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Science Matters

Science Faculty Newsletter

Message from the Dean

A common message around the world is that 2020 is like no other year in our lifetime. As many activities came to a halt and the lockdown forced us to imagine new ways of working and living, science (re)occupied centre stage in everyday life. The young and old had to ask questions about viruses: what they are, how they spread, and what we must do to survive. The value of science for human survival was there for everyone to see.

Governments – who dare to listen to scientists – assembled teams of scientists to get advice on how to govern citizens under the pandemic. The World Health Organization brought together the world's scientists and global health professionals to speed up research on the coronavirus and to advise on measures to contain its spread. As I write this message the coronavirus pandemic is still with us, and the science faculty continues to work remotely.

In the science faculty, colleagues have been hard at work to ensure the smooth running of our administration, teaching and research. The faculty quickly adapted to working remotely with determination and the highest level of commitment for which I am sincerely grateful. The challenge of emergency remote learning was tackled with one vision in mind: to complete the 2020 academic year *nomakanjani* (no matter what)!

Despite the challenges of our time, our researchers continue to be counted among the best in their fields and among their peers internationally. Dr Sarah Fawcett and Professor Salome Maswime joined the elite group of young scientists at the Young Scientists Programme of the World Economic Forum. The African Academy of Sciences and the Royal Society awarded research grants to Dr Lauren Arendse from the Drug Discovery and Development Centre (H3D); Dr Rondrotiana Barimalala and Dr Ross Blamey, both from the Department of Oceanography; and Dr Felix Sizwe Dube from the Department of Molecular & Cell Biology, who joined a global group of 30 promising researchers. Professor Ed Rybicki and his team in the Biopharming Research Unit (BRU) received an award from the Department of Science and Innovation, the South African Medical Research Council, and the Technology Innovation Agency to develop diagnostic reagents. Professor William Bond was the finalist for the 22nd National Science and Technology Forum annual awards. Professor Kelly Chibale from the Department of Chemistry and H3D was selected as one of the top 20 inspirational medicine makers in the field of small molecules by the United States-based The Medicine Maker's prestigious 2020 Power List. These and many other dedicated scholars and students make the faculty proud.

Best Wishes

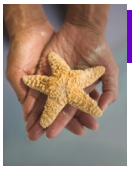
Maano Ramutsindela

Global subject rankings

Earlier this year, UCT performed well in the QS World University Rankings by Subject 2020, with a total of seven subjects featuring in the top 100. UCT's development studies – ranked 10th in the world – was the best performing. The six other subject areas placed in the top 100 globally were Anatomy & Physiology, Anthropology, **Archaeology,** Architecture/built environment, **Geography**, and Medicine.

UCT has also been ranked among the top 100 universities in four subject areas by the Global Ranking of Academic Subjects (GRAS) 2020 recently released by ShanghaiRanking. The subjects are **Oceanography**, Mining and Mineral engineering, Public health, and Clinical medicine.

UCT performed best in oceanography, placing 48th in the world. The top three universities for this subject were the University of Washington (1st), the University of California, San Diego (2nd), and Sorbonne University (3rd).



Our Science Stars:

World Economic Forum Young Scientist Award for Fawcett

Every year, the World Economic Forum (WEF) selects an elite group of researchers under the age of 40 to participate in their Young Scientists programme. This year, UCT is represented by two brilliant women scientists. **Dr Sarah Fawcett,** a senior lecturer in the Department of Oceanography is one of them, along with **Professor Salome Maswime**, head of Global Surgery . They will be joining young scientists from across the globe on a three-year journey of growth and impact. The Young Scientists have been selected on the basis of their contribution to advancing the frontiers of science in the areas of health, sustainability, inclusiveness and equity. Under normal circumstances, the new cohort would have gathered at the Annual Meeting of the New Champions in the People's Republic of China for a curated community programme. However, due to COVID-19, this has been postponed until further notice. Instead, the Young Scientists made each other's virtual acquaintance during an online on-boarding programme last week.

After completing her PhD in geoscience at Princeton University, Fawcett returned to South Africa where she took up a position as a lecturer in UCT's Department of Oceanography in 2015. Since then, Fawcett has spent the four years establishing a strong and diverse research group and raising funds to build a new marine biogeochemistry lab at UCT, which is in its final stages of completion. Fawcett's research seeks to understand the connections between the components of Earth's climate system, as well as the impacts of human activities on marine environments. Since stable isotopes provide a powerful tool for investigating these links, having access to a method for analysing nitrogen isotopes in water and small organic samples – called the denitrifier method – is central to her lab. This is not currently available in Africa, and Fawcett's lab will be a first for the continent.

"My ultimate goal is to catalyse sustainable transformation in a white- and male-dominated field and support the development of womxn scientific leaders and role-models." Fawcett emphasises that the goal of this new laboratory is to facilitate high-quality, high-impact research and train the next generation of African scientists. "I am committed to shifting the center of gravity with regards to perceived scientific excellence (from the north) by conducting research of significant relevance to Africa in an African laboratory using increasingly high-resolution and innovative techniques that also push the frontiers of global knowledge," she explains. Fawcett's commitment to the development of African scientists is what drives her work. She is especially passionate about improving the retention, success and visibility of womxn in science, particularly black womxn.

Minister's funding award to South African Covid-19 testing ability to BRU

BRU BIOPHARMING RESEARCH UNIT

The Department of Science and Innovation (DSI), the South African Medical Research Council (SAMRC) and the Technology Innovation Agency (TIA) made seven funding awards to local companies, organisations and researchers in order to ramp up the country's ability to produce locally developed reagents and test kits for COVID-19. The awards are valued at approximately R18 million and the funding recipients will commence their responsibility immediately, with six months to begin production.

The Biopharming Research Unit (BRU), at UCT, under the leadership of Professor Ed Rybicki, received one of these awards for the development of diagnostic reagents. The BRU will develop and produce highly stable synthetic DNA and RNA molecules, containing all the commonly used target sequences used for SARS-CoV-2 nucleic acid detection, as well as internal control sequences to check for the integrity of the nucleic acids.

The combination of this and projects from CSIR and CapeBio Technologies will address South Africa's immediate needs for locally produced RT-PCR reagents for gold standard test kits. The planned used of biopharming technologies, which involves the production of pharmaceutical proteins in plants that have been genetically modified for this purpose to produce these reagents will be an added advantage.

Emeritus Professor William Bond is finalist in Science 'Oscars'

On 30 July 2020, the National Science and Technology Forum (NSTF) will host its 22nd annual awards event in partnership with South32. **Professor William Bond,** from the Department of Biological Sciences is one of the finalists for the Lifetime award. Also known as the 'Science Oscars' of South Africa, the NSTF Awards were established in 1998 to recognise outstanding contributions to science, engineering, technology and innovation by professionals, teams and organisations in South Africa.

The theme for this year is Plant Health in recognition of the 2020 International Year of Plant Health declared by the United Nations. A special theme award will go to the researcher who has made an outstanding contribution to this field. Due to the COVID-19 pandemic, the awards gala dinner will take the form of a live-stream broadcast. This year also marks the 25th anniversary of the founding of the NSTF, a milestone that the virtual event will celebrate.

Bond's citation is as follows: Bond is an ecologist who has championed the ecological role of tropical grasslands and challenged the idea that they are 'degraded forests'. Since the new millennium, planetary ecology has been contributing to global change science. Bond's research contributes to this field by focusing on the non-forested 'open' ecosystems of the world, such as grasslands, shrublands and savannas.

Open ecosystems are common in South Africa and very common in Africa, often in climates that also support forests. Long viewed as deforested and degraded by frequent fires and herds of large, grazing mammals, these systems have been shown by Bond and others to be ancient. New concepts for open ecosystems have spread widely in tropical regions challenging out-dated perceptions and policies. They are also contributing to new thinking on ecological processes in north temperate forests and Eurasian forest-steppe mosaics.

World Leader in Pharmaceutical Industry

Professor Kelly Chibale, founder and director of Africa's first integrated drug discovery and development centre, H3D, has been chosen as one of the world's top 60 inspirational leaders in the pharmaceutical industry.

The United States-based The Medicine Maker's prestigious 2020 Power List celebrates the most inspirational professionals working in the global pharmaceutical industry. Chibale was selected as one of the top 20 inspirational medicine makers in the field of small molecules. "I am greatly encouraged that what we have been doing in Africa in the field of drug discovery is being acknowledged and recognised on the global stage," said Chibale, whose research focuses on delivering safe and affordable treatment options for tuberculosis and malaria, while also creating jobs. H3D is well known for its ground-breaking research into a potential single dose treatment against malaria.

Editor of The Medicine Maker, Stephanie Sutton, said 2020 had proven to be a challenging year for humanity, with volcanic eruptions, bushfires, floods, storms, the melting of glaciers and the emergence of the novel coronavirus (COVID-19), which has brought much of the world to a standstill. "At times like this, we believe it is even more important to recognise the many people working hard to improve our world. The professionals highlighted in the 2020 Power List are driving the industry forward and saving lives by developing new medicines. The professionals highlighted in the 2020 Power List are driving the industry forward and saving lives."

