was found that writing retreats, one-on-one consultations with students and editing are key activities to retain students' interest in pursuing their doctoral studies. A critical pilot project was funded in another faculty which will review Masters and PhD examination guidelines and practices in order to reduce the amount of post-examination administration and the frequency of time-consuming ad hoc committees. The results will be shared with all faculties.

The University-wide automation of postgraduate admissions systems is underway with the first phase due to be rolled-out in 2019. Overall, it has been a strong developmental year for postgraduate affairs, with many projects in the pipeline that will be realised as Wits approaches its centenary year.



PROFESSOR IMRAAN VALODIA

Dean: Faculty of Commerce, Law and Management

FACULTY OF

COMMERCE, LAW AND MANAGEMENT

Situated in the economic hub of the African continent and connected to the most powerful and influential industrial, commercial and social agents in the country, the Faculty of Commerce, Law and Management (CLM) pursues a vibrant research agenda that changes the way that business, law and economics is practiced in the country. The Faculty also contributes towards setting public policy in multiple fields.

Producing research with impact is a priority for the Faculty which continues to build its reputation and collaborative networks in the areas of economics, finance, business, law, governance and public administration.

In 2018, the Faculty maintained its performance in research productivity, publication output, and the number of PhD and Masters degree completions. Much effort has been

focused on building research capacity and productivity at the School level. The Faculty's research footprint in 2018 included over 200 journal articles and contributions to approximately 50 scholarly books, and numerous local and international conference proceedings. It recorded its highest ever output at over 250 publication units.

Individual schools continue to make significant progress such as the School of Law, which maintains its QS subject area ranking and has had a record number of research output units, up nearly 20% from 2017, including over 50 journal articles.

The Wits School of Governance also recorded its highest ever output and is up 30% from 2017. The School of Accountancy is proving to be one of the most research-active schools of its kind, and has recorded over 35 units,

50

NRF-RATED
RESEARCHERS

200

JOURNAL ARTICLES

250

PUBLICATION UNITS



with over 25 journal articles and 20 conference papers published in the 2018 period.

The School of Economic and Business Sciences and the Wits Business School have maintained excellent levels of productivity, with well over 80% of article outputs from the latter appearing in international journals. The Faculty continues to host numerous public lectures and debates on topics of contemporary national and international interest. It also continues to host and edit prestigious international journals in the areas of law and finance.

The Faculty boasts over 50 NRF-rated researchers, a reflection of its success in the attraction and retention of high-quality staff. Nearly 50% of all permanent staff in the Faculty hold PhDs. It is growing the cohort of postdoctoral fellows and has set aside funds to support this as an initiative to grow research capacity.

The *Life in the City* project funds PhDs and postdoctoral students in creative ways through looking at challenges in Johannesburg. The Faculty's professors continue to be inducted into prestigious national academies and international societies.

In 2018, the Faculty brought two new centres on board – the Energy Leadership Centre and the Southern Centre for Inequality Studies, which adopts a multidisciplinary approach to understanding and addressing inequality in the global south. The Faculty also announced a new South African Research Chair in Equality, Law and Social Justice. New Chairs in Digital Business and in African Philanthropy were also welcomed. They complement existing Chairs, Distinguished Professor appointments, and numerous high-

profile figures from the public and private sectors that have joined the Faculty.

The Faculty has been successful in pursuing its research goals and strengthening its research profile. It continues to draw on its unique combination of expertise, to grapple with and contribute solutions to the economic and social challenges facing South Africa and, more broadly, the developing world. The impact of research is reflected in how Wits is increasing its African footprint, influencing public policy, informing judgments by the courts, and transferring new knowledge to the Faculty's curricula ensuring that Wits students are at the leading edge of their professions.



“In 2018, the Faculty brought two new centres on board – the Energy Leadership Centre and the Southern Centre for Inequality Studies.”



"We can show the correlation between food prices and crime in different provinces – but correlation is not causation. What we try to do in the paper is identify the causal effect and to do that, we have to exploit differences in these prices in different provinces at different times," says Roberts.

While Roberts acknowledges that it is difficult to identify causality in applied microeconomics, a key finding from the study is that a relative increase of food prices leads to an increase in certain types of crime. Conversely, an increase in the relative price of beer resulted in a decrease in some crimes.

"We show that an increase in the relative price of food leads to an increase in many types of violent crime and theft, while an increase in the price of beer generally does the opposite, including for crimes of a sexual nature. This tells us that there is a socioeconomic component to the high level of crime in South Africa. It also tells us that the availability of alcohol plays a role," explains Roberts.

However, it's almost impossible to know exactly why the increase in beer prices leads to a decrease in the numbers of crimes of sexual violence.

THE FIGHT IN FOOD PRICES

New research demonstrates the link between a relative increase in food and beer prices with levels of crime and violent behaviour.

To say that South Africa is a country with high levels of violence is not new – the crime statistics shock us every year. It is to be expected that our divided past will affect us but the reasons behind the nature of our society today are deeper than trans-generational trauma.

While the causes of violence and the links between poverty and mental illness have been researched globally, and to an extent locally, a new paper has found that relative increases in food and beer prices can be linked to crime levels and violent behaviour in South Africa.

The Effects of the Price of Food and Beer on Crime in South Africa is a paper authored by Dr Gareth Roberts, Professor Tendai Gwatidzo and Dr Dambala Kutela from the School of Economic and Business Sciences at Wits.

The researchers looked at the South African Police Service's crime statistics in every province for each month between January 2008 and March 2012. They combined the crime statistics with data released by Statistics South Africa on the consumer price indices of different goods and service categories in these provinces. This allowed them to estimate the impact of food and beer prices on crime. However, methodological constraints make it difficult to determine in which provinces the impact was the highest.

"One possible explanation is that the consumption of alcohol is sometimes associated with aggression and with people not being as alert as they normally would be. If the price of beer goes up and a person has one less beer, this may reduce their chances of becoming more aggressive, or of being less alert," says Roberts.

The research also touches on the topic of hunger. The authors hypothesise that a possible explanation for rising food prices and corresponding increased levels of theft is that hungry poor people may have to steal to feed themselves.

"In the case of beer, we suspect that a relative increase in the price of beer reduces consumption at the margin – that is, consumers now have only one beer instead of two and are less likely to become aggressive and less likely to be exposed to theft. That said, this is only an overall net effect – it's possible that people could steal to afford beer."

The study may have implications for policy, as it's possible that the VAT zero rating on certain items of food, and sin taxes, reduce crime. Policy-makers should also plan for a possible spike in crime when food prices increase.

"This may happen if the domestic production of food becomes constrained in some way. However, it's difficult to generalise beyond the main findings at this stage," says Roberts.



ADDRESSING AFRICA'S ENERGY CHALLENGES

The energy landscape in Africa is changing dramatically. Opportunities abound for investments, partnerships and other initiatives in the sector, particularly in oil and gas and renewable energy. The World Bank's Africa Energy project portfolio currently carries 48 projects totalling 3 billion US dollars. From Uganda, to Kenya, to Morocco, new projects are being implemented at a rapid pace.

In addition, Africa is blessed with an abundance of natural resources for energy generation - good solar radiation and wind, as well as substantial reserves of natural gas, oil and coal. Despite all these resources, Africans are still experiencing severe energy shortages. According to the International Energy Agency, 625 million people are without power in sub-Saharan Africa alone.

It is estimated that the energy supply bottlenecks and power shortages cost Africa between 2% and 4% of gross domestic product every year, undermining economic growth, job creation and investment.

It is against this background that the Wits Business School established the Africa Energy Leadership Centre in 2017, in partnership with the Chemical Industries Education and Training Authority.

"The Centre is the first of its kind in Africa and aims to address the critical issues of energy shortages in Africa as well as the skills deficit in an industry which is of vital importance to economic growth on the continent," says Professor Rod Crompton, Director of the Centre.

"This country and continent needs highly skilled and knowledgeable leaders to oversee the growth and development of the burgeoning energy sector in Africa. It is fitting for Wits to be spearheading the drive to develop people to take Africa's energy sector into the future," he adds.

The Centre, a hub of new research and teaching, developed two new academic programmes – a Masters degree and a postgraduate diploma in the field of Energy Leadership.

"These programmes are aimed at professionals who are interested in following a career, or enhancing their existing career, in energy management," explains Crompton. "The curricula will provide candidates with a solid foundation in all aspects of energy and energy

management to help develop a new generation of decisive, effective and solutions-oriented leaders that the sector so badly needs."

Core modules cover everything from energy demand and supply, the role of energy in macroeconomics, strategic management of energy innovation, environmental sustainability, investment, ethics, and policy, among others. The School is also inviting doctoral candidates to pursue a PhD to build on the body of knowledge and develop new research in African energy leadership.

