RESEARCH REPORT

2020/2021

UNIVERSITY OF THE
FREE STATE
UNIVERSITEIT VAN DIE
VRYSTAAT
YUNIVESITHI YA
FREISTATA

UFS

Contents

Foreword

Prof Francis Petersen, Vice-Chancellor

In 2021 the Council of the University of the Free State (UFS) unanimously approved the re-appointment of Prof Francis Petersen for a second five-year term as Rector and Vice-Chancellor. In this Foreword he reflects on his first term and looks forward to the next.

Looking back over the last five years, we clearly met almost all we set out to do. In terms of quantitative measures there was an increase in the percentage of staff members with a doctoral qualification (from 41% to 56%), there was an increase in the number of postgraduate qualifications (particularly in terms of Master's by research – with a 61% increase), and the upward growth in research outputs continued. There was a substantial increase in funding for infrastructure and equipment, with a matching fund system introduced for faculties to partner with external organisations in order to access funding for large pieces of equipment. We also developed and rolled out the *Differentiated Research Strategy* and have selectively grown certain areas.

One of our major successes was probably in a changed perception of our staff to the importance of research, as a critical core business of the university, and contributing to the aim of being a 'research-led' university.

Over the past five years, significant time and effort has been invested in developing and streamlining systems, policies and processes for stronger governance across the University, and rolling them out. Improved strategies have been put in place to support research, which is leading to a deeper and richer research culture. For example, our appointments, promotion and performance management system now takes into account individuality and discipline, as well as measuring if individuals are performing at the level at which they are appointed, in terms of teaching and learning, research and engaged scholarship. We have moved away from the status quo of 2017, when only 40% of academics produced 100% of the research outputs.

The concept of Advisory Boards was strengthened and embedded, and we now have close to 40 multi-sectoral Advisory Boards in place across the faculties. These will hopefully lead to increased engagement with the government, private sector, business and industry. The growth in our third stream income is gaining momentum.

We also now have people in various strategic leadership positions, who can assist with leading and changing attitudes. In addition, our programme 'Transforming the Professoriate', an intense programme of support and development, has been successful in the last few years of increasing the number of female, black and international scholars.

However, all these successes are, for me, tinged with a measure of disappointment. I would have liked to see greater implementation, at a faster pace and a more marked increase in the numbers! Yes, the research agenda has moved forward, but not at the rate I would have liked.

The last five years have been a time where much of my attention and energies were focused on areas that resulted in my not being as involved in the research endeavor as I would have liked to have been. But what we have done has laid a solid foundation for research in the years ahead.

So, what of the future?

The UFS is currently developing VISION 130 to take us to the year 2034 (when the UFS will be 130 years old). This strategic plan will retain the current vision of the UFS – to be a research-led, student-centred and regionally-engaged university that contributes to development and social justice through the production of globally competitive graduates and knowledge. However, the focus will be on visibility and impact, framed through the Sustainable Development Goals. There will be greater emphasis on being 'research-led' and how we structure our research agenda, making it globally, nationally and regionally relevant.

Any improvement in research at the University will be affected by the academic staff. If they are productive and enthusiastic, the numbers and the culture can only improve. In the next five years, we will aggressively drive the upward trajectory of improved staff qualifications and continue with the 'Transformation of the Professoriate' to increase the number of excellent female, black and international scholars. Our systems and new appointments must speak to these requirements.

I want us to focus robustly on our postgraduate students. We need to increase the number of postgraduate students, including more international students. Over the past five years a great deal of attention was given to improving systems related to undergraduate studies. We are considered to be the leading university in the country to understand and drive student success – not just for academic purposes, but as an imperative of social justice. This has longer-term benefits for research, as the quality of undergraduate students coming into the University is improving. My focus now needs to shift to that of postgraduate students. Currently we have very large undergraduate programmes, with heavy teaching loads and potentially 'over-teaching'. We will continue to assess the cost-effectiveness of programmes, and phase some out to free up time for research and create more capacity for postgraduates. It is unrealistic to expect everyone to be involved in research (though that would be first prize), but we need to increase the levels of involvement to above 80%.

In order to support our vision of becoming a research-led university, we have to increase the number of Research Chairs and Centres of Excellence in our selected focus areas. This not only requires maximally utilising the opportunities that are available, but also building strong partnerships with industry and other collaborating institutions.

To attract excellent scholars, we have to have the resources. We have to grow our third stream income substantially. This needs to be part of the mindset of particularly those in leadership positions – our vice-rectors, deans, directors and heads of departments. We need a much more vibrant and active engagement with external stakeholders across all three campuses. There is a growing confidence in engaging with industry and commerce and the outside world, and this needs to be nurtured and developed, so that it becomes second nature!

VISION 34 contains a bold statement – our aim is to be one of the top five universities in South Africa. It is bold but doable and will require major commitment from everyone.

I am excited for the next five years, in which the UFS becomes a truly research-led university!

Preface

Professor Corli Witthuhn, Vice-Rector: Research and Internationalisation

During the past two years, we have experienced major changes in our work environments. Everyone had to quickly adapt to restricted movement, working remotely, meeting online, wearing face masks and being patient with disruptions in global supply chains. Therefore, we had limited or remote engagements with our colleagues, collaborators, partners and team members. Owing to these changes, this Research Report (2020–2021) focuses primarily on individual researchers and their activities and achievements; this differs from the approach to our previous reports, which focused on themes and groups of researchers working on multidisciplinary projects.

We report on Prof Willem Boshoff, the first leading visual artist to ever receive an A-rating from the NRF; Dr Matteo Grilli's NRF P-rating in History, which indicates that he has the potential to become a leader in his field; Prof Felicity Burt's role in the fight against COVID-19; Prof Martin Nyaga's collaboration with the World Health Organization (WHO); the interesting and impactful work done by Dr Ralph Clark and his colleagues and collaborators in the Afromontane Research Unit (ARU) on the Qwaqwa Campus; and Prof Gilbert Matsabisa, who negotiated significant funding for his research on Indigenous Knowledge Systems (IKS).

The focus of this report is on ***Growth and Impact***. Many UFS researchers are motivated by the fact that their research has influence beyond the academic environment. We are committed to ensuring that the knowledge we create changes our society, assists in protecting our environment and contributes to diversifying our economy.

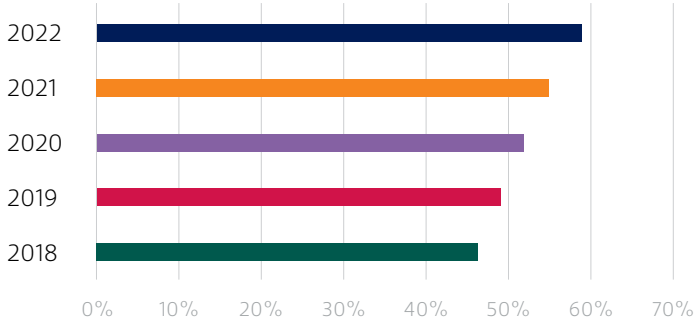
There are various indicators of growth in the research environment. For many years, I have advocated for the appointment of academic staff with a doctoral degree as their highest qualification. We have also introduced several support structures to encourage academic staff to obtain a doctoral degree. This has resulted in an increase in permanent academic staff with doctoral degrees from 47% in 2018 to 59% at the start of 2022 (unaudited data).

The NRF-rating system is a further indicator of growth in the research environment. This continues to be an important metric, as it allows each researcher to evaluate their contribution to research outputs and impact, and plan future research. It is also the only mechanism available with which our peers evaluate the quality of our research outputs. The UFS has increased its number of rated researchers from 164 in 2019 to 198 in 2021. In addition, we are proud of the growth in the quality of research on the Qwaqwa Campus, where we now have 13 NRF-rated scholars. It is also encouraging that we have significantly increased the number of Y-rated researchers from 32 in 2017 to 56 in 2021.

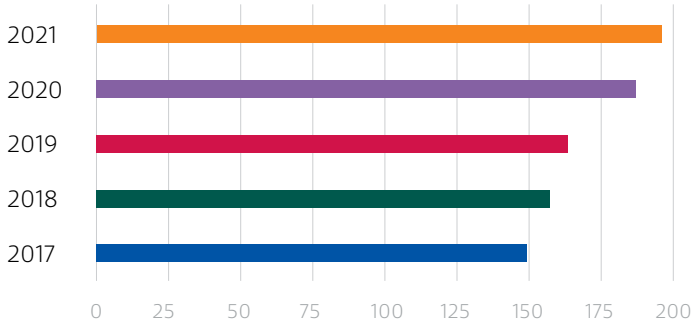
The appointment of postdoctoral fellows is essential to improving our research standing and outputs, and it contributes to the internationalisation of our campuses. In 2021, the UFS had 188 postdoctoral fellows, 60% of whom were from abroad.

Over the past 10 years, the UFS's research productivity has increased exponentially. A decade ago, we had no Y-rated researchers, a limited number of researchers with NRF-ratings, and relatively few academic staff with doctoral degrees. Since then, we have witnessed annual growth in the number and quality of research outputs, and we celebrate the fact that we have produced the most books in the South African higher education sector in the past eight years, despite a sharp increase in undergraduate students. We celebrate the academic staff who grew their research output and impact during this time!

Permanent academic staff with doctoral degrees 2018–2022



NRF-rated researchers 2017–2022



Introduction

Dr Glen Taylor, Senior Director: Research Development

In the coming years, when we look back on 2020 and 2021, it might always be remembered as a dark period and one that changed the world. Globally it started with much hope and then stuttered to a standstill, and then moved on with fits and starts – with masks, lockdown, social distancing and the image of the virus with its spike protruding clumps being constant reminders that the COVID-19 pandemic was ever-present.

And yet so much that was positive came out of those two years. Of significance for us was the realisation that UFS research was strong and built on a solid foundation. During these turbulent times research could continue apace, despite the restrictions that the pandemic placed on us, and possibilities for new and different engagements were embraced. So, as this report celebrates the growth and impact of UFS research, these past two years have certainly brought home to us that there has been significant growth and impact over the last decade in our research portfolio, and that this continued during 2020 and 2021. Also taking cognisance of the importance of how information and knowledge can be accessed, how research findings are adopted and how this is assimilated, are aspects that stood out.

Individual researchers continued to make their mark, and new faces emerged on the list of excellent researchers. The fact that many of our researchers were drawn into international and national groups to help the fight against the virus, is testament to the standing that these researchers enjoy beyond the boundaries of our institution. Established partnerships were of critical importance, as were the new ones forged in a consolidated effort to not only seek solutions for the pandemic but also ways to overcome the constraints placed on the core business of the university.

However, it was not all about COVID-19. The nature of research is to search for the unknown, and so our researchers continued to push the frontiers of knowledge in a range of other areas that had nothing to do with the pandemic. Reaffirming that life goes on beyond COVID-19, as we tried to continue as normal in the current abnormal environment facing not only universities as a sector, but also society and industries globally.

Research funding in particularly the health sciences increased, and in general 2020 and 2021 saw a welcome increase in third stream funding, confirming that there is trust and respect for UFS researchers and the work they do.

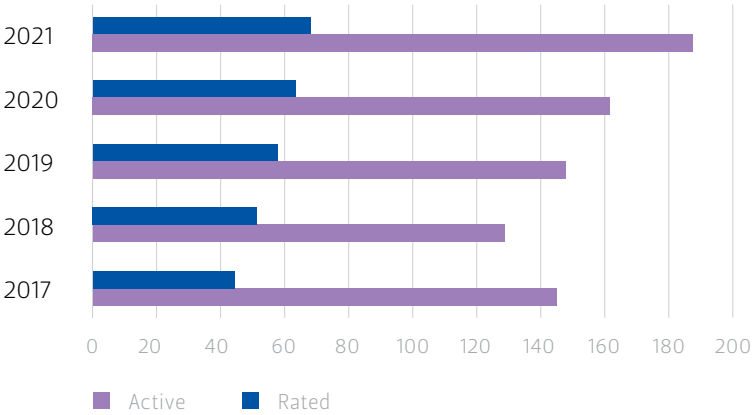
As we move into the next period of UFS research development, we know that things will not be the same. We have learned much from the last two years, about how research can be done under stringent circumstances, how collaborations can be built, how communication and interaction can continue and even be improved. Resources needed to be strategically aligned to achieve the necessary impact and our researchers did not sit still and wait for things to be "normal" again – they continued to produce excellent results in innovative ways. Although we continue to face considerable challenges, the future looks good!

Women in scholarship

According to UNESCO, only 30% of the world's researchers are women. With 41% of the active researchers at the University of the Free State (UFS) being women, four of the UFS SARChI Research Chairs being led by women, and women comprising 34% of our rated researchers, the UFS has broken through that barrier. However, we still lag behind the overall average for South Africa (45%). The days of a male-dominated research cohort are changing, and some of our women researchers are leaders in their fields – such as Melanie Walker (Human Development and Capabilities Education), Felicity Burt (Medical Virology), Heidi Hudson (Feminist Studies) and Cynthia Miller-Naudé (Hebrew Studies), among others.

We are proud of our women researchers – those who have for many years provided the backbone to our research endeavours, and those representing a new young cohort establishing themselves doing research that makes a difference. In this edition of our Research Report, we are pleased to celebrate the activities and achievements of some of our researchers who made their mark during 2020 and 2021.

UFS Women Researchers 2017–2021



Katinka de Wet, Associate Professor in the Department of Sociology, is a medical sociologist**.** She obtained her PhD at the *Ecole des Hautes Etudes en Sciences Sociales* in France. Her monograph, *The Normalisation of the HIV and Aids Epidemic in South Africa*, was launched in March 2020 – just as the COVID-19 pandemic hit South Africa, and a timely reminder that the HIV and AIDS crisis has been with us for four decades. The framing of this book is relevant to the emergence of any epidemic or pandemic, as it asks questions on how diseases are framed as well as what the medical, sociopolitical and economic consequences and actions were in response to HIV and AIDS's exceptionalism. Prof De Wet also recognises the activism that the HIV pandemic stimulated. In her opinion, the vibrancy that went with HIV and AIDS activism will prevent the disease from becoming just another neglected condition (such as tuberculosis). Throughout this book, she shows the wide-ranging ramifications of the framing of a disease and cautions against unintended consequences that could be unleashed with processes of exceptionalising certain disorders. As a continuation of this work, she has obtained NRF funding for a project titled 'Community Health Workers: Foot soldiers during pandemic times', in which the emergence of this cadre of informal health care workers is scrutinised under COVID-19 conditions and compared to its evolution since the height of the HIV and AIDS pandemic in the early 2000s Katinka de Wet was appointed as the Interim Co-Director of the Interdisciplinary Centre for Digital Futures in January 2021.

Maria Tsakeni strives to forge a better future for the next generation through improvements in education and schooling. Dr Tsakeni is a Senior Lecturer in the School of Mathematics, Natural Sciences and Technology Education on the Qwaqwa Campus, where she coordinates Postgraduate, Research and Engaged Scholarship. A champion for the Qwaqwa Faculty of Education Programme Qualification Mix curriculum renewal, she is also a firm believer in the role of innovation in science education. Her current research, supported by NRF-Thuthuka, focuses on curriculum innovations and innovative instructional strategies in science education through preservice science teacher preparation and school classroom practices. The curriculum innovations include inquiry-based learning, education for sustainable development, science, technology engineering and mathematics (STEM) education and learning science in virtual learning environments, with a special focus on implementation in multiple-deprived classrooms. The study is influenced by the existence of multiple-deprived science classrooms in Qwaqwa rural and township schools. Dr Tsakeni is the Chairperson of the Local Organising Committee for the 31st Conference of the Southern African Association for Research in Mathematics, Science and Technology Education (SAARMSTE 2023), to be hosted by the UFS. She is a candidate in the UFS Future Generations Professoriate Group, which is part of the Transforming the Professoriate Mentoring Programme, for emerging scholars.

Aliza le Roux, Associate Professor in the Department of Zoology and Entomology on our Qwaqwa Campus and Assistant Dean of Natural Sciences on that campus, is a behavioural ecologist with a focus on the evolution of complex cognition and communication in wild animals. Her previous work focused on the cognitive ecology of bat-eared foxes in the Kalahari Desert, and more recently she was involved in a project on risk-related decision-making in black-backed jackals in the Golden Gate Highlands National Park. As an NRF-rated scholar, and closely associated with the Afromontane Research Unit, she drives research on biodiversity and behavioural responses to a risky landscape. Since her doctoral studies at Stellenbosch University and postdoctoral fellowship at the University of Michigan, Aliza has been an active member of many collaborative initiatives. Thus, it is not surprising to find her as part of the Snapshot Safari Network – a large-scale multi-national camera trap network to monitor the diversity and ecological dynamics of African mammals. Aliza is also passionate about making an impact beyond her ecological research. She is a steering group member of the new Scientific Advisory Group on Emergencies, housed within the Academy of Science of South Africa (ASSAf), and leads a women's mentorship programme as part of the Mountain-to-Mountain partnership with the Appalachian State University.

Karin van Marle – Professor in the Department of Public Law, Vice-Dean of the Faculty of Law and Programme Director: Research and Postgraduate Study – is described as one of the vanguards of legal philosophy, critical jurisprudence and feminist legal theory in South Africa and is recognised internationally as a leading scholar in the field. Her research falls within the broad field of law and the humanities and involves critical theory, legal philosophy and jurisprudence. For the past two decades, the main focus of her research has been on the thinking of a post-apartheid jurisprudence, situated in themes of transformation, memory, reconciliation and reparation. Her work on post-1994 jurisprudence, inspired by and embedded in feminist theory, engages with the crisis of modernity and a rethinking of law and legal theory along the lines of fragility, finitude and a 'giving up of certitudes'. She has published widely and serves on a number of the international editorial boards including *Law and Critique*. She is an adjunct professor at Southern Cross University, Australia, and is Fellow at the Stellenbosch Institute for Advanced Study (STIAS). Since taking up a position at UFS in 2019, she has expanded on her previous work on the public realm, with a specific focus on the university as a space of conscience. In a recent keynote address she reflected on the notion of 'Democracy and the city' – the city standing in as symbol or metaphor for politics, including constitutional politics. Together with Prof Lochner Marais and Prof Danie Brand, she convened an interdisciplinary project titled 'The endurance of spatial inequality: Race, property and spatiality in Bloemfontein and surrounds', that will culminate in an edited collection in the next year. Other recent publications include work on critical jurisprudence and the LLB curriculum, spatiality and property in the work of South African poet and writer, Antjie Krog, and a reflection in a collection on Decoloniality. She is also continuing work on the role of aesthetics in conversations on transformation and a public spirited re-imagining of South African law.

Alice Ncube chose to be a scientist due to her desire to make a difference. Today she is Senior Lecturer and Programme Director in the Disaster Management Training and Education Centre for Africa (DiMTEC). With more than 15 years of experience in disaster (risk) management, her research interests are social vulnerability and climate change, international forced migration, gender issues, climate change and adaptation resilience, and sustainable livelihoods of disadvantaged communities. She participates in rapid vulnerability assessments as part of the practical teaching activities. For her PhD she researched international migration, specifically on women from developing countries to other developing countries (South-South), particularly South Africa. Her study helped to demystify the perception that migrants come to a host country to take local jobs and put pressure on local resources. Exploring the coping and adaptation strategies that women employ in the host country, she found that, despite the intersecting adversities faced by women migrants, migrant women cope and adapt well where there are opportunities. Her research, combined with her work of more than 10 years with vulnerable communities, including migrants, has established that the resilience of vulnerable communities goes beyond just looking to the intervention strategies that governments and other stakeholders envisage. Dr Ncube is a Disaster Management Professional registered with the Disaster Management Institute of Southern Africa (DMISA), and a member of the Southern Africa Society for Disaster Risk Reduction (SASDiR), Gender and Disaster Network (GDN) and the Women in Migration Network (WIMN). She has also been actively working with migrant communities in Mangaung Metropolitan Municipality, particularly in Bloemfontein, resulting in her and two compatriots establishing a Non-Profit Organisation – Africa Advanced Network for Development (AAND) – which has worked with migrants throughout the COVID-19 pandemic. Dr Ncube is a devoted mother of three adult children, one of whom is following her path into research.

Adré Minnaar-Ontong, Senior Lecturer in the Department of Plant Sciences, is an integral part of the plant breeding research group. Her research focuses on breeding for resistance against fungal diseases across multiple crops, with specialisation on resistance breeding against *Sclerotinia sclerotiorum* diseases in both sunflower and soybean. This forms part of the South African Sclerotinia Research Network (SASRN). Dr Minnaar-Ontong's research includes the identification and characterisation of the *Fusarium* species responsible for sudden death syndrome (SDS) in South Africa, as well as the genetic analysis of soybean resistance against this pathogen. The outcome of this project contributed to the initiation of an SDS pre-breeding programme that started with the evaluation of commercial soybean cultivars for resistance. This research will contribute signficantly to soybean production of South Africa.

