

Science Matters

Science Faculty Newsletter



Message from the Deam



Around this time last year, we thought we were dealing with a temporal disruption of our lives and the way we work. We also considered the transition to emergency remote teaching as a short-term intervention. More than a year on now, the transition looks like the beginning of a new world in which we must reimagine a new academic environment. Many public and private institutions have embraced the reality of an emerging new world, which forces us to ask and engage with many questions. What does this reality mean for the Faculty of Science at UCT? What is the future of Science? How does Science contribute to shaping the new world? How should we teach Science under evolving and uncertain conditions?

We are also being challenged to continuously reflect on our relationship

with the biophysical environment and other life forms. This challenge was brought home by the fires that gutted some buildings at UCT on the 18th of April this year. We suffered immeasurable losses, and our colleagues and students in the Biological Sciences are in the process of rebuilding their research and teaching spaces that were destroyed by the fires. We asked ourselves many questions: should we have understood the relationship between fires and plants on campus better? Did we perhaps pay less attention to the impact of fires on societies? How should we organize societies to be protected from fires and other natural hazards? Emeritus Professor William Bond (featured in this issue) provides insight into open ecosystems and the forces that shape global vegetation, including wildfire. Speaking to UCT News, he reminded us that many forms of life require wildfires to complete their life cycles.

The Oscar award-winning documentary, my *Octopus Teacher* (featured in this issue), reminds us of the wonder of nature and the many lessons we should continue to learn but also new relationships we should forge with

other beings. It demonstrates the importance of interdisciplinarity in the production of knowledge and science communication.

The two inaugural lectures we had in the first semester took us on a journey of discovery into the oceans and on land. Professors Isabelle Ansonge and Muthama Muasya showed us how their experiences from a young age influenced their research interest; an indication of how lived experiences play a critical role in the development of scientific inquiry. This observation challenges us to harness the experiences of our students in our teaching and supervision.

Enjoy reading this issue!

Best Wishes

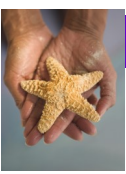
Maano Ramutsindela

UCT ranks among best 100 institutions globally for six subjects

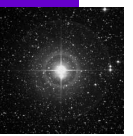
The University of Cape Town (UCT) is among the best 100 institutions in the world for six subjects, according to the Quacquarelli Symonds (QS) World University Rankings by Subject 2021.

To produce its rankings, QS combines information from four sources: two global surveys of academics and employers to assess international reputation, and two indicators (research citations per paper and h-index in the relevant subject) to assess research impact. These are weighted differently depending on the discipline.

This year, QS analysed information for 1 453 institutions across 51 subjects. UCT was ranked in 36 of the 51 subjects assessed by QS. Five were placed in the 51–100 band and two were from the Science Faculty, namely Archaeology and Geography



Our Science Stars:



Professor William Bond elected as Fellow of the Royal Society

Emeritus Professor **William Bond**, from UCT's Department of Biological Sciences, has been elected as a Fellow of the Royal Society, the world's oldest scientific academy. Bond is the seventh South African to be accorded the honour and will join the ranks of other icons of science, including Charles Darwin, Isaac Newton and Stephen Hawking, when he is inducted as a Fellow later this year. Bond is recognised as a global authority on open ecosystems and his research into the forces that shape global vegetation, including wildfire, CO2 levels and herbivores, is credited with transforming our understanding of how these systems emerged. In 2013 he was admitted as a foreign associate of the United States' National Academy of Sciences and in 2020 was once again included in the Highly Cited Researcher list, which recognises the contribution of scientists who demonstrate significant and broad influence through the publication of multiple papers frequently cited by their peers over the course of a decade.



The first time Bond travelled to give a speech at the Royal Society he was in awe of the beautiful building and august history of the society, including the book which holds the signatures of all Fellows, including the likes of Isaac Newton and Charles Darwin. "Charles Darwin has always been a hero of mine because he is such a wonderful guide to travelling the world as a biologist and such an astute observer of human society," Bond says. Bond says at this moment in time when misinformation is a real danger and the biomes that he has spent his career studying are under serious threat, it is a great honour to be recognised by an institution such as the Royal Society which promotes the role of science. "Science has given us a way to test new human ideas and that is something to be treasured. Reason has been such a powerful tool for us humans, but logic alone is not the answer. In fact, science requires the imagination to make connections that lead to new discoveries and this creativity comes from all sorts of sources, including art, music, myth and poetry. I think that's where South Africa and Africa has much to offer: our perspective is unique and valuable; it leads to new ways of seeing," Bond says.