"The energy sector in Africa is an exciting place to be. It is becoming increasingly interconnected and interdependent. And apart from the exponential technological change and innovation is the global transition to cleaner energy," adds Crompton. "From natural gas, oil, coal, hydro and nuclear to renewable energy, rooftop solar PVs, energy storage technologies, hydrogen, fuel cells, electric vehicles, distributed generation, mini and micro grids, DC transmission and distribution, smart metering, energy efficiency and energy management, ICT and artificial intelligence, Africa has a mix of energy technologies and capabilities. We now need to develop the leadership skills to manage change and transformation."



PROFESSOR ROD CROMPTON
Director: Africa Energy Leadership Centre



PROFESSOR IAN JANDRELL

Dean: Faculty of Engineering and the Built Environment



FACULTY OF

ENGINEERING AND THE BUILT ENVIRONMENT

The Faculty of Engineering and the Built Environment is the proud home of seven schools, two 21st Century institutes and six externally funded centres. The newest centres are the Centre in High Voltage Engineering and the Specialisation Centre for Combustion Engineering.

The Faculty remains at the cutting edge of research which crosses many disciplines and includes collaborations with other academics, government and the private sector across South Africa and beyond. The 2018 NRF-rated researchers stand at 40, of which 1 is A-rated, 6 are B-rated, 22 are C-rated and 11 are Y-rated.

The Faculty hosts four Department of Science and Technology / National Research Foundation South African Research Chairs. Three of these are hosted in the School of Chemical and Metallurgical Engineering: Clean coal technology; Sustainable process engineering (headed by Professor Thokozani Majosi) and Hydrometallurgy and Sustainable Development (headed by Professor Sehliselo Ndlovu). The fourth Chair in Spatial Analysis and City Planning is headed by Professor Philip Harrison and is hosted in the School of Architecture and Planning.

40

NRF-RATED
RESEARCHERS

1

A-RATED
NRF
RESEARCHER

6

B-RATED
NRF
RESEARCHERS

22

C-RATED
NRF
RESEARCHERS

11

Y-RATED
NRF
RESEARCHERS



Professor Sehliselo Ndlovu



Professor Craig Sheridan

THE FACULTY HAS HAD SEVERAL ACHIEVEMENTS IN 2018

- Dr Sechaba Maape, Professor Ariane Janse van Rensburg, Anita Szentesi and Mike Dawson from the School of Architecture and Planning won the 2018 Vice-Chancellor's Team Teaching Award for their innovative and transformed approach to first year design in the Bachelor of Architectural Studies degree.
- The first dedicated Welding Research Laboratory at a South African university to support industry with welding research problems and investigate new and novel approaches to welding applications was completed in the School of Chemical and Metallurgical Engineering.
- The School of Chemical and Metallurgical Engineering produced the presidents of both learned societies of the professions taught by the School: Professor Sehliselo Ndlovu (pictured above) as President of the South African Institute of Mining and Metallurgy and Professor Craig Sheridan as President of the South African Institution of Chemical Engineers (South African branch).
- The establishment of the Centre in Water Research and Development, one of Wits' flagship research centres for the coordination of water research across all schools and faculties at Wits was a highlight, including the appointment of Professor Craig Sheridan (pictured above) as its first director.
- Professor Beric Skews from the School of Mechanical, Industrial and Aeronautical Engineering was awarded an NRF A-rating for the fifth consecutive time. He was also awarded the John Weston Gold Medal by the Aeronautical Society of South Africa and he delivered the John Weston Memorial lecture. Professor Skews is the Director of the Flow Research Unit which organised the 23rd International Shock Interaction Symposium with delegates from 12 countries. Further, two doctoral and three Masters students graduated from his group.
- Professor Michiel Postema was appointed Distinguished Professor in Biomedical Engineering until September 2021. He works on the ultrasonic manipulation of cells and antibubbles and high-speed photography.
- Professor Richard (Dick) Minnitt was bestowed with the title of Emeritus Professor in the School of Mining Engineering, effective from January 2018.
- Professor Claudia Polese was approved as a Fellow of the Royal Aeronautical Society and was invited as a speaker at the Laser Applications Conference in Boston in November 2018. She also won the Faculty's Supervision Award in recognition of her outstanding contribution to postgraduate supervision.
- The Laser Shock Peening Research Group within the School of Mechanical, Industrial and Aeronautical Engineering developed a process diagnostic system which was patented in South Africa, Europe and China. Since this innovative tool can play a major role in the establishment of South African laser-based technologies, the group received seed funding from the Technology Innovation Agency for developing the "heartbeat" of Laser Shock Processing. Another provisional patent on laser shock peening was filed and the Patent Cooperation Treaty application was published in November 2018.



"The Faculty hosts four
Department of Science and
Technology / National Research
Foundation South African
Research Chairs."





AN EYE ON **ASSISTIVE TECH** AT HOME

Eye-gaze devices as assistive tech have the potential to empower people with disabilities by improving their independence at home.

Wits biomedical engineer Dr Adam Pantanowitz discovered that he had a neuromuscular condition as a teenager. Since then, the Lecturer in the School of Electrical and Information Engineering has researched the potential of technology to empower people with disabilities. In particular, he has explored the untapped potential of the brain through brain-computer interfaces (BCIs).

THE BRAIN AS A NETWORK DEVICE

In an experiment believed to be a world first, Pantanowitz and colleagues incorporated the human brain as a computer network. Dubbed 'BrainConnect', the proof-of-concept innovation is under review for publication in the journal *Communications in Information Systems*.

The researchers connected two computers through the human brain and successfully transmitted words like 'hello' and 'apple', passively, without the user being aware that a message is present.

"We don't know of anywhere else where the brain has been used to connect two disconnected computers so this

presents an interesting theoretical system with a human literally being 'in the loop'," says Pantanowitz, co-author of the paper with Wits alumni Rushil Daya and Michael Dukes.

MORSE CODE VIA LIGHT SIGNALS

BrainConnect links light, signal transmission, the visual cortex of the human brain, and two computers. It works by attaching a device to a person's head, which links the two computers.

The person passively stares at a flashing light whilst a word, for example, 'apple', is encoded in the light signal. The flashing light stimulates the visual cortex in the brain and an electroencephalogram [EEG – a measurement that detects electrical activity in the brain] wirelessly transmits information to a second computer, which decodes the signals to appear on the second computer.

"You can think of it like Morse code via light signals," says Pantanowitz. BrainConnect can decipher up to 17 symbols at a rate of four seconds per symbol. The more relaxed the person is, the greater the possibility of invoking a response through this 'steady state visually evoked potential'.

VISIONARY ASSISTIVE TECH

Although BrainConnect is fledgling research, Pantanowitz says this brain-computer interface may have applications in eye-gaze devices, which allow for the control of the environment by detecting where gaze is focussed.

In a similar project, Wits students Kimoon Kim and Chelsey Chewins worked with Pantanowitz to create an eye-tracking system to interface more naturally with a computer. This project enables you to control your computer using a mouse that you control with your eyes.

"BrainConnect works through light stimulus of the visual cortex. Similar eye-gaze devices already serve as assistive tech to empower motor-impaired people or paraplegics," he says.

FRUGAL INNOVATION IN AFRICA

He cites futurists who predict greater human-tech integration by 2030. The Fourth Industrial Revolution [4IR] is a feature of 21st Century society – human beings are now deeply connected to tech through smart phones and other close-contact devices. Research in South Africa and Africa, similar to this engineering innovation at Wits University, has the potential to advance 4IR.

"Africa's challenges need unique solutions. The brain research is being conducted under what's known as a 'frugal innovation', where low-cost equipment and innovative approaches keep costs down," says Pantanowitz.

ROBOTIC HANDS AND BRAINTERNET

Another of his similarly frugal innovations was a basic robotic hand, the prototype of which cost just R1 800 in South Africa, compared to a budget of close to a million Euros for a similarly functioning device in Europe. Pantanowitz and Wits students Graham Peyton and Rudolf Hoehler created a device with similar intentions to the European model, using the same technology of gazing at light to turn the device off and on.

Pantanowitz previously also pioneered 'Braininternet', where he connected the human brain to the internet in real time and streamed brainwaves onto the internet. He says that for people with epilepsy, for example, Braininternet could potentially predict the next seizure. "If they get into a particularly bad space, they could alert their friends and family without them being able to do so physically."

Pantanowitz says, "There is potential for us in Africa to advance brain-computer interfaces and other assistive technologies, which could empower people with disabilities to control their environments with greater ease, and their homes are one context in which this can be life-changing."





SAND SWEEPS WATER CLEAN AT HOME

Wits scientists are developing technology to purify water with sand and are exploring how the natural environment functions in rural communities in southern Africa.

The slow sand filter method has been used for centuries to treat water. It's so effective that the World Health Organization has given it its stamp of approval: "Under suitable circumstances, slow sand filtration may be not only the cheapest and simplest but also the most efficient method of water treatment."