Chibale, who is the holder of the Neville Isdell Chair in African-centric Drug Discovery and Development and the South Africa Research Chair in Drug Discovery, said the COVID-19 pandemic had shown how vital it is to invest in drug discovery and development in Africa and across the world. "It is time to train a generation of African scientists to conduct drug discovery and build the critical infrastructure and expertise that can be sustained into the future so that Africa can respond adequately to future pandemics like COVID-19, Chibale said.

FLAIR fellowships for Researchers from Science

Four young researchers from the University of Cape Town (UCT) have been selected to form part of the 2020 cohort of Future Leaders – African Independent Research (FLAIR) fellows. These fellowships are awarded to talented African early-career researchers whose work is focused on solving the needs of the continent. One of the goals of the FLAIR Fellowship programme is to help researchers develop independent careers within African institutions, and ultimately, to lead their own research groups.

The initiative is a partnership between the African Academy of Sciences (AAS) and The Royal Society, supported by the Global Challenges Research Fund. This year, the 30 promising young researchers will receive up to GBP300 000 each to conduct research over two years. The 2020 cohort was selected from a competitive pool of more than 700 applicants. Among the 30 successful candidates, four are from the Science Faculty at UCT.

The recipients are **Dr Lauren Arendse** from the Drug Discovery and Development Centre (H3D); **Dr Rondrotiana Barimalala** and **Dr Ross Blamey**, both from the Department of Oceanography; and **Dr Felix Sizwe Dube** from the Department of Molecular & Cell Biology.

Dr Lauren Arendse is leading a drug discovery programme that aims to explore novel treatments for malaria by building on the knowledge gained from using human kinase inhibitors to treat cancer. The *Plasmodium* parasite, which causes malaria, relies on enzymes known as kinases to reproduce and spread via the mosquito. Arendse and her colleagues are looking for new ways to disrupt multiple stages of the parasite's lifecycle by inhibiting novel kinase targets. By producing *Plasmodium* kinases in a laboratory, studying their structure and function and testing the ability of compounds to selectively inhibit them, Arendse and her team will gain insight into the role of these enzymes in the parasite, enabling the design of new antimalarials.

Historically, tropical cyclones that form on the south-eastern coast of Africa have been considered 'too weak' for inclusion in hazard planning. But with the catastrophic damage caused by cyclones Idai and Kenneth in 2019, it has become clear that these weather events are intensifying. To understand what's behind this change, **Dr Rondrotiana Barimalala** is investigating the role that ocean eddies, upper ocean temperature and salinity play in the occurrence of tropical cyclones in this region. "For FLAIR, I will particularly focus on the role of the oceanic processes on tropical cyclone intensification in the Mozambique Channel," she explains.

Along with collaborators at UCT and in the United Kingdom, **Dr Ross Blam**ey is currently investigating the role large thunderstorms play in the climate along the tropical edge of southern Africa. "Compared to other regions of the world, little is known about these storms in southern Africa, yet they are an important component of our climate system," he says. Through the FLAIR fellowship, he aims to address this gap in African climate science using a combination of newly available observations and state-of-the art climate model output. A better understanding of the present and projected future climate of this region will help address some of the complex socio-economic and environmental issues it faces in relation to water and food security.

A recent but rapidly expanding component of **Dr Felix Sizwe Dube's** research is around the evolution of the microbiome at different body sites in African children," he says. "[I'm looking at] the relationship between the microbiome and child health, with a specific focus on respiratory and skin infections, as well as antimicrobial resistance."

As part of his FLAIR research, Dube will lead the microbiological aspects of a clinical trial that seeks to understand the effects of a proposed long-term treatment (the antibiotic azithromycin) on the microbiome in the lungs and airways of children with HIV and chronic lung disease in sub-Saharan Africa.

Biological Sciences student to be awarded a PhD for her work on Rooibos farming and climate change by Duna MacAlister

Dunja MacAlister, who is a PhD student in the Department of Biological Sciences, recently had an article published in Landbouweekblad about her work on Rooibos tea farming and climate change. On the day that the article was published, she heard that she would be awarded her PhD for this work.

My rooibos study stems from a larger project looking at thermotolerance and heat stress in African legumes, namely chickpea, cowpea and rooibos, all of which are important legumes or in the case of chickpea, have the potential for a bigger impact in SA's economy. My interest in rooibos and climate change came from reading papers and news about climate change and the ever-increasing temperatures in the Cederberg, which is forcing farmers to shift farming further south. I wanted to find out more about this plant, how it reacts to heat, what mechanisms it could have for alleviating heat stress, because it must to some degree do this already as the Cederberg is known for being hot.

During my studies, which included 3 years of fieldwork and a few glasshouse experiments, I found that changes in soil nutrients along with increasing temperatures had negative impacts on the rooibos yields. The farms further south from the Cederberg, which were cooler and had more rain and water inputs, had similar yields to fields in the Cederberg and the quality of tea, showed no major differences from the main growing area for rooibos. Low rainfall and the occurrence of dry spells and drought, associated with climate change are likely to reduce the production of rooibos in the Cederberg through a loss of biomass and productivity in plants. Rooibos plants exhibited drought tolerant mechanisms that enabled them to tolerate these conditions via producing more roots, that are thin and deep, allowing them to take up more nutrients and water. I also looked at protein production in rooibos and found that they produced more proteins involved with heat shock responses, therefore playing a critical role in their acquired heat-stress tolerance, while plants in the colder sites upregulated proteins involved in photosynthesis and chlorophyll production to allow them to have higher photosynthetic activity and therefore higher productivity.

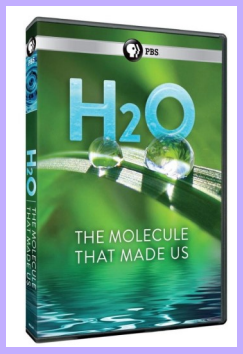
This all suggests that farmers moving the operation further south could still achieve good growth and high yield without compromising the quality of the tea. Working with the farmers was a great experience and I particularly enjoyed doing night time measurements of the plants in the field—we got to sit in quiet fields with no light pollution and stargaze!

Students shine in data science hackathon

Ehsaan Rajak, Taru Singhal, Patrick Chang and Ivan Jericevich, from the Department of Statistical Sciences, competed in Zindi, the first data science competition platform in Africa, which hosted UmojaHack Africa inter-university machine learning hackathon. Student teams at universities across Africa competed while honing their skills and developing machine learning solutions to complex real-world challenges. Ehsaan, Taru , Patrick and Ivan formed a dynamic team and competed in the hackathon on the Zindi platform, coming first in the intermediate challenge. They represented UCT and competed against other universities for cash and in-kind prizes.

Associate Professor Francesca Little, HOD of Stats congratulated the participants, "Congratulations on your excellent performance in the Zindi hackathon on Saturday, by coming first in the intermediate challenge on Saturday. Your achievement is even more important during such stressful and uncertain times. While most people were taking Saturday to figure out how they were going to continue to operate under social distancing, you got on with the job of applying your analytical skills to a problem posed to you in a competition and came out tops. We are very proud of you."

Jill Farrant features in documentary: H2O - The molecule that made us



Professor Jill Farrant recently featured in a 3 part documentary, H2O:The Molecule That Made Us - a 3-hour series from WGBH Boston, which premiered on three consecutive Wednesdays in April/May. The film dramatically reveals how water underpins every aspect of our existence; how in the emptiness of outer space, Earth is alive because of water and looks at how humanity's relationship with this simple molecule is everything. Prof Farrant appears as a thread throughout the documentary with a special focus in the last episode which concentrates on the crises associated with drought. In this she includes a feature on the effects of the drought in SA. There was also an additional documentary on her work, which appears on the website. View it here: https://www.pbs.org/wgbh/molecule-that-made-us/home/features/resurrection-plants/

In the words of Prof Farrant, "It is encouraging to see that academics from UCT are being recognized for their work that might be a solution to world crises".

Scholarship to do PhD at University of Cambridge for Jess Lund

FitzPatrick Institute MSc student and previous UCT undergraduate/Hons student, **Jess Lund** (pictured right) has obtained a prestigious scholarship to do her PhD at the University of Cambridge. For her PhD she will be investigating the mechanisms and ecological consequences of host specificity in honeyguides, specifically looking at how phenotypic plasticity can facilitate host-specific adaptations in the absence of genetic specialization. Jess comments, "The lockdown has set my MSc back a few months, so I will be starting my PhD later than anticipated, but being part of Claire Spottiswoode's wonderful research group (spanning UCT and Cambridge) has helped me remain sane during the pandemic". For more details about the honeyguides see www.africancuckoos.com and www.africanhoneyguides.com

Publication of world's first African research paper on solar geoengineering

In January, global Solar Radiation Management (SRM) research reached an important milestone: the publication of the world's first African research paper on solar geoengineering. The paper's lead author was Mozambican climatologist **Dr Izidine Pinto,** working with colleagues at the University of Cape Town and the American National Center for Atmospheric Research (NCAR). It was also the first publication to come from the DECIMALS Fund, the developing country research fund set up by SRMGI in 2018.