Thulisile Ncamsile Mphambukeli is an NRF-rated scholar. She is a member of the South African BRICS Think Tank and is a co-editor of the *Journal of BRICS Studies*, a Review Editor and a Topic Editor for *Governance and Cities for the Frontiers in Sustainable Cities Journ*al. She was a fellow at The World Academy of Sciences, Italy (hosted at University of Konstanz, Germany), an alumnus of the Brown International Advanced Research Institutes, Brown University USA, an alumnus of the Public Affairs Research Institute, University of the Witwatersrand, and an alumnus of the African Peacebuilding Network in the Social Science Research Council, USA. She is a recipient of many research grants and awards, such as the BRICS Think Tank Academic Forum Grant, NRF Knowledge Interchange and Collaboration (KIC) Individual Travel Grant, the Herrenhausen Conference Travel Grant, BRICS Think Tank Academic Forum Seed Funding, and the African Pathways Programme (APP)/BRICS Teaching and Research Mobility Grant. She is presently leading a team of scholars from China and South Africa as part of a jointly awarded research grant by the National Institute for the Humanities and Social Sciences (NIHSS) and the Chinese Academy of Social Sciences (CASS) for 2019/2022. Her research project team consists of Dr Abraham Matamanda, from the UFS Department of Geography, Dr Victor Okorie, from the Obafemi Awolowo University, Nigeria, and Prof Peter Ho, a Professorial Research Fellow specialising in Chinese Economy and Development at the Department of International Development of the London School of Economics and Political Science. Titled 'Exploring the situated political ecology and economy of agricultural land policies in BRICS: A case study of China and South Africa', Dr Mphambukeli's team is researching within the parameters of social justice, sustainable development and quality of life. They will also document the policy approaches and strategies adopted by the two countries to support the agriculture-land-water-labour nexus, and propose an agricultural land policy for China and South Africa.

Liezel Herselman, Professor and Head of the Department of Plant Sciences, and the researchers working with her on molecular plant breeding, make a considerable contribution to stable, sustainable agriculture. As a molecular plant breeder, Prof Herselsman's research focuses on marker-assisted disease resistance breeding, focusing specifically on rust resistance (stem, stripe, and leaf rust) and Fusarium head-blight (FHB) in wheat. This work has produced rust- and Fusarium head blight-resistant wheat lines, which are available to South African breeding companies. By contributing to the fight against fungal diseases in South Africa and further afield, these help to secure the yield and livelihoods of farmers and consumers. In 2020 the Southern African Plant Breeders' Association (SAPBA) bestowed the prestigious Fellow Award on Prof Herselman in recognition of her exceptional contributions to plant breeding in southern Africa, especially training and mentoring the plant breeders of the future.

Stephanie Cawood is passionate about our continent, its people and, in particular, its women. Which makes her a fitting leader for the Centre for Gender and Africa Studies (CGAS). Trained in communication science and media studies, her field of specialisation is oral communication, particularly rhetoric and oral tradition. One of her most recent research projects is 'Memorialising Struggle Dynamics of Memory, Space and Power in Post-Liberation Africa', funded by the British Academy under the Newton Advanced Fellowship. Various memorial sites form part of the project, including, *inter alia*, Freedom Park on Salvokop in Tshwane/Pretoria, Mamelodi Memorial Wall at Solomon Mahlangu Square, the Hector Petersen Memorial in Soweto, the Women's Living Heritage Monument at Lilian Ngoyi Square in Tshwane/Pretoria, Walter Sisulu Square in Kliptown, Nobel Square in Cape Town, Liliesleaf Museum in Rivonia, Nelson Mandela Museum in Mthatha, Winnie Mandela's House in Brandfort, Independence Memorial Museum and Heroes' Acre in Windhoek, and the monument to the NRM liberation war in Uganda. The project has been undertaken in collaboration with Dr Jonathan Fisher from the International Development Department of the University of Birmingham. By her own admission, she is not afraid of trying new things and thinking and doing things in unique and unconventional ways – which led her to team up with Dr Tascha de Vos, a limnologist from the UFS Centre for Environmental Management, to study how water quality can be used at informal heritage sties to measure the health of these sites. This interdisciplinary study is unique, bringing the science of aquatic ecology together with the cultural and social dynamics of heritage, pilgrimage and ritual.

Deidré van Rooyen is the Programme Director for Development Studies and an Associate Professor in the Centre for Development Support (CDS). The specialisation fields of her research are social entrepreneurship (SE) and local economic development (LED) in small towns. For the past few years she has been involved with colleagues from the Faculty of Economic and Management Sciences and the Department of Urban and Regional Planning, on research related to mining and community in the South African platinum belt, coal and energy in South Africa, economic transitions in South Africa's secondary cities, the impact on women in declining mining towns, and social entrepreneurship in the Free State. Prof Van Rooyen is the project leader for the UFS in the Support Youth Social Entrepreneurs in sub-Saharan Africa (SYSE) project. This is a tri-partnership between Glasgow Caledonian University, Challenges Ghana and UFS that is supported by the British Council as part of the Innovation for African Universities (IAU) programme. The project is designed to support the development of Africa-UK University Partnerships that build institutional capacity for higher education engagement in entrepreneurship and innovation ecosystems in selected African countries. SYSE will be working with NGOs and applying social entrepreneurial principles and practices to generate measurable and meaningful outcomes. Students will therefore improve (self) employability and social impact experiences, as well as obtain hard social and economic skills, along with soft skills during this programme.

Lynette Jacobs is Associate Professor and Head of Research on the South Campus for Open Distance Learning. She is an NRF-rated researcher with a passion for research capacity development amongst young academics and administrators, and provides mentorship beyond institutional and national boundaries. Her research is grounded in Comparative and International Education, with an emphasis on inclusive education opportunities. While her research started with a focus on external barriers to education, it has evolved to concentrate on inclusive internationalised education opportunities. She has established a scholarly community on the South Campus, focusing on inclusive and comprehensive internationalisation of higher education. Prof Jacobs is one of the working group leaders in iKudu, a European Union (EU)-funded Capacity Building in Higher Education (CBHE) project which is being realised over a three-year period until November 2022. The iKudu project has been conceptualised to develop a contextualised South African concept of Internationalisation of the Curriculum (IoC), which integrates Collaborative Online International Learning (COIL) virtual exchanges. The concept will allow South African partner-universities to become this country's leading higher education institutions (HEIs) in IoC, curriculum transformation and COIL virtual exchanges. The consortium includes 10 partner institutions – UFS (co-coordinator under the leadership of Dr Cornelius Hagenmeier), University of Antwerp, Belgium (co-coordinator), University of Siena, Italy, Coventry University, UK, The Hague University of Applied Sciences, the Netherlands, Amsterdam University of Applied Sciences, the Netherlands and, in South Africa, the Central University of Technology, Durban University of Technology, University of Limpopo and University of Venda. Underlying the formation of this consortium is the long-standing partnership between the UFS and the University of Antwerp. REFLECTIVE PHOTOGRAPHY

Karen Ehlers is the Programme Director of the Forensic Sciences Programme in the Department of Genetics. The research in the Programme focuses on improving post-mortem interval estimation using gene expression studies of insects, cuticular hydrocarbon dating and soil microbes; investigating Y-STR loci in different population groups in South Africa, Zimbabwe and Botswana; and the statistical analysis and interpretation of genomic DNA Short tandem repeat (STR) databases in South Africa. In 2020, over 300 males were successfully DNA-typed with Y-STR markers. Section 20 approval was obtained for research into the improvement of the estimation of the post-mortem interval. Dr Ehlers' own research is on the forensic application of Y-STR markers, the statistical analysis of DNA profiles and touch DNA. In appreciation of her expertise in the field of forensic sciences, she was elected as a member of the National Forensic Oversight and Ethics Board (NFOES) for a second term. While serving on this board, she is ensuring that South Africa has a functioning DNA database that contributes to lowering the crime rate in the country.

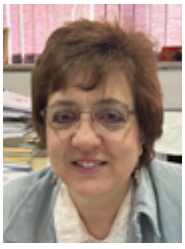
Lizette de Wet, an Associate Professor in the Department of Computer Science and Informatics, has been making an impact in the field of Human-Computer Interaction (HCI). She is considered a pioneer in the HCI environment, particularly in terms of the evaluation of usability and user experience in diverse application areas. Prof De Wet believes that in this research field the focus should be on the user and her/his overall user experience when using computers – including emotions, feelings and competence. Over the past few years she has concentrated on using brain-computer interfaces (BCIs) and virtual reality (VR) in her research. Together with one of her postgraduate students, Mr Bennie Botha, she did ground-breaking research using virtual reality in the training of Nursing students. The prototype developed involved virtually examining and evaluating a patient with a foreign object lodged in a lung, in a virtual ward. Continuing research with the Department of Nursing focuses on using an omnidirectional treadmill to reduce cyber sickness while navigating immersive VR in a virtual clinical simulation.

Joy Owen is Head of Department and Associate Professor in the Department of Anthropology. Her research interests encompass transnational migration, academic motherhood, social justice and global race relations. An important strand of her research considers the hierachisation of citizenship as employed by the state when dealing with particularly African migrants, and the ways in which African transnational migrants create spaces of belonging. Prof Owen's most recent research consolidates her research with those of two of her postgraduate students – Ingrid Juries and Mamokoena Mokoena – as they explore the experiences of migrants in light of a history of xenophobia aimed particularly at African transnational migrants in South Africa. Their work illustrates the complicated experiences of both migrants and citizens and the ways in which both weave intimacies across externalised socio-cultural differences. Their findings confirm that negative experiences between South Africans and African transmigrants are but one side of the narrative, and that 'experiences with the other' are also positive and life-affirming for both migrant and citizen. Prof Owen is of the opinion that we need more research that demonstrates the ways in which non-citizens have become part of the South African landscape and its socio-political fabric. With a keen interest in decolonisation of the mind, Prof Owen also continued her research on the 'Decolonial Project', funded by The Andrew W Mellon Foundation. The research has an 'internal' reflective focus that attempts to understand decolonisation as teaching and learning praxis, arguing that a solitary focus on decolonising the curricula or ensuring redress through providing supported access to students from underserved communities, is insufficient as a decolonial intervention in Anthropology and more broadly within academia.

Adelheid von Maltitz, Lecturer and Head of the Department of Fine Arts, was the recipient of the prestigious Absa L'Atelier award (Group A). She now takes on the title of Absa L'Atelier Ambassador 2021. Part of the prize is the opportunity of holding a collaborative exhibition at the end of 2022 as well as a solo exhibition within the next five years at the Absa Gallery in Johannesburg. These exhibitions will also travel nationally and internationally. The criteria for selecting the Ambassador included technical execution (i.e. the artist's expert handling of material and techniques), conceptual and thematic engagement (i.e. how they revealed an honest and intellectual reasoning or rationale), freshness of artistic vision within the context of the contemporary African art landscape (i.e. how the artist engaged with honest and fresh ways of seeing), as well as aesthetic appeal – which implies that the artist must have shown great consideration for visual quality and conceptual concerns and whether the portfolio of artworks was a cohesive submission carrying the intended message or thematic idea. Adelheid is a lecturer, primarily in drawing and sculpture, and her research focuses on the transformative potential of dynamic threshold places, such as roadside shrines in South Africa. For her, making sculpture and installation art involves processes that allow her to constructively engage personal anxieties around death and loss.

Rudo Ngara, a Senior Lecturer in the Department of Plant Sciences at the UFS Qwaqwa Campus, was awarded a PhD in Biotechnology by the University of the Western Cape in 2009. Her research revolves around understanding the molecular responses of cereals (sorghum, wheat and maize) to a range of abiotic stresses, including drought, heat, salt and their combinations. Dr Ngara uses a range of high-throughput 'omics' technologies – such as proteomics, metabolomics and transcriptomics – together with basic plant physiology methods in her research. Most of her work has been on sorghum plant systems due to the crop's natural resilience to drought stress and the availability of a wide germplasm for comparative studies. Dr Ngara and her research team have published their research findings in international journals and she is currently supervising three PhD and six Master's students. Over the years, her research has been funded by both national and international organisations, such as the NRF and the Royal Society. From 2017 to 2019, Dr Ngara held the prestigious Royal Society-Newton Advanced Fellowship with Durham University, United Kingdom, which funded her research activities, equipment purchases, and annual research visits to the UK for herself and her postgraduate students. She currently holds an NRF-Thuthuka grant to study the abscisic acid signalling systems and transcriptome changes in drought-stressed sorghum plants.

Innocensia Mangoato, Lecturer and Researcher in the Department of Pharmacology, was invited to visit the University of Bonn in Germany to work with Dr Gudrun Ulrich-Merzenich, who heads the Synergy Research and Experimental Medicine Unit. She was recently appointed as a member of the Ministerial Expert Working Group on Traditional Medicine by the South African Department of Health to provide technical support and advice on Traditional Medicine to local and international organisations, such as WHO, BRICS and IBSA. Mangoato's PhD in Pharmacology, under the supervision of Prof Motlalepula Matsabisa, focuses on cannabis and cancer drug resistance reversal through studying various efflux transporters that play a major role in anticancer drug resistance. According to Mangoato, this is because anticancer drug resistance plays a major role in the failure of standard chemotherapy when treating human cancer. She credits her exposure to traditional medicine as one of the most pivotal moments in her life, as it made her realise it is not 'dark magic', but rather a holistic approach to healing that can and should work hand in hand with scientific methods. She hopes that her research into traditional medicines, like cannabis, will create a better understanding of the drug development process, and result in more scientific innovation that will help improve our country and help Africans appreciate, and make use of, their own natural resources. AHNAF ADIL



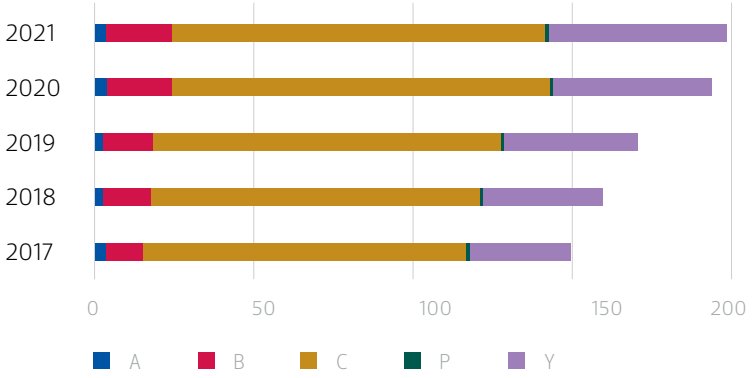
Muriel Meiring is an Associate Professor and Principal Scientist in the Department of Haematology and Cell Biology. She is a leader in the research and diagnosis of haemostatic disorders in South Africa. Her research on the role of Von Willebrand factor (VWF) in haemostatic disorders has led to collaborations with a number of international and national laboratories. As part of these collaborations, they found that VWF plays a major role in the pathogenesis of hypertension, strokes, heart disease, COVID-19 and inflammation. Prof Meiring's research also laid the foundation for innovative development of diagnostic assays. She is the inventor and patent holder on inhibitory antibody fragments to human tissue factor and developed cost-effective assays to diagnose thrombotic thrombocytopenic purpura (TTP), a thrombotic disorder, and Von Willebrand disease (VWD) with increased clearance of VWF. Prof Meiring is also part of the South African Thrombotic Microangiopathy (TMA) Network where research on TTP is conducted on a national level. She also develops research capacity in the largest pathology organisation in the country, the National Health Laboratory Service (NHLS) by leading the Research and Development Committee of the NHLS. The Special Haemostasis research group headed by Prof Meiring obtained NRF funding of R2.5 million for a micro-plus flow cytometer to study the role of micro-vesicles in haemostatic disorders. The Special Haemostasis laboratory is the only one in South Africa that conducts all the diagnostic tests needed to accurately diagnose VWD and TTP, and is the only reference laboratory for VWD and TTP in the country.

Researchers of excellence

The contribution made by a university's top researchers is far greater than the acclaim and profile they bring to the institution. They contribute to the research ethos and culture of the institution, impact on their students who go out into the wider world to ply their trade, and push back the frontiers of knowledge, paving the way for new ideas and debate. Top researchers need to be measured not only by quantitative metrics, but also by their creativity and intellectual initiative, while taking into account discipline-specific characteristics. Meaningful research is essentially a contested concept and the environment is constantly changing. However, ultimately we need to rely on the views of peers and experts.

In this edition of our Research Report, we proudly highlight some of our outstanding researchers – some of those who are highly ranked by the NRF Rating System, some who are identified in the international listings of leading researchers (such as the Stanford List and the Clarivate Web of Science List), some who are holders of the prestigious SARChI Chairs, and those who have maintained a high level of research productivity and presence for a number of years.

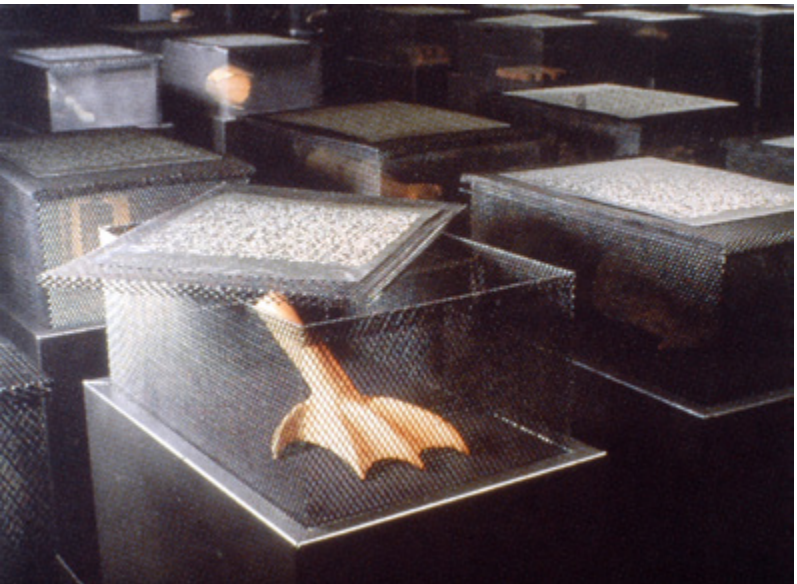
UFS Researchers with NRF-Rating 2017-2021



Willem Boshoff has been a Senior Professor in Fine Arts at the University of the Free State (UFS) for the past ten years. In 2021 he was awarded the NRF A2-rating – the first South African artist to be awarded this honour. He is an internationally acclaimed practising artist. As conceptual artist Willem Boshoff primarily engages with text and language. For more than four decades his visual artworks have commented on established language systems and how these function in society to empower or to exclude. His artistic practice involves extensive interdisciplinary research in the fields of lexicography, botany, philosophy, as well as music, with a special interest in contemporary New Music composers. He has donated his entire digital research archive to the UFS Fine Arts Department. The writing of dictionaries forms an integral part of Willem Boshoff's artmaking, whether published in book form or presented as large sculptural installations.

The *BLIND ALPHABET* project (1993 and ongoing) is a three-dimensional dictionary of morphology with the 'entries' being sculptural interpretations in wood of obscure words hidden inside wire baskets. The words interpreted, from the letter A and currently up to the letter L, are hidden from clear view as traditionally gallery signs stating DO NOT TOUCH prevent the sighted visitor from touching or opening them. Only a blind viewer may open the lids of the wire baskets, interpret the sculpted concept and read the definition of the word in braille, acting as guide to the disenfranchised sighted viewer. The open box in the image below contains the word 'Bicolligate'. (See Blind Alphabet under Artworks at www.willemboshoff.com).

For many decades, Prof Boshoff has consistently brought value and critical perspective to arts education in South Africa by teaching, formally evaluating MA and PhD candidates in Fine Arts and in being called on to review South Africa's foremost Fine Arts faculties. His academic qualifications include an honorary PhD in Philosophy awarded by the University of Johannesburg in 2008. Prof Willem Boshoff's work has been exhibited extensively locally and abroad, including the Sao Paulo and Venice Biennial exhibitions, at the Centre Pompidou in Paris, France, and the Museo Nacional Centro de Arte Reina Sofía in Madrid, Spain. His work is included in the permanent collections of the Smithsonian National Museum of African Art, in Washington DC, and the Yorkshire Sculpture Park in Yorkshire, United Kingdom. He was the 1998 winner of the *Ludwig* Giess *Preis für Kleinplastik* by the LETTER Stiftung of Cologne, Germany.



The image depicts 'bicolligate', from the Latin *com* and *ligare*. Most commonly used in ornithology, it refers to the anterior toes of birds that are united by a basal web. The shape in the BLIND ALPHABET shows how a bicolligate web spans the gap between every pair of toes on the flat paddle-ready foot of an aquatic bird. The piece was carved in Toon wood (*Cedrela toona*) on 7 June 1993.

Abdon Atangana, Professor in the Institute for Groundwater Studies, is a leading researcher in Applied Mathematics. His research interests lie in methods and applications of partial and ordinary differential equations, fractional differential equations, perturbation methods, asymptotic methods, iterative methods and groundwater modelling. In 2020, the Clarivate Web of Science listed him among the top 1% of scientists, recognised for their exceptional research influence, demonstrated by the production of multiple cited papers (one of only ten South African scientists listed). He was also named on a global list of leading scientists by Stanford University. Very recently, he also ranked number one in the world in mathematics, number 186 in the world in all the fields, and number one in Africa in all the fields on the single-year data set. In 2021, he was elected a fellow of The World Academy of Sciences (TWAS), in recognition of his outstanding contribution to sciences and its promotion in the developing world. He is only the second South African and sixth African researcher to be elected a fellow in the field of mathematics. Prof Atangana is known for his work in developing a new fractional operator, the Atangana-Baleanu operator, that is used to model real-world problems in science, technology and engineering – from predicting groundwater flow to the spread of infectious diseases. With this operator, he not only describes the rate at which something will change, but also accounts for disrupting factors that will help to produce better projections. He is editor of more than 20 leading journals of applied mathematics and mathematics, and for some of these journals he was the first African to be appointed as editor.