However, this method has mostly been used on a large scale and isn't suitable for the thousands of South African households who battle daily to have clean drinking water in their homes.

Busisiwe Mashiane, a chemical engineering student in the School of Chemical and Metallurgical Engineering at Wits, is researching and developing a slow sand filter to meet the needs of South Africans.

"Many South Africans living in disadvantaged communities across the country not only have difficulties accessing water but also face many health risks due to the lack of access to clean drinking water," explains Mashiane.

"Our aim is to develop a low-cost but highly efficient water treatment system that can treat river water effectively and make it consumable. We want to ensure that even though people in these communities cannot afford elaborate water treatment methods, our system can assist in their basic human right of having access to clean potable water."



Busisiwe Mashiane

HOW IT WORKS

A continuous water flow from a 25 litre tank feeds into a reactor tank (the sand bed). From here the water flows into a 25 litre transparent sterilisation tank, after which the clean water can be dispensed into a storage container for use.

The sand bed in the reactor tank is made up of layers of fine gravel, then activated carbon, and finally coarse gravel and fine sand.

A layer of biological matter, called the *schmutzdecke*, forms on top of the sand and the *schmutzdecke* in the water is prevented from flowing through the sand. This layer of biological matter ensures that the filtered water is free of harmful bacteria and pathogens, while the sand bed strips the physical impurities out of the water.

"Our research project is aimed at figuring out the mechanisms of the slow sand filter, to see how it functions under different conditions, and to find ways to optimise it," said Mashiane, adding that the plan in future is to take the project out of the lab and into homes where it can make a difference in people's lives.

"We want to discover what its limitations are and eventually find the best way to replicate the design and easily cut down the set-up time which is currently between three to four months due to the need to wait for the biological layer to form."



"The sand bed in the reactor tank is made up of layers of fine gravel, then activated carbon, and finally coarse gravel and fine sand."



PROFESSOR MARTIN VELLER

Dean: Faculty of Health Sciences



“The Faculty of Health Sciences celebrated a number of notable achievements pertaining to research in 2018.”



FACULTY OF

HEALTH SCIENCES

The Faculty of Health Sciences is well known for its internationally recognised, cutting-edge research. In 2018, the Faculty produced 574 research publication units through its seven schools. Postgraduate throughput included 59 PhD completions, 66 Masters by research graduates, and 274 Masters by coursework and research graduates.

The Faculty of Health Sciences celebrated a number of notable achievements pertaining to research in 2018, some of which are highlighted below.

Professor Shabir Madhi, Director of the Medical Research Council/Wits Respiratory and Meningeal Pathogens Research Unit (RMPRU) was elected as a fellow of the prestigious World Academy of Sciences. He is renowned for his pioneering work in researching vaccine-preventable diseases and is one of four South Africans among the 55 new Fellows elected into the

Academy in 2018. Professor Lynn Morris won the Academy's prize in the medical sciences category.

Researchers in the RMPRU also published a landmark paper in the *New England Journal of Medicine* demonstrating that pregnant women vaccinated against influenza have 50% less pertussis infection than those not vaccinated. The paper was co-authored by Associate Professor Marta Nunes, Dr Clare Cutland and Professor Shabir Madhi..

Professor Laetitia Rispel was elected as the President of the World Federation of Public Health Associations. She holds the South African Research Chair that focuses on the Health Workforce for Equity and Quality.

Professor Stephen Tollman, Director of the Medical Research Council/Wits Rural Public Health and Health Transitions Research Unit (Agincourt) and the Health

574

RESEARCH
PUBLICATION UNITS

59

PHD DEGREES

66

MASTERS BY
RESEARCH
GRADUATES

274

MASTERS DEGREES BY
COURSEWORK AND
RESEARCH REPORT



PROFESSOR BAVESH KANA

Head of the DST/NRF Centre of Excellence in Biomedical TB Research

and Population Division in the School of Public Health, received a prestigious National Science and Technology Forum Management Award, which recognises excellence through management and related science, engineering, technology and innovation activities by an individual over five to 10 years.

Wits scientists pioneered a process to detect *Mycobacterium tuberculosis* (Mtb) by adding a molecule to the bacteria's own armour that lights up under fluorescent light. In a paper published in *Science Translational Medicine*, authors report that Mtb specifically can be detected with a fluorescent trehalose analog. Patients with TB can now be more accurately and quickly diagnosed and treated. Professor Bavesh Kana, Head of the Centre of Excellence in Biomedical TB Research co-authored the paper.

Dr Gbenga Olorunfemi received a Certificate of Commendation at the Faculty prize-giving to acknowledge his significant research into cervical cancer, which is among the leading cancers that kill South African women, along with breast cancer.



PROFESSOR LAETITIA RISPEL

Professor of Public Health

Research Professor Patrick Arbuthnot, Director of the Antiviral Gene Therapy Research Unit, was the recipient of the Vice-Chancellor's Research Award for his work in the field of advancing the use of gene therapy to treat the hepatitis B virus infection and liver cancer.

Finally, in a world first, surgeons from the Wits Donald Gordon Medical Centre performed the first living donor liver transplant from an HIV-positive mother to her critically ill HIV-negative child with end-stage liver disease. In a paper published in the journal *AIDS*, Wits scientists, surgeons and ethicists explain how a chronic shortage of organs compromise their efforts to save lives, and how the decision to perform a world-first operation could advance transplants. Read more overleaf.

It has been a pleasing year overall for the Faculty from a research perspective and I would like to extend my deep appreciation to all those who contributed to raising the Faculty's research profile in 2018.



WORLD'S FIRST INTENTIONAL HIV+ LIVER TRANSPLANT

Would you rather die of liver failure or live with HIV?

This was the ethical dilemma faced by doctors at the Wits Donald Gordon Medical Centre on how to save a child's life. In 2017, doctors from the Transplant Unit at the Wits Donald Gordon Medical Centre performed what is believed to be the world's first intentional liver transplant from a mother living with HIV to her critically ill HIV-negative child, who had end-stage liver disease. More than a year later, the mother and child recovered - however, doctors are unsure of the HIV-status of the child. In South Africa, a country with the largest anti-retroviral therapy (ART) programme in the world, people with HIV live long and healthy lives. The success of this world-first operation presents a potential new pool of living donors that could save additional lives.

In a paper published in the peer-reviewed journal *AIDS* in October 2018, experts in surgery, ethics and HIV from Wits explain how a chronic shortage of organs compromise their efforts to save lives, and how the decision they made to perform a world-first operation could advance transplantation.

Professor Jean Botha, principal investigator and transplant surgeon from the Department of Surgery says: "Two aspects of this case are unique. Firstly, it involved an intentional donation of an organ from a living HIV-positive individual. Secondly, pre-exposure prophylaxis [medication to protect at-risk individuals from contracting the HI virus] in the child who received the organ may have prevented the transmission of HIV. However, we will only know this conclusively over time." He is also the Director of Transplantation at the Transplant Unit at the Wits Donald Gordon Medical Centre.

STRINGENT ADHERENCE TO ETHICAL GUIDELINES

In this case of transplanting liver from an HIV-positive donor to a non-infected recipient, the transplant team had to unpack the potential risks and benefits to both. The Human Research Ethics Committee (Medical) at Wits approved the liver transplant from the mother living with HIV to her HIV-negative child. Their personal details remain confidential.

The child – on the waiting list for a deceased donor for 180 days (the average is 45 days) – was frequently admitted for life-threatening complications of end-stage liver disease. Without the transplant, the child would have certainly died. However, saving the child's life needed to be balanced against harm to the donor and the risk of almost certainly transmitting HIV if the mother was the donor.

Dr Harriet Etheredge, a medical bioethicist who holds an honorary position in the Department of Internal Medicine, oversees ethics and regulatory issues at the Centre says: "Extensive efforts were made to identify either a deceased liver donor or an HIV-negative living donor for the child before considering an HIV-positive parent donor. Transplanting HIV-positive organs is not illegal in South Africa; however, it is not considered best practice internationally because of the risk of HIV transmission to the recipient. To minimise risk to donors and recipients, this operation is offered only under exceptional circumstances. Full consent is required from the parents who must be able to care for a child infected with HIV."

In this transplantation case, the mother asked a number of times for the opportunity to save her child's life by donating a segment of her liver. For this mother, quantifying the risk was simpler than for the transplant team. HIV clinician, Dr Francesca Conradie says, "When considering an HIV positive parent, it is important that they have an undetectable viral load. This means that they know they are HIV positive and that they have been taking their antiretroviral medication properly for at least six months."

INTENTIONAL TRANSMISSION OF HIV TO SAVE A LIFE

The transplant team faced the dilemma of saving the child's life while at the same time knowing that he or she might end up HIV positive because of this decision. However, because this intentional HIV positive living donor liver transplant was likely a world first, the actual chance of transmitting HIV was unknown.