It's a considerable achievement for Izidine, not least because he failed physics and chemistry in high school. Growing up in Quelimane, Mozambique, he came through the poorly funded public education system, where there were more than 60 pupils in his science classes. He found physics fascinating and kept persevering, however, taking opportunities as they came to him. He pursued a postgraduate degree (Licenciatura) in meteorology at Eduardo Mondlane University in Maputo, before earning a bursary to study for a master's degree in Atmospheric Science at UCT. The masters was followed by a PhD, then a postdoctoral position in the Climate Systems Analysis Group (CSAG) and now he is also a lead author on Working Group I of the 6th Assessment Report of the Intergovernmental Panel on Climate Change (IPCC).

Dr Lynne Shannon attends first of its kind World Biodiversity Forum

Dr Lynne Shannon (SARChI Chair in Marine Ecology and Fisheries Group in the Department of Biological Sciences) was invited to attend the only strictly marine-focused component of the World Biodiversity Forum 2020 held in Davos, Switzerland, from 23-28 February. The World Biodiversity Forum is the first of its kind and brought together a range of leading researchers, early career researchers, decision-makers, practitioners and representatives from various sectors to debate the sort of biodiversity future we do and/or do not want. The primary aim was to *'redefine and set the agenda for biodiversity as a focal point over the next 10 years.'*

The component of the Forum Lynne attended dealt with *'Connecting the human dimension and global marine ecosystem services towards a better wealth and health of the Planet'.* Lynne delivered a presentation entitled *'Getting the balance right – thoughts from a South African fisheries perspective*', which was co-authored with Dr Lauren Waller (SANCCOB) and used a South African case study to emphasize the multi-faceted trade-offs requiring careful consideration in the purse seine fishery for small pelagic fish, such as sardine and anchovy. A joint paper entitled *'Marine Biodiversity: linking transformative changes and the oceans' human dimensions'* is being prepared for *People and Nature* as joint output from this session.

Lynne found the conference fascinating and particularly enjoyed the keynotes that encompassed the diverse spectrum of authorities, mainly in the terrestrial environment and representing many unique fields including ecology, politics, biodiversity, anthropology, philosophy, environmental ethics, economics and geography. Noteworthy were two South African speakers, Prof Emma Archer, a world-recognized geographer from the University of Pretoria (and a former UCT student), and Dr Benis Egoh, a conservation biologist now tenured in California but who trained at UCT and the University of Stellenbosch.

Lynne was part of the team that was responsible for proposing the World Biodiversity Conference Resolution, adopted as output from this conference. The weekend after the conference was concluded, Lynne was invited to participate in a high-level, focussed workshop on '*Synthesizing the best available scientific evidence to inform the development of the post2020 Global Biodiversity Framework'*. A report was subsequently submitted to the Convention on Biodiversity (CBD) and a high-level scholarly article is in preparation as well.

New species of plant discovered in Tokai Park

A new species of sedge, the Hidden Veldrush (*Schoenus inconspicuus*) which is listed as critically endangered, has been discovered in Tokai Park. The plant is currently known from fewer than 10 plants on the planet and has only been collected six times at two localities. The discovered Hidden Veldrush is described in a recent publication by University of Cape Town (UCT) researchers **Dr Tammy Elliott** and **Professor Muthama Muasya** and **Doug Euston-Brown** who first officially noticed the occurrence of the plant in November 2019.

It closely resembles a grass with which it often grows – *Tenaxia stricta*, the Cape Wire Grass – and telling them apart requires a very careful look at the leaf sheath (which grass aficionados would know as the flange on the leaf blade where it curls around the stem, and sedges have a closed sheath). Unlike its close relatives, which like wetlands or rocky mountains, the Hidden Veldrush prefers deep, dry sands.

As with other threatened species, the Hidden Veldrush's future is complicated. It appears that this species especially needs fire: but we don't even know if it coppices to survive fire, or – as appears likely – is killed by fire and has to establish from seeds: an unusual trait among Veldrushes. Its rarity may suggest that this is a species that likes open spaces such as grazed areas and might not compete well with coppicing species such as the Cape Wire Grass. However, Veldrushes are often eaten and don't fare well in heavily grazed areas. But studies on its regeneration ecology will need to wait for the next fire, and [in the] meantime we have to plan for its future," shared the research team.

STAFF NEWS

WELCOME TO NEW STAFF

The Science Faculty welcomed the following new staff members during the first half of the year:

Astronomy
- Dr Lucia Marchetti—Senior Lecturer

Biological Sciences:
- Dr Charlene Janion-Scheepers—Lecturer
- Mr Dean Phillips—Scientific Officer, Bolus Herbarium

Computer Science
- Mr Emmanuel Tuyishimire—Senior Scientific Officer
- Mrs Jenine Christians—Senior Secretary

Environmental & Geographical Science
- Mrs Johanna von Holdt—Lecturer
- Mrs Natalie Johnson - Senior Administration Officer

H3D Drug Discovery & Development
- Dr Kathryn Wicht—Research Officer
- Dr Nicole Cardoso—Senior Research Scientist

Mathematics & Applied Mathematics
- Dr Christian Rohwer—Lecturer

Molecular & Cell Biology: Biopharming Research Unit
- Dr Albertha van Zyl—Junior Research Fellow

Physics
- Dr Ntombizikhona Ndabeni—Research Officer

Science Faculty Admin
- Mrs Lisl George—Finance Officer

Lockdown limerick lament by Emeritus Professor John Bolton

#UCTLockDownLetters is a new feature on the UCT news site where staff, students, parents of students write about their experiences of work and life in lock-down. Emeritus Professor John Bolton wrote this on the last day of lockdown level 4.

When moved to be poetic he opts for writing limer-icks.

FAREWELL TO STAFF

The Faculty said goodbye to the following staff:

Environmental & Geographical Science—CSAG
- Ms Katinka Waagsaether—Junior Resesarch Fellow

H3D Drug Discovery & Development
- Mr Ashlyn Bhana—Research Scientist

Mathematics & Applied Mathematics
- Ms Kim Peters—Senior Secretary

Statistical Sciences
- Mr William Msemburi—Lecturer
- Mrs Kim-Joy August—Admin Assistant

Faculty Office
- Mrs Nalinee Majaraj—HR Business Partner

Lockdown's a miserable state
You sit and you wait, then you wait …
You feel such a loner
As you wait for Corona
To avoid it, now that would be great
It was once just a Mexican beer

Tasted awful, but nothing to fear
Corona's a brand
That could have been banned
But beer was banned anyway, here

It's not a good time to be male
Or old, or with parts that may fail
Blood vessel rigidity
Becomes co-morbidity
We all feel increasingly frail

I drag myself out of my bed
Early morning, a brisk walk instead
But all down the road
Gagged in facemasks they strode
Feels like I'm in 'Shaun of the Dead'

We hope soon the last will be seen
Of murderous Covid-19
A year maybe, or two
Like the old Spanish flu
Corona will be a has-been

NEW IN THE FACULTY

The Water Hub: treating contaminated runoff from an informal settlement

By Dr Kevin Winter, Environmental & Geographical Science & Lead Researcher: Future Water Institute, UCT

Contaminated runoff from informal settlements in South Africa poses an immediate public health risk to residents living in high density compact urban spaces, but the impact is also evident in the receiving waters further downstream. Surface water runoff from informal settlements comprises a mix of grey- and blackwater and is often accompanied by solid waste. Getting water and sanitation into an informal settlement is seen as a 'basic' service, but getting water out of an informal settlement and ensuring that it is safely treated is woefully neglected in municipal service plans.

Biofiltration treatment cells that are used for polishing and cleaning polluted water from the informal settlement

The Water Hub: treating surface water runoff

In 2017 the Western Cape government established the Water Hub as a research and innovation site for the purpose of demonstrating new technologies and techniques in water treatment. The decision to establish this test bed site was prompted by a regional drought, the worst on record that resulted in Cape Town's 'Day Zero'. The site is situated in the beautiful Franschhoek valley, north east of Cape Town, surrounded by majestic mountains and vineyards. Less than 1 kilometre upstream of the site is an informal settlement characterised by pervasive urban poverty, unemployment and vulnerability to health risks. In contrast, the formal historical town of Franschhoek is a mere 2.5km away and is well-known as a tourist attraction, hospitality industry and award-winning culinary restaurants. The setting is a microcosm of South African cities and towns. Context is important. It positions the Water Hub, as research and development centre, to engage in socio-economic and environmental issues and to contribute to the transformation conventional thought and practice. The site is located on an old abandoned wastewater treatment plant. The project began by repurposing existing infrastructure and changing the drying beds into large biofiltration cells for polishing and cleaning up to 100 000 litres of water each week. Each cell is filled with different media such as stone aggregates and carbon sources. Water quality and flow are measured by using real-time sensors and loggers and transmitting this data via the internet. After two years of data collection the results have led the researchers to tentatively conclude that nature-based solutions are capable of cleaning contaminated runoff from informal settlements without the need to add chemicals. Nitrogen and phosphorous concentrations are reduced by up to 90%, and almost all *Escherichia coli* bacteria is removed. Treated water is used for irrigating vegetables and the crop is regularly tested to comply with health and safety standards.