Speaking at the announcement of the 2021 cohort of 52 fellows chosen from over 700 applicants, Sir Adrian Smith, President of the Royal Society, says the global COVID-19 pandemic has demonstrated the importance of scientific thinking and collaboration across borders. "Each Fellow and Foreign Member brings their area of scientific expertise to the Royal Society and when combined, this expertise supports the use of science for the benefit of humanity."

Assoc Prof Moodley to join ICA #4 on Intelligence and Artificial Intelligence

The Intercontinental Academia (ICA) has chosen **Associate Professor Deshen Moodley** from the Department of Computer Science at UCT, (pictured right) as a fellow for the 4th edition of ICA. The ICA creates a global network of future research leaders in which some of the very best young academics work together on paradigm-shifting, cross-disciplinary research, mentored by eminent researchers from across the globe, including Nobel prize winners Robert Aumann and Ada Yonath. Moodley, a member of the recently established AI Research Unit, an accredited research unit in the Department of Computer Science in the Faculty of Science, is one of just nineteen fellows selected globally to participate in the 4th ICA on Intelligence and Artificial Intelligence. The 4th ICA will start with a virtual opening meeting in June 2021, followed by two main sessions in Paris, France in October 2021, and in Belo Horizonte, Brazil in June 2022.



Moodley's research focuses on the development of Adaptive and Cognitive Systems. His current interest is on general mechanisms for model learning, model update, knowledge discovery and belief revision. His research has a strong applied focus, and he is investigating novel ways to engineer adaptive "thinking" systems for data fusion, situation analysis and prediction and knowledge discovery in diverse application domains, including health, biodiversity, finance, and earth observation. The AI Research Unit (AIRU) hosts two research groups and the Directorate of South Africa's national Centre for AI research (CAIR). CAIR is a distributed South African research network with nine established and two emerging research groups across eight universities funded primarily by the Department of Science and Innovation (DSI).

Forbes Africa The List: Women in Science

Associate Professor Sheetal Silal from the Department of Statistical Sciences, UCT; and Director of the Modelling and Simulation Hub, Africa, who is also an Honorary Visiting Research Fellow: Oxford University in the United Kingdom, was recently named as one of Forbes Africa's notable Women in Science, in recognition for her work as part of the South African Covid-19 modeling consortium and of the team that has created a dashboard to map the underlying risks associated with the pandemic. This allows for alerting the public of infection levels and provides an analysis of second waves at a district and provincial level.



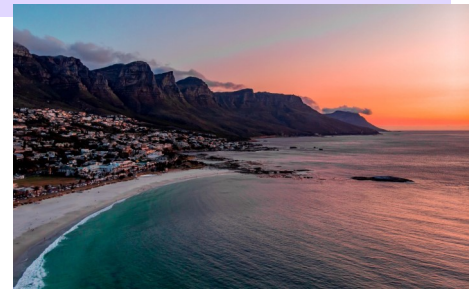
Mathematicians and data scientists have been at the heart of the response to the Covid-19 pandemic as they have assisted with understanding underlying trends, mapping possible risk factors, and determining the possible rate of virus spread. "I have always had a passion for helping people and the African continent has always been plagued by endemic, highly contagious diseases; being in the field that I am has allowed me to study this closely and contribute [in whatever way] I can to combat these diseases," she says. She believes that to attract more women to the sciences, they need to be encouraged to explore it at a primary level and programs need to be created for more awareness on the options available to them. The motto that she swears by? "It's impossible until it's done!"

Finalist in NSTF Awards

The 'Science Oscars': The NSTF-South32 Awards are referred to as the 'Science Oscars' of South Africa. They are the largest, most comprehensive, and most sought-after national awards of their kind in the country. **Associate Professor Sheetal Silal** has been nominated for the TW Kambule-NSTF Award: Emerging Researcher award. The Awards gala will take place on 29th July. We wish her well...

UCT part of UN endorsed international network to boost sustainable ocean cities

The Ocean Cities (OC-NET) Programme, in which the University of Cape Town's Marine and Antarctic Research Centre for Innovation and Sustainability (MARIS) participates, has received endorsement as an official United Nations (UN) Decade of Ocean Science for Sustainable Development programme under the first 'Decade call for Action'. The UN Ocean Decade harnesses, stimulates and coordinates interdisciplinary research efforts at all levels, in order to generate and use knowledge for the transformational action needed to achieve a healthy, safe, and resilient ocean for sustainable development by 2030 and beyond.



The ultimate goal of OC-NET is to turn ocean cities into communities permeable to the marine environment, regenerating the coastline as much as possible and enhancing a harmonic community-land-ocean connection through mind (science), heart (art) and soul (awareness). It will be carried out with and for the people, promoting bottom-up collaboration of all actors and endorsing policy dialogue towards effective evidence-based policies that set the city border well beyond the shoreline. As an inter- and transdisciplinary research centre at UCT, MARIS as the South African OC-Net partner, will be responsible for building and co-ordinating a local network of investors, sponsors, supporters and/or allies who will design and implement projects that speak to the over-arching goals of the programme.