Kobus Marais is Professor of Translation Studies in the Department of Linguistics and Language Practice. He has published two monographs, *Translation theory and development studies: A complexity theory approach* (2014) and *A (bio)semiotic theory of translation: The emergence of social-cultural reality* (2018). The introduction to a review of the latter by Michael Cronin, the renowned translation studies school, reads as follows:

"Few books are discipline changing. This is one of them. To paraphrase Naomi Klein, A (Bio)- Semiotic Theory of Translation may not change everything but it will change a great many things."

He also published an edited volume with the title *Translation studies beyond the postcolony* (2017) with Ilse Feinauer and two edited volumes with Reine Meylaerts, namely *Complexity thinking in translation studies: Methodological considerations* (2018) and *Exploring the implications of complexity thinking for translation studies* (2021). His research interests are translation theory, complexity thinking, semiotics/biosemiotics and development studies. His work was recognised when he was awarded a B-rating in 2020. Prof Marais is the Founding Editor of the *Journal for Translation Studies in Africa*. He won the UFS Book Prize for Distinguished Scholarship for 2020.

Maxim Finkelstein, a Distinguished Professor in the Department of Mathematical Statistics and Actuarial Science, is the only researcher with an A1-rating in South Africa in Probability, Statistics and Operational research – recognising him as a world leader in his discipline. Prof Finkelstein's area of expertise is the modelling of random events and quantifying probabilities of their occurrence. He develops advanced models which take into account numerous factors, such as that the object is operating in a random environment, that its structure could change, that there can be human errors affecting the outcome, that the object interacts with other objects, etc. One of his evolving interests is in the area of healthcare engineering, when, for instance, monitoring the key health parameters of a patient, some optimal cost-wise decisions can be made on preventive treatments and interventions. He is the author of six books and around 250 papers on various aspects of reliability theory. Since September 2021, Prof Finkelstein has also held the position of a Visiting Professor at the Department of Management Science at the University of Strathclyde, Glasgow, UK.

Heidi Hudson is a Professor of International Relations and is currently Dean of the Faculty of the Humanities. Prof Hudson, who specialises in feminist security studies with a specific focus on Africa, obtained a B2-rating from the NRF and is an elected member of ASSAf. She serves on several editorial boards, including *International Feminist Journal of Politics*, *Civil Wars*, *Revista Relaciones Internacionales,* and *Stichproben: Vienna Journal of African Studies.* As a former Advisory Board member of the African Peacebuilding Network (APN) of the Social Science Research Council in New York, Prof Hudson regularly mentors APN fellows. She also serves as an Advisory Board member for the African Research Universities Alliance (ARUA) Center of Excellence for Post-conflict Societies, hosted by the Institute of Peace and Security Studies (IPSS) of the Addis Ababa University. During her career she has been awarded several fellowships, from among others, the Oslo Peace Research Institute (PRIO), the Nordic Africa Institute, the University of Calgary, and Fulbright. In 2018, she was the Claude Ake Visiting Chair, hosted by the Department of Peace and Conflict Research, Uppsala University and the Nordic Africa Institute.

Jeanet Conradie, Professor in Chemistry, has regularly ranked as one of the top-ten researchers at the UFS in terms of annual publication output units. Prof Conradie is specifically interested in computational chemistry, and her research focus is the synergy between experimental and computational chemistry in understanding structure and reactivity of transition metal complexes. Her research group focuses on the synthesis, characterisation, computational chemistry, electrochemistry and kinetics of ligands, transition metal complexes, transition states and reaction-intermediates for application in drugs, dye-sensitized solar cells (DSSC) and catalysis. Prof Conradie was named in the global list of leading scientists published by Stanford University, as one of the top scientists in Inorganic and Nuclear Chemistry – in both the single-year data set and in terms of career-long data.

DIGIPIX

Cynthia Miller-Naudé is a Senior Professor and Head of the Department of Hebrew. A B1-rated scientist, Prof Miller-Naudé specialises in the syntax and pragmatics of Classical Hebrew and the related Northwest Semitic languages. She is particularly interested in moving the field of traditional Semitic philology to an understanding of, and appreciation for, contemporary linguistic approaches to the study of ancient texts.

Prof Miller-Naudé works closely with Prof **Jacobus Naudé**, who is also a Senior Professor and B-rated scientist in the Department of Hebrew. His research focuses on the Linguistics of Premodern Hebrew, as well as alterity and orality in Religious Translation. In his research he seeks to understand 'otherness' of ancient culture and to preserve it while representing it intelligibly for modern users. Prof Miller-Naudé and Prof Naudé are involved in a long-term project on religious translation. In particular, they examine the role of metatexts/paratexts in religious translation and, with Dr Tshokolo Makutoane, a senior lecturer in the Department of Hebrew, on orality and performance of religious texts. In addition, they are investigating the ways in which ancient Hebrew changed over time by recognising that change occurs in cycles. Through their collective leadership, they have engendered a commitment to the internationalisation of their field, especially throughout Africa. To that end, they are bringing the study of Hebrew to Africa through innovative pedagogical methods that take into account the differing linguistic backgrounds and cultural contexts of African students. They are especially interested in empowering Bible translators on the African continent to gain the competency to translate the Bible from the source texts.

Ivan Turok holds the DSI/NRF Research Chair (SARChI) in City-Region Economies at the UFS. This is the first partnership of its kind between a university and a research council (the HSRC). The Chair seeks to understand how cities can accelerate economic growth and inclusive development, why some cities are more successful than others, and what policies and practices can improve conditions for citizens, firms and communities. Prof Turok is an NRF B1-rated researcher and one of the most highly cited social scientists in the country, with over 150 scientific papers in international journals and books. He is the former Editor-in-Chief of *Regional Studies*, and currently Editor of *Area Development and Policy* and *Development Southern Africa*. Ivan is an adviser to the United Nations, Organisation for Economic Co-operation and Development (OECD), African Development Bank and European Union. He chaired Durban's City Planning Commission for four years, helped prepare South Africa's Integrated Urban Development Framework and contributed to the National Development Plan. He is an urban and regional economist and development planner – covering urbanisation, affordable housing, township economies, labour markets, urban policy, regional economic development and tradable services. He was short-listed for the National Science and Technology Forum (NSTF) lifetime award in 2021.

Dirk Opperman, Professor in the Department of Microbiology, is a B-rated scientist whose research specialisations lie in biocatalysis, structural biology and directed evolution. He was a co-investigator in the international team of the Global Challenges Research Fund-Synchrotron Techniques for African Research and Technology (GCRF-START) project, which enables collaboration between African and British scientists using synchrotron radiation. The team of researchers recently contributed to an influential paper 'Accurate prediction of protein structures and interactions using a three-track neural network' in *Science* (373[6557] pp. 871-876). Most of the research and data collection was undertaken at a specialised facility, Diamond Light Source, in the United Kingdom. Having insight into the three-dimensional structure of a protein is essential to understand its function and mechanism at an atomic level. Prof Opperman also has long-standing collaborative projects with the Biotechnology group at the Delft University of Technology in the Netherlands. In 2021, together with research groups from Norway, the United Kingdom, France and Kenya, he secured funding via the ERA-NET co-fund on Food Systems and Climate (FOSC) to develop biotechnological processes to upcycle waste products into valuable products and promote a circular economy.

Peter Taylor is a Research Professor in the Department of Zoology and Entomology under the Afromontane Research Unit (ARU), at the Qwaqwa Campus. Prof Taylor, a B-rated scientist, is an ecologist, systematist and conservationist, whose research focuses on small mammals – particularly bats and rodents. He has described 17 new species of small mammals and co-authored five scientific books and almost 200 peer-reviewed articles. A former NRF/SARChI Head at the University of Venda (2013-2020), his standing as a researcher was acknowledged by the Academy of Science of South Africa (ASSAf), when he was inaugurated as a member in 2021. In the same year, he was elected a Fellow of the Linnean Society of London, the world's oldest extant scientific society. He and his research team of students and postdoctoral fellows at the Mountain Bat Lab on the Qwaqwa Campus, have initiated new projects to investigate the ecosystem services provided by bats in natural and agricultural ecosystems in the mountains near Phuthaditjhaba and surrounding farms. They have also embraced an engaged scholarship approach to involve school and farm communities in the research and increase awareness about the importance of protecting nature's goods and services for a sustainable future for the region. He has supervised 22 MSc and 16 PhD students.

Hussein Solomon, Senior Professor in the Department of Political Studies and Governance, was inaugurated as a new member of ASSAf in 2020. Prof Solomon is an Extraordinary Professor at the North-West University's School of Government Studies, Visiting Professor at the Osaka School of International Public Policy, Nelson Mandela University, and the Department of Political Science at Stellenbosch University. He is also a Senior Research Associate of the Israeli-based think tank on Research on Islam and Muslims in Africa, a Research Fellow at Niger Delta University, a Senior Analyst for the New York-based WikiStrat, a Research Associate of the Centre for Defence Studies at the University of Zimbabwe and a Research Associate of the South African Institute for International Affairs. In addition he is Deputy Chair of the Pugwash Conferences on Science in World Affairs (South African Chapter) and Vice-President of the African Studies Association (India). He is a member of the International Advisory Boards of the Middle East Institute and the Research Institute for European and American Studies in Athens, a member of the Security Council of the Gerhson Lehrman Group of Companies, the International Steering Committee of Global Action to Prevent War, and the International Advisory Council of the Toda Institute for Global Peace and Policy Research in Hawaii, and sits on the Board of Trustees of All Africa Women for Peace. Prof Solomon serves on the editorial boards of a number of journals, in various capacities, including *Politeia; Globalizations; Southern African Peace and Security Studies; London Security Policy Study; Africa Insight; Afro-Eurasian Journal, African Security; Contemporary Review of the Middle East; Alternatives; Journal of Administrative Science;, Afro-Arab Social and Economic Review; Journal of African Union Studies; Politikon; African Journal for the Prevention and Combating of Terrorism; Scientific Journals International* and I*nsight on Africa.* His research interests include security studies, conflict and conflict resolution in Africa, South African foreign policy, international relations theory, religious fundamentalism, the nexus between religion and politics in Africa, and population.

Daryl Codron is Associate Professor in the Department of Zoology and Entomology and a B-rated scientist, recognising him as an internationally acclaimed researcher. He leads the Animal Ecology research group, which studies patterns of resource use and how these shape the ecological dynamics and evolutionary adaptations of primarily mammalian faunas. Emphasis is on stable isotope analysis for reconstructing trophic niche dynamics over multiple space and time scales, as well as on the theoretical principles underpinning this approach. Current projects aim specifically to quantify individual- and population-level niche variations, the life history characteristics that constrain these diet niches, and to model the impacts on species' competitive interactions and coexistence mechanisms. In November 2021, the group published an article in which resource competition was shown to organise coexisting species' niches into distinct clusters rather than unique units, with the emergence of sizeable gaps in the available niche space. They also provided the first empirical support for the evolution of niche clustering, using the fossil record of the South African central interior.

Hendrik Swart is a Senior Professor in the Department of Physics and a B1 NRF-rated researcher who was included in the global list of leading researchers in Applied Physics by Stanford University. He brought luminescence materials to South Africa in 1996 after a highly productive sabbatical in Florida University, USA. This laid the foundation for his subsequent research and since than he has led research in the area of the degradation of phosphors for field emission displays, as well as developing materials for nano solid state lighting. He has been key in the development of processes to synthesise and deposit thin films of various types of semiconductor nano-particles, which will enhance the colour, luminescent intensity and lifetime of such displays. His research led to the establishment of a strong group working on luminescent materials, which culminated in the award of the SARChI Chair in Solid State Luminescent and Advanced Materials in 2012, which was renewed for another five years until 2022. The main focus of his research group is the improvement of luminescent materials for applications in flat panel displays, solar cells, solid state lighting, dosimetry, and thermometry.

Maryke Labuschagne, from the Department of Plant Sciences**,** leads the SARChI Chair in Disease Resistance and Quality of Field Crops. The Chair, which was extended for a further five years in 2020, focuses on advancing food security and nutrition in Africa. Prof Labuschagne emphasises that, despite recent advances in addressing hunger and food security, they remain critical issues. She believes that the uniqueness and strength of the Chair lie in its dual emphasis of breeding of cereal crops for resistance to fungal diseases and improving the nutritional value and quality of crops for processing and human consumption. Prof Labuschagne's research has taken her all over Africa to undertake research on the genetic improvement of staple food crops in communities. Through decades of research and collaboration, she has also contributed to the establishment of a strong network of researchers on the continent.

Francois Tolmie is Professor of New Testament in the Faculty of Theology and Religion. He is a B-rated researcher, specialising in Johannine Literature (in particular, narratological approaches) and Pauline Literature (in particular, the rhetorical analysis of the Letter to the Galatians and the Letter to Philemon). With a DTh in New Testament Studies and a PhD in Greek, Prof Tolmie is considered an expert in narratology, rhetorical analysis and the translation and theology of these New Testament texts. In 2022 the results of several years of focused research on the history of interpretation of the Letter to Philemon were published as an academic book by Mohr Siebeck in Germany, one of the leading international publishers in Theology. This work, titled *Pointing out Persuasion in Philemon. Fifty Readings of Paul's Rhetoric from the Fourth to the Eighteenth Century* (383 pages), was chosen to launch a new academic series, *History of Biblical Exegesis,* and is the most comprehensive study of the way in which commentators on the letter interpreted Paul's rhetoric from the fourth until the eighteenth centuries.

Melanie Walker is a Distinguished Professor and holder of the SARChI Chair on Higher Education and Human Development. She has been awarded the NRF's highest rating of A1 for the second consecutive five-year period. Prof Walker's specific interest in education research lies in how it can explore and reveal inequalities and opportunities in ways that might enable improved social justice in higher education settings, but also foster an understanding of what higher education is for in relation to society. Through her own international reputation, her research and outstanding mentorship, she inspires and capacitates young sub-Saharan researchers and has had a significant impact on the standing and reputation of the UFS. Prof Walker is listed as one of the leading scientists globally by Stanford University. In 2021, Prof Walker was elected President of the international Human Development and Capability Association (HDCA). This is the first time that the HDCA president is based in the Global South. Also in 2021, she was reappointed as honorary professor at the University of Nottingham and appointed extraordinary professor at the University of Pretoria

Paul Oberholster, Director of the Centre for Environmental Management, won the NSTF-Water Research Commission (WRC) Award in 2021 for his contribution to water resource management in South Africa over the past five years, with special reference to the field biological passive wastewater treatment. The NSTF-South32 Awards were the first science awards in South Africa, and are the largest, most comprehensive and sought-after national awards of their kind in the country. The NSTF Awards honour and celebrate outstanding contributions to science, engineering and technology (SET), and innovation. Prof Oberholster's research focuses on the use of freshwater algae to treat acid mine drainage or domestic wastewater. Current wastewater solutions take into account sustainable development and the global move towards a more circular use of resources, where waste is reduced and resources are recycled. In this context, he and his research team have undertaken new research at the phycoremediation pilot plant in Mossel Bay, on the reuse of domestic wastewater and the use of the algae biomass for biofuel and biofertilisers.

Carlien Pohl-Albertyn, Professor of Microbiology in the Department of Microbiology and Biochemistry, is the holder of the SARChI Chair in Pathogenic Yeasts, which studies pathogenic yeast infections and necessary treatment options. The research group focuses on molecular mechanisms of virulence and the role of bioactive lipids in pathogenic yeasts, specifically *Cryptococcus neoformans* and several *Candida* species. They are also interested in the virulence of polymicrobial infections consisting of *Candida* spp. and the bacterium, *Pseudomonas aeruginosa*. This research brings hope to many immunosuppressed patients battling HIV/Aids, cancer and diabetes, who suffer from opportunistic yeast infections. Prof Pohl-Albertyn was on the team of researchers which wrote the health sector response to the COVID-19 pandemic in South Africa for the Country Report for submission to Parliament.

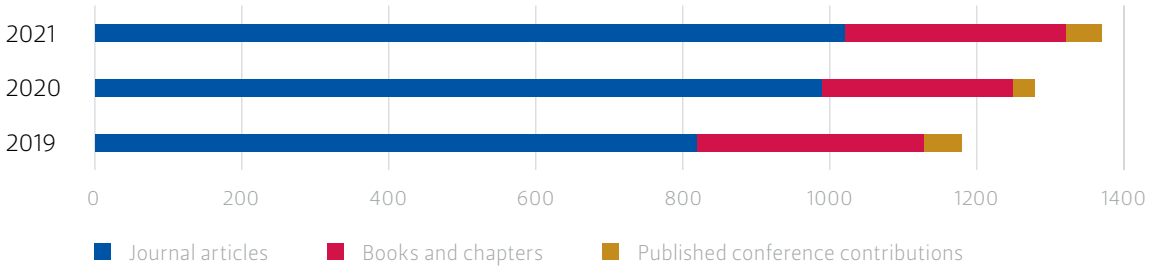
Felicity Burt is an expert in arbovirology in the Division of Virology of the Faculty of Health Sciences and the National Health Laboratory Service. With more than 25 years of research on medically significant viruses that cycle in nature and are transmitted to humans via mosquitoes, ticks or animals, Prof Burt is a B-rated scientist, and the holder of the SARChI Chair in Vector-borne and Zoonotic Pathogens Research, which was extended for a further five years in 2020. The Chair builds on existing research strengths at the UFS and aims to contribute towards identifying and investigating medically significant arboviruses and zoonotic viruses in the country. To this end, the research chair facilitated progress towards establishing serosurveillance studies for various vector-borne viruses, including Crimean-Congo haemorrhagic fever virus, a tick-borne and zoonotic virus that causes severe disease with fatalities. The new biosafety level 3 BSL-3 laboratory in which the UFS has invested, has enabled the research group to extend their research of pathogens that were previously excluded from the programme due to biosafety considerations.

Prof Burt emphasises that the majority of new and emerging viruses are zoonotic in origin and that the SARS-CoV-2 pandemic highlights the impact of an emerging zoonotic pathogen on society. As a consequence, her research group uses a One Health approach in their surveillance programmes, in which interactions between humans, animal hosts and the environment are considered, in order to further our knowledge and understanding of viruses circulating in nature with public and/or veterinary health implications. In the absence of commercially available assays, the group is adept at developing and validating multiple assays for application in their research. Their surveillance has confirmed the presence of several viruses with public health implications circulating within mosquito populations in the Free State.

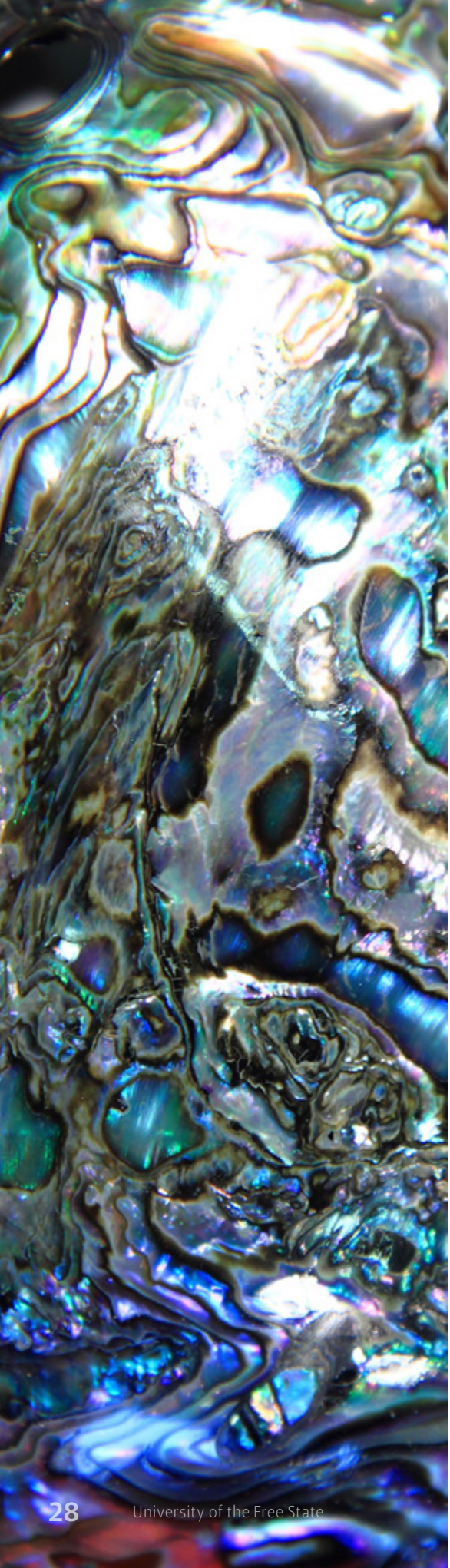
Due to her expertise, Prof Burt has been leading the UFS COVID-19 Task Team which has advised on implementation of national guidelines for the safety of staff and students on the UFS campuses.

There is no doubt that our top researchers, some of whom are featured above, have contributed significantly to the growth in our research outputs of the last few years.

UFS Research Outputs 2019–2021



The steady upward trend annually in the number of journal articles has been particularly pleasing – increasing by 43% over the past five years.



Future leaders

One of the most exciting things about research at a university, is to watch the next generation of researchers emerge and establish their footprint. 2020/21 has been an exceptional period at the University of the Free State (UFS), with a range of young researchers making their mark.