The circular economy

The project aims to incorporate a Circular Economy approach that will help to close the loop on a small portion of the material and energy flows that from the formal town of Franschhoek, for example, organic waste that is destined for landfill. The challenge will be addressed by integrating the Food-Energy-Water-Waste nexus and to focus attention on resource recovery, reuse and production of market goods to support cooperative business enterprises. This development of this theme is in a partnership with the European Belmont SUGI WASTEFEW project in which the Water Hub is one of four international "Urban Living Labs" (ULLs) with a common aim of reducing and understanding the waste economy in the United Kingdom, Netherlands, South Africa and Brazil.

EVENTS IN THE FACULTY

Meeting Room in Computer Science renamed after visionary professor

A meeting room in the Department of Computer Science was recently named in honour **of Prof Gary Marsden.** Colleagues, family and former students of the much-loved and visionary Professor Gary Marsden gathered to name a meeting room in his honour at the Centre in Information and Communications Technologies for Development (ICT4D) in the University of Cape Town's (UCT) Department of Computer Science.

Marsden passed away suddenly from a heart attack in December 2013 at age 43, but it was clear at the naming ceremony that he has left a lasting impression on people in the department, the faculty, UCT and the international research community. Speakers, including Vice-Chancellor Professor Mamokgethi Phakeng, told of the ripple effect of Marsden's passion for teaching and research, and spoke movingly about the influence he had had on them, both personally and professionally, during his 13 years at UCT.

Marsden was the founding director of the Centre in ICT4D, an accredited research group within the university, with a focus on computing solutions to human and socio-economic development problems. In a proposal to name the boardroom after Marsden, head of the computer science department, Associate Professor Hussein Suleman, said Marsden's research was recognised internationally, evidenced by numerous publications and concomitant citations, and a multitude of leading international researchers who visited UCT as a consequence. Marsden's book *Mobile Interaction Design* is considered a seminal work on the design of mobile applications, especially for and in poor communities.

Marsden earned a Distinguished Teacher Award and was remembered by his students for his exceptional and inspiring lectures often punctuated with laughter. "Gary's humour opened the way to point out the inequalities, incongruities and urgent need for change. I remember the laughter of the enthralled audience of undergraduates or the bemused donors from the tech industry as they laughed as they gave him lots of money," said Associate Professor Marion Walton, convener of Digital Media and Informatics at UCT's Centre for Film and Media Studies.

Global Women's Breakfast 2020: Empowering Women in Chemistry

Drs Cesarina Edmonds-Smith and **Roxanne Mohunlal,** from UCT's Department of Chemistry, organised the IUPAC Global Women's Breakfast 2020: Empowering Women in Chemistry, which was hosted at Rhodes Memorial Restaurant. More than 50 women from UCT, Stellenbosch University, UWC and CPUT, as well as representatives from Lasec gathered in conjunction with woman at 242 breakfasts being held in countries across the world. The Global Women's Breakfast was designed to assist women chemists to expand their network of contacts, both locally and internationally. Women at different stages of their individual careers were encouraged to inform each other about their career progress, and together explore opportunities, in professional development and in research or teaching horizons.

The postgraduate students, academics, scientific officers and sales representatives enjoyed a morning of networking and forming new bonds. The morning comprised of an introduction and brief history highlighting the importance of this initiative by **Dr Cesarina Edmonds-Smith,** followed by a relaxed breakfast where delegates chatted about what life is like as women in science and exchanged stories about their personal journeys which was empowering and inspiring to all who attended.

Successful 2nd AFIRM: ACM SIGIR/SIGKDD Africa Summer School on Machine Learning for Data Mining

In January 2019, UCT hosted a Summer School on Machine Learning for Data Mining and Search, which took place at UCT. The event was conceived with the aims of increasing opportunities in research from traditionally underserved communities, growing the IR and data mining communities in sub-Saharan Africa, and expanding the horizons of IR and data mining research. The school took place for the second time in January of 2020, again at UCT. **Professor Hussein Suleman**, event organiser and HOD of the Department of Computer Science says, "AFIRM 2020 grew in many ways from AFIRM 2019. It went from single-track to parallel-track; both the number of students and the speakers increased; topics were more diverse and we had more sponsors". **Dr Maria Keet** and 10 Computer Science PhD students were integrally involved in the successful running and presentation of the event.

At the end of the meeting, they started discussions to plan a third Summer School in East or West Africa in 2021 or later.

Inaugural oceanography symposium by and for students

Postgraduates from the **Department of Oceanography** had the opportunity to showcase their research to their peers, locating their work in global conversations about climate, biodiversity, food production and environmental resource management. The symposium, titled "Ocean Meets Sky: Oceanographic Research – A Global Perspective", was hosted by the department in March. It was the first oceanography departmental symposium at UCT. The symposium was organised by a committee of UCT PhD and master's candidates: Faith February, Wade de Kock, Precious Mahlalela, Wanjiru Thoithi and Liisa Shangheta.

February, who is pursuing her PhD in physical oceanography and Thoithi, whose MSc is in ocean and atmospheric science, are also members of the inaugural cohort of Ocean Womxn. The programme is supported by UCT's Advancing Womxn Initiative, championed by the vice-chancellor (VC), Professor Mamokgethi Phakeng.

Professor Isabelle Ansorge, head of the Department of Oceanography, said she was proud of the organising committee for taking the initiative. "This is an amazing opportunity for the students and lecturers from the oceanography department to come together as a single body. The excitement shared by all today was truly inspirational and I know that this is the first of many annual symposiums … I feel very privileged to be head of this department with such astounding and talented students."

The "Ocean Meets Sky" symposium organising committee: (Back row, from left) Liisa Shangheta, Wade de Kock and Wanjiru Thoithi, (Front row, from left) Faith February and Precious Mahlalela.

Research Bytes

When the research is blowing in the wind

by Associate Professor Frank Eckardt

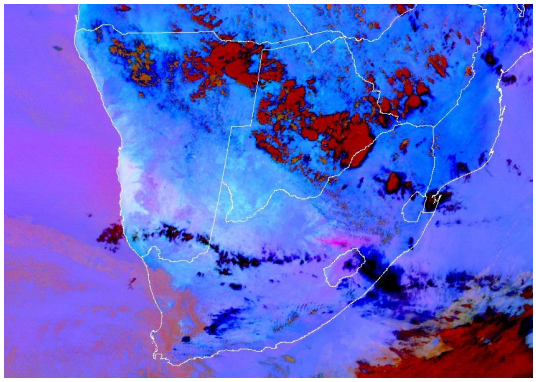
Most of the world's dry lands produce dust, which may travel over hundreds or even thousands of kilometres, affecting air quality, fertilizing the oceans on the way and reaching far flung icecaps. At source, the transport of dust also constitutes a loss of valuable nutrients. Our study areas are determined by long term observations from space-borne data. For the past 15 years we have been trying to locate the dustiest place in Southern Africa, to then visit these and to understand the surface conditions and processes that lead to persistent and frequent dust storms seen in the satellite records.

We work primarily with weather satellites that produce images, every 15 minutes, both day and night. In this study we examined satellite images covering South Africa over a 10-year period. After exploring more than 300 000 images, we found that much of the big dust events in South Africa occur in a few places in the Free State. These observations resulted in us surveying farms around Bultfontein, in the pursuit of the responsible soil types, while also collecting wind data, dust samples and details of the farming practices. We used a portable wind tunnel in conjunction with Swiss project partners from the University of Basel, who were able to establish dust emissions thresholds in response to variable soil conditions, such as soil crusts, silt and moisture content.

Our results show that the difference in dust emission potential is quite variable and in fact quite patchy even within a single field. We also found that some farmers were practising soil conservation, by retaining maize stubble and limiting surface disturbance. But such measures are not equally adopted and are also crop dependant. We also learned that the dustiest year in the image archives was one of the driest on record and that much of the agricultural areas in Free State were left bare in 2016.

Given future drought years and cycles, it is apt to identify farming practices that could lead to widespread soil conservation practices during drought years but also consider longer term land use changes, should drought become the new normal. For example, the establishment and protecting of soil crusts might provide a short-term intervention, while switching back to grass cover could be more sustainable in the long-term. Project partners from the South African Agricultural Research Council and UCT PhD candidate Nolusindiso Ndara, the recipient of a Faculty Scholarship currently examine grassland cover as a more appropriate landcover which protects soils but also stores more carbon. Other work is still under way as well. Our partners from the University of Pretoria have been looking at soils and dust microorganisms to determine if specific dust sources carry a genetic fingerprint and to ascertain the biological impact of dust fallout at its destination.
Research is never dull. Often, we don't know exactly where funding will come from, who we will end up working with and where one will land up doing fieldwork. But asking strategic questions takes care of many of these issues. We have been fortunate to received NRF funding which has brought together a multidisciplinary team. Fieldwork is now complete and the slow work of generating papers is under way.