Speaking on the significance of the endorsement **Dr Louise Gammage**, (pictured left) MARIS Ocean Cities co-ordinator shared: "This programme presents the opportunity to draw on our vast experience with real-world challenges facing Cape Town and other South African coastal cities. Specifically, it provides a platform to actively pursue a truly transdisciplinary approach to promote the implementation of the SDGs in our ocean cities."

Prestigious award proves UCT's Rosalie Tostevin rocks

Dr Rosalie Tostevin has been recognised by international peer reviewers for her potential as a leader in her field. Dr Tostevin, who heads up the Ancient Life and Environments (ALE) Lab in the Department of Geological Sciences, is the latest UCT researcher to be awarded a prestigious P-rating from the National Research Foundation (NRF), proving that this geologist does indeed rock!



The geology lecturer described her research as the study of interactions between life and the environment in “deep time”, meaning millions to billions of years ago. Because the earth was so different then, Tostevin likened it to “studying an alien planet”. Her research entails reconstructing conditions from the physical and chemical traces left behind in the rocks and involves “careful detective work”. Understanding even the basic aspects of the environment, such as temperature or oxygen levels, can be a challenge.



Climate Change researcher selected for global STEMM leadership initiative

Associate Professor Gina Ziervogel, a geographer and climate change adaptation expert based in the Department of Environmental & Geographical Science at UCT, has been selected to join Homeward Bound, an international leadership programme that encourages women working in STEMM (science, technology, engineering, mathematics and medicine) to take up leadership positions. According to the World Economic Forum, only 30% of global researchers in STEMM are women. Overall, women also still hold far fewer leadership positions, both in science and technology, than their male counterparts. In the United States women currently make up 48% of the workforce but hold less than 18% of leadership roles at top tech companies. In South Africa, according to Stats SA, women make up 23% of the STEM workforce. Homeward Bound, an international initiative started in 2016 by Australian entrepreneur, Fabian Dattner, aims to change that. Each year 100 women from all over the world are selected to join the 12-month leadership programme, culminating in a voyage to Antarctica.

Ziervogel, who will be one of 25 nationalities joining this year's programme, has a particular interest in water and governance. During Cape Town's recent drought she was appointed to a water advisory committee for the municipality governing the city. “During Cape Town's recent drought I was excited to bring my years of experience in climate adaptation research to bear in my own city, contributing to looking at what actions we can take to reduce vulnerability to climate change,” she says. “Now I am looking forward to joining a programme which is centred around both personal development - encouraging women in STEMM to seek leadership positions - as well as a core understanding of the pressing need for scientists to collaborate to create a more resilient future in the face of climate change.”

UCT drug discovery trailblazer among Juneteenth biotech leaders

Professor Kelly Chibale, the founder and director of the University of Cape Town's (UCT) [Drug Discovery and Development Centre \(H3D\)](#), has been named among 22 rising black biotech leaders in the [Timmerman Report](#), published in the United States (US). Professor Chibale is the only Africa-based scientist included in the group. The list was published to honour innovative black biotech leaders who are changemakers in their fields. Its publication marked Juneteenth (sometimes called Black Independence Day) on 19 June, a US federal holiday commemorating the emancipation of African-American slaves in 1863.



Chibale, said he was honoured by the latest acknowledgement. “As a hardcore natural scientist and entrepreneur, I believe in the power of science to transform lives and create jobs,” he said. “Encouraging, supporting and incentivising scientific entrepreneurship will help move the continent of Africa forward.” “I believe in the power of science to transform lives and create jobs.” The listing also affirms Chibale's vision to seed an innovative pharmaceutical research and development (R&D) industry in Africa. “I am relentless when it comes to pursuing this vision. For our work and lab, it shows [that] what we do collectively is world-class.” Chibale said he hopes it will inspire and encourage other black researchers to use the disadvantage they feel and/or experience on the basis of their race as an advantage. Despite the “real boundaries” to black scientists, one has to make a personal choice, he said.

STUDENT IN THE NEWS:

Student's start-up prioritises sneakers, soap and art

Mathematics Honour's student **Anele Siyotula** is a maths whizz and creative genius, and he draws on these and other skills for his start-up, 1Stop Tekkie Wash. His love for colour means that he breathes life into students' old sneakers with art; and because he's a numbers man, no one crooks his books. Siyotula established 1Stop Tekkie Wash in 2018 from his residence room at Leo Marquard Hall. Back then, he provided only a single service – sneaker cleaning – and the business was thriving. UCT students supported his venture, and the entrepreneurial bug bit him hard. "No one likes a pair of dirty takkies. Many fellow UCT students were supporting us, and we were doing so well. I was on top of the world, and told myself many times that this is for me," he said. Instead of becoming complacent, Siyotula said, he realised that sneaker cleaning on its own would not always be enough to sustain the business. He began to look for inspiration on how best to grow his brain-child, and he found it.