The team decided to work on the basis that the child would contract HIV, and provide management accordingly. But in the time since the transplant, there have been some surprises when it comes to the child's HIV status.

"In the weeks after the transplant, we thought that the child was HIV positive, because we detected HIV antibodies," says Botha. The transplant team then accessed specialised testing by HIV experts at the National Institute of Communicable Diseases that subsequently could not find any active HIV infection in the blood stream of the child, meaning there is a chance that the child is HIV negative.

Caroline Tiemessen, Research Professor in the School of Pathology and Head of Cell Biology within the Centre for HIV and STIs, explains "At the moment, we are developing new methods for testing the child, and we hope to be able to have a definitive answer to the question of seroconversion in future. For now the child will remain on ART until we have a more comprehensive picture."

EXPANDED ORGAN DONOR POOL TO ADVANCE TRANSPLANTATION IN AFRICA

More than a year since the intentional liver transplantation from a mother living with HIV to her HIV negative child, both donor and recipient have recovered from the operation.

Dr June Fabian, a nephrologist and Research Director at the Wits Donald Gordon Medical Centre says: "We have formalised this procedure as a research programme. As we offer this type of transplantation to more children, we hope to be able to draw more definitive conclusions."

Organ transplantation at the Wits Donald Gordon Medical Centre is offered to any person irrespective of income or demographic according to the "sickest first" criterion. This is possible through an existing partnership between the Centre and the Gauteng Department of Health. "We hope that this ground breaking operation will be the first of many like it and will contribute towards promoting justice and equity in liver transplantation in South Africa," concludes Fabian.



Dr June Fabian



Prof. Caroline Tiemessen



Dr Harriet Etheredge



Prof. Jean Botha

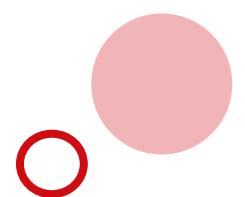
Not pictured: Dr Francesca Conradie



A GLOBAL BREAKTHROUGH

IN TREATING HAEMOPHILIA

Wits haematologist Professor Johnny Mahlangu was the lead author of a paper published in the *New England Journal of Medicine* in August 2018.



The Head of the School of Pathology in the Faculty of Health Sciences and Head of the Haematology Diagnostic Section in the Department of Molecular Medicine and Haematology at the University was involved in research that is set to revolutionise the treatment of haemophilia, a genetic blood disorder.

The HAVEN 3 study found that a new type of protein, emicizumab (trade name: Hemlibra), can be administered subcutaneously [under the skin], rather than intravenously [in the veins], and that it does not cause an immune response which prevents blood from clotting.

People with haemophilia bleed spontaneously, following trauma. The most common sites of bleeding are into joints,

but bleeds can also happen into any tissue in the body, including the muscles, brain, or eyes. Many bleeds can be life-threatening, organ-threatening or fatal. Haemophilia affects males only because it is an X-linked condition (males have one X chromosome, whereas females are obligate carriers as they have two X-chromosomes).

Haemophilia impairs the body's ability to make blood clots, the process needed to stop bleeding. Haemophiliacs are born missing a protein called the clotting factor and people who lack the clotting factor VIII (FVIII) have haemophilia A.

To treat haemophilia A, the missing clotting factor VIII must be replaced. The replacement therapy is given prophylactically [as a preventative measure] to prevent

In the multi-centre, global HAVEN 3 study, patients aged 12 years and older were given a skin injection of a new protein called emicizumab, which performs the same function as the missing FVIII. The injections were administered weekly in one group, every second week in another group, and then the patients' number of bleeds were measured when compared with those not receiving emicizumab.



"Subcutaneously administered emicizumab reduced the bleed rate by 96% in those getting weekly emicizumab and by 97% in those receiving fortnightly emicizumab when compared to those not receiving emicizumab," says Mahlangu.

Furthermore, 56% of patients receiving weekly emicizumab and 60% of those receiving fortnightly emicizumab did not experience any bleeding events while receiving emicizumab. For patients already on prophylaxis, there was a 68% reduction in bleed rate on emicizumab when compared with the normal FVIII prophylaxis.

"Hemlibra is a prescription medicine used to prevent or reduce the frequency of bleeding episodes in adults and children with haemophilia A with factor VIII inhibitors. In the HAVEN 3 study, Hemlibra showed a significant and clinically meaningful reduction in bleeds in people with haemophilia A without factor VIII inhibitors, while offering flexible subcutaneous dosing options," concludes Mahlangu.



PROFESSOR JOHNNY MAHLANGU

Head: School of Pathology

spontaneous bleeds. However, there are two challenges:

- FVIII replacement is done intravenously and many patients – especially children – have difficulty accessing veins, and
- The FVIII may elicit an immune response in which antibodies are formed towards the replacement FVIII, thus rendering the replacement useless and incapable of stopping the bleeding.



PROFESSOR RUKSANA OSMAN

Dean: Faculty of Humanities



FACULTY OF

HUMANITIES

In 2018, the Faculty of Humanities comprising of five schools, two institutes and several research centres, produced well over 400 accredited units. Despite the dip in outputs partially due to changes in journal and book accreditation criteria, the Faculty experienced significant growth in postgraduate throughput, and specifically the graduation of 59 PhDs, the highest number in a single year in its history.

The Faculty also inaugurated its PhD to Monograph initiative, thus moving towards its long-term strategic goal of embedding postgraduate research as an important driver for overall research productivity. The Faculty's outputs continue to encompass creative works alongside traditional research outputs, with the Department of Higher Education and Training (DHET) now moving to accredit these works in line with the Faculty's exemplar process that informed the development of formal policy.

In 2018, the Faculty increased its pool of A-rated researchers to five within the 87 staff rated by the National Research Foundation (NRF). This proportion of rated researchers is amongst the highest in the University. The Faculty also has seven South African Research Chairs, another marker of international research leadership among the disciplines and focus areas in the humanities around the world. The Faculty's African Centre for Migration Studies

400

ACCREDITED UNITS

59

PHD DEGREES



was recognised as a Centre of Excellence by the African Research Universities Alliance, making it the leading node of scholarship in this area on the continent.

Intra- and international collaborations with other universities continue to feature prominently in the Faculty's work, with several additional collective projects launched in 2018. Salient amongst these was the hosting of the *Mapping African Futures* Mellon Seminar series, which drew leading international scholars as keynote speakers and discussants to the Faculty. These collaborations provide important routes for broadening participation in research communities for emerging scholars in the Humanities disciplines, and thus, form a key part of the Faculty's transformation initiatives through opening access to networks while building the next generation of scholars.

Research income streams to the Faculty continue to be strong even in the midst of cuts in funding from traditional funders such as the NRF. In 2018, staff in the Faculty received large research grants (over R1 million) from a diverse range of national and international sources including the NRF, the DHET, and the Ford and Mellon foundations.

Alongside the research, Faculty staff members continue to produce a range of reports and policy briefs that are widely cited by academics and policymakers. This work feeds

"The Faculty increased its pool of A-rated researchers to five within the 87 staff rated by the National Research Foundation (NRF)."



into policy formulation across a range of fields including education, health, demography, migration and the labour market.

This work reflects an ongoing commitment in the Faculty to draw on its breadth of research expertise, to contribute to societal issues and debates as engaged academic citizens, while emphasising the value that the study of the Humanities can make towards more informed, and ethical decision-making. The staff and the outputs of the Faculty therefore remain in high demand in the national and international higher education and research landscapes.

DIVING DEEPER

IN A TIME OF DRYNESS

There's a salty distance between the known and the unknown, as if ocean depths have escaped interrogation despite water, the liquid of life, being impossible to ignore.

Finding ways to explore water and oceans differently requires a new kind of fluidity, the kind proposed by Oceanic Humanities. This new research and postgraduate project based in the School of Literature, Language and Media at Wits is headed by Professor Isabel Hofmeyr and is funded by the Mellon Foundation.

Hofmeyr says oceans are shouting out to be researched by humanities, rather than just from conventional entry points of marine science and engineering.

"Humanities research on oceans has primarily focused on what happens on the surface of oceans, like the backwards and forwards move of people and cargo. We need to go deeper. The oceans are literally getting closer as sea levels rise and climate catastrophe becomes our reality," she says.

It is also imperative that we find solutions to the burdens that our waste has on the oceans, which caused the floating plastic island predicament.

The Oceanic Humanities programme is a platform to tackle wide ranging themes – from finding solutions to our water crisis and reversing our environmental devastation, to exploring hydro-colonisation and the politics of sovereignty claims on mineral-rich sea beds exposed by receding polar ice.

"It's also about slipping under the surface of the ocean to explore things like marine archaeology, or looking at [the impact] of non-human actors like monsoons and

cyclones on people and societies. It's re-thinking human entanglement with oceans," she says.