The UFS has a number of initiatives in place to support developing researchers. Foremost among these is the Transformation of the Professoriate programme, which focuses on the holistic development of the skills and attributes of emerging scholars in the core functions of teaching and learning, research, community engagement and academic leadership, in preparation for their roles as future professors and academic leaders. The emerging scholars selected for the programme are divided into two groups – the Future Generation Professoriate (FGP) and the Emerging Scholar Accelerator Programme (ESAP). To date 75 participants, representing all faculties, have been involved in the programme. Five members of the FGP have been promoted to the level of Associate Professor – Anthonio Adefuye, Samuel Adelabu, Rodwell Makombe, Martin Nyaga and Olusola Olosade.

Some of our emerging scholars have also been involved in the prestigious Future Professors Programme of the Department of Higher Education and Training (DHET). This initiative to invest in the future South African professoriate, involves a rigorous and highly competitive selection process.

Here we celebrate and profile some of our exceptional emerging researchers, who are already making headlines nationally and internationally.

Matteo Grilli, from the International Studies Group, received a coveted P-rating from the NRF. The P-rating honours young researchers (normally younger than 35 years) who have held a doctorate or equivalent qualification for less than five years, and who have demonstrated the potential to become future international leaders in their field based on exceptional research performance and output. Dr Grilli specialises in the political history of Ghana and southern Africa, focusing on transnational histories of African liberation movements, the history of Pan-Africanism, the Cold War and decolonisation in Africa, and the history of European migration in sub-Saharan Africa. He published *Nkrumaism and African Nationalism: Ghana's Pan-African Foreign Policy in the Age of Decolonization* with Palgrave Macmillan in 2018. Together with Dr Frank Gerits, he edited a book titled *Visions of African Unity: New Perspectives on the History of Pan-Africanism and African Unification Projects* in 2021.

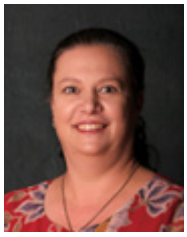
Gladys Kigozi is a Senior Researcher in the Centre for Health Systems Research and Development (CHSR&D) and part of the cohort of the Future Generation Professoriate. Dr Kigozi has worked in the field of tuberculosis (TB) and HIV/AIDS since 2007. She seeks to understand the structural and socio-behavioural dimensions of (integrated) TB and HIV/AIDS management and to monitor the implementation of TB and HIV-related policies in health care facilities and communities.

Other areas of interest include occupational health, human resources for health and mental health. She is the principal investigator of a collaborative project to explore TB patients' experiences of depression, anxiety and alcohol abuse and is playing a key role in other collaborative projects exploring the impact of the COVID-19 pandemic on individuals and communities.

Philip Aghoghovwia, Senior Lecturer in the Department of English, has been a fellow and awardee of several prestigious organisations, including the African Humanities Program of the American Council of Learned Societies, the Carnegie Corporation of New York and African Studies Association (CCNY-ASA) 2021 Fellow, the DHET Future Professors Programme and the UFS Future Generation Professoriate. He was invited as a visiting scholar to the University of Alberta, Canada in 2020 (truncated due to the Covid-19 pandemic).

Dr Aghoghovwia holds an NRF Y1-rating. His research is in environmental humanities, African literature, energy and water studies and the cultures and politics of resource extraction in Africa. His recent essays appeared in *English Academy Review* (2020), *Climate Realism: the Aesthetics of Weather and Atmosphere in the Anthropocene* (Routledge, 2020), *South African Journal of Science* (2021), *Safundi* (2021), *Interventions* (2021) and *Social Dynamics* (2022). His book, *Violent Tropes: Reading Petroculture in the Niger Delta,* is due later in 2022 by HSRC Press.

Alice Brink, Associate Professor in the Department of Chemistry, was selected for the first cohort of 29 candidates of the DHET Future Professors Programme. An inorganic chemist, her research concentrates on developing systematic approaches to understand the foundational driving forces of chemical, kinetic mechanisms, biological and catalytic factors affecting drug and catalysis development. Prof Brink's work is funded by SASOL, NRF-Thuthuka and the NRF-NEP. She has a longstanding research collaboration with Manchester University in the UK, investigating the coordination of organometallic complexes with proteins utilising protein crystallography. She serves on the Editorial Board of *Crystallography Reviews* and is an invited member on the International Union of Crystallography (IUCr) Committee on Data. Prof Brink holds a Y1-rating from the NRF and in 2019 she was nominated for the South African Women in Science Award in the category for Distinguished Young Woman. RHONA KLOPPER PHOTOGRAPHY



Corlia Janse van Vuuren is part of the cohort of the Future Generation Professoriate. Having started her academic career in the Department of Physiotherapy, she subsequently moved to teaching and learning management in the Faculty of Economic and Management Sciences. Throughout her career Prof Van Vuuren has dedicated most of her research to Higher Education studies, with a specific focus on student success and data-informed teaching and learning. Due to her specific research focus, she was privileged to be selected to the Teaching Advancement at University (TAU) programme, hosted by the DHET in collaboration with the Higher Education Learning and Teaching Association of Southern Africa (HELTASA) in 2015/2016. She returned to the Faculty of Health Sciences in 2019 and is currently the Head of the School of Health and Rehabilitation Sciences. She has continued with her research in Higher Education, focusing now on the health domain, also as an advanced scholar in the UFS Learning and Teaching Fellowship programme since 2021.

Brian van Soelen, Associate Professor in the Department of Physics, was selected for the prestigious DHET Future Professors Programme in 2021. Prof van Soelen is an astrophysicist whose primary research focuses on high energy gamma-ray sources, particularly gamma-ray binaries and active galactic nuclei, focusing on how synergy can be formed between optical and gamma-ray observations. He has been supported by NRF-Thuthuka as well as the NRF Competitive Support for Unrated Researchers (2019–2021). He is a member of the High Energy Stereoscopic System (HESS) Collaboration, the operating body for the world's most sensitive high energy telescope, as well as the Cherenkov Telescope Array (CTA) Consortium. He currently holds a Y1 NRF-rating.

Bekithemba Dube, Senior Lecturer in the School of Education Studies on the Qwaqwa Campus, is a member of the Future Generation Professoriate. His research interests are in religious studies, curriculum and the post-colonial nexus of religion, education and politics. In 2021 he was recognised by the UFS for his scholarly impact, when he was listed as the third largest contributor to research journals across all disciplines in 2020 – having published 26 articles. In 2021 he published 23 articles and an edited book volume. Dr Dube was invited as a visiting scholar to work with international scholars on collaborative research projects at Reich College of Education's Department of Curriculum and Instruction at the Appalachian State University. He successfully edited special issues in DHET- and Scopus-indexed journals such as *Alternations* and the *Journal of Culture and Values in Education*. In the past three years he has received 12 academic excellence awards.

Jared McDonald is a Senior Lecturer in the Department of History on the Qwaqwa Campus and Assistant Dean of the Faculty of the Humanities. He is part of the UFS Future Generation Professoriate, and his research interests include indigenous responses to British colonialism in the Cape Colony in the nineteenth century, the work of the London Missionary Society in southern Africa, comparative histories of settler-colonialism and genocide, and histories of children as victims of genocide. He is also a project scholar and the lead contact for southern African research for Livingstone Online, a digital humanities project that preserves and curates through digitisation the surviving manuscripts of the nineteenth century missionary-explorer, David Livingstone. In 2019, a sub-project titled 'Livingstone's Manuscripts in South Africa (1843-1872)', which was co-directed by Dr McDonald, won an award from the Committee on Scholarly Editions (CSE) of the Modern Language Association (MLA) in the USA. He is also the lead contact for southern African research in a new digital humanities project, 'One More Voice', based at the University of Nebraska-Lincoln, which brings together a number of researchers from the USA, UK and Africa. The project intends to uncover and highlight long-neglected materials in the British imperial archive that illuminate the important roles played by African guides and assistants to famed Victorian explorers in the nineteenth century.

Sevias Guvuriro is a Senior Lecturer in the Department of Economics and Finance, a candidate in the Future Generation Professoriate, and an instructor for the University of Bremen Summer School. His research interests are in behavioural development economics and his work revolves around dynamics of intra-household decision-making processes, investments in family-type public goods, and relevance of risk, time and social preferences on development issues, including health related decisions. Dr Guvuriro was selected for the University of Michigan African Presidential Scholars (UMAPS) Program. He will travel to Ann Arbor in Michigan and spend five months at that university to expand his international network and further develop his research.

Ralph Clark has been the pioneer Director of the Afromontane Research Unit (ARU) since 2018 and was the Interim Coordinator of the ARU's Risk and Vulnerability Science Centre (RVSC) programme (2020–2021) funded by the Department of Science and Innovation. He is considered a leader in southern African mountain research, and co-ordinates a large multidisciplinary, multi-campus team, as well as numerous domestic and international partnerships for the ARU. His personal research expertise focuses on improving our understanding of plant diversity and plants endemism in poorly explored parts of southern African mountains, and translating these into biogeographic interpretations, as well as conservation and sustainable use outcomes. He has conducted extensive research along the southern Great Escarpment (South Africa) and has important collaborative projects in the Manica Highlands (Zimbabwe–Mozambique) the Angolan Highlands and on the Limpopo-Mpumalanga-Eswatini Escarpment (South Africa). He pioneered a new collaboration with BirdLife South Africa and internal ARU stakeholders looking at the acoustic diversity of birds in a large, unexplored wetland in Golden Gate Highlands National Park (GGHNP) that has added 20 new birds to the GGHNP records. Anticipated work includes the floristics of the Qwaqwa Malotis and the western Malotis (South Africa–Lesotho), with partners in Ezemvelo KZN Wildlife and Lesotho.

Samuel Adelabu is Associate Professor and Head of the Department of Geography. His research focus is on remote sensing and geographical information systems, targeting the development of ecological change monitoring, disaster management and climate change in mountainous environments, using geospatial analysis. He is actively involved with Afromontane Research Unit and is part of the UFS Future Generation Professoriate and one of the candidates who was promoted to the level of Associate Professor in 2020.

WA Lombard, from the Department of Agricultural Economics, was the winner of the Joseph F Donnermeyer New Scholar Award from the International Society for the Study of Rural Crime in 2020, for his research on the economic impact of stock theft in South Arica. The award is bestowed on an early-career researcher for a publication pertaining to rural criminology during the previous 12 months. Dr Lombard's article focused on sheep and goat theft in KwaZulu-Natal where the direct cost of sheep and goat theft was calculated. It was found that official stock theft statistics under-represented actual sheep and goat thefts. Furthermore, the recovery rates were much lower than shown in official statistics. This showed that the recovery actions of the South African Police Service and/or the livestock farmers were far less successful than what was indicated in the official statistics.

Lehlohonolo Makhakhe, a Senior Lecturer and specialist in the Department of Dermatology, recently published the very first comprehensive full-colour atlas on skin diseases commonly seen in the African setting. The book is a collaborative effort working with different contributors within the medical fraternity. His aim was to promote the culture of writing and producing quality, well-researched works, with relevant and local content. The book is fully endorsed by the UFS and is offered as part of the curriculum for medical students. Dr Makhakhe is also a director of Epicutis Skincare range and will be launching his own cosmetic range in 2022. He remains passionate about research and plans to continue contributing meaningfully in academia and upholding the rich heritage of excellence that has defined the UFS.

Martin Nyaga, an NRF-rated fellow of the UFS Future Generation Professoriate programme, and one of the candidates who was promoted to the level of Associate Professor in January 2021, is the head of the UFS-Next Generation Sequencing Unit and the Director of the WHO Collaborating Centre for Vaccine Preventable Diseases Surveillance and Pathogen Genomics. Prof Nyaga's research interests entail enteric and respiratory virome studies. He is the Principal Investigator and a co-founder of the African Enteric Viruses Genome Initiative (AEVGI), that is investigating the long-term effects of the introduction of the monovalent RV1 vaccine in three African countries (Ghana, Malawi and South Africa). He is also part of the Network for Genomic Surveillance in South Africa (NGS-SA), undertaking SARS-CoV-2 genome sequencing to generate the Free State data for the national consortium. Prof Nyaga's research outputs have been disseminated widely, in high impact factor journals, including *Science* and *Nature*.

Ntsoaki Matumelo Lucia Meko is a Senior Lecturer in the Department of Nutrition and Dietetics. Her research focus has evolved from mainly focusing on overweight and obesity to include nutrition interventions, infant and young child feeding and food insecurity. Dr Meko is a candidate in the Future Generation Professoriate. Her current research is on health communication in resource-poor communities and she is also working on a Nutrition Communication Strategy to bridge inter-cultural, language and literacy gaps found in communication between dieticians and their patients.

Tshepo Moloi is a Senior Lecturer and Subject Head in the Department of History at the Qwaqwa Campus, and is a member of the UFS Future Generation Professoriate. His research interests include student and youth politics, oral history and clandestine political resistance in South Africa. Dr Moloi is the deputy president of the Southern African Historical Society and former president of the Oral History Association of South Africa. He is the editor of *New Contree* and co-editor of a recently published book, titled *Guerrilla Radios in Southern Africa: Broadcasters, Technology, Propaganda Wars, and the Armed Struggle*. This book is a collection of eleven essays on the histories of the radios attached to the armed wings of the liberation movements in the region.

Lintle Mohase is a Senior Lecturer in the Department of Plant Sciences and part of the UFS Future Generation Professoriate. Her research interests are in the physiology/biochemistry of plant-insect interactions, particularly wheat challenged with the Russian wheat aphid (RWA, *Diuraphis noxia*). Dr Mohase's primary research examines how wheat reacts to aphid infestation at protein and metabolite levels. She investigates the critical enzymes associated with biosynthetic pathways of signalling molecules, such as reactive oxygen species, and the associated antioxidants and defence-related hormones, such as salicylic, jasmonic and abscisic acids. In addition, she investigates the potential of phytohormones and non-pathogenic microorganisms as priming agents to enhance plant resistance to pests. She also investigates the effect of drought on plant resilience to pests. In her research, she collaborates with entomologists from the Agricultural Research Council-Small Grains, Bethlehem, and pathologists at the UFS.

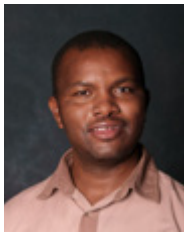
Mikateko Mathebula, Senior Researcher at the SARChI Chair for Higher Education and Human Development, was selected for the prestigious DHET Future Professors Programme in 2021. Dr Mathebula is currently leading an NRF/Thuthuka-funded project on life after university for graduates of rural origin. She is co-investigator on the scoping study, funded by the Society for Research into Higher Education (SRHE), on access to higher education for youth from informal settlements. She is also a co-researcher on a Transforming Education for Sustainable Futures (TESF) Network Plus-funded project that aims to reconceptualise universities as sustainable communities from a pan-African perspective. Mikateko recently completed the *Miratho* research project with Prof Melanie Walker, Dr Patience Mukwambo from the University of Pretoria and Prof Monica McLean from the University of Nottingham. This was a longitudinal (2016-2021) ESRC/DFID-funded project which examined the factors and dynamics that influence the achievement of higher education learning outcomes for low-income youth from rural and township areas across South Africa. The forthcoming (2022) co-authored book from this project is titled *Low-Income Students, Human Development and Higher Education in South Africa: Opportunities, obstacles and outcomes.*

Anthonio Oladele Adefuye is an Associate Professor in the Division Health Sciences Education and part of the Future Generation Professoriate Group. He was promoted to Associate Professor in 2021. Prof Adefuye is a researcher, writer, medical educator and a physician-scientist. He has published in both national and international peer-reviewed journals in the domain of molecular biology/immunology and medical education and he is a peer reviewer for the *South African Family Practice Journal and Journal of Medical Education and Curricular Development (SAGE).*

Jacques Matthee, a Senior Lecturer in the Department of Private Law, is part of the UFS Future Generation Professoriate. Dr Matthee has research interests and experience in Criminal law, Law of Criminal Procedure, Legal Pluralism, African Customary law and Medical Law. His current research focuses on the conflict between culture, religion and crime. He is also an Advocate of the High Court of South Africa and in 2017 he was admitted as an associate member of the National Forum of Advocates.

Jolly Musoke, a Senior Medical Scientist in the Department of Medical Microbiology, is in the cohort of the Future Generation Professoriate. She obtained her PhD in Veterinary Tropical Diseases from the University of Pretoria, in 2016. One of her main research interests is investigating the prevalence, molecular epidemiology and potential transmission of zoonotic diseases (i.e. zoonotic tuberculosis and brucellosis) at the wildlife-livestock-human interface. Dr Musoke also has a keen interest in establishing mechanisms of antibiotic resistance and virulence factors in hospital outbreaks. Furthermore, her work includes epidemiological investigation of clinically novel pathogens such as hyper-virulent *Klebsiella pneumonia*. She has a growing publication list in local and high impact international journals, such as *Emerging Infectious Diseases* and *Pathogens*. Dr Musoke has supervised award-winning MBChB, BSc Hons, MSc and MMed candidates, some of whom have graduated *cum laude*.

Brownhilder Neneh is an Associate Professor and academic chair for the Department of Business Management and a candidate in the Future Generation Professoriate. Prof Neneh, whose core research domain is entrepreneurship, with a special interest in women's and students' entrepreneurship, is an NRF-rated researcher. In 2019, she was a winner of the Emerald Literati Awards for Highly Commended paper, published in the *African Journal of Economics and Management Studies*. She is collaborating on a project on women entrepreneurship with Prof Dianne Welsh, the Hayes Distinguished Professor of Entrepreneurship at the Bryan School of Business and Economics, University of North Carolina, to which Prof Neneh has been invited as a visiting scholar. Some of her academic research has appeared in journals such as the *Journal of Small Business management*, *Journal of Vocational Behaviour*, *Journal of Retailing and Consumer Services*, *Studies in Higher Education*, and *Education + Training*.



Rodwell Makombe is an Associate Professor in the Department of English on the Qwaqwa Campus. His areas of research include cultural studies, postcolonial literary studies (particularly literatures of southern Africa), cultural studies (specifically social media discourses) and cultures of resistance. Prof Makombe is part of the UFS Future Generation Professoriate, and one of the candidates who was promoted to the level of Associate Professor in 2021. With his latest book, *Cultural texts of resistance in Zimbabwe: Music, Memes, and Media*, he won the 2021 UFS Book Prize. He has also recently published two book chapters, 'COVID-19 as a platform to rethink the decolonisation of education in South Africa' in the book *Covid-19: Interdisciplinary Exploration of Impacts on Higher Education and Social media* and 'COVID- 19 and the Second Republic in Zimbabwe', in the book *The Zimbabwean crisis after Mugabe: Multidisciplinary perspectives*.

Oliver Nyambi, Associate Professor in the Department of English at the Qwaqwa Campus, was a fellow of the Alexander von Humboldt Foundation, hosted by Susan Arndt in the Professorship of English Studies and Anglophone Literatures at Bayreuth University, Germany, from 2018 to 2021. He was selected to be among the first cohort of DHET Future Professors Programme in 2020. Nyambi's research focuses on crisis/humanitarian literatures, critical political discourse analysis and onomastics. He has been involved in co-editing two books to be published shortly – *Cultures of change in contemporary Zimbabwe: Socio-political transition from Mugabe to Mnangagwa (Routledge, 2022)* and *The Zimbabwean crisis after Mugabe (Routledge, 2022)* – which investigate how culture reflects change in Zimbabwe, focusing predominantly on Mnangagwa's 2017 coup, but also uncovering deeper roots for how renewal and transition are conceived in the country.

Champion Nyoni, a Senior Researcher in the School of Nursing, became the first UFS staff member, and only the third African, to win the prestigious Sigma Emerging Researcher/Scholar Award. The award recognises nurses whose research and scholarship have impacted the profession and the people it serves. Sigma has appointed him as an Advisor to their Global Nursing Education Academy, based in the USA. Dr Nyoni's research focuses on health professions education, and he has published up to 30 articles in this field. He is an Associate Editor with the *African Journal of Health Professions Education* and the Chairperson for the Boards of Directors for the Africa Interprofessional Education Network (AfrIPEN) and the Sub-Saharan Africa FAIMER Regional Institute (SAFRI). Interprofessional. Global, a global confederation for interprofessional education based in the Netherlands, recently appointed him as their board's Deputy Chairperson.

Olusola Ololade, a member of the UFS Future Generation Professoriate, is an Associate Professor in the Centre for Environmental Management. Her research interests include land use/cover analysis, water-energy-food nexus, mining and sustainability, and sustainable development. She has supervised 21 Master's and two PhD students to completion. She is also involved in mentoring programmes, especially for young women. Prof Ololade was nominated and elected as a full member of the Sigma Xi Scientific Honour Society in 2020 and appointed as one of the eight foundation members of the Global Research Committee of Sigma Xi in 2021. She was elected a Lifetime Fellow Member of the International Society for Development and Sustainability in Japan, based on her research contribution to environmental sustainability issues, and received an NRF C2-rating in 2021. Shola Ololade was one of the five members of the FGP who was promoted to the level of Associate Professor in 2021.