It took a broken foot to analyse the data and write a paper and a pandemic to find time to finally



The bright pink patch on the left is dust in a Weather Satellite image.

The image on the right reveals a field typical of the Free State that produces significant dust

Land Reform and its impact on the arid South African environment

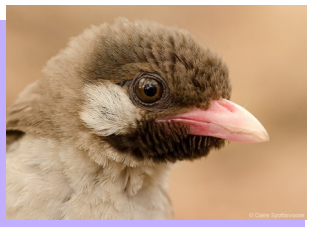
While in the Northern Cape doing field research, Gabriela experiencing the thrills of a donkey cart ride, a common mode of transport in the area.

Gabriela Fleury, was a Rotary International Scholar from the USA, who was part of a Masters of Science Conservation Biology class at the Percy FitzPatrick Institute and worked with **Professor Timm Hoffman** as her supervisor. Her classmates were drawn from Japan, Mozambique, Zimbabwe and South Africa, with diverse interests in botany, ornithology and human-wildlife conflict. Gabriela's dissertation was developed into a paper co-authored with Prof Hoffman and Simon Todd, which was recently published in the *African Journal of Range & Forage Science.*

Riemvasmaak, a unique area of the Northern Cape was used as a case study. This 75 000ha hyper-arid area represents one of the first land restitution cases in post-apartheid South Africa. People were forcibly removed in 1974 and the land was without livestock grazing pressure for 20 years before being resettled in 1995. In the paper, they describe the impact that people and domestic livestock have had on the vegetation of Riemvasmaak since resettlement. Matched photographs and botanical surveys undertaken at 10-year intervals (1995, 2005 and 2015), were used to estimate the percentage cover of herbaceous (primarily grasses) and woody vegetation of the major land forms (slopes, plains, ephemeral streams). The results of a linear mixed-effects model suggest that herbaceous vegetation decreased from 1995 to 2005 and increased from 2005 to 2015 while woody cover did not change significantly over the study period, indicating resilience in this arid rangeland. Linear regressions of individual *Vachellia erioloba* (Camelthorn), an important tree species in the study site, indicate that there were fewer new seedlings over the period 1995-2015 than in the period before the initial survey in 1995. Rainfall, as well as the number of livestock have influenced changes in vegetation cover and the recruitment of *V. erioloba.*

Following graduation from UCT, Gabriela worked in Kenya before joining Cheetah Conservation Fund in Namibia as Human Dimensions Research Manager. Recently, Gabriela returned to the USA where she is Conservation Partnerships Officer with Rainforest Trust. She is looking forward to executing her 2021 Fulbright Award researching anthropogenic impacts on carnivores in Botswana before beginning a Ph.D.

Wanted: Honeyguide sightings by Jessica van der Wal



The Honeyguide Research Project at UCT's FitzPatrick Institute has recently launched *Honeyguiding.me*: a citizen science initiative to improve the understanding of the cooperative partnership between honeyguide birds and humans in Africa. The project invites bird enthusiasts to share where they've seen a Greater Honeyguide and whether they were guided or not, to allow mapping where the bird occurs and how much guiding still occurs on the continent. These records will help our understanding of how this unique interspecies relationship is maintained across time and space. Visit: Honeyguiding.me to share a sighting or for more info.

The Greater Honeyguide (*Indicator Indicator*) is known for its habit of guiding people to bees' nests in parts of Africa. Bird and human cooperate to gain access to bees' nests, from which humans gain honey, and honeyguides get wax. The birds know the whereabouts of the bees' nests but cannot access the wax alone, whereas humans have the tools to open the nests. This relationship between birds and humans in which both parties benefit is called a mutualistic relationship, and is an extremely rare example of animal-human cooperation that has evolved through natural selection.

The honeyguide-human mutualism is thought to have once been common in sub-Saharan Africa, but is now much reduced and is known to exist regularly in only a few remote areas where people still rely on a supply of wild honey. However, honeyguides still attempt to guide humans at least occasionally in other places in sub-Saharan Africa. When a Greater Honeyguide wants to guide you, it will alert you to its presence with a distinctive, nasal chattering call –"tjrrr tjrrr tjrrr tjrrr". Through inviting bird watchers to share their honeyguide sightings, the *Honeyguiding.me* citizen science project will be able to map the extent of the guiding behaviour across Africa, and track it over time. The site is available in English, French and Portuguese.

Wealth, Water and Wildlife – new study finds more biodiversity in richer neighbourhoods, especially in dry regions

An Egyptian goose – a species that likely benefits from irrigated lawns in urban areas.

A unique global study has found that wealthier neighbourhoods in cities have more biodiversity in comparison to poorer ones – a pattern that scientists have called the 'Luxury Effect'. However, this study found that this 'effect' is far greater in the more arid regions of the world. This new study involved what is called a meta-analysis, whereby all of the previous individual studies exploring this pattern are combined, to test whether the Luxury Effect is consistently seen around the globe. This approach also allowed the researchers to explore other factors that influence these patterns.

The study was conducted by an international team of scientists from the University of Turin, Italy, UCT and WITS in South Africa and the Centre for Ecological Research, Hungary. Their findings were published recently in the international journal *Global Ecology & Biogeography.* The researchers used 96 different studies conducted in cities from around the world. They found that biodiversity, including plants, birds, reptiles and insects, increased in wealthier areas of a city. However, this increase was far greater in the drier regions of the world, all but disappearing in cities that experience high rainfall.
This finding suggests that the Luxury Effect is likely driven by water availability. Richer people living in dry regions may invest more in water features, such as ponds or swimming pools, or in irrigation of their gardens and parks. Alternatively, wealthier areas may be associated with wetter areas within these arid landscapes, with higher property prices associated with lakes, rivers or other wetland features. Surprisingly, the study found that the overall wealth of a country did not influence the likelihood that the Luxury Effect would be present.

Lead author Professor Dan Chamberlain from the University of Turin said: "Our study shows that rich people have greater access to biodiversity in cities, especially in drier parts of the world. This is important, because biodiversity is a key component of the quality of life of city dwellers, but it is clearly not distributed equally across society. Moreover, given that climate change will likely increase aridity in many cities, this inequality will become more pronounced in the future."
Co-author on the study, **Associate Professor Arjun Amar** from UCT said: "Extreme inequality and arid conditions in South Africa make the environmental injustice caused by the Luxury Effect especially acute. Increasing our understanding of how these patterns arise can help in the creation of more equitable cities in the future." The authors said they hope the findings "will facilitate the management of urban areas in a more equitable manner, helping to ensure that the benefits of urban biodiversity are available to both rich and poor alike".

The "firewalkers" of Karoo: dinosaurs and other animals left tracks in a "land of fire"

Several groups of reptiles persisted in Jurassic Africa even as volcanism ruined their habitat

Palaeoenvironmental reconstruction of the Highlands ichnosite at the Pliensbachian–Toarcian boundary.

In southern Africa, dinosaurs and synapsids, a group of animals that includes mammals and their closest fossil relatives, survived in a "land of fire" at the start of an Early Jurassic mass extinction, according to a recent study published in the open-access journal PLOS ONE by **Associate Professor Emese M. Bordy,** a sedimentologist in the Department of Geological Sciences at UCT.

The Karoo Basin of southern Africa is well-known for its massive deposits of igneous rocks left behind by extensive basaltic lava flows during the Early Jurassic. At this time, intense volcanic activity is thought to have had dramatic impacts on the local environment and global atmosphere, coincident with a worldwide mass extinction recorded in the fossil record. The fossils of the Karoo Basin thus have a lot to tell about how ecosystems responded to these environmental stresses.

In this study, the researchers describe and identify footprints preserved in a sandstone layer deposited between lava flows, dated to 183 million years ago. In total, they report five trackways containing a total of 25 footprints, representing three types of animals: 1) potentially small synapsids, a group of animals that includes mammals and their forerunners; 2) large, bipedal, likely carnivorous dinosaurs; and 3) small, quadrupedal, likely

herbivorous dinosaurs represented by a new ichnospecies (trace fossils like footprints receive their own taxonomic designations, known as ichnospecies).

These fossils represent some of the very last animals known to have inhabited the main Karoo Basin before it was overwhelmed by lava. Since the sandstone preserving these footprints was deposited between lava flows, this indicates that a variety of animals survived in the area even after volcanic activity had begun and the region was transformed into a "land of fire." The authors suggest that further research to uncover more fossils and refine the dating of local rock layers has the potential to provide invaluable data on how local ecosystems responded to intense environmental stress at the onset of a global mass extinction.
Bordy adds: "The fossil footprints were discovered within a thick pile of ancient basaltic lava flows that are ~183 million years old. The fossil tracks tell a story from our deep past on how continental ecosystems could co-exist with truly giant volcanic events that can only be studied from the geological record, because they do not have modern equivalents, although they can occur in the future of the Earth."