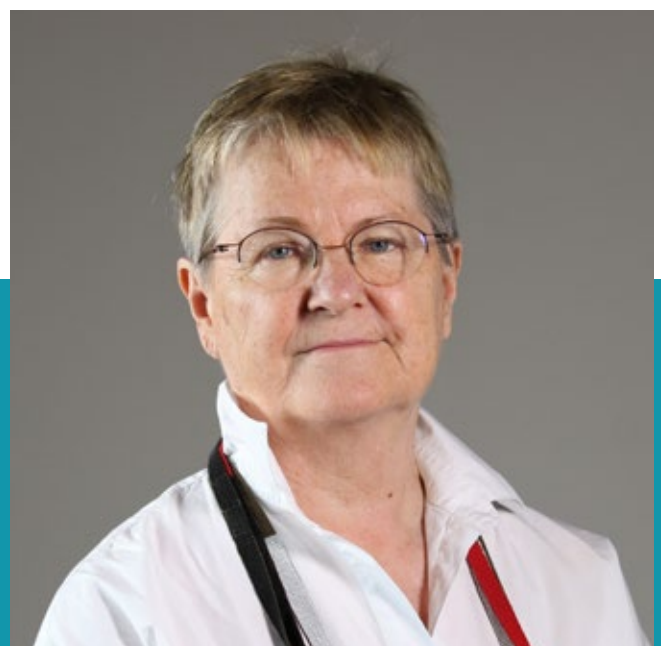
Teaching Oceanic Humanities deserves a shake-up too. Hofmeyr is no stranger to challenging conformity in pedagogy. In 2009 she participated in a project by former Wits students Molemo Moilola and Nare Mokgotho. They set out to probe the limits of public lectures, the barriers to learning, and the inherent exclusivity of universities and academia. Hofmeyr delivered a lecture – no different from what she would typically give in a classroom at Wits – to random commuters on their everyday train ride between Park Station and Phomolong in Soweto.

Hofmeyr also hosted a workshop called *Sound on Water* at the Wits Institute for Social and Economic Research. It brought together the diverse expertise of a musician, a musicologist, an engineer, and a social scientist. It was billed as "a workshop exploring ways to think with and through water in radically interdisciplinary ways".

The keyword is "interdisciplinary" because Oceanic Humanities seeks to grow connections beyond the limitations of an individual's field. The programme is also founded with strong global south links and emphasises partnerships with Mozambique, Mauritius, India, Jamaica and Barbados.

"It is about learning from each other and from the new connections that can change the conversations we are having about our oceans and seas, also our water," says Hofmeyr.

Talking and thinking water in a time of dryness demands collaboration, creativity and innovation. Taking a deep breath and plunging into the murky depths is an invitation to find the clues to make 'human' more resilient, more adaptive, and more respectful of one of our most precious resources.



PROFESSOR ISABEL HOFMEYR
NRF A-Rated Researcher



x x x

AT HOME IN THE **ARTS**

home: /həʊm/ noun

1. The place where one lives permanently, especially as a member of a family or household.

Arts: the theory and physical expression of creativity found in human societies.

For Dr Duduzile Ndlovu from the African Centre for Migration and Society (ACMS) at Wits, the way memory, identity and a sense of belonging keep changing – especially for migrants – makes art one of the most powerful ways to make meaning of dislocations, disorientations and journeys. It is also a way to process versions of truths and to find power in personal creative expression.

She argues that art, like indigenous wisdom, is a part of knowledge production that has depth and reveals clues to lived experience, even if it may remain outside of academic convention. She believes that art deserves increased academic inquiry to avoid becoming a blind spot that prevents transformation in academia.

Zimbabwe-born Ndlovu has lived in South Africa for 13 years. Through her research and poetry, she has explored the use of poetry, story, music and performance art in how she and other Zimbabweans living in Johannesburg remember the Gukurahundi. This was a series of massacres of Ndebele civilians by the Zimbabwe National Army between 1983 and 1987. Conservative estimates put the number of people killed in that period at around 20 000.

When you are thousands of kilometres away, 'home' may be what you carry in memories, but it might also be what you choose to forget.

HOSTAGE TO HOSTILITY AT HOME

"In Zimbabwe, Gukurahundi remains silenced from the public domain, although people continue to speak (about it) in ways that are not always clearly recognisable, to avoid a backlash from the government. There is no narrative to make sense of the event or to justify the experience as necessary in people's lives. This means the narrative of Gukurahundi is open to being reframed in different contexts," she says.

For many Zimbabweans living in South Africa, being away from home has opened up a space of freedom to speak out. And art has given them the tools to frame and reframe their stories for different contexts and different audiences.

"The idea of home is therefore a complex one. It is not necessarily the place of safety we think it should be," she says. Distance from home allows people to "constantly re-story their lives", creating versions of themselves to fit different spaces at different times.

"With art, we don't need to be after absolute truths. We're about asking questions about versions of the truth. Questions like 'whose voice gets heard?' and how official versions of the truth don't turn out to stand up over time," she says. "There is also a sense of hope in art; it creates a space that allows people to be, to be social, and even to take enjoyment in expressing and sharing."

These days, Ndlovu finds herself singing songs from her childhood to her children, who are growing up as South Africans. These songs connect her to Zimbabwe, she says. The words are reminders of what's been passed to her, a kind of birthright in lyrics, but they are reminders, too, that for her there is no "going back".

It doesn't leave her in an in-between space, though. Ndlovu stresses that it's not a case of being split or not feeling at home in either place. Rather, that she's still wholly and fully herself, existing in two different contexts.

Meghna Singh, a Research Associate at the ACMS relates to the contexts that Ndlovu speaks of as liminal spaces. They're the 'no man's lands' that Singh explores in her artistic video productions and installations.

Since Singh moved to South Africa from India in 2013, her works have included a short film called *Arrested Motion*. For nine months, she followed a group of Indian seafarers stuck in Cape Town as the supply ship they were working on was detained en route to Dubai from Nigeria.

"These men literally didn't know when they would be allowed to set sail again and they were caught up in a world of complex channelling of capital between shipping corporations," she says.

PRISON HOMES

Singh used the technique of observation film with no dialogue, and soundscapes, to create an immersive experience for her audience. Her art showed the passage of time and its effects on the bodies confined to a place that became both home and prison.

She did something similar in *Rusted Diamond* when, on and off for three years, she spent time with a group of Ghanaian men who were left to pump water daily from a rusted wreck they lived in, which was once a deep-sea diamond mining vessel in Namibia.

She also turned this film into an installation that included flooding three rooms at The Castle in Cape Town and asking people to enter, mostly on their own, to temporarily be immersed in these other worlds of precariousness.

"I am hoping that I am creating experiences for my audiences to think about how people on the fringes are caught up in capitalism, and how they are abandoned when capitalism moves onto the next thing. It is part of creating connection and empathy," she says.

Singh brings this visual methodology to her current research and art project called *Container*, in collaboration with her filmmaker partner, Simon Woods. The virtual reality and installation art piece has received funding and is expected to be completed soon.

Container makes visible the history of the slave trade and focuses on the São José Paquete Africa, a Portuguese slave ship that sank with 212 slaves on board en route to Brazil from Lisbon in 1794, near today's Clifton beach.

FORCED REMOVALS

The project hooks back to the present day, showing how more than 200 years later, people are still reduced to commodities, often forced from their homes to become modern-day slaves. They often moved in metal shipping containers across oceans, stuck here for weeks with the memory of home as a place of safety and sanctuary – or just the known – disrupted forever.

These are the contexts and lived experiences from which Singh and Ndlovu want people never to turn away.



Top left: *Rusted Diamond* by Meghna Singh
Left: Screen shots from *Arrested Motion* by Meghna Singh



PROFESSOR ROB VEALE

Acting Dean: Faculty of Science



FACULTY OF

SCIENCE

The Faculty of Science showcased its research outputs in over 800 peer evaluated publications and a series of book chapters and books in 2018. A record-breaking 100 PhD degrees, 152 Masters degrees by dissertation and 56 Masters degrees by coursework and research report were awarded in 2018.

Significant publications include a paper by Professor Andrew Forbes from the School of Physics in *Scientific Reports*, which demonstrated the world's first vector holographic trap, showing how complex vectorial light patterns could be used to control the micro-world by optical trapping and tweezing. This was highlighted by *Nature* as one of the top ten optical trapping advances to celebrate the Nobel Prize in Physics awarded to Arthur Ashkin in 2018.

Forbes received a prestigious A-rating from the National Research Foundation, together with Professor Roger Sheldon from the School of Chemistry. The Royal Society of Chemistry also admitted Sheldon as an honorary fellow. This rare distinction recognises his contribution to biocatalysis, green chemistry, and catalytic oxidation. He joins just 116 honorary fellows as a member of the oldest chemistry society in the world. In 2018, Sheldon's research titled *Metrics of Green Chemistry and Sustainability: Past, Present, and Future in ACS Sustainable Chemistry & Engineering* received significant attention.