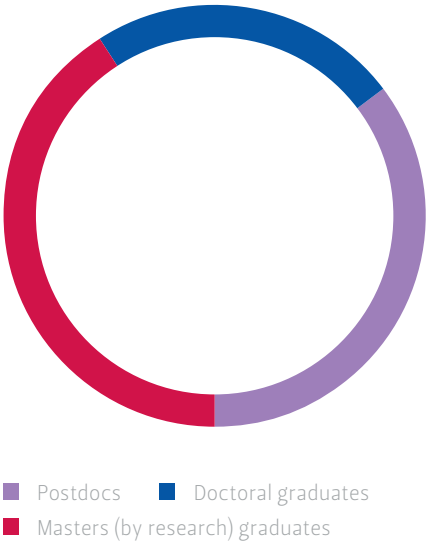
Mamello Sekhoacha, Associate Professor from the Department of Pharmacology, was appointed as the new chairperson of the National Health Research Ethics Council of South Africa (NHREC), in 2021. The NHREC is the national statutory body responsible for the governance and advance of health research ethics in South Africa. Prof Sekhoacha represents South Africa on the African Vaccine Regulatory Forum (AVAREF), a network of African national regulatory authorities established by the World Health Organization (WHO) as a platform for building ethics and regulatory capacity for clinical trials in Africa and promoting the harmonisation of ethics and regulatory processes on the continent. As a researcher, her focus is on the scientific development of potential treatments for cancer. Her research addresses challenges of chemo resistance, chemo toxicity and treatment failure, which all emphasise the need for affordable, effective and less toxic chemotherapeutics. Her research develops chemo nano medicinal agents through 'green' technological innovations, and designs targeted chemo delivery nano-systems, in an effort to combat non-specificity and subsequent toxicity of chemotherapy. Her research also investigates patients' genetic profile as a potential influence of treatment outcome. This preliminary research paves ways to personalised chemo treatments, which is the future of individualised healthcare.

Sandy-Lynn Steenhuisen, Senior Lecturer and Subject Head in the Department of Plant Sciences at the Qwaqwa Campus, and affiliate of the Afromontane Research Unit (ARU), was selected to be part of the first cohort of the DHET Future Professors Programme in 2020. She is an evolutionary ecologist specialising in the pollination and reproductive ecology of native and invasive alien plant species in South Africa, and specialises in investigating shifts in pollination systems and associated floral traits between bird, beetle and mammal pollination systems in South Africa's flagship genus, *Protea*. She does much of her research in collaboration with the Centre for Biological Control at Rhodes University, the Centre for Invasion Biology at Stellenbosch University, the South African National Biodiversity Institute (SANBI) and the SARChI Research Chair in Ecosystem Health and Biodiversity at the University of KwaZulu-Natal. Her research group is primarily focusing on determining factors contributing to the spread of invasive alien plant species in sensitive high-elevation grasslands. In addition, she is a co-PI on an international collaborative Dimensions-Horizon 2020 project, RangeX, with the ARU and the Mountain Invasion Research Network (MIREN), using remote cameras to investigate the impact of range-expanding plant species on pollinator services in the Maloti-Drakensberg. This research is essential to understand how these species may impact our natural biodiversity and rangelands, contributing to integrated management regimes. Dr Steenhuisen has a Y1 NRF-rating, was a Claude Leon Fellow and NRF Research Career Advancement Fellow, and serves on the editorial boards of the *South African Journal of Botany* and *American Journal of Botany*.

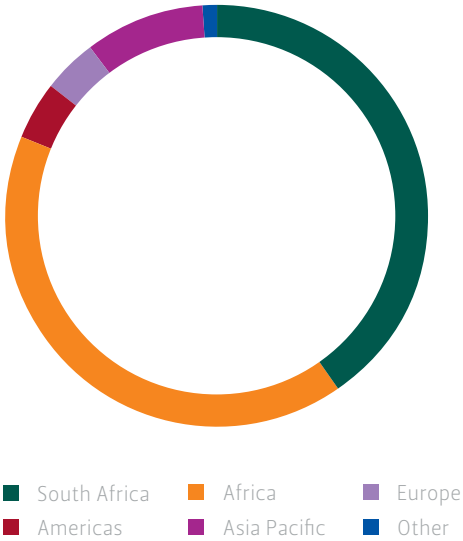
Our next generation of researchers comes from our postdoctoral fellows and our postgraduate students.

There is undoubtedly mutual benefit to postdoctoral fellowships – to the individual and to the university. Our postdoctoral fellows contribute to the research activities and the research culture of the institution. With 60% of the postgraduate cohort being international postdoctoral fellows (i.e. from countries other than South Africa), they help to create a richly diverse environment. They are the potential future leaders in the research endeavor.

Next Generation Researchers 2021

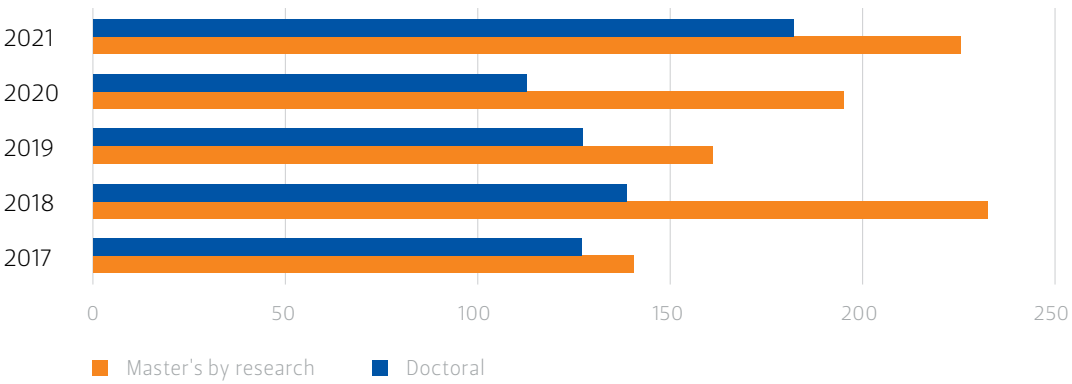


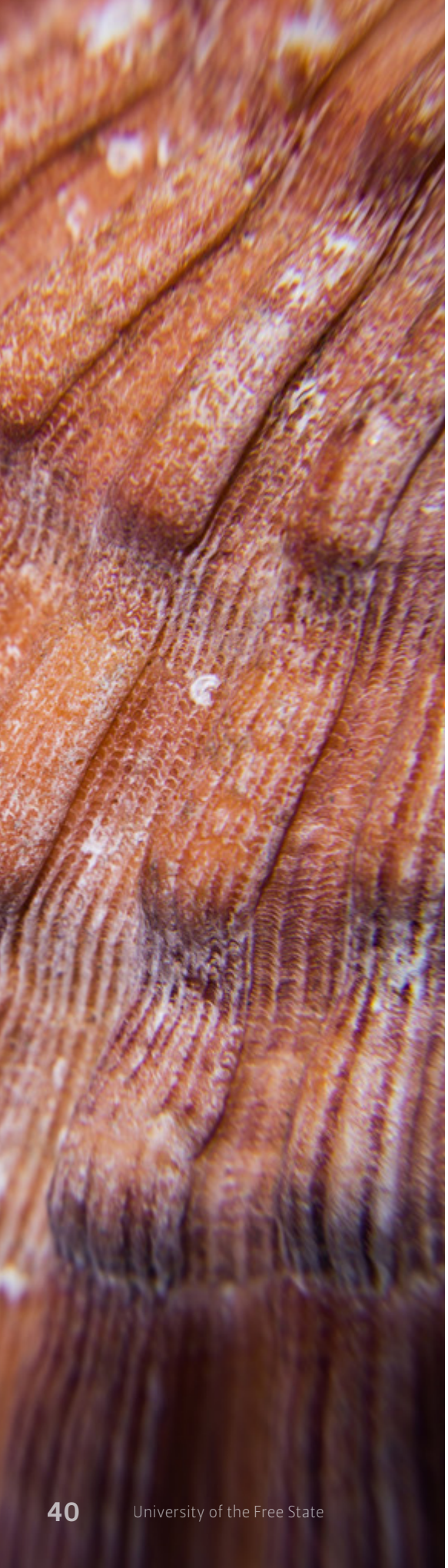
Postdoctoral Fellows by Region 2021



The starting point for all future research leaders is of course postgraduate study, and 2021 saw a pleasing increase in the number of students graduating with a Master's by research degree, and, and the number of PhDs conferred.

M&D Graduates 2017–2021





Engaged research

At the University of the Free State (UFS), engaged scholarship activities are guided by the vison of being a research-led, student-centred and regionally relevant university, focused on development and social justice. Engaged scholarship thus involves the various ways in which an institution engages with the diverse community in which it finds existence. It is about linking the best of the research, teaching and learning skills of staff and students to specific learning and development needs of civil society, the private sector, government and non-governmental organisations. Engaged scholarship embraces the inculcation of citizenship and the social responsibility of the UFS to society, by giving effect to one of the key 'public good' dimensions of the University.

Engaged scholarship has emerged as a fundamental strategic pillar of the UFS scientific agenda. During the period from 2017 to 2020, the input from engaged activities delivered by the UFS, resulted in 285 engaged-activity outputs, of which the majority constituted engaged citizenship (44%), followed by engaged research (33%) and engaged learning and teaching (23%). A pilot case study of a community-university research partnership has been launched to engage in a community-based participatory research project to support one of the UFS flagship partnerships.

Some of the engaged research activities during 2020/21 are reported on below.

Two Observatories Project

South Africa is a major player in world astronomy and the Free State is particularly suited to research in astronomy due to its dark skies and stable atmosphere. The UFS has substantial astronomy resources, both in terms of research capacity and facilities. The Two Observatories Project, managed by the Department of Physics, ensures the sustainability and development of the Boyden Observatory and the Naval Hill Planetarium (formerly the Lamont-Hussey Observatory), to promote science communication and education, foster astronomical research and preserve and share our important astronomical heritage. The Boyden Observatory is still used as a research facility, while the Lamont-Hussey Observatory was converted to a Planetarium on Naval Hill – as the first component of a fully developed 'Centre for Earth and Space'.

The great conjunction of Jupiter and Saturn in December 2020 was the closest since 1623. A combined team from the UFS and the Astronomical Society of South Africa – led by Prof Matie Hoffman, Associate Professor in the Department of Physics – joined their counterparts from the Ellinogermaniki Agogi School and the Skinakas Observatory in Greece, to broadcast the event. The Boyden Observatory in Bloemfontein and the Ellinogermaniki Agogi Observatory in Greece were chosen as the two selected vantage points from the southern and northern hemisphere, respectively. The live-stream event of the conjunction was a catalyst that will result in continued collaboration between the UFS and colleagues in Greece in the field of astronomy.

During 2020, an interdisciplinary team of researchers at the UFS helped to conceptualise and put together detailed plans to install a data visualisation facility at the Planetarium site. In order to incorporate spatial information into decision-making tasks, it is overlaid digitally and analysed, which is known as a visualisation technique. A section of the Environmental Education Hall on the site of the Naval Hill Planetarium is ideal for the planned visualisation laboratory. The laboratory will bolster the use of the facilities at the Planetarium and leverage its capacity to be used for 3-D visualisations. The visualisation facility will assist researchers and industry and support a longer-term UFS plan to promote research into planetary science, including Geology and Astronomy, and explore the connections with Chemistry and other natural science fields.

The Naval Hill Planetarium (left) and the Environmental Education Hall (right).

Community University Research Partnerships

Engaged scholarship can advance sustainable development for positive social change through co-creation of action-oriented knowledge, in democratic community university research partnerships (CURPs). At the interface of a CURP, different knowledges from science and society can merge and contribute to address glocal (from local to global) challenges for the common good. In 2009, the UFS established a long-term CURP with Bloemshelter, a non-profit organisation (NPO), which provides shelter, food and development opportunities for homeless vulnerable women and children. This CURP serves as a collaborative learning and inquiry platform for engaged scholarship, uniting partners from community, the service-sector and the University.

As part of a doctoral study recently completed, the CURP engaged in a qualitative Participatory Action Learning Action Research (PALAR) case study to explore the development of an innovative CURP model for inclusive and holistic development. The participants included a group of community members living at the shelter, the leader of the NPO, a doctoral scholar and service-learning students. This community-led collaborative learning and inquiry enabled community members to establish micro-enterprises for personal and professional viability and to re-enter society as self-sustainable citizens.

The South Africa Knowledge for Change (K4C) North Hub, which was established in 2019, forms part of the global K4C Consortium (consisting of 22 Hubs), an initiative of the UNESCO Chair in Community-Based Research and Social Responsibility in Higher Education, based in Canada and India.

The K4C North Hub is a partnership between the K4C mentors at the UFS (central regions) and North-West University (NWU) (northern regions). It is headed by Prof Lesley Wood of NWU, while Karen Venter, from the UFS Directorate of Community Engagement, leads the K4C partnership at the UFS. Bloemshelter is the UFS's community partner as part of the Hub.

The main aim of the Hub is to support community-based research aimed at the development of methodologies, theory, and practice based on a holistic, systematic and integrated approach to the promotion of the Sustainable Development Goals (SDGs), particularly, but not exclusively, SDGs 1, 3, 4, 10 and 17. The knowledge generated will contribute to social transformation applicable to a local as well as a global scale.

As part of the north K4C Hub activities, the Bloemshelter-UFS CURP conducted a case study (January 2020) through community-based participatory research (CBPR), which focused on moving Bloemshelter from the status of an NPO to becoming a social enterprise. The research built on the findings of the afore-mentioned PALAR study. The co-created knowledge was innovatively disseminated through a digital story, to reach a broader audience beyond academia, in advocacy for addressing social challenges of homelessness, joblessness and poverty. The case study will be included as a chapter

Karin Venter (front left) and Alfi Moolman (front right), together with participants from Bloemshelter.

in the book *Community-based Research with Vulnerable Populations: Ethical, Inclusive and Sustainable Frameworks for Knowledge Generation,* edited by Prof Lesley Wood, to be published in 2022.

Also in 2020, 15 Bloemshelter community members were trained as trainers and coaches to explore blended learning approaches with community partners. The outbreak of the COVID-19 pandemic created opportunities to re-imagine practice, platforms and partnerships, which required a paradigm shift from working face-to-face towards creating a blended E-Community engagement environment.

Together with their collaborators at NWU, a case study on 'Digital storytelling as a tool for bridging knowledge gaps in rural health education', was undertaken, focusing on the UFS Faculty of Health's Trompsburg project.

Autism Support Unit

When one is committed to the idea that the first 1000 days of life matter, one cannot ignore a developmental condition with an almost two percent prevalence. Autism Spectrum Disorder (ASD) is considered to be a global public health concern; however, little is known about it in sub-Saharan Africa. Early identification of and intervention in children with an ASD have proven positive effects and enable them to reach their optimal capabilities. For this reason, an Autism Support Centre (ASC) was opened at the Unit for Professional Training and Service in the Behavioural Sciences (UNIBS) and Universitas Hospital, where training, evaluations and interventions take place.

Training in the Autism Diagnostic Observation Scale (ADOS), the gold standard instrument for autism diagnosis, is arranged at the Centre. The unit is now used for ADOS evaluations by different professionals. This was followed by the first training in Africa for trainers in the Early Start Denver intervention model for autism. The training was part of a collaboration with Prof Lauren Franz of Duke University, North Carolina. The unit has been a hub for national and international collaboration, specifically with the WHO nurturing care initiative and research projects, in partnership with Prof Petrus de Vries's laboratory and the Centre for Autism Research in Africa at the University of Cape Town and the Karolinska Institute in Sweden. The focus on autism

ADOS assessment room at UNIBS, with one-way mirrors for observation purposes.

at UNIBS has enabled a developmental paediatrician, Dr DJ Griessel, to be selected as a senior country representative for autism at the International Society for Autism Research. The goal is to develop the unit as a focal point for service and research at the UFS.

The Autism Support Centre was initiated by Dr Griessel, and forms part of the 'Make the first 1 000 days count' project – a three-year awareness-raising campaign, launched on 1 November 2020, as an initiative of the UFS and the MACAH Foundation in co-operation with the Department of Institutional Advancement and the UFS Department of Paediatrics and Child Health.

Digital Storytelling

Universities, non-profit organisations, government departments and Bloemfontein community members collaborated in a symposium on 'Scholarship of Engagement through Digital Storytelling for the Common Good', hosted by the UFS in March 2020. Organised by the Directorate for Community Engagement and the Centre for Development Support, the symposium presented the opportunity to investigate the area of overlap between community involvement, social innovation and digital storytelling, in order to enhance engaged scholarship. The great potential of digital storytelling, especially in higher education, was highlighted. Essentially, digital storytelling is a first-person narrative created by means of recorded voice, images, music and sounds, and participants come together in a small facilitated 'story circle', where they can share their experiences in an emotionally safe environment and co-collaborate to shape and develop each other's stories into personal scripts. As a methodology digital storytelling is greatly adaptable to different contexts, living voice to lived experiences. For this reason, digital storytelling is an excellent tool for identifying community needs, enhancing digital skills, informing scholarship and sharing ideas. The Centre for Development Support (on the Bloemfontein Campus) opened a digital storytelling lab, as well as mobile labs, reinforcing that universities are not ivory towers that are disengaged in the lives and the well-being of their societies. Smaller labs with the same equipment are also operational in the southern Free State (as part of the Interprofessional Education Rural Community Initiative in Trompsburg) and the Qwaqwa Campus.

Environmental conservation through folk stories

Two researchers from the UFS Qwaqwa Campus are examining the portrayal of environmental conservation in oral stories from indigenous South African culture and hope to add the under-researched genres of oral cultures to mainstreaming inter-, cross- and multi-disciplinary inquiries on environmentalism, climate change, conservation and indigenous knowledge systems.

Through this inter-disciplinary research project, Oliver Nyambi, from the Department of English, and Patricks Voua Otomo, from the Department of Zoology and Entomology, aim to gain an understanding of folk oral stories about humanity's interactions with the environment and how traditional societies consciously thought about environmental conservation, preserving plant and animal species and sustaining ecological balance.

Focusing on oral stories from the Zulu, Sotho and Tsonga traditions, the study seeks to understand what in the stories, as well as modes of their transmission, reflects certain consciousness, knowledge and histories of African indigenous environmentalism before the advent of Western forms of conservation. They envision their research to spotlight the potential, but currently untapped, utility of oral cultures in conservation. Their field work in rural KwaZulu-Natal revealed a rich tradition of environmental knowledge and awareness and nature conservation which is mediated and transmitted through oral folk stories. However, they observed that traditional modes of storytelling have declined, mostly due to the pressures of modernity, the often uncritical reverent acceptance of conventional science and its knowledge systems, as well as the dwindling number of human repositories and tellers of indigenous stories. The study recommends the archiving of the stories in written form, inclusion in school material as part of moral education and modernisation for easy circulation through, for example, animation.

Addressing the water crisis in Qwaqwa

Water problems in the Maluti-a-Phofung (MAP) Municipality go back many years. The severely affected communities in the Phuthaditjhabe area have all but given up hope of ever having a decent and healthy water supply. However, the team of researchers in the Ecotoxicology Research laboratory at the Qwaqwa Campus, under the leadership of Dr Patricks Voua Otomo, have taken their plight seriously, and since 2016 have been doing serious work to try and address the problem. With the permission of Mr Tello Mphuti, from MAP, the researchers have been allowed access to municipal wastewater treatment plans in Phuthaditjhaba and Harrismith, which has allowed limited environmental sampling and laboratory testing using the live, organisms such as snails and earthworms.

Starting in 2016, Dr Voua Otomo and his team of postgraduate students focused on the quality of natural water bodies and its ability to support life. Their research drew attention to potential localised incidences of terrestrial contamination linked to sewage sludge management. In an attempt to mitigate sewage sludge-induced soil pollution, research was conducted on the potential beneficial effects of biochar amendment on the sewage sludge as an alternative management strategy. Subsequent research focused on metal pollution in the Elands River (Phuthaditjhaba) and the Wilge River (Harrismith), which revealed that although there was some evidence of metal enrichment after wastewater procedures by the treatment plants, some of the metal in the rivers emanated from the communities that, due to the lack of adequate refuse removal services, often dispose of their household waste directly into the rivers.

The overall project then moved in the direction of focusing on pollution in mountain areas in South Africa – for which there is a paucity of research. The project focused on developing fast and reliable behavioural testing protocols that could be easily used to screen soil and aquatic environments. Subsequent research has focused on water remediation strategies to improve the state of rivers in the region.

This ongoing research is the first such project focusing exclusively on pollution issues in a select Afromontane region, with researchers working together with the local authorities to address concerns of the community and find answers to some of the environmental challenges of the eastern Free State.

Dr Patricks Voua Otomo

Risk and Vulnerability Science Centre

The Afromontane Research Unit (ARU) on the Qwaqwa Campus was granted R8,4 million to establish a Risk and Vulnerability Science Centre (RVSC) programme. The RVSC programme was established by the Department of Science and Innovation (DSI) as part of the Global Change Research Plan of South Africa. The RVSC focuses on the need to generate and disseminate knowledge about risk and vulnerability on global change grand challenges that face local policy makers, governance structures and communities. The theme of the UFS RVSC is 'The Sustainable Development of Phuthaditjhaba as an African Mountain City'. As a programme under the ARU, the RVSC will contribute to much-needed solutions in an area marked by major sustainability challenges, and will assist in moving Phuthaditjhaba away from its negative apartheid history towards becoming a sustainable African mountain city. The RVSC also forms the embryonic first step towards a Sustainability Sciences Hub, envisaged by the Rector since 2017.

Harnessing expertise for the fight against COVID-19

March 2020 and the outbreak of the COVID-19 pandemic, focused attention and resources on engaged research as never before, as it disrupted the entire world. Throughout 2020 and 2021, the UFS not only took great care to base all its decisions around the COVID-19 pandemic on sound, verified science, but was also committed to using scientific knowledge and facilities in support of efforts to fight the COVID-19 pandemic.

A substantial and critical role was played by the UFS COVID-19 Task Team, led by Prof Felicity Burt from the Division of Virology, set up to advise the Special Executive Group using epidemiological knowledge in order to monitor the spread of the pandemic. The Task Team communicated with the National Institute for Communicable Diseases and the Free State Department of Health and assisted with the preparedness of staff and students on all three campuses.