Marine microfibres: less plastic than predicted

Microfibres are fine strands of thread used to make clothing, carpeting and household items like mops. They are found in the air we breathe, the water we drink, and throughout the world's oceans. Natural, rather than synthetic, microfibres, though, make up the majority of those found in the ocean's surface waters – despite the fact that currently two-thirds of all human-produced fibres are synthetic. Over the course of two years and five expeditions, UCT's **Professor Peter Ryan** and his team gathered 916 seawater samples from oceans around the world. "Some of these were collected as part of the Antarctic Circumnavigation Expedition, which took place from 2016 to 2017. Others were collected by researchers at sites in the Mediterranean, and Indian and Atlantic oceans," explains Ryan, director of the FitzPatrick Institute of African Ornithology based at UCT.

Vonica Perold (right), a doctoral researcher at the UCT FitzPatrick Institute of African Ornithology, and Manuel Taque (left), from the Mozambique Ministry of Sea, Inland Waters and Fisheries, sample seawater onboard the South African ship SA Agulhas II. Photo Peter G. Ryan.

In most cases, the researchers collected a sample of 10 litres of sea water using a metal bucket lowered from the ship's bow during navigation. They then filtered the water in a laboratory and counted and analysed all the fibres. "In general, each 10-litre sample of sea water contained 10-20 fibres, with a maximum of up to 500 fibres counted in a single sample." Only 8% of the fibres in these samples were microplastics. The rest, more than 90%, were plant or animal-based materials, like cotton, wool and other celluloses, such as linen and flax. The painstaking work of identifying thousands of fibres was conducted over the course of a year by Dr Giuseppe Suaria, an ocean scientist based at the Italian Institute of Marine Science and the lead author of the research published today in *Science Advances*. During 2018, the world produced 107 million tonnes of fibre – or the weight of more than 1 million Eiffel Towers. Of this, 62% was synthetic, with the majority produced from polyester plastics. "Our results showed that while it is true that textile fibres are ubiquitous in our oceans, there is a striking shortage of synthetic fibres," says Ryan. What accounts for this mismatch? "It may be that natural fibres are not degrading in the marine environment due to dyes, coatings or chemical additives. Or, it could be that synthetic fabrics shed and release less fibres into the environment (for example, when being laundered) compared to natural fabrics."

The impacts of microfibre ingestion on marine organisms are poorly understood – irrespective of whether they are natural or synthetic in origin. Some lab studies have indicated adverse impacts, but not at the low concentrations currently found in the environment. Plastic pollution is definitely a serious issue. For larger animals, such as the seabirds Ryan studies, microfibres probably pass through the digestive tract quite rapidly, and thus have less of an impact than do larger plastic fragments, which might be retained for months by some birds. "We must also reconsider the impact of natural fibres – as well as synthetic ones – by looking into ways for fabrics to shed less overall, rather than swapping out synthetic for natural fabrics." says Ryan.

When giant mustelids roamed South Africa 5 million years ago

Recent discoveries by scientists at Iziko Museums of South Africa and UCT have shown that 5 million years ago, wolf-size otters and leopard-sized relatives of the living wolverines lived along the West Coast of South Africa.

What South Africa's West Coast might have looked like 5 million years ago. In the foreground, a giant wolverine feeds on a pig while chasing away a primitive hyaena. Image Maggie Newman, Geological Society of South Africa and the University of the Witwatersrand.

In their research, **Dr Alberto Valenciano**, a postdoctoral research fellow at Iziko and UCT, and Dr Romala Govender from Iziko, describe the teeth, forelimb and hindlimb skeletons of these carnivores both of which are mustelids – a family of carnivorous mammals that includes weasels, badgers and ferrets. The fossils, which shed light on the species' nature and relatedness to other mustelids, represent the first new specimens of the family described from Langebaanweg palaeontological site, on South Africa's south-west coast, in more than 40 years.

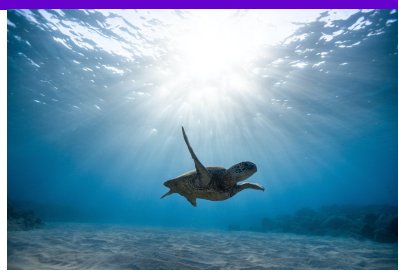
"Our work has led to important new data about the locomotion and diet of the rather poorly known giant otter that is unique to Langebaanweg," says Valenciano. "In addition, we confirm that Langebaanweg's wolverine is a different species to that of the large-bodied *Plesiogulo botori* from Kenya and Ethiopia." The carnivores at the Langebaanweg fossil locality are quite common and they include a minimum of 20 different species of mustelids, bears, seals, jackals, hyenas, saber-tooth cats, giant civets and mongoose. "We report for the first time the presence of both giant mustelids in the main members at Langebaanweg. This conclusion brings to the fore the need for new and detailed studies of Langebaanweg fauna housed at Iziko in the Cenozoic Collections. These studies will not only give us insight into the fauna that lived along the west coast 5Ma but will also allow us to study and understand the faunal change that has occurred over the past 5Ma" commented Dr. Govender.

Epigenetic autism study breaks new ground

After three years of lab work, and a year of banging on school doors to recruiting a cohort and then writing up a paper while home-schooling young children through Covid-19 lockdown, **Dr Colleen O' Ryan** finally published her ground breaking new study on epigenetic autism. When Dr O'Ryan embarked on an ambitious project to research the genes associated with autism spectrum disorder (ASD) in a cohort of South African children, she hardly expected the study to lead her right back to UCT's Chemical Pathology laboratory where her academic career started thirty years ago. "I often tell my students that nothing you learn is ever lost," said O'Ryan, who established and currently heads up the Genetic Autism Cape Town Research group within UCT's Department of Molecular and Cell Biology.

It would be hard to find better testament to this statement than O'Ryan's own full-circle journey to the recent publication of *"DNA methylation associated with mitochondrial dysfunction in a South African Autism Spectrum Disorder cohort"*, a ground-breaking paper appearing in the *Autism Research* journal. O'Ryan explained that what makes their paper unique is the fact that it's the first paper from a South African research group examining a South African group of children using a whole genomic approach, as well as one that used an epigenetic (methylation) approach. "So, what we're basically showing is that in a South African cohort of children, DNA methylation is different between children with and without autism, and that this methylation is associated with mitochondrial dysfunction in ASD." Their findings also open up a range of new study possibilities for up-and-coming researchers to embark on.

Protecting and sharing the Ocean's genome



The vast array of species that inhabit the oceans has already proven to be an important source of innovative resources, including enzymes for COVID-19 testing and a protein valuable in the fight against the Middle East Respiratory Syndrome. **Professor Rachel Wynberg**, a member of the High Level Panel for a Sustainable Ocean Economy, explains how we can better protect and share the benefits from this biodiversity to ensure it continues to be a resource for future generations.

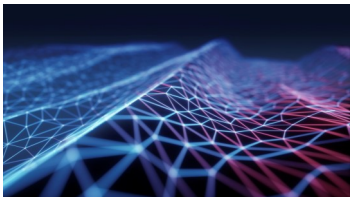
"It is not an understatement to say that the genetic biodiversity we see on land is just a tiny fraction of the biodiversity that is in our oceans," explains Wynberg. "In fact, much of the deep ocean and ocean bed remain unexplored, which is also why researchers frequently find new species on ocean expeditions." According to two recently published papers Wynberg co-authored as part of the High Level Panel for a Sustainable Ocean Economy – a global group of experts and leaders working to protect the ocean – there are thought to be 2.2 million marine species. Only 230 000 of these have so far been confirmed – and that's not counting single-cell organisms, such as viruses and bacteria.

This genetic variety is important for a number of reasons. "Firstly, genetic diversity allows for species to evolve faster and to adapt better to disease or changing conditions," says Wynberg. "When it comes to the ways us humans rely on the oceans, however, genetic biodiversity – what we call the marine genome – provides a treasure trove of helpful products. They are used as food, medicine and much more, and we're only just beginning to understand the extent of these possibilities." For example, in the case of testing for the novel coronavirus, SARS-CoV-2, an enzyme found in bacteria that live near deep-ocean hydrothermal vents is crucial to the polymerase chain reaction that amplifies DNA signals of the virus. And a protein derived from a coral reef red alga has been valuable in the fight against the Middle East Respiratory Syndrome, an illness caused by a coronavirus closely related to SARS-CoV-2.