Professor Rais Latypov and his geosciences team published a paper in *Nature Communications*, proposing a new model to explain the formation of economically significant chromitite layers in the Bushveld Complex, the world's

800

PEER EVALUATED
PUBLICATIONS

100

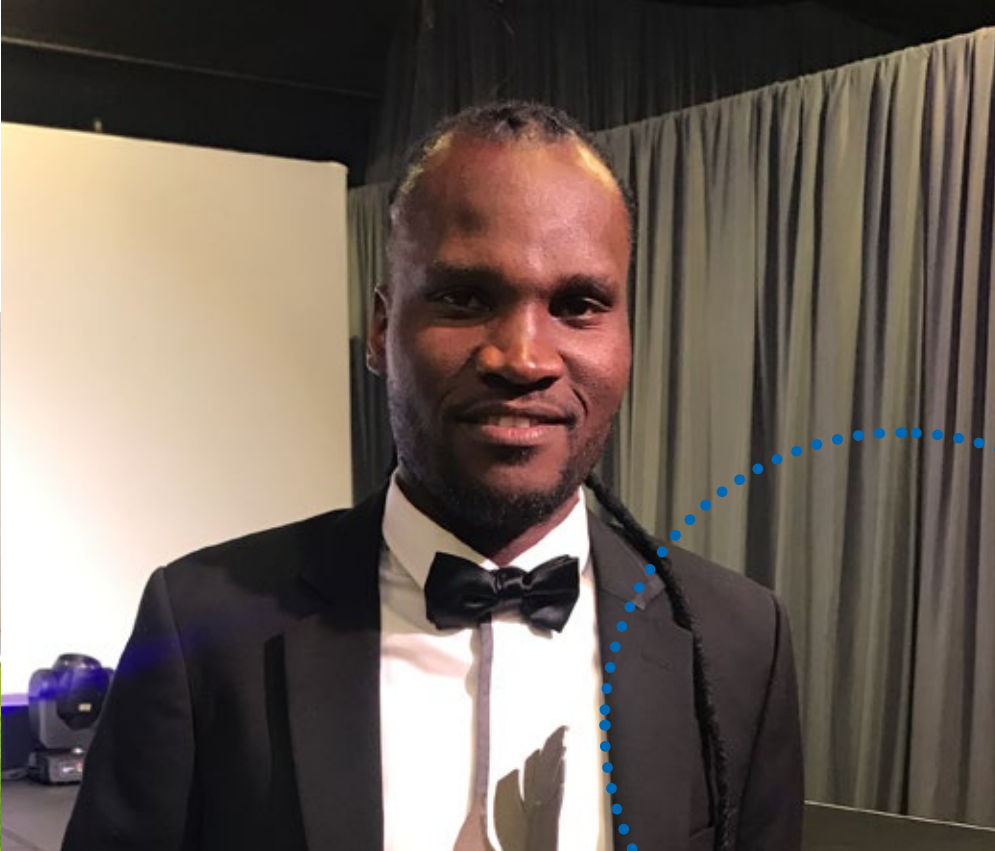
PHD DEGREES

152

MASTERS DEGREES
BY DISSERTATION

56

MASTERS DEGREES BY
COURSEWORK AND
RESEARCH REPORT



Professor Musa Manzi
Senior Researcher and Director: Seismic Research Centre,
School of Geosciences



largest source of platinum group elements. Dr Katie Smart from the School of Geosciences was a co-author on a paper in *Earth and Planetary Science Letters*, titled *Geodynamics of Kimberlites on a Cooling Earth: Clues to Plate Tectonic Evolution and Deep Volatile Cycles*.

Three staff members from the School of Geosciences also received major national awards in 2018 - Professor Musa Manzi received the 2018 TW Kambule-NSTF Emerging Researcher Award in recognition of his achievements over the past five years; Professor Grant Cawthorn was awarded the Geological Society of South Africa's Draper Medal for his outstanding contribution to the geology of South Africa; and Professor Lewis Ashwal was selected as the Geological Society of South Africa's 2018 Alex Du Toit Memorial Lecturer to deliver his talk *Wandering Continents of the Indian Ocean* at which he detailed his recent research results on reconstruction of plate tectonic movements in the Indian Ocean. Professor Ashwal's YouTube video on *The lost continent under Mauritius* has had more than 750 000 views since it was published.

From the School of Molecular and Cell Biology, Professor Stefan Weiss published on Alzheimer's disease in *Oncotarget*, which attracted media attention and was reported on in the *Sunday Times* in July 2018. In addition, Professor Bao-Zhu Gu from the School of Computer

Science and Applied Mathematics published three highly cited papers in *IEEE Transactions on Neural Networks and Learning Systems*. The School of Physics, through its involvement in the ATLAS, HESS and FERMI LAT collaborations also featured in a number of highly cited papers in journals such as the *Journal of High Energy Physics*, *Science and Physics Letters B* on topics such as dark matter and the Higgs boson. In 2018, the University also recognised the Institute for Collider Particle Physics led by Professor Bruce Mellado.

From the National Equipment Programme, the Faculty of Science secured four major pieces of equipment. Professor Orde Munro (Chemistry) secured a J-1500 Magnetic Circular Dichroism Spectrometer. Professor Daniel Wamwangi (Physics) obtained a PPMS DynaCool 9 (for magnetic and thermal property characterisation). Professor Martin Ntwaeaborwa (Physics) was awarded a FS25 Steady State Spectrometer and Professor Weiss (Molecular and Cell Biology) was awarded a SkyScan 1278 Ultra Low-Dose, High Throughput In-Vivo X-Ray Microtomograph. The total value of the instrumentation was close to R21 million.

On a sad note, Professor Sergio Colafrancesco, a radio astronomer who held the Square Kilometre Array Research Chair passed away in September 2018.



WITS SCIENTISTS CLOSER TO **SLOWING PROGRESSION** **OF ALZHEIMER'S DISEASE**

A breakthrough by Wits scientists could see patients with Alzheimer's disease use a nasal spray to slow down the progression of the disease, the main cause of dementia.

Alzheimer's, which starts out with loss of memory and problems with thought processing, becomes a debilitating disease as it progresses – it attacks parts of the brain that controls walking, coordination and even swallowing. Mood swings, aggression, repetition and volatile behaviour are typical as the disease takes hold, making life for patients, their families and caregivers difficult.

"If we can slow down the progression of the disease, we can dramatically improve the quality of life for patients, as well as extend their lifespan. In advanced stages, Alzheimer's can affect the functioning of the whole

body and eventually lead to death," says Stefan Weiss, lead researcher and Professor in the School of Molecular and Cell Biology in the Faculty of Science at Wits University.

Until now, there has been no cure for treating Alzheimer's, which viciously attacks brain cells when proteins group together and deposit amyloid-beta plaque. But Weiss and his team of researchers from Wits, including Dr Eloise Ferreira, Dr Monique Bignoux, Tyrone Otgaar, Nicolas Tagliatti, Katarina Jovanovic and (the late) Dr Boitelo Letsolo have discovered an antibody that targets the protein aggregation itself.

"We conducted mouse studies which showed that the anti-LRP/LR specific antibody rescues cells from A-beta induced cytotoxicity and A-beta secretion. What this means is that the antibody significantly reduces amyloid plaque formation, a hallmark for Alzheimer's disease. This suggested that the antibody might delay the progression of Alzheimer's disease in mice – it is the amyloid plaques which ravage brain cells," says Weiss.

He explains, "We administered the antibody nasally, twice a week for eight weeks. By effectively reducing amyloid plaque formation, we saw improvements in memory and cognitive functions in the mice."

Their study, funded by the South African Medical Research Council, was initiated in 2015. It has taken three years to conduct the study, analyse the results and publish the paper. Now Weiss and his team are planning Phase 1 of the clinical trials on 30 to 50 volunteers who have Alzheimer's.

The team expects to see similar results as with the mice: a significant improvement of memory and cognitive functions in the Alzheimer's disease patients. If the outcomes are as expected, it hopes to get regulatory approval on the nasal spray containing the anti-LRP/LR specific antibody. The nasal spray could then be available to Alzheimer's patients in the near future.

"We ideally need a pharmaceutical partner to be involved in this next study, to carry out further clinical trials and to subsequently commercialise the drug," says Anne Gabathuse, Innovation Support Manager at Wits Commercial Enterprise, which assists Weiss in further development and commercial negotiations.

Wits Enterprise's Innovation Support is mandated by Wits to manage and commercialise intellectual property that emanates from research at the University. Through the development of products, processes and services with social and economic impact, Innovation Support has worked with Weiss and his team to file for patent protection for the antibody.

Weiss is hopeful about the clinical trial on Alzheimer's patients and about the new possibility that the antibody treatment may bring: "Alzheimer's patients have had no way of tackling their disease, aside from medicines to reduce pain and discomfort. With the anti-LRP/LR specific antibody, there is the potential to actually target the protein clumping and stop the formation of amyloid plaque.