Other individual scientists and academics also played their part in various ways. These are some of the unsung heroes of our battle against COVID-19.

Ms Matefo Litabe, a PhD student in Virology, working on severe acute respiratory coronavirus 2, in the BSL 3 facility.

Contributions towards research on severe acute respiratory coronavirus 2

The emergence and global spread of the severe acute respiratory coronavirus 2 (SARS-CoV-2) has impacted research worldwide, with an urgent diversion of research efforts to further knowledge and understanding of the virus causing the pandemic in an effort to control the outbreak. As a consequence, the research team in the SARChI Research Chair on Vector-borne and Zoonotic Pathogens, headed by Prof Felicity Burt, has conceptualised and initiated various research projects to contribute to the understanding of SARS-CoV-2. Building on their existing expertise of protein expression systems and development of tests, the group have successfully developed and evaluated in-house assays for detecting SARS-CoV-2 IgG antibody for serological studies. The assays have been shown to detect antibody against all variants of concern that have circulated in South Africa to date. These assays could have important application for low resource countries for which commercially available assays are too expensive for large scale surveillance to determine the seroprevalence of SARS-CoV-2. To increase the repertoire of in-house assays, collaborative studies are underway to identify monoclonal antibodies that can be used to develop rapid antigen tests.

With a biosafety level 3 (BSL 3) facility at their disposal, the research group has been able to isolate SARS-CoV-2 variants. These isolates are currently being used to investigate the immune response against each variant of concern and the duration of antibody response in naturally infected and vaccinated individuals. This research should contribute towards understanding the role of natural infections and vaccine boosters to maintain protection against severe disease. In addition, collaborations have been established to investigate the in vitro efficacy of various immune modulators and anti-viral products against SARS-CoV-2.

Importance of rapid sequencing

Rapid sequencing of the SARS-CoV-2 genome has played a fundamental role in accelerating the development of emergency vaccines. The UFS-NGS Unit has been actively involved in sequencing SARS-CoV-2 samples in the Free State, channeled through the National Health Laboratory Services (NHLS-FS). The sequenced data generated by the Unit is continuously deposited in the Global Initiative on Sharing Avian Influenza Data (GISAID) database. The UFS-NGS Unit has performed whole-genome sequencing runs of approximately 100 SARS-CoV-2 samples per month. Through the continuous processing of such samples, the UFS-NGS Unit has optimised several techniques for COVID-19 genomics, from wet-lab to dry-lab analysis, captured in the internal protocols of the Unit. The Unit is also generating quality SARS-CoV-2 sequence data for the Network of for Genomic Surveillance in South Africa (NGS-SA), a genomic consortium established to respond rapidly to public health threats in South Africa. The key members of the NGS-SA working on SARS-CoV-2 genomics samples from the Free State are Prof Dominique Goedhals, Prof Martin Nyaga, Phillip Bester, Dr Peter Mwangi, Milton Mogotsi and Ayodeji Ogunbayo. The UFS-NGS Unit has been working collaboratively with other African scientists and actively training students from different cultural backgrounds, on *inter alia*, SARS-CoV-2.

Prof Martin Nyaga in the UGS-NGS Unit.

Represented in strategic places

A number of UFS academics and researchers were appointed to positions outside of the University, to provide their expertise in the fight against COVID-19:

- Prof Motlalepula Matsabisa, from the Department Pharmacology, is leading Africa's fight against the COVID-19 pandemic through his appointment as chairperson of the WHO Regional Expert Advisory Committee on Traditional Medicines for COVID-19.
- Dr Nicholas Pearce, Head of the UFS Department of General Surgery, was appointed to lead the COVID-19 response team at the Universitas Hospital.
- Prof Philippe Burger, UFS Professor of Economics and Pro-Vice-Chancellor: Poverty, Inequality and Economic Development, was appointed as a member of the Lancet COVID-19 Commission's task force on Fiscal Policy and Financial Markets.
- Mr Herkulaas Combrink, the Interim Co-Director of the UFS the Free State Department of Health (FSDoH), to provide analytics to different decision-makers and for targetted interventions related to the COVID-19 pandemic.

Societal and human impact of COVID-19

The COVID-19 pandemic has affected all aspects of life, caused economic disruptions and posed immense challenges to both public and private healthcare, food systems, education and employment The Centre for Health Systems Research and Development (CHSR&D), in the Faculty of the Humanities, has investigated the effects of the pandemic on post-traumatic stress and the coping strategies of nurses, as well as the vaccine literacy and uptake of adult South Africans.

The study on post-traumatic stress and coping strategies of nurses in South Africa during the second wave of the pandemic, found that 44% of nurses were experiencing post-traumatic stress disorder (PTSD), which was comparatively higher than their counterparts in other countries. A lack of preparedness to manage COVID-19 patients, poorer health and avoidance coping mechanisms were associated with increased PTSD in nurses. Some of the intervention strategies recommended by nurses included emotional, psychological and debriefing sessions; positive and open communication between managers and their subordinates; psychological support through the Employee Assistance Programme and occupational health units; and an uninterrupted supply of quality personal protective equipment (PPE). The findings of this project were shared with the Free State Department of Health (FSDoH).

The vaccine literacy study aimed to determine people's abilities to collect and understand information about vaccinations in order to make an informed choice when opting whether or not to have the COVID-19 vaccine. An online survey was conducted among the adult population in South Africa during September 2021 and included 10 466 respondents. Approximately 60% of respondents were not vaccinated. An overall profile of unvaccinated persons indicated the following groups: more women than men; younger people (18-34 years): less educated

people; unemployed, part-time employed and students; and vaccine illiterate persons. Approximately 30% of unvaccinated persons were unsure if they would vaccinate in the future and 16% said that they would definitely not do so. The main reasons for not vaccinating or being unsure included concerns about the side effects; belief that vaccines had been developed too rapidly; desire to obtain natural immunity; fear of needles; questioning whether vaccines are effective; and being against vaccines in general. Most people had heard about COVID-19 vaccines via social media, television or radio.

These findings highlight the importance of vaccine literacy and suggest that when advertising COVID-19 vaccines there should be a concerted focus on women, younger people, less educated people, the unemployed, part-time employees and students. People need access to accurate information from reputable sources that address issues such as concerns about the side effects of COVID-19 vaccines, how the vaccines were developed and why it was possible to develop vaccines so quickly, as well as the effectiveness of the COVID-19 vaccines.

The CHSR&D has two ongoing COVID-19 research projects. Firstly, in collaboration with the UFS Department of Social Work, the School of Nursing and the Disaster Management Training and Education Centre for Africa (DiMTEC), CHSR&D researchers are investigating the impact of COVID-19 on the health and well-being of 300 vulnerable families in the Mangaung Metropolitan area. The results of this project have the potential to inform health and social policy in other metropolitan areas in South Africa – particularly with regard to preparedness and management of pandemics such as COVID-19.

Secondly, CHSR&D researchers together with a team from the FSDoH and WHO, are collaborating on a project looking at the impact of COVID-19 on essential health services, mortality in hospital-admitted patients, and outcomes in patients with a history of tuberculosis.

Distributing masks to a school in Botshabelo, from the left, Alfi Moolman (UFS Directorate for Community Engagement), Sonja-Venter Botes (Bloemshelter), Tina Moleko (Rekopane Primary School) and Michelle Engelbrecht (CHSR&D).

Convenient and cost-effective technology

Prof Anthony Turton, affiliated to the UFS Centre for Environmental Management, was part of a South African team which became the first to isolate the SARS-CoV-2 virus from wastewater and develop a commercially viable virus risk forensic service. This was rolled out through a new enterprise named Amanzi-4-All, part of the Impuma Group of Companies. Other companies include Instru-serve, the providers of the samplers that enable precise measurements to be taken over a 24-hour cycle, and Praecautio which deals with the laboratory aspect of the business.

It is accepted that the major risk arising from COVID-19 is that asymptomatic carriers are the vectors for accelerating infection. The virus is shed in human waste, which has a traceable presence in both urine and faeces before a patient manifests with symptoms and after a patient has been treated. South Africa has 824 wastewater treatment works (WWTWs), each serving a population of known size. By taking samples of sewage according to a defined protocol, it is possible to determine the viral load of the entire population in the catchment area of a particular sewage works. The data can be compared weekly to determine increases or decreases in the viral load.

An engineered sluice enables wastewater velocity to be measured with great precision over a 24-hour period. This flow data, when correlated with viral load data, enables an accurate calculation of transmission dynamics in the population being serviced by a specific wastewater treatment plant.

The flume at the WWTW with the sampler and secondary flowmeter.

The technology has been demonstrated in a large mining operation in South Africa, where close cooperation was maintained with the corporate health team responsible for internal risk mitigation measures. This technology demonstration tracked the so-called Fourth Wave as it manifested across various mining sites managed by this specific corporation, and it enabled the accurate identification of specific hot-spots. This enabled the corporate health team to develop mitigation strategies targeted to precise cohorts in defined geographic areas. It also enables a high confidence picture to be developed of the effectiveness of vaccination and other company developed risk mitigation strategies. This programme is now being rolled out across the mining group in a phased manner.

At all times the forensic chain of custodianship is tightly controlled and audited for each sample, from the moment of sampling to the moment it is processed in a laboratory. This includes the temperature control for each sample as it moves from a remote mine site to a laboratory hundreds of kilometres away. It is this precise sampling and robust protection of the custodial chain inherent to any forensic investigation, that has reduced errors and increased the confidence in the data to the point where it can now accurately track epidemiological parameters.

The system developed is also substantially more cost-effective than individual sampling – as it can sample 100 000 people at the

same cost as 15 sampled individually. The commercial virus-risk forensic service can identify specific hot-spot areas, and those can be targeted for higher saturation coverage of individual testing.

Since the announcement of the findings and the technology, there has been interest from a range of role players in North America, Africa, the Middle East, and Southeast Asia. Consideration is being given to expanding the commercial offering to include narcotic monitoring at industrial sites where heavy machinery is involved. This has positioned the Impuma Group to roll out an efficient commercial service offering at continental level.

Laboratories equipped for COVID-19 testing

The UFS-based South African National Control Laboratory for Biological Products (SANCLBP) is one of only 15 laboratories worldwide contracted to perform vaccine testing for the World Health Organisation (WHO). The SANCLBP is also the only vaccine testing laboratory in the country that performs the final quality-control testing of all human vaccine batches marketed in South Africa on behalf of the South African Health Products Authority (SAHPRA).

When the first COVID-19 vaccines arrived in the country, the SANCLBP performed the all-important task of vaccine lot release. Due to the expansion of vaccine production capacity in South Africa, driven by the ongoing pandemic, the role of the SANCLBP is also expanding. As the releasing national control laboratory for locally produced COVID-19 vaccines, the SANCLBP will be responsible for the lot release of these products destined not only for the South African market, but also for the African Union and potentially other export markets.

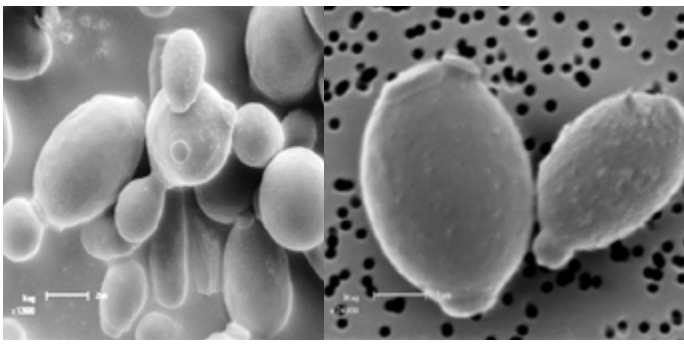
With the national lockdown due to the COVID-19 pandemic, the South African Doping Control Laboratory (SADoCoL) quickly moved to re-organise workspace and refurbish a laboratory area to be able to undertake some COVID-19 related testing. SADoCoL, an ISO17025 and World Anti-Doping Agency (WADA) accredited service laboratory, has the equipment to conduct serology testing on serum and full blood samples for immunity against the SARS-COV-2 virus. SADoCoL is equipped to do antibody tests, to detect the presence of antibodies (IgM and IgG) in human blood after exposure to the virus, as well as the response after vaccination. This method enables SADoCoL to support the UFS in determining infection data, as well as the sporting community to determine the spread of infection with the virus among elite athletes.

Senior analyst Mrs Angela Sekabate performing vaccine potency testing.

Hanno du Preez, SADoCoL Director.

Contribution to developing vaccines

Prof Robert Bragg and his research team in the Veterinary Biotechnology Research Group in the Department of Microbiology and Biochemistry, have for a number of years been looking at strategies for improved disease control, mainly in avian species, through vaccine development, treatment and biosecurity. With the outbreak of the COVID-19 pandemic, the relevance of their research was immediately recognised, and they submitted an article on the design of a possible COVID-19 vaccine, based on work they have done on infectious bronchitis virus – which is also a coronavirus of poultry. Efforts are underway to express variant spike protein genes from SARS-CoV-2 in their patented yeast-based expression system, to demonstrate proof of concept and to establish a platform whereby new variants of the virus can be quickly expressed to assist with diagnostics – in conjunction with Prof Felicity Burt – and possible vaccine development.



The yeast strain which is being used for the SARS-CoV-2 spike protein expression experiment. In these images, the expressed coat protein on another virus (Beak and feather disease virus) can be seen as the small 'bumps' on the surface of the yeast.

Risk of fungal infections

COVID-19 patients with severe symptoms who are admitted to intensive care units in hospitals are at risk of contracting an invasive fungal infection that might influence their outcomes and hamper treatment efforts. Prof Carlien Pohl-Albertyn and Dr Obinna Ezeokoli from the Pathogenic Yeast Research Group in the Department of Microbiology and Biochemistry, have researched and published articles on the incidence of fungal infection in COVID-19 patients and on the potential risk factors of COVID-19 treatment for contracting fungal infections. The incidence of severe infection and mortality in COVID-19 is thought to be due in part to a lack of natural immunity and to viral replication in the lower respiratory tract, as well as superinfections, secondary infections, or co-infections, leading to severe lung injury and acute respiratory distress syndrome (ARDS).

Dr Olihile Sebolai.

Researchers from the same laboratory carried out a pilot project, led by Dr Olihile Sebolai, which investigated the possibility that cryptococcal protease(s) could facilitate host invasion by SARS-CoV-2 (the causative agent of COVID-19). The efficiency of cryptococcal protease(s) to activate a mimetic peptide similar to the viral S protein's S1/S2 site was comparable the human protease viz. furin. This pilot study detailed the first empirical data that were formative because it shed light into the possible role of microbial proteases in intensifying the sporadic viral activation.

Data analytics to inform decisions and strategies

Staff members from departments in different faculties assisted various government departments and NGOs with data management, data infrastructure, modelling, forecasting and advising on the approaches to be taken to put the necessary systems in place.

The lingering effects of the COVID-19 pandemic on society led Herkulaas Combrink, a data and medical scientist, and Prof Katinka de Wet, a medical sociologist, to conduct a study analysing social media data in order to assist government health communicators to reflect on their communication strategies, and to gain new perspectives from the general social media user. The study used real time snapshots of online interactions as a means to augment more traditional communication analytics. The findings and ongoing work of the research project were presented to the Parliamentary Committee on Communications.

The opportunity to pursue this study was the result of Herkulaas Combrink's secondment to the Free State Department of Health (FSDOH), where he identified the need to develop additional analytics to assist various communication strategies linked to developments regarding COVID-19 infections. This method lends itself to staying abreast of emergent and burning issues that are trending on open-source media sites. The magnitude of the research study required the involvement of stakeholders from a variety of institutions in order to contextualise the data, and to provide social and technical input. The core team of experts included Dr Vukosi from the Department of Computer Science at the University of Pretoria, Dr Ming-Han Mothloung from the Department of Community Health at UFS and FSDOH, and Dr Samuel Mokoena, Priscilla Monyobo, Mondli Mvambi and Elke de Witt of the FSDOH.

In the light of their expertise, Combrink and De Wet have been appointed as Interim Co-Directors of the UFS Interdisciplinary Centre for Digital Futures.

Impactful collaborations

Increasing the international, regional and domestic connectedness and depth of engagement of research is fundamental to the long-term competitiveness of a country's research, and ensures that research drives economic and social advancement. However, benefits are not only at national and institutional level. Collaboration, particularly international collaboration, also holds benefits for individuals. It enables researchers to access additional, often specific, expertise, gain new perspectives on research and build relationships with others in the field. For early stage researchers this can be key to career development. By combining expertise and resources, bigger and more complex questions can be addressed, broadening research and maximising impact. Collaboration also attracts increased funding, as researchers expand their networks, and it offers opportunities to gain new skills and perspectives.

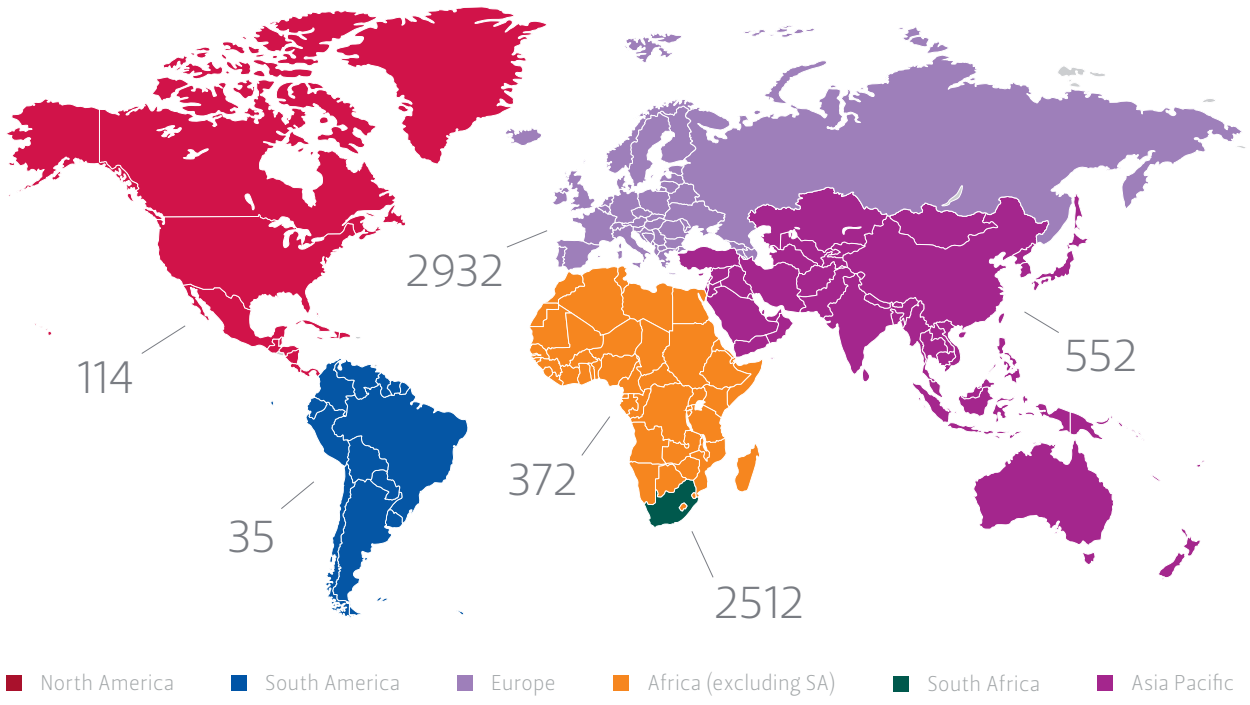
The University of the Free State (UFS) has increased its collaborations with international and regional institutions. Between 2018 and 2021, UFS researchers were involved in 6 517 co-authored publications with researchers from other institutions, with most of the papers (45%) being co-authored with researchers from Europe and the United Kingdom.

In that period, the UFS had active collaborations with 100 institutions (based on co-authored publications), of which 77 were outside South Africa.

Top collaborating Institutions 2018–2021

All collaborating institutions		Collaborating Institutions outside SA	
University of KwaZulu-Natal	302	KU Leuven, Belgium	130
University of Pretoria	252	CNRS, France	101
University of the Witwatersrand	247	University of Nigeria, Nigeria	93
North-West University	184	Swiss Federal Institute of Technology	75
University of Cape Town	178	University of Antwerp, Belgium	75
University of Stellenbosch	173	University of Amsterdam, Netherlands	71
KU Leuven	130	University of Zurich, Switzerland	68
Agricultural Research Council	122	University of Hamburg, Germany	68
University of Johannesburg	109	Université PSL, France	67
CNRS	101	Sorbonne University, France	66

Co-authored Papers by region 2018 - 2021



A collaborative partnership between the **UFS Unit for Institutional Change and Social Justice** with the **University of California, Los Angeles (UCLA**) and the **Vrije Universiteit Amsterdam (VUA)**, focuses on transformation, diversity and inclusion in higher education. The partnership, which involves administrators, academics and students, was initiated in 2014 when the UFS hosted the first research colloquium. These events are designed to share knowledge, to address diversity and transformation issues from different regional and global contexts, and to learn from best practices. The partnership between the three institutions aligns closely with the vison of the Unit for Institutional Change and Social Justice – to create a socially more just and inclusive university though institutional change that involves high impact practices, innovative research and advocacy.