These kinds of scientific breakthroughs rely on technologies that allow for the rapid genetic sequencing of marine organisms. "In the past decades, it's become possible to store the genetic information of a species' DNA digitally. This information, which for the most part is stored in enormous databases, can then be used to make proteins, recreate molecular processes and even modify organisms." While this can lead to many novel discoveries and useful innovations, Wynberg explains that at present, there is a big discrepancy between research capacity in high-income countries – with the resources to conduct marine genetic research and mine such data – and low- and middle-income countries – where many biodiversity hotspots are located, but which frequently lack the resources to undertake the research themselves or to use the genetic sequence data.

Human activity is the greatest threat to the biodiversity of our oceans. "There is now widespread recognition that overexploitation, habitat destruction, pollution, invasive species, and increasingly, the degradation of marine ecosystems are the central threats eroding the ocean genome. One of the most important measures to safeguard ocean biodiversity is for world leaders to unite in conserving the oceans in protected areas and beyond." explains Wynberg. Large areas that are fully or highly protected as well as networks of marine protected areas can encompass multiple sites of importance for the lifecycles of marine species. When well managed and with adequate protection levels, they can act as storehouses of genetic diversity that also serve as important reference points for understanding changes to the ocean. Such measures need to respect the rights of local fishing communities and place emphasis on avoiding the damaging impacts of activities such as mining, which ic increasingly prevalent along the South African coastline and elsewhere. Other measures described by the High Level Panel include ecosystem-based approaches to fisheries management, spatial planning, effective quotas and reducing run-off pollution into the ocean. Beyond protecting the ocean genome itself, how can we also ensure that the benefits derived from it are shared equitably? Wynberg says there are a few ways to do this. "Overall, we need to ensure that there is greater equity in genomics research and commercialisation." This can be achieved through ensuring that marine biodiscovery collaborations are based on equitable research partnerships, including researchers from low- and middle-income countries, with attention given to capacity building, appropriate technology transfer and the fair distribution of research funding.

Creative collaboration between Centre in ICT4D and d-school inspires students to respond to Covid-19 pandemic with innovative solutions to mask wearing challenges



A collaboration between the UCT Centre for ICT4D in the Faculty of Science and the d-school resulted in creative and critical project approach to addressing the current COVID-19 crisis and coming up with creative solutions for mask-wearing challenges. Not only was this a particularly relevant project, but it was an example of **just how successfully emergency remote teaching and learning can take place**. This inter-disciplinary collaboration involved ten Honours, Masters and PhD students in Computer Science and Information Systems who were thrown together in the deep end of on-line learning. The project took on a life of its own and morphed into something different from what the co-ordinators **Melissa Densmore** and **Hafeni Mthoko,** who co-teach the Introduction to ICTs for Development course, had initially intended it to be. This year, for the fieldwork component the course conveners decided to use a hands-on real-life project on masks for COVID-19, for which they also included a Design Thinking component led by Nailah Conrad from the School of Design Thinking.

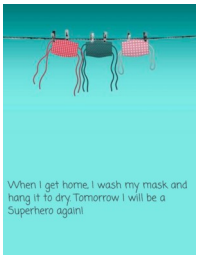
The project scope

Initially it was thought that the project would be about mask production and dissemination – where to get hold of masks, etc. However, after having scoped the problem, the students realised that the far greater issue was information about correct usage and wearing of masks. The student's research revealed that many people did not understand how to wear a mask properly and were not understanding Covid-19. While many people were wearing masks, they were wearing the same mask day in and day out, they were not wearing it properly and were not washing it. After the first round of interviews, the data showed that the interviewees were more concerned about what types of mask was safe to wear and were confused about the mixed opinions on using medical masks, cloth masks, 2 or 3-layer masks, etc. In interviews with teachers, the students learned how teachers and parents were struggling to get children to wear their masks in the correct manner. As noted by Rebecca Njuguna, "our team concluded that the biggest problem we observed across the diverse pool of interviewees was the need for reliable information about masks, not necessarily a need for the masks themselves". This necessitated reframing the challenge and addressing the problems highlighted by their interviews.

Despite the challenges of having to work remotely, the one group came up with an innovative children's storybook about mask wearing (which is in English, isiXhosa, Tshivenda, and Afrikaans – with Swahili and isiZulu translations in process) and a follow up quiz for Heroes to assess knowledge of mask wearing . The other group developed a concept for a unified platform for government communications about Covid-19.

Outcomes

This project revealed a team of students who are passionate about developing their communities and coming up with strategies to address the issues those communities face, by utilising Information and Communication technology strategies. One of the outcomes of the course is that it generated a high degree of social awareness and produced a decolonised curriculum, while producing something that could potentially have significant impact. Furthermore, the presenters were encouraged about the inter disciplinary nature of the project and hope that this will encourage future interdisciplinarity and publicise the course, which is open to all majors. Wallace Chigona, Director of the Centre in ICT4D, commented, "What stood out was the inter-disciplinary nature of the project which brought together students from different faculties and study levels, where they worked on practical issues in a hands-on manner which involved real people and real issues. This was not just a theoretical project but was about students engaging with communities".



Antarctic ice-shelf puzzle by Katherine Hutchinson

Journeying to one of the most remote parts of the planet to gather valuable ocean data.

Ice shelves, massive floating bodies of ice, are well-known for their buffering effect on land-based ice sheets as they slow their flow towards the sea. This buffering effect plays an important role in moderating global sea level rise.

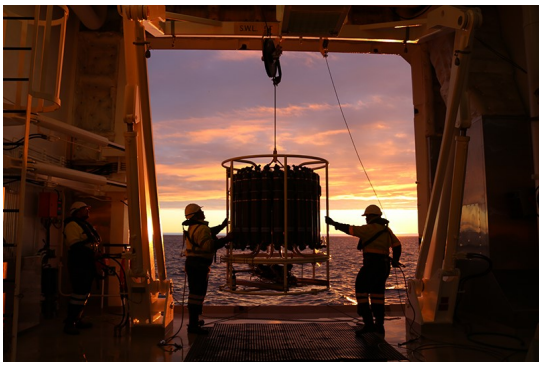
The Antarctic Peninsula has been experiencing high levels of change during the last 30 years due to atmospheric and ocean warming. Larsen A Ice Shelf collapsed in 1995 and Larsen B broke up in 2002. The demise of its neighbours has raised questions regarding the future stability of Larsen C, Antarctica's 4th largest ice shelf. The enhanced melting of ice shelves is concerning as this leads to the thinning and acceleration of their tributary glaciers which means more fresh water is injected into the surrounding ocean. The consequence of this is a rise in sea level and a change in ocean properties. Both having potentially disastrous repercussions on human populations and natural systems.

During the last 30 years Larsen C has exhibited considerable variability in ice thickness and extent. Yet the role of the ocean in driving these changes remains unclear. To understand what processes were underway I embarked on the Weddell Sea Expedition to one of the most remote areas of our planet, the Antarctic Weddell Sea. My team and I focused our oceanographic measurements in the area of exposed ocean lying between Larsen C and the recently calved massive iceberg A-68. We wanted to measure the properties of the ocean adjacent to Larsen C Ice Shelf to find out what processes are at play. The aim was to improve our understanding of how the ocean could impact the stability of the ice shelf. This region is crucial in setting the properties of Antarctic Bottom Water.

Antarctic Bottom Water constitutes the deep limb of the global ocean conveyor belt which controls global climate. We were able to identify that a foreign water mass was flushing onto the continental shelf adjacent to Larsen C, bringing heat to the area. Our data revealed a high level of mixing between this warm water and the local very cold waters. This could have implications for the melting of the ice shelf and a change in properties the parent waters of Antarctic Bottom Water.

Breaking new ground

The measurements we took in the Weddell Sea adjacent to Larsen C Ice Shelf represent the highest spatial resolution sampling in this area to date. They provided us with a clear view of the underwater conditions in an area where we have very little data. The mighty *SA Agulhas II*, a powerful ice-class ship, enabled us to gather high resolution data during the the Weddell Sea Expedition. The results revealed that the heat brought into the area is redistributed via effective mixing with local shelf waters. This showed that there is potential for transformation of the source waters of Antarctic Bottom Water. We also identified the possibility for a flow of the continental shelf waters into the ice shelf cavity underneath Larsen C, raising questions about future ice shelf melting and thinning.



Scientific equipment being deployed in the Weddell Sea by the light of the Antarctic midnight sun.

Where to from here?

The measurements we took in the Weddell Sea are extraordinarily valuable and provide great insight into a remote and data-sparse part of our ocean. But scientists need to go beyond observations. We need to make use of innovative tools such as numerical climate models to further understand ocean-ice shelf interactions and the feedback effects on the global ocean.

COVID-19 and Science

Harnessing plant power to curb COVID-19

Here's a different reason for tobacco to be in the news: Cape Bio Pharms, a biotech company with its origins in the Biopharming Research Unit (BRU) at UCT, has joined the global effort to create a fast and affordable antibody test for COVID-19, using a distant relative of the tobacco plant. The team of scientists who works at the lab is using *Nicotiana benthamiana*, a relative of the tobacco plant, as a bioreactor to produce COVID-19 antibodies. They are working towards developing a serology test, which detects antibodies in a patient's blood and can be used to see if they have been exposed or previously infected. "This is unlike most diagnostic COVID-19 tests, which look for genetic material [from the virus] to see if someone is currently infectious," says Cape Bio Pharms Co-Founder Tamlyn Shaw.