"Although we have not conducted any study into the potential of the antibody as a prophylactic drug for preventing Alzheimer's, it is certainly a possibility. For now, our focus is to have the antibody administered as a therapeutic for Alzheimer's disease patients."

Gabathuse adds: "This discovery is indeed a giant leap forward in the treatment of Alzheimer's disease and we are very excited about the recent results obtained from the mouse studies. We are looking forward to the next stage of the project, which is to investigate whether the compound will be as effective in humans as it has been in the mice."

She says the number of people living with symptoms of Alzheimer's disease globally is estimated at 35 million with the lives of millions of others – such as their families, colleagues and caregivers – indirectly affected. "It is clear to see what the far-reaching, positive impact of the antibody could be for society."



PROFESSOR STEFAN WEISS

Head: Biochemistry and
Cell Biology Laboratory





SHEDDING NEW LIGHT ON OPTICAL TRAPPING AND TWEEZING

Wits physicists demonstrate a new device for manipulating and moving tiny objects with light.

When you shine a beam of light on your hand, you don't feel much, except for a little bit of heat generated by the beam. When you shine that same light into a world that is measured on the nano- or micro-scale, the light becomes a powerful manipulating tool that you can use to move objects around – trapped securely in the light.

Researchers from the Structured Light Group in the School of Physics have found a way to use the full beam of a laser light, to control and manipulate minute objects such as single cells in a human body, tiny particles in small volume chemistry, and possibly on-chip devices.

While the specific technique, called holographic optical trapping and tweezing is not new, the researchers found a way to optimally use the full force of the light – including vector light that was previously unavailable for this application. This forms the first vector holographic trap.

"Previously, holographic traps were limited to particular classes of light (scalar light), so it is very exciting that we can reveal a holistic device that covers all classes of light, including replicating all previous trapping devices," says Professor Andrew Forbes, a Distinguished Professor in the School of Physics who heads up the Wits Structured Light Laboratory. "We have demonstrated the first vector holographic optical trapping and tweezing system. The device allows micrometer sized particles, such as biological cells, to be captured and manipulated only with light."

The final device could trap multiple particles at once and move them around just with vector states of light. The experiments for this study were performed by Nkosi Bhebhe as part of his doctoral studies. The work is published in *Nature's* online journal, *Scientific Reports*.

In conventional optical trapping and tweezing systems light is focused very tightly into a small volume that contains

small particles, such as biological cells. At this small scale (typically micro- or nanometres) the forces that the light can exert are significant, so particles can be trapped by the light and then controlled. As the light is moved, the particles will move with it. This idea won American scientist Arthur Ashkin the 2018 Nobel Prize in Physics. Originally, the light was controlled mechanically with stages and mirrors, but the idea was later improved on by moving the light around holographically, that is, by using computer generated holograms to control the light without moving parts, thereby controlling the particles. Until now only special classes of laser beams, called scalar beams, could be used in such holographic traps.

In their paper titled *A vector holographic optical trap* the Wits researchers demonstrated how to create and control any pattern of light holographically, and then used this to form a new optical trapping and tweezing device.

"In particular, the device could work with both the traditional laser beams (scalar beams) as well as more complex vector beams. Vector beams are highly topical and have found many applications, but no vector holographic trap was possible until now," says Forbes.

The Wits researchers demonstrate their new trap by holographically controlling both scalar and vector beams in the same device, advancing the state-of-the-art technology and introducing a new device to the community. The group expects the new device to be useful in controlled experiments in the micro- and nano-worlds, including single cell studies in biology and medicine, small volume chemical reactions, fundamental physics and possibly on-chip devices.

Having previously shown that it is possible to create hundreds of custom light patterns from one hologram, the research brings together their prior work on holographic control of light with the application of optical trapping and tweezing.



The Wits Commercial Enterprise (Pty) Ltd is 100% owned by Wits and is mandated to market and commercialise the University's intellectual capital through short course management, contract research and consulting, intellectual property management and technology transfer.

Wits Enterprise comprises of three divisions: short courses, technology transfer and research support. The Wits Enterprise research support unit manages the relationships of external stakeholders and funders with Wits academics from various disciplines.

Its diverse research priorities include the arts; energy; information and communication technologies; monitoring and evaluation and labour and economics.

EXTERNALLY-FUNDED PROJECTS

Key research projects initiated in 2018 include the "Driver Behaviour" study funded by the Passenger Rail Association of South Africa, which was conducted by the Wits Transnet

Centre for Systems Engineering and the "Unmanned Ariel Vehicle and its associated systems" project, which was funded by the Mine Health and Safety Council, and which was led by the Wits Mining Institute.

The Faculty of Humanities continues to dominate the externally-funded project pipeline with the ICT Integration in Education Programme being provided to almost 1 000 teachers across Limpopo and Gauteng. This is funded through the provincial Education, Training, Development Practices Sector Education Training Authority and the Limpopo Department of Education. The Centre for Researching Education and Labour also secured a number of research contracts through the BANK SETA.

INNOVATION SUPPORT

Innovation has been entrenched in Wits' strategy as an outcome of research that enhances an economy. In this vein, the Innovation Support Unit has seen high growth in the number of promising innovations amongst its researchers. During 2018, the Unit was able to secure seed funding from the Technology Innovation Agency for four more projects, bringing the total to 28 since 2014. Seed funding is relatively modest amounts of funding for activities that are critical in taking the next steps towards the commercialisation of promising innovations. The momentum built on a number of innovations has driven efforts to raise a further R50 million in funding for the development of commercially viable products and services. These aim to solve many of South Africa's developmental and inclusive growth needs, will enhance the country's competitiveness, and position Wits as a powerhouse of research that makes a tangible difference in people's lives.

THE PICOGRID

A HOUSEHOLD ELECTRIFICATION ENABLER



Almost one billion people worldwide need off-grid electrification. In Africa, this problem is the most severe, where 620 million Africans (two-thirds of the African population) do not have access to electricity. Current off-grid solar home solutions do not accommodate multiple and different types of power sources (solar panels and wind generators) or batteries, and are restricted in terms of the number of load devices or appliances (mobile phone chargers, lights and television sets) that can be connected.

When household needs increase and another solar panel or wind generator and/or battery is added, the customer has to call in the experts to ensure that their household grid works. This increases the costs. In rural areas, it can be impractical due to the location of communities.

Professor Willie Cronje from the School of Electrical and Information Engineering has led a team of engineering students in developing a so-called "picogrid," which provides a highly flexible solution for homes that are not

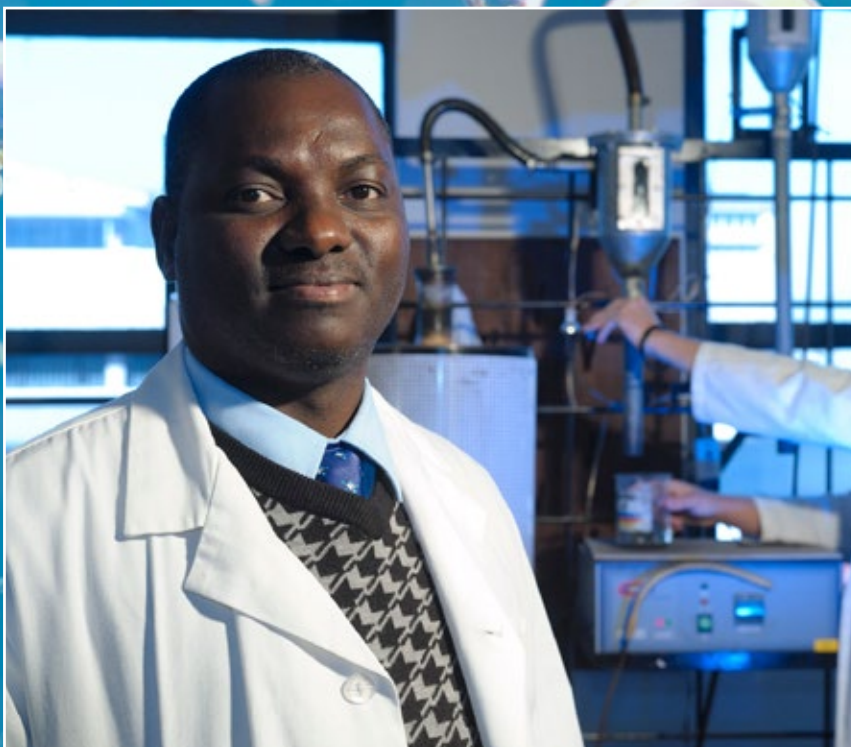
part of the national electricity grid. The picogrid system enables the plugging in of energy sources, batteries, as well as devices using energy flexibly in a "plug and play" manner. This empowers households to expand their own picogrid as their needs increase. The Innovation Support Unit has assisted Cronje and students Muhammed Aswat and Mohammed Raees Dangor and other team members, through a Seed Fund project. This enabled the team to develop a battery controller which is crucial in providing the system with its core functionality.