The most recent research symposium, on 'Fragility and Resilience: Facets, Features and (Trans) Formations in Higher Education', was held in January 2020 on the UFS Bloemfontein Campus. The symposium also addressed mental health in higher education, as all three regions were witnessing an increase in mental health issues among students and staff. This was a timely discussion, given that just two months later all regions were facing the challenges of the COVID-19 pandemic. Since then, although in-person colloquia were impossible, online platforms allowed the vice-chancellors and presidents of all three universities to meet virtually, while the staff partners supported a three-part online exchange between students from all the universities under the banner of 're-visibilizing students' during the pandemic. As international restrictions continue to shift, the project will continue to adjust and, hopefully, can resume fully in the near future.

Dr Robert Hansen.

Under the leadership of Dr Robert Hansen, the **Centre for Mineral Biogeochemistry (CMBG)** in the Faculty of Natural and Agricultural Sciences, forms part of the **Biogeochemistry Research Infrastructure Programme** (BIOGRIP), which was established in 2019. BIOGRIP is one of the Research Infrastructures developed by the Department of Science and Innovation (DSI) as part of the South African Research Infrastructure Roadmap (SARIR). BIOGRIP is a research initiative that drives discovery in how biological, geological, chemical and physical processes interact to shape natural environments over time and space. It consists of a network of research laboratories organised into four nodes, each hosted by a South African university (University of Cape Town, North-West University, Stellenbosch University and UFS).

The BIOGRIP Node for Mineral Biogeochemistry is hosted by the CMBG. Research at the CMBG is centred on understanding the biogeochemical processes operating in environments impacted by industrial and mining activities. The ultimate goal is to use this knowledge to develop sustainable water treatment options using biogeochemical processes in engineered technology. Some technologies have already been rolled out with industry partners.
The CMBG is also focused on agricultural bio-augmentation research with industry partners to help ensure long-term food-security in South Africa and the larger Africa. The centre is conducting integrated, multidisciplinary research investigating how the interaction between natural elements can be used to practically improve the lives of South Africans, especially in areas plagued by dirty water.

A collaborative, multi-disciplinary project, titled 'Threats of extreme weather events: Improving the resilience of Qwaqwa to the multiple risks of climate change', funded by the Water Research Commission, focuses on Phuthaditjhaba and the streams draining the surrounding area.

The overarching theme of this study is to understand how river ecosystem services (including water provisioning) may be influenced by the possible cumulative impacts of successive extreme weather events in future; the effect this may have on the vulnerability and resilience of local communities in the Qwaqwa area; and how these impacts may be ameliorated through risk reduction planning.

The team members for the study are the Project Leader, Dr Marinda Avenant (**UFS Centre for Environmental Management**), Dr Patricks Voua Otomo (**UFS Department of Zoology and Entomology**), Dr Johannes Belle (**UFS DiMTEC**), Prof Beatrice Opeolu (**Cape Peninsula University of Technology**), Dr Dirk Jungmann and Dr Hilmar Börnick (**Technical University of Dresden**), Emeritus Prof Roland Schulze (**University of KwaZulu-Natal**), and Mr Nick Davis (**private consultant**). The team also includes four UFS postgraduate students – Matsoana Masoabi, Nduduzo Kubheka, Ngitheni Nyoka and Fumiso Muyambo.

Participants at a post fieldtrip workshop held on 22 April 2021, from the left Nduduzo Khubeka (MSc Zoology student, Qwaqwa Campus), Marinda Avenant (Centre for Environmental Management, project leader), Beatrice Opeolu (CPUT), Ngitheni Nyoka (PhD Zoology student, Qwaqwa Campus), and Patricks Voua Otomo (Department of Zoology and Entomology, Qwaqwa Campus).

Ngitheni Nyoka, Patricks Voua Otomo and Beatrice Opeolu taking water quality samples in the headwaters of the Namahadi River, Qwaqwa, in April 2021.

During the first phase of this three-year project, eight sampling sites were identified on the Namahadi, Metsi-Matsho, Mphukojwane and Elands Rivers to serve as a focus area for the study. Ecological surveys were conducted at these sites during 2021. These included tests for physical and chemical water quality, river sediment and environmental health (measuring heavy metal content and ecotoxicity), ecological integrity of the rivers in the study area (assessing the importance and sensitivity of the river reaches, extent to which river reaches have been modified from their natural state, fish habitat assessment, and ecological state of the fish community).

During the second phase the emphasis will shift to the identification of ecological risks, based on the ecological field surveys, and risks to the local communities, based on social surveys. The identified risks will then be assessed in terms of probability, frequency, intensity and magnitude against the simulated changes in runoff and accumulated streamflow resulting from projected changes in the climate. During the third and final phase, the risk reduction strategy and plan for the Qwaqwa area will be developed.

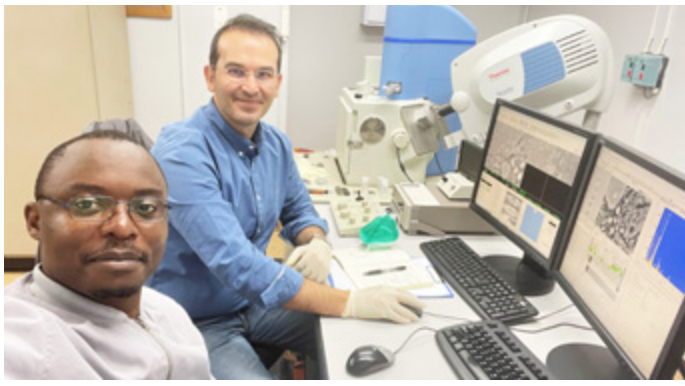
Prof John Mubangizi, Dean of Law.

The **UFS Faculty of Law** and **ILI-South African Centre for Excellence (ILI-SACE)** entered into a collaboration aimed at leveraging the synergies of the two institutions to enhance teaching and research. Although the collaboration is intended to initially focus on the joint offering of executive training/short learning programmes, it will also involve exchange of academic staff members and researchers for purposes of teaching, conducting lectures, research and exchange of expertise.

ILI-SACE is a new Johannesburg-based institute which is affiliated to the Washington-based International Law Institute (ILI). It is also affiliated to the ILI-African Centre of Excellence based in Kampala, Uganda. The MoU underpinning the collaboration was signed by both parties on 30 November 2020 and the Project Agreement to give effect to the MoU was signed on 16 December 2020. The first joint courses between the two institutions started running in 2021.

The UFS **Department of Engineering Sciences**, under the leadership of Dr Abdolhossein Naghizadeh, is heading a collaboration of scientists from universities in South Africa (**University of Johannesburg, University of KwaZulu-Natal, Central University of Technology** and **Nelson Mandela University**) and abroad (**University of Yaoundé** in Cameroon and **Erzurum Technical University** in Turkey), to create a green concrete that will reduce the impact of cement on the environment. The Department of Engineering Sciences has established and equipped a new laboratory facility dedicated to cement and concrete research, with a specific current focus on green concrete.

Conventional cement production is responsible for more than 6% of the overall carbon emissions in the world, and alternatives are sorely needed. Besides its ability to reduce the impact on the environment through reduced carbon emissions, this product is also expected to perform at equal or even superior strength and durability compared to conventional concrete, with potentially substantial economic benefits. This product has the potential to be used as an alternative to conventional concrete in large-scale constructions, such as residential buildings and infrastructure, as well as small-scale constructions such as pavements and brickworks.



Dr Abdolhossein Naghizadeh (right) from the UFS and Mr Léonel Tchadjie (left) from University of Johannesburg conducting microscopic analysis on Green Concrete samples at the UFS Department of Geology.

The green concrete is made from waste materials or industrial by-products, replacing the cement, sand and stone content of normal concrete. Using these waste substances as binding material in green concrete, also reducing waste and contribute to the circular economy. The research group plans to develop green concrete in a powdered form, to be mixed with water, instead of a chemical. Approximately 95% (by mass) of the composition of the formulated concrete consists of waste materials, and the remaining 5% are locally available industrial products.

Concrete Lab at the UFS Department of Engineering Sciences.

Two US-SA University Staff Doctoral Programmes were in place in 2020 and 2021. These collaborative programmes are particularly supportive of the research capacity development agenda of the Afromontane Research Unit.

The **US-SA USDP**, involving the **UFS, University of Venda, Appalachian State University, Colorado State University** and the **University of Montana** continued to provide valuable support to the staff doctoral cohort on the Qwaqwa Campus. The first scholar, Dr Grey Magaiza, graduated in 2020 and the second, Dr Moeketsi Dlamini, graduated in 2021. Another seven scholars are expected to complete their studies in 2022. Three scholars will be presenting papers at the forthcoming Southern African Mountain Conference (SAMC2022), while another two will be presenting papers at other international conferences.

The **UK-SA USDP**, involving the **UFS, University of Venda** and **University of the Highlands and Islands**, was launched in 2020. The UK-SA USDP supports five UFS academics on the Qwaqwa Campus. The UK-USDP programme is in its infancy but the progress of the candidates has been very good and the support architecture for the students has been consistent. We are looking at creating more support workshops and envisage some publications from the students in the next 12-16 months.

Substantial funding from the US Embassy and Consulates in South Africa has further strengthened the collaboration between the **UFS** and **Appalachian State University**. The funding is toward the Mountain-to-Mountain research project, based primarily at the Afromontane Research Unit and headed by Dr Grey Magaiza as the Project Director and Prof Geofrey Mukwada as the Project Coordinator. The funding will cover two Master's degree programmes (the MSc in Mountain Environments and the MA in Community Development), meteorological weather stations, leadership capacity building for black women in academia and doctoral research projects.

This project will reinforce the mandate of the ARU and provide the basis for a long-term research development agenda. It will also support innovation in climate change research, enabling climate data to be recorded and received from weather stations that are situated in isolated and generally inaccessible locations. We will be able to understand how the climate of the region is changing and assist in developing adaptation measures and decisions that are appropriate and applicable to agriculture, water, tourism, environment and other sectors. The project is scheduled for completion in 2023.

Prof Geofrey Mukwada.

Dr Grey Magaiza, first PhD graduate from US-SA USDP.

The partnership between the **World Health Organization (WHO**) and the **University of the Free State (UFS)** has resulted in the University being designated as a WHO Collaborating Centre (WHO CC). The UFS-Next Generation Sequencing Unit (UFS-NGS), in partnership with the WHO, will conduct genome sequencing of pathogenic organisms, including rotavirus and SARS-CoV-2 strains from the African continent. An institution is designated as a WHO CC by the WHO Director-General and endorsed by the host county's Minister of Health to form part of an international collaborative network, to carry out activities in support of the WHO programmes. A designation as a WHO CC is a time-limited agreement of collaboration. The WHO CC will be part of the Vaccine Preventable Diseases (VPD) Surveillance and Pathogens Genomics Cluster until September 2024.

Prof Martin Nyaga, Associate Professor in the UFS-NGS Unit, is the Director of the WHO CC. He says that the designation was as a result of a contract which the UFS-NGS Unit undertook to perform a pilot rotavirus surveillance project at whole genome level for a WHO service contract on rotavirus samples from Rwanda and Zambia between 2018 and 2020.

The new WHO CC will, upon request by the WHO, implement agreed work assignments on genome sequencing of pathogenic organisms causing VPD, including rotavirus and SARS-CoV-2 strains, collected as part of the routine VPD surveillance using NGS technology and analysis of the generated datasets using bioinformatics tools. As part of the agreement, the UFS-based WHO CC will be required to:

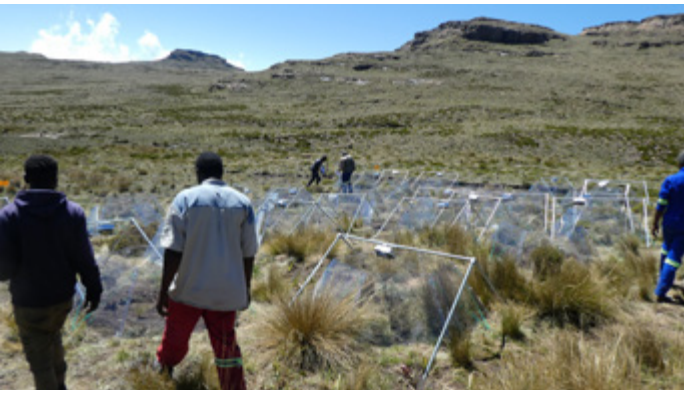
- Conduct molecular characterisation of specimens collected during outbreaks and public health emergencies as part of the support for monitoring, preparedness and response to VPD disease outbreaks in Africa.
- Provide technical guidance to WHO on strategies to improve laboratory molecular diagnostics, molecular typing and NGS of rotavirus diarrheal strains and other enteropathogens to detect novel and re-emerging strains.
- Conduct validation of tools and new molecular diagnostics for detection and characterisation of unusual or rare VPD strains to guide studies and development of new vaccines for VPD.
- Organise capacity building and training workshops on whole genome sequencing of priority VPD pathogenic organisms.

The collaboration will enhance co-ownership of data and offers opportunities to train postgraduate students and other scientists. It also expands the research infrastructure and will contribute to policy on public health for numerous African governments from an informed science-based view.

The centre is located in the UFS-NGS Unit whose academic home is the Division of Virology in the Faculty of Health Sciences. It is also part of the Network for Genomic Surveillance in South Africa (NGS-SA), a genomics network/consortium established to respond rapidly to public health threats in South Africa, especially COVID-19 genomics. The SARS-CoV-2 sequenced data generated by the UFS-NGS Unit for the NGS-SA is continuously deposited in the Global Initiative on Sharing Avian Influenza Data (GISAID) database.

Research in the **Afromontane Research Unit (ARU)** has been greatly enhanced through strategic international and domestic partnerships and collaborations.

All mountains around the world have native and non-native species that are expanding their ranges quite dramatically; however, little research has been conducted towards understanding the long-term redistribution of species and the effects of global change on biodiversity. The ARU is contributing to this research topic through the project "RangeX", a multi-institutional research consortium under the **Mountain Invasion Research Network (MIREN)**, led by **ETH Zürich**. The South African component of the project is underway in the Witshieshoek area of the Maloti-Drakensberg and is led by Dr Ralph Clark, Director of the ARU, with Dr Sandy-Lynn Steenhuisen as co-PI of the South African team. Other RangeX partners are Germany, Norway, Sweden, Denmark, Australia, China, Chile and France, with research locations in the Swiss Alps, Himalayas, Andes, Australian Alps and Scandes. The ARU was one of only three South African research groups to receive this competitive and highly prestigious BiodivERsA funding (Horizon 2020) from the Department of Science and Innovation, and is the only African partner in the consortium.



Open top chambers at the summit site of the RangeX experiment at Witsieshoek, with the Sentinel in the background.

The official launch of the South African research site took place on 20 October 2021. The project will explore the effects of global change, biological invasions, as well as climate and land-use change. The team of researchers will conduct experiments using open-top chambers – causing an increase in temperature of 3 or 4 degrees to what is naturally found – on plant species from lower down to the top of the mountain, to see how they function and what is driving range expansion. This represents a novel experiment in this context in South Africa, made possible due to the unique relationship between the ARU and Transfrontier Parks Destination / Witshieshoek Mountain Lodge.

The project places the spotlight on the rich biodiversity of the area, and how data could contribute to the overall priorities of the government in terms of biodiversity.

The **ARU** also has strong ties with the **Akita International University** and the **International Christian University** in Japan. The project-based collaboration focused on the rural mountain towns of Phuthaditjhaba in the eastern Free State, and Gojome in Akita Province in Japan. The project is led by Dr Melissa Hansen from the UFS Department of Geography and the ARU, and Prof Shogo Kudo from Akita International University.

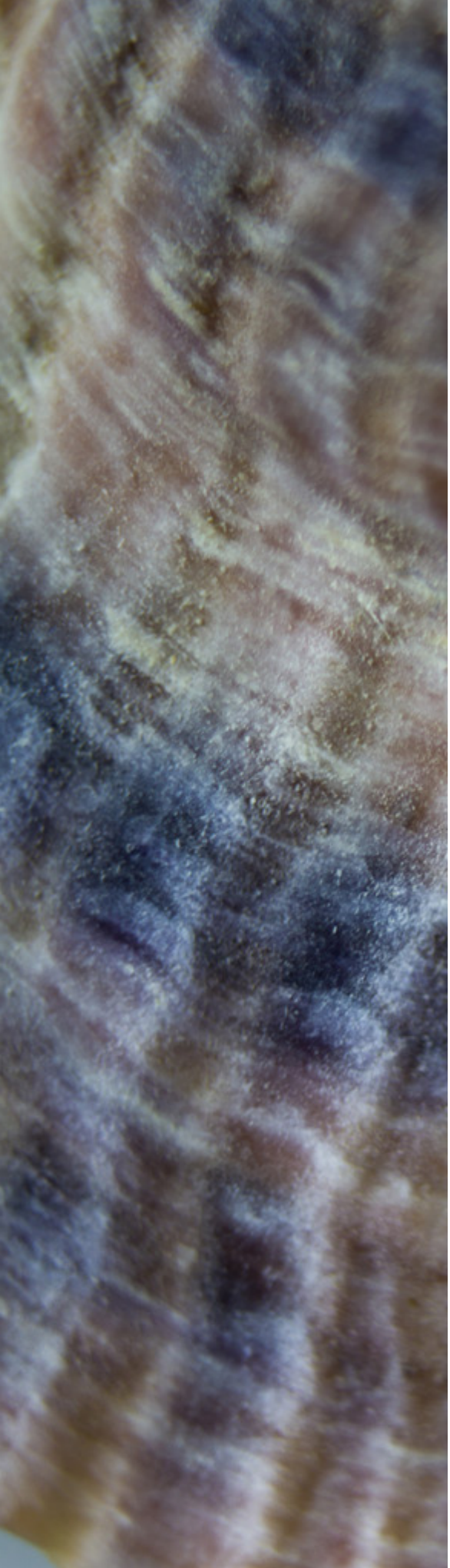
The project has sought to propose 'trans-local' learning – which connects different locations in order to learn from each case study – as a new approach in social learning for sustainability. The project explored the relationship between migration and sustainable development, with a focus on the entrepreneurship of young migrants in the two different locations. In addition, the project aimed to contribute to the development of the Qwaqwa Campus as a Sustainability Science hub and to foster the development of inter- and transdisciplinary research.

A significant funding agreement was finalised in 2020 between the **UFS Department of Geology** and the **Hans Merensky Foundation** (HMF) to launch a five-year project titled the 'Merensky Group for Airborne Geological Image Classification (MAGIC)', under the leadership of Dr Martin Clark. The overarching aim of the MAGIC project is to perform focused research on the development of remote sensing technologies using unmanned aerial vehicles (UAV) and satellites for application in the mineral and groundwater exploration industries in South Africa and beyond. Specific focus areas include exploration, extraction and remediation of mineralised areas, as well as regional groundwater exploration and management strategies utilising remote sensing technologies. The proposed research targets two primary areas – the Barberton Greenstone Belt (Mpumalanga) and the Karoo. Remote sensing technologies will aim to facilitate a better understanding of the structural architecture and history of the rocks in Mpumalanga and identify and manage near-surface groundwater resources in the Karoo.

Having completed his license in November 2021, Dr Clark is a registered remote pilot (RPL) with the South African Civil Aviation Authority (SACAA). This makes a significant improvement in terms of enabling larger and managed surveys using drones in mine environments.

Small UAVs such as the DJI MAVIC 2 Pro in the image below, facilitate aerial orthophotography, photogrammetric 3D modelling and associated rock fracture, and high-resolution exploration of quarry highwalls where it is not possible to approach due to height, obstacles, or instabilities in the highwall rocks.

Dr Martin Clark with a DJI MAVIC 2 Pro UAV in the inoperative Salvamento Blockstone Quarry, near Parys in the Free Sate.



Platforms for innovative research

Innovative research focuses on creating new ideas, analysing problems, diagnosing them and identifying their causes. Innovative research has impact, and requires people and infrastructure to provide the platform.

Based on the foundation of our strategic planning and through our partnerships and the initiative of individual researchers and research groups, the University of the Free State (UFS) has been able to develop the available infrastructure, in order to support research at a high level and unfold our vision to become a research-led university.

World-class Sensory Laboratory

The Sensory Laboratory in the Department of Sustainable Food Systems and Development is considered to be world-class. The laboratory performs sensory analysis, which is a scientific discipline used to evoke reactions from humans, using the senses of sight, smell, touch, taste and hearing. These reactions can be captured from first bite to complete mastication and are then statistically analysed and interpreted by a sensory analyst.

New state-of-the-art equipment has been added to the laboratory. The Tobii Pro Nano and Tobii Pro Glasses 3 eye trackers, installed in April 2021, enable a much higher level of profiling and comparing food products than was previously possible, and places the Sensory Laboratory in a unique position to its competitors. In addition, it also adds value to the services offered by the laboratory and establishes it at the forefront of using digital technology in the analysis of consumer behaviour.

In an eye-tracking study with a sample of consumers, the eye activity is recorded with an eye tracker and a webcam, with a built-in microphone, to capture the participants' facial expressions and comments, in response to stimuli that are presented, such as advertisements on websites, television commercials, magazines and newspapers, as well as shelf displays. The eye tracker indicates where a person looked and what was overlooked. It establishes whether the person saw a specific advertisement, how much time was spent reading it, whether the product name was seen, and if the fine print in the advertisement was read. The resulting data can be statistically analysed and graphically rendered to provide evidence of specific visual patterns. The data provides better insight into how consumers view the world and how to best position a product or brand to reach the consumer.

UFS Sensory Laboratory.