Dr Inga Hitzeroth, a biochemist based at UCT's BRU, explains that they have been using *Nicotiana benthamiana* for over 20 years because of the plant's strength, ability to grow quickly and weakened immune system. She and her colleagues – as well as others around the world who work with *N. benthamiana* – essentially harness the plants immune system as a factory to produce antibodies that can later be extracted and used in vaccines. They do this by 'infecting' the plants with a foreign substance that induces them to produce antibodies to fight the 'infection'. "When the plants are about six weeks old, we infiltrate them with antigens – substances that provoke an immune response. The plants then start producing proteins to fight this 'infection'," she explains.

Professor Ed Rybicki, virologist and director of the BRU, explains that what makes plant-produced antibodies particularly useful is the speed with which they can be harnessed: from seed to extraction can take weeks. By comparison, when using mammals like rabbits or sheep in the same way, the process can take months to half a year, he says. Rybicki also notes that each batch of plant-based reagents is derived from the same genetic construct, standardising the results – another advantage that doesn't apply to animal-made antibodies.

Harvesting antibodies from plants

In the case of COVID-19, the team at Cape Bio Pharms first sourced the gene sequences for the virus SARS-CoV-2 under the banner of the global partnership Plants Against Corona, which consists of commercial research labs and academic partners around the globe. The team then developed antigen constructs that they used to infiltrate the plants and turn into highly effective bioreactors whose immune systems churn out antibodies against the virus. These antigen constructs are an essential component of global efforts to create both diagnostic tests and a vaccine for COVID-19. The antigens created by Cape Bio Pharms have been shared with the Plants Against Corona network to be used by researchers around the world. "We have already sent samples of our antigens to local test-kit manufacturers who are validating our proteins externally. These proteins have passed our own internal validations and tests, and one of the test-kit manufacturers has confirmed our protein has been clearly recognised by antibodies against the virus," says Shaw.

Local solution to a global need

According to Shaw, the ability for South African scientists to have access safe, reliable and reproducible reagents in South Africa also strengthens their position in global biotech innovation. "At the moment, our scientists rely on the imports of these products, which costs a lot of time and money. The easier it is for them to secure a sustainable supply of stable and reproducible proteins, the more medical innovations we'll be seeing coming from our shores." While time is of the essence in the current COVID-19 crisis, the team also take a long-term view of the role of plant-powered antibodies in biotech research. **Dr Ann Meyers,** another BRU researcher, explains that the techniques being harnessed against COVID-19 also have applications far beyond this virus and the generation of medically useful comounds. "At the BRU, we work on creating antigens and vaccines for a wide range of diseases that affect both humans and animals. These include everything from HIV-1 and HPV to other diseases like the Rift Valley virus and bluetongue virus, which infects sheep. By creating affordable diagnostic tests, we can help local researchers to better understand the incidence of these diseases in Africa. The BRU is also an essential incubator for highly-trained researchers who understand this work and who go on to create important research networks across the continent."

Coronavirus at UCT – twice in one career

by Professor Justin O'Riain

In December 2002, a virulent enteric coronavirus struck UCT's captive naked mole-population (pictured right) that was housed in the John Day building on Upper Campus. The virus ravaged what was then the world's largest captive population of arguably the world's most fascinating mammal. The founder of (Prof Jenny Jarvis), and heir to (Prof Justin O'Riain), this biological treasure trove watched helplessly as the virus spread like wildlife, wiping out decades of work in research and husbandry in a few months. We did salvage some data from this disaster says O'Riain, with a research paper showing that being old, male and inbred significantly increased the probability of mortality. Some 18 years later and coronavirus was back on campus but this time as the COVID-19 human pandemic, with gender and age again once again amongst the predictors of increased vulnerability.

Lockdowns have resulted in what scientists are referring to as the "Anthropoause" in which human impacts on the world have been temporarily curtailed. Initially lockdowns were thought have provided many wild animals with a welcome reprieve from the hustle and bustle of human activities. Collisions with vehicles on land, in the sea and in the air account for an extraordinary number of animal deaths annually and reduced traffic across all mediums is certain to have had an immediate positive impact on wildlife. Additionally, reduced presence of people in streets and open spaces in urban areas was reported to coincide with more animals being detected deeper in urban areas than normal. In Japan deer were roaming the empty streets of major cities and monkeys in parts of India were pushing deeper into urban areas in search of food that is normally easily obtainable from street vendors that have had to stay at home. Of course, these observations come with bias in observer effort with more people at home for prolonged periods being more likely to notice normally elusive animals in their neighbourhood. In time those researchers who had sampling devices like camera traps in place before and during the lockdowns will perhaps reveal just how much animals adjusted their activities in the Anthropause.

Of direct concern to wildlife biologists was that COVID-19 has proven transmissible to other wildlife, with early reports of a tiger and lion testing positive at the Bronx Zoo in New York and displaying surprisingly similar symptoms to humans (coughing and listlessness). The risk of cross transmission to the great apes put them on tourist lockdown and concerns are rising over the financial viability of their ongoing protection in the absence of tourism revenue. More locally there is concern for primates that frequent urban areas including vervet monkeys in KZN and baboons in the Western Cape. Monkeys have been shown to have receptors for COVID19 and to experience illnesses such as pneumonia once infected. Conservation authorities are on alert for possible signs of cross-transmission to either primate.

While the full extent of these negative impacts will only emerge in time the pandemic has undoubtedly driven a global reflection on our relationship with wildlife and how we trade animals and their parts for consumption. Markets with live animals are the melting pots for people and wildlife where pathogens can mix, mutate and evolve the ability to infect both humans and animals. The unregulated harvesting, transporting and sale of wildlife in live markets has always posed enormous welfare and conservation concerns. Now that it has been confirmed in the minds of most that it carries a serious human health risk, the brakes are finally being applied to runaway illegal trade train.

Arguably the biggest potential negative impact of the current pandemic is the drying up of revenue for protected areas across much of Africa. Reduced protection and increasing poverty of communities neighbouring protected areas makes bushmeat harvesting for both subsistence and for sale a real threat that is predicted to escalate. The pangolin might have been removed from the medicinal cabinet of many Asian countries, but it and many other wildlife remain on the menu as a critical source of protein for communities who may be experiencing heightened levels of food insecurity linked to COVID-19.

In Memoriam:

We are deeply saddened by the death of **Emeritus Professor Ken MacGregor**, who passed away from COVID-19 on 17 June 2020. Ken joined the University of Cape Town (UCT) in 1974 and was head of the Department of Computer Science for more than 30 of his 38 years of service to our university. He built up the department from its inception to the world-class department it is today.

Passionate and committed to computing, to his staff and to his students, he was one of UCT's best-known professors, whose sense of humour, larger than life personality and Scottish accent were as legendary as his sense of fairness and his integrity. His knowledge of UCT and its people, his strategic thinking and innovative nature were at the heart of the department's success over the years. Under his guidance the department grew in size and stature – its degrees became internationally accredited; an industrial advisory board was established; and his students left their mark on research and industry, both locally and abroad.

His contribution to the South African computer science academic community was recognised by the South African Institute of Computer Scientists and Information Technologists (SAICSIT) with a special Pioneer Award in 2011. Ken was one of the founding members of SAICSIT and also a long-time member of the International Federation of Information Processing's WG2.4 on Systems Implementation Technology, where his refreshing presentations and discussions were remembered by all. Ken published numerous conference and journal papers, predominantly in the field of distributed computing. His computer science interests and expertise extended well beyond this, and his considerable contribution to postgraduate supervision spans an impressive range of subjects and students, such as Mark Shuttleworth and many other noteworthy achievers. Ken was instrumental in forging successful careers for hundreds of students, and he remained in touch with many long after their graduation.

Ken was innovative not only as an educator and researcher; he was also a pioneer in the computer industry and always keen to work with emerging IT companies. After retirement he continued to run his own computer company and collaborate in local and international research. A prominent figure in the Cape Town Computer Society, he was known for many years as Mr Unix and as an evangelical supporter of free and open-source software. Thanks to his outgoing, friendly, highly entertaining and often irreverent sense of fun, he was extremely well known not only within but also far beyond university circles.

Ken was a keen golfer in his later years and a keen soccer player in his earlier days – he earned his colours playing football for UCT. He loved the outdoors and travel. He continued to pursue these interests after retiring from UCT and had recently returned from trips to St Petersburg, the Galapagos Islands and Paris. Ken was a loving and devoted father and grandfather to his daughter, Linda, and her children, and a loving and devoted partner to Joan Rapp, Emeritus Director of UCT Libraries. A kind, supportive and vibrant man, father, partner, colleague and professor, he leaves a huge gap in the lives of so many whose careers and friendships he blessed, and he will be sorely missed.

LAST LAUGH….