The outputs of the Seed Fund project enabled extensive testing. The showcasing of the technology features in the Gold Fields Laboratories, as well as a mock informal settlement housing setup. The underlying intellectual property is protected through patent applications. The next step is to pilot it in a community, which entails finding commercial partners. The team attracted the interest of Umbono Natural Resources, a South African black-owned investor in the energy sector, to fund the development of a business case as well as to run a full scale pilot in 2019.



**PROFESSOR
MICHAEL DARAMOLA**

School of Chemical and
Metallurgical Engineering



PROFESSOR SUNNY IYUKE

School of Chemical and
Metallurgical Engineering

THE WITS PROTON EXCHANGE MEMBRANE

A critical component in fuel cells

Fuel cells are an energy solution that create electricity through a chemical reaction using a fuel, typically hydrogen, and an oxidising agent, typically oxygen. These gases are abundant and the chemical reaction produces no emissions. Fuel cells hold significant promise as a clean, renewable energy solution in the transport (buses) and industrial sectors, where relatively large power sources are required. The Hydrogen South Africa strategy of the Department of Science and Technology has supported the development of a South African renewable hydrogen economy, through funding the development of components required in fuel cells. A critical challenge is that some parts have to be imported at high cost, thereby undermining the viability of a South African fuel cell manufacturing industry.

This is the case with the proton exchange membrane (PEM), required for the chemical reaction to take place. A South African-developed membrane could act as an import replacement in a growing hydrogen economy, and if sufficiently competitive, could be exported.

Wits, through Professor Sunny Iyuke and Professor Michael Daramola from the School of Chemical and Metallurgical Engineering have developed and patented a proton exchange membrane using rubber material easily sourced from the car tyre industry that is strengthened with nano-materials. This proton exchange membrane is expected to be cheaper than imports and will thus play a key role in facilitating South Africa's ability to meet its green energy targets through the manufacturing of its own fuel cells.

The Membrane's industrialisation and local manufacturing capability will create jobs and potentially export revenue. The Innovation Support Unit assisted the team with a Seed Fund project to undertake preliminary optimisation at the laboratory scale. It was pleasing to note that the resulting membranes' efficiency is comparable to that of commercially available proton exchange membranes.

The next step is to undertake further optimisation and upscaling of the technology, in collaboration with relevant partners.

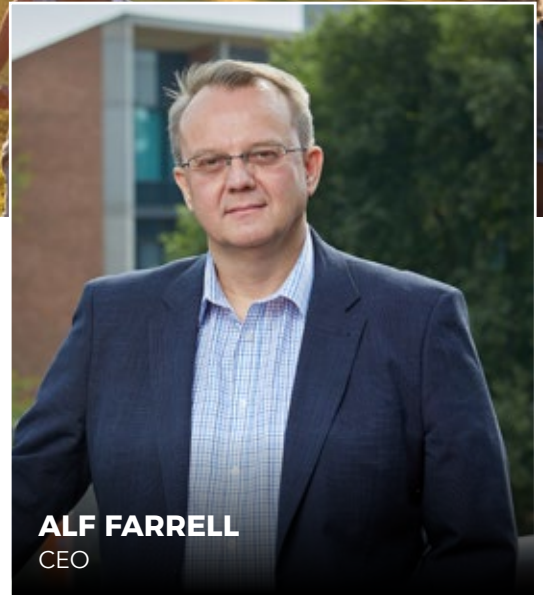


The Wits Health Consortium (WHC) (Pty) Ltd is wholly owned by Wits and was established to serve as a legal entity through which the University, and primarily the Faculty of Health Sciences, can conduct contract or sponsored research, entrepreneurial or commercial activities, philanthropic funding activities and services including clinical services. The primary role of the Consortium is to provide the governance, legal framework, human resource management, financial and grant management services for the research entities linked to the academic departments within the Faculty. Management of pharmaceutical trials is an important income stream for the Consortium.

The Wits Health Consortium creates an enabling environment for an entrepreneurial approach to academia and performs this role through the Shared Services Centre. The Consortium assists Wits' internationally-renowned academics and researchers to pursue specialist research in their respective fields of expertise without carrying unnecessary burdens of administration.



PROFESSOR SHABIR MADHI
Professor of Vaccinology and Director of the Respiratory and Meningeal Pathogens Research Unit



ALF FARRELL
CEO

RESEARCH WITH IMPACT

The Wits Health Consortium and its divisions are actively focused on improving health outcomes through research. For example, Wits' researchers are well known locally and internationally for their contribution to research in HIV. A number of the Consortium's divisional heads and senior staff were invited as speakers at the South African HIV Clinicians' Society Conference.

The Wits Reproductive Health and HIV Institute (WRHI) was well represented with Professor Francois Venter presenting on *Therapy success and failure: first, second- and third-line therapy*; Dr Gloria Maimela presenting on *The Implications of scarcer resources for 90:90:90* and Professor Helen Rees on the *Big challenges in introducing and scaling up new prevention technologies*.

Marije Versteeg-Mojanaga from the Rural Health Advocacy Project presented on *Justice and the distribution of healthcare resources: Leaving No One Behind* and Dr Limakatso Lebina from the Perinatal HIV Research Unit (PHRU) who presented on *Medical Male Circumcision*.

Earlier in 2018, the PHRU also collaborated with local and international researchers on a study titled *Voluntary Medical Male Circumcision for the prevention of heterosexual transmission of HIV*.

Health e-News hailed Professor Shabir Madhi from the Respiratory and Meningeal Pathogens Research Unit as South Africa's foremost vaccine expert. He has also researched the relationship between the HIV epidemic and the transmission of measles.

The Wits Health Consortium remains committed to making an impact by facilitating research excellence and academic innovation, conducted through the Consortium's various operating divisions and units.

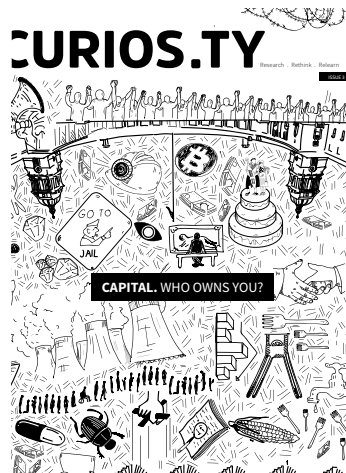
CURIOS.TY



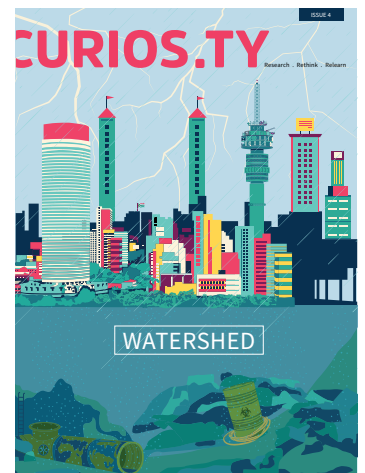
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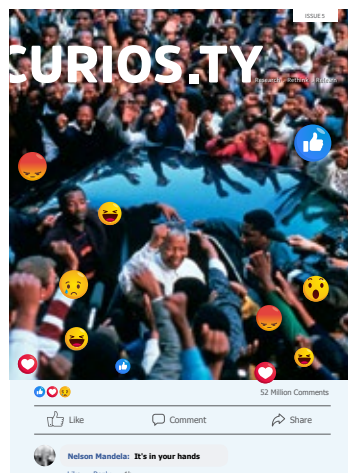
iHUMAN



CAPITAL



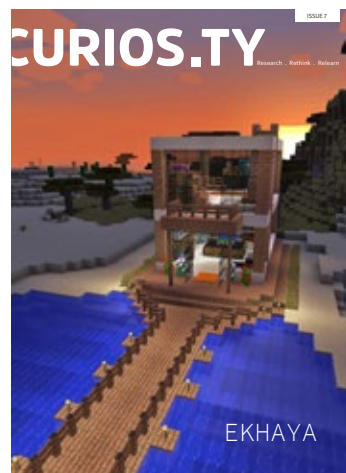
WATERSHED



MANDELA100



HUNGER GAMES



EKHAYA [HOME]



CODE

Curios.ty is a print and digital magazine that aims to make the research at Wits University accessible to multiple publics. It tells the stories of pioneering research at Wits through the voices of talented researchers, students and academics. First published in April 2017, *Curios.ty* is published three times per year.

Each issue is thematic and explores research across faculties and disciplines at the University that relate to the theme. Since its inception, research themes have included: Cities, iHuman, Capital, Watershed, Mandela100, Hunger Games, Ekhaya [Home], Code, and Green.

www.wits.ac.za/curiosity



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