The main function of the lab is to do sensory testing of food products. Some of the projects recently undertaken include, *inter alia*:

- Sensory testing of frozen meals for children aged 6 to 12 years old for a well-known company which specialises in frozen meals.
- The effect of various cooking methods on leaves of the *spekboom* (*Portulacaria afra*) were described with the CATA (check-all-that-apply) questionnaire, and *spekboom* products were developed, using the JAR (just-about-right) scales.
- A variety of products were developed by using nixtamalised maize, such as chips, nuggets, patties, *mageu*, cakes, rusks and biscuits, again by using JAR scales.
- The replacement of soy isolates in polony with cricket protein, was evaluated with JAR scales.
- The protein content of steamed bread (*dombola*) was increased, by replacing wheat flour with cricket protein and testing the products with the JAR scales.
- The humble raisin was uplifted with the JAR scales into raisin spread and raisin chocolate cups.
- The CATA question answered once and for all the instant coffee brand loved by South Africans.
- Nine-point hedonic ranking scales were used to evaluate the replacement and reduction of salt in *boerewors*.

Biosafety Level 3 Laboratory

Biosafety and biosecurity are essential in the investigation of emerging pathogens with potential to cause significant disease and fatalities. A new biosafety level 3 (BSL 3) laboratory – the Pathogen Research Laboratory – was established to allow the University's researchers to further advance their research on and surveillance of infectious pathogens, with the ultimate benefit being the improved quality of health for the communities of the Free State and beyond.

Research and handling of infectious viruses and bacteria require appropriate biosafety and containment measures to prevent laboratory workers, personnel and the environment from being exposed to potentially biohazardous agents. A BSL 3 laboratory is designed and precision-built to operate under negative pressure, with all exhausted air passing through a dedicated filter system to ensure that no pathogens escape into the environment. In addition, researchers wear appropriate personal protective equipment suited to the pathogens under investigation. The BSL 3 laboratory is registered with the National Department of Health and the Directorate of Animal Health (Department of Agriculture, Land, Reform and Rural Development).

The BSL 3 laboratory.

The Pathogen Research Laboratory is managed by Prof Felicity Burt, an arbo-virologist with more than 25 years' experience in handling infectious viruses. As COVID-19 will not be the last pandemic we have to manage, the ongoing potential for the emergence of novel viruses and bacteria underscores the need for training young researchers and developing skills to tackle future outbreaks, develop new vaccines, understand how pathogens cause disease and discover alternate ways to mitigate outbreaks. The BSL 3 laboratory is situated next to a suite of laboratories including a biosafety level 2 and is well equipped for molecular and serological research. A significant focus of the current research projects involves surveillance of wild caught mosquitoes and ticks for known and novel viruses. The BSL 3 laboratory allows researchers to culture viruses enabling characterisation of viral isolates. One of the objectives is to maintain a collection of well characterised viruses for future research projects.

This state-of-the-art laboratory allows the researchers to safely handle those pathogens previously excluded from the research and surveillance programme and provides world-class training for young scientists.

National and Continental Pharmacological Centre of Excellence

The UFS is recognised as a national leader in the pharmacology of herbal medicines, as well as research and development in Indigenous Knowledge Systems (IKS), including in the pharmacology of traditional medicines and medical cannabis. This was confirmed when Prof Motlalepula Matsabisa, from the Department of Pharmacology, received a DSI high-end infrastructure (HEI) grant of R58 million, to establish an advanced modern Pharmacology GLP and current GMP-accredited research and development laboratories and product manufacturing facilities.
The laboratories and manufacturing facilities are supported by the UFS TIA Platform in traditional medicines, funded to employ a complement of experienced staff and scientists to work in these laboratories and facilities. The UFS Pharmacology laboratories and manufacturing facilities will be a Centre of Excellence for the South African government, the World Health Organization (WHO) and the African Union's (AU) Commission for Social Development. The grant will also be used to build a herbal medicines production/manufacturing facility, as well as to pilot a health centre for traditional medicines at the UFS.

The facility will be a unique place to learn and put theory into practice and develop the research from the bench to the hospital bedside. The research and development laboratories, as a centre of excellence, will host students, researchers and scientists from the continent in order to strengthen bilateral African science and technology development, as well as support South-South collaborations, while maintaining its international outlook. This will lead to proper drug discovery, drug development and product development, serving a number of clients, including communities, traditional health practitioners, entrepreneurs and the pharmaceutical industry. Effective, safe, quality and fit for intended use products will be produced under one roof – from basic and clinical research to finished, final, marketed proprietary products based on IKS and traditional medicinal botanicals.

Under the leadership of Prof Matsabisa, the Department of Pharmacology has also been awarded an annual Technology and Innovation Agency Platform (TIA) grant of R17 million for the next five years. This research and teaching programme, known as African Medicines Innovations and Technologies Development (AMITD), will help to recruit and employ the best skills throughout the research, development, sales, marketing and herbal-medicine manufacturing value chains.

AMITD will act as a national and regional training and capacity development facility in drug research and development, and the formulation and production of quality, safe, effective and well-researched medicines.
As part of the AMITD, four community tea projects have been started in rural areas, in order to establish a sustainable community commercial enterprise for job creation, business development and wealth creation.

Community tea project in Krwakrwa near Alice in the Eastern Cape.

The production and laboratories will be ideally situated in Bloemfontein, in Central South Africa, so that the facility can be accessible to all. The facility will serve as a platform to strengthen our collaborative efforts with industry, communities and traditional health practitioners to address their research, R&D and production needs, and strive to contribute to the local development of an African medicines-based pharmaceutical industry. The facility will also be a national asset for the training of postgraduate students, technicians and scientists in this field, with more emphasis on assisting institutions in rural provinces. The laboratories as well as the production facilities will do contract research to assist and address the complementary medicines pharma industry R&D and research questions and challenges. The challenges include quality control, analytical method development, stability testing for product shelf life determinations, formulations, extracts and concentrates production to finished final product manufacturing and packaging.

The foundations for these latest developments have been long in the strategic planning by the Department of Pharmacology and the UFS. The UFS research strategy recognised the important role of IKS and African traditional medicines in the health and socio-economic fabric of our society, and, over the past five years, the UFS has systematically built and invested in an IKS platform to become a centre of excellence, not just institutionally, but also with a national, regional and international science and research standing. The fruits are now being realised with the UFS Pharmacology and Beijing University of Chinese Medicines (BUCM) project being given a flagship project status and funded for the next three years. Similarly long-standing collaborations between the UFS with the Korean Institute of Oriental Medicine (KIOM) and other collaborative initiatives with India, Germany, Brazil, India and others, are a testimony of UFS being a leader in this field.

Never before has such a bold funding decision been made in the IKS funding sphere in the country. This is not only the first such big grant for the UFS, but also for the country and region in terms of IK.

Prof Matsabisa is the current chair of the WHO Regional Expert Committee on Traditional Medicines for COVID-19. He is Guest Professor at BUCM and a technical expert member of the United Nations Narcotics Control Board based in Geneva. He is a member of Plant based Medicines Task for Medical Therapies Commission for ILAE based in Dublin and at home he is the deputy president for the South African Society for Basic and Clinical Pharmacology, including serving in government committees and in SAHPRA. He has recently been appointed by the Minister of Health to serve as a technical expert in traditional medicines for the Department of Health's international and local initiatives.

Prof Motlalepula Matsabisa.

Digital Scholarship Centre

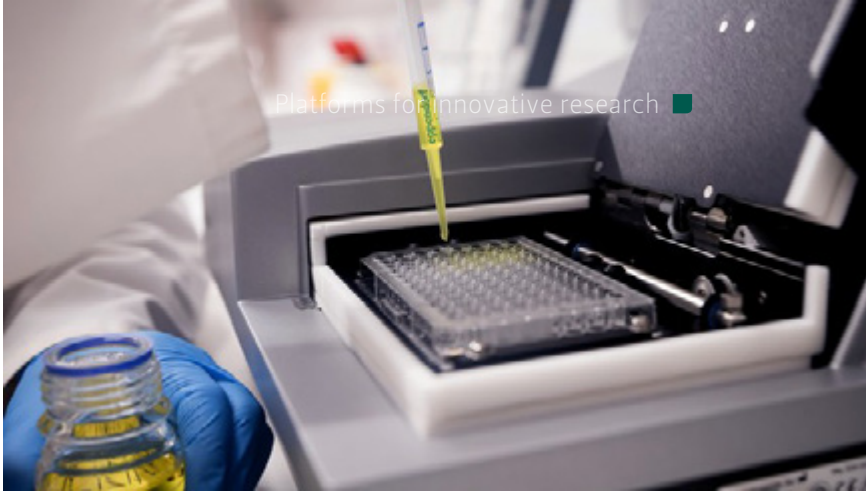
The recently established Digital Scholarship Centre (DSC) is playing a pivotal role in contributing to the development of a collaborative research culture at the University – from cross-faculty and international collaboration to support and administrative services for research. The DSC was established after an investigation by the Library and Information Services (LIS) revealed the clear need for digital scholarship support in order to help escalate research output and quality and to support the institutional strategic aim of being a research-led university.

The DSC, managed by Cornelle Scheltema-Van Wyk, has its roots in the digital, open and networked environment. It also helps to maximise the effectiveness of scarce and limited resources by minimising duplication, not only in research practice with the help of research data management, but also at support level with knowledge of the institutional research environment and where resources can be shared.

The benefit of digital scholarship services with a main hub to act as coordinator and consolidator, is that the hub has a wider view of the research environment at the institution throughout the research cycle. This includes the planning stages, to data collection and analysis in a digital world, to the preservation of research, and publication in a new scholarly communication environment.

The UFS has a sound foundation of capabilities when it comes to existing research support services for digital scholarship, having developed these capabilities over the past ten years. This includes the High-Performance Computing unit in ICT Services, innovation support by the Directorate for Research Development (DRD), and digitisation, digital collections infrastructure, electronic publishing and repository services at LIS.

The DSC uses a hub-and-spoke service model. This model includes a strong central node that links to many other resources. Knowledge, expertise, staff and services are embedded in academic departments, interdisciplinary units (for example, the newly established Interdisciplinary Centre for Digital Futures), libraries and other service points around the University, which are connected and coordinated through this central node. The advantage of this model is that it allows growth to take place organically. Services and expertise develop where needed, rather than researchers depending on a centralised unit that may lack the resources to meet ever-evolving digital scholarship needs. Distributed knowledge and skills, however, make it difficult to identify where to go for specific services, training and assistance. The DSC as a central hub combats the confusion this may cause, linking to the various spokes at the institution.



State-of-the-art equipment for SADoCoL

The WADA-accredited South African Doping Control Laboratory (SADoCoL) purchased and installed a R11.6 million Thermo QE-HF-X instrument, which will enable the laboratory to expand its capability to enhance analytical throughput and sensitivity, as required by the International Standard for Laboratories set out by the World Anti-Doping Agency (WADA).

The high-resolution Orbitrap mass spectrometer was procured with funding from the National Lotteries Commission (NLC) and the UFS research fund. It is specifically designed for the analysis of high-molecular mass molecules, such as peptides and peptide fragments. The instrument capability ensures a fast detection rate with excellent sensitivity and can detect very low concentrations of large molecules. The instrument may also be used for the detection of insulin and insulin-like growth factors in human urine. The instrument will now be utilised on a routine basis for the analysis of hypoxia-inducible factors (HIFs), growth hormone-releasing peptides, as well as research on the protein fragments developed from infection by the COVID-19 virus.

With the newly installed Thermo QE HF-X. Front, from the left: Betsie Human (Senior Analyst, SADoCoL), Patricia Lamusse (Deputy Director, Institutional Advancement), Itumeleng Mabusa (Analyst, SADoCoL) and Zeenat Raffie (Analyst, SADoCoL). Back, from the left: Hanno du Preez (Director, SADoCoL) and Faith Latha (Analyst, SADoCoL).

High standards of the SANCLBP

The South African National Control Laboratory for Biological Products (SANCLBP), based on the Bloemfontein Campus, is a full member of the international WHO-National Control Laboratory Network for Biologicals. In its role as one of only 15 vaccine-testing laboratories worldwide for the WHO, the SANCLBP helps to ensure that the vaccines purchased through the WHO prequalification programme for international distribution to resource-limited countries, meet the high standard of quality, safety and efficiency.

The laboratory received the status of a pharmaceutical testing laboratory after the South African Accreditation System (SANAS) endorsed its quality management system as of a high standard according to the International Standards Organisation's requirements.

The Certificate of Good Manufacturing Practice Compliance indicates that the laboratory testing is on the expected level for any pharmaceutical testing laboratory and shows that the SANCLBP complies with exceptionally strict standards for pharmaceutical labs anywhere in the world. The laboratory is also licensed as a pharmaceutical manufacturer and authorised to act as a testing laboratory in terms of the Medicines and Related Substances act. Although the laboratory does not manufacture, it needs to comply with manufacturing standards. It is rare for a pharmaceutical testing laboratory such as the SANCLBP outside of a manufacturing context to qualify for both certificates.

IGS laboratory staff - back row from the left: Tania Hill, Masego Letebele, Vanessa Koagile and Bonolo Moruri. Front from the left: Trevor Chiweshe, Thobeka Ntshingila, Lore-Mari Deysel (head) and Wanda Geyer.

Accreditation for IGS laboratory

The Institute for Groundwater Studies (IGS) is the leading groundwater research group in Africa, conducting research on fractured rock aquifers, industrial and mining contamination, groundwater governance and groundwater resources. Technologies developed through their research are now being used worldwide.

The IGS water research laboratory recently obtained ISO 17025 accreditation from the South African National Accreditation System (SANAS) for all methods used in the IGS. This accreditation indicates that they adhere to all the conditions and requirements as stipulated by this body via the international standard.

As the laboratory was accredited for its microbiological methods in 2016, the latest accreditation demonstrates that the IGS laboratory has technical competency in the scope of both microbiological and chemical analysis and the operation of a quality management system. Accreditation by SANAS promotes the global acceptance of results generated in the laboratory, as results provided by an accredited laboratory will also stand in court.

With this accreditation, the IGS laboratory is setting itself apart from its competitors and will continue with its contract research on water-related topics in the mining and industrial sectors.

High-end microscopic support

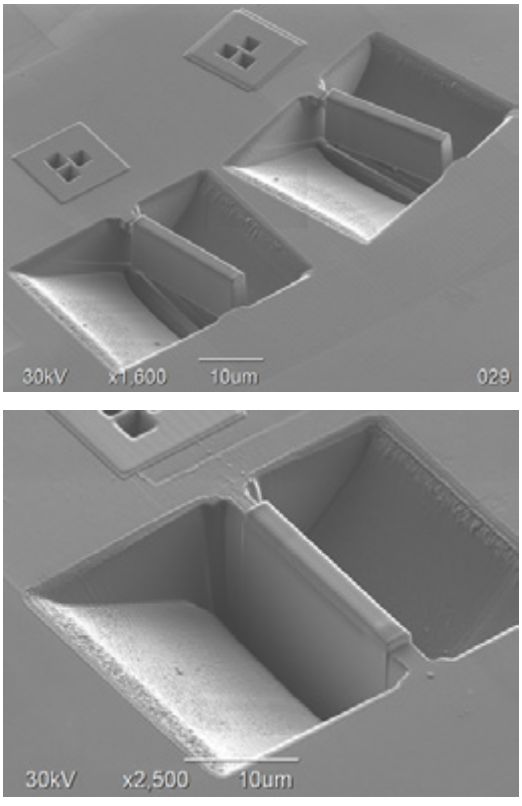
The UFS undertook a project to the value of R65 million to install state-of-the-art microscopy instruments. A high-resolution transmission electron microscope (HRTEM), a scanning electron microscope (SEM) and a focused ion beam secondary electron microscope found their new home at the Centre of Microscopy.

The HRTEM, which is the largest instrument, allows for direct imaging of the atomic structure of samples. This powerful tool will allow researchers to study the properties of materials on atomic scale. It will be used, *inter alia*, to study nanoparticles, semiconductors, metals and biological material. The instrument will also be used to optimise heat treatment of materials, as it can heat the sample up to 1000°C while recording live images of the sample. The JEOL F200 HRTEM is a high-resolution transmission electron microscope featuring a high spatial resolution of up to 0.1 nm at an accelerating voltage of 200 kV. The HRTEM is equipped with an advanced scanning system allowing scanning of the electron beam, which can provide higher analytical performance in EDS (energy dispersed x-ray spectroscopy), such as elemental mapping on a nanometre scale. To make specimen exchange easier, a new device known as a SPECPORTER has been attached to the HRTEM to facilitate both loading and unloading of the specimen holder, thus reducing the chance of human error. The UFS is the only South African institution that can perform these functions.

According to Edward Lee, researcher at the Centre for Microscopy, the focused ion-beam secondary electron microscope is used to cut out samples on microscopic level to be placed inside the HRTEM.

The SEM allows researchers to produce images of a sample by scanning the surface with a focused beam of electrons. Biology researchers will benefit from this machine as it will produce high-resolution SEM photos as never seen before.

These instruments place the UFS at the forefront of microscopy research in South Africa and will promote research on many levels such as Chemistry, Physics, Microbiology, Geology, Plant Sciences, Zoology and Cardiothoracic Surgery.



The images above show an example of the initial preparation of silicon lamellas that will later be placed in the HRTEM. Further etching and polishing on the FIB will still be required to ensure that the thickness of the specimen is of suitable thickness for the HRTEM.

Awards and recognition 2020/2021

Prof Abdon Atangana, Professor in the Institute for Groundwater Studies, was elected a fellow of The World Academy of Sciences (TWAS) in 2021, in recognition of his contribution to sciences and its promotion in the developing world.

Prof Philippe Burger, Professor of Economics and Pro-Vice-Chancellor: Poverty, Inequality and Economic Development, was appointed to serve on the Fiscal Policy and Financial Markets task force of the Lancet COVID-19 Commission.

Dr Johan Coetzee, Senior Lecturer and researcher in the Department of Economics and Finance and the UFS Business School, was nominated as a senior member of the inaugural Pan-African Scientific Research Council.

Mr Herkulaas Combrink, attached to the Office of the Dean of Economic and Management Sciences and Co-Director of the Interdisciplinary Centre for Digital Futures, was seconded to the Free State Department of Health to assist in the COVID pandemic, providing senior strategic data science support. He was also nominated as a BRICS young Scientist for 2020.

Dr Innocent Dande, scholar in the International Studies Group, was named the 2021 winner of the JSAS Colin Murray Prize for his research on food politics in Zimbabwe.

Prof Liezel Herselman, Professor in the Department of Plant Sciences, was awarded the Southern African Plant Breeders' Association Fellow Award in 2020, in recognition of her contribution to plant breeding in southern Africa.

Dr WA Lombard, from the Department of Agricultural Economics, was a winner of the Joseph F Donnermeyer New Scholar Award from the International Society for the Study of Rural Crime.

Prof Rodwell Makombe, from the Department of English at the Qwaqwa Campus, won the 2021 UFS Book Prize for his book *Cultural Texts of Resistance in Zimbabwe – Music, Memes, and Media*.

Prof Kobus Marais, Professor in Translation Studies in the Department of Linguistics and Language Practice, was awarded the 2020 UFS Book Prize for Distinguished Scholarship.

Prof Motlalepule Matsabisa, Professor in the Department of Pharmacology, was appointed by the Minister of Health to serve as a technical expert in traditional medicines for the Department of Health's international and local initiatives.

Dr Champion Nyoni, from the School of Nursing, won the Sigma Emerging Nurse Researcher/Scholar Award in 2020.

Prof Paul Oberholster, Director of the Centre for Environmental Management, won the NSTF-WRC Award for 2019/2020 for outstanding contribution to science, engineering and technology and innovation in South Africa in terms of sustainable water management, knowledge generation and solutions. He was also nominated in 2021, for his contribution to water resource management in South Africa over the past five years.

Dr Sipho Pitjana was awarded an Honorary Doctorate (DPhil (h.c.) by the UFS in 2021.

Prof Zakkie Pretorius, Research Fellow in the Department of Plant Sciences, was nominated for the 2019/2020 NSTF-South 32 Award in two categories – Plant Health as well as the Lifetime category.

Prof Mamello Sekhoacha, Associate Professor in the Department of Pharmacology, was elected chairperson of the National Health Research Ethics Council of South Africa (NHREC) in 2021.

Prof Pearl Sithole, Vice-Principal: Academic and Research on the Qwaqwa Campus, was appointed by Pope Francis as a member of the Pontifical Academy of Social Sciences in recognition of her work in the Social Sciences.

Dr Rebecca Swartz, scholar in the International Studies Group, won the 2020 Grace Abbott Book Prize (best book in English) from the Society for the History of Children and Youth, and the International Standing Conference for the History of Education First Book Award, for her book, *Education and Empire: Children, Race and Humanitarianism in the British Settler Colonies 1833-1880*. The book was also nominated for the Kevin Brehony Prize for the best first single-authored book written in English on the history of education, from the History of Education Society.

Prof Ivan Turok, SARChI Chair in City-Region Economies, was short-listed for the NSTF Lifetime Award in 2021.

Dr Dolf van Niekerk was awarded an Honorary Doctorate (DLitt (h.c.) by the UFS in 2021.

Dr Adelheid von Maltitz, Lecturer in the Department of Fine Arts, was awarded the Group A Absa L'Atelier Award in 2021.

Prof Melanie Walker, Distinguished Professor SARChI Chair on Higher Education and Human Development, was elected President of the International Human Development and Capability Association.

Justice Zak Yacoob was awarded an Honorary Doctorate (LLD (h.c.) by the UFS in 2021.

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