While channel hopping in front of the TV one afternoon, knee-deep in his undergraduate course material, Anele watched a show featuring a Johannesburg sneaker artist. The programme explored the artist's business model and her journey to date. Siyotula was inspired. He had the clientele and the tools, and he remembers thinking that sneaker art would be a welcome addition to his business model. He was sure his clients would love it. "It sparked something in me. I thought about it, and did some research. As far as I knew, the concept wasn't offered in Cape Town, and I jumped at the opportunity to add it to my service," he said. Two years down the line, and 1Stop Tekkie Wash has successfully retained the sneaker art concept. Today, the business operates from premises in Mowbray. "We try to make it as simple as possible for clients, and everyone likes the collect and deliver option. It just means that you don't have to worry about dropping the sneakers yourself. We already have so much to worry about, don't we!" said Siyotula.

Siyotula said the COVID-19 pandemic reinforced his business philosophy – don't put all your eggs in one basket. It challenged him to think outside the box to keep his business afloat; and part of changing things up included bringing Onke Yeye, his business partner, on board. "I'd like to think that we've always tried to improve our business; sneaker art is one such example. Suddenly, when COVID-19 hit, we needed to do that more than ever to survive," he said. Even marketing was tough. Before the pandemic, Siyotula and the team would take to the streets of Mowbray and Rondebosch to speak to students. They would ask about their likes and dislikes, get a sense of what was trending, and explore ways of incorporating those trends into their business model. But when the university closed its physical campuses in March 2020, and students returned home, that exercise was dead in the water.

In response, the team focused their attention on online marketing. Updating their social media channels was their primary goal, and Siyotula said this presented a means to connect with new and existing clients. The business made giant strides in 2020, adding clothing dyeing to its service offering. "That's what makes us unique. We're constantly looking for ways to innovate and shake up our business. We're also not afraid to try. Young aspiring entrepreneurs out there, don't be afraid to try," he said.



STAFF NEWS

WELCOME TO NEW STAFF

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

Archaeology

- Dr Yonatan Sahle Chemere — Senior Lecturer

Astronomy

- Ms Kechil Kirkham—Operations Manager IDIA
- Mr Jeremy Ernst Jean Paul Avenant—Chief ICT Specialist for IDIA
- Mr Michael Currin—Chief ICT Specialist for IDIA

Biological Sciences:

- Dr Emma Roche— Assistant Lecturer
- Dr Jasper Slingsby—Senior Lecturer

Computer Science

- Mr Lebeko Poulo - Senior Scientific Officer

H3D Drug Discovery & Development

- Dr Carel Oosthuizen—Investigator
- Mrs Deidre van Rooyen—Junior Operations Manager

Mathematics & Applied Mathematics

- Mr Tremaine Robertson – Assistant Lecturer
- Mr Mashudu Mokhithi—Assistant Lecturer
- Mrs Melissa Largier—Admin Assistant

Molecular & Cell Biology: Biopharming Research Unit

- Dr Chanel Avenant—Research Officer
- Mrs Karen van der Merwe—Research Admin Assistant

Oceanography

- Dr Moagabo Ragoasha—Lecturer

Statistical Sciences

- Dr Innocent Karangwa—Research Officer
- Dr Wessel Oosthuizen—Junior Research Fellow/ Assistant Lecturer

Science Faculty Office

- Ms Fairoza Parker-Dawood—HR

FAREWELL TO STAFF

The Faculty said goodbye to the following staff:

Biological Sciences

- Dr Heather Marco

Chemistry

- Ms Adelaide Khoape
- Mr Molefe Makuebu
- Dr Takalani Theka

Environmental & Geographical Science—CSAG

- Mrs Natalie Johnson

H3D Drug Discovery & Development

- Dr Diego Gonzales-Cabrera
- Dr Hemachandra Nishanth Kandepedu
- Dr Claire Le Manach
- Dr Kawaljit Singh

Mathematics & Applied Mathematics

- Dr Claire Blackman
- Mrs Gisela McBride

Statistical Sciences

- Ms Anneli Hardy

Faculty Office

- Ms Shahieda Samsodien



NEW IN THE FACULTY

Archaeology: 1st Science Department with black staff majority

The University of Cape Town's (UCT) Department of Archaeology has marked a major milestone by becoming the first department in the Faculty of Science with a black staff majority. This follows the appointments of alumni **Dr Vuyiswa Lupuwana** and **Dr Yonatan Sahle**. Dr Lupuwana and Dr Sahle, an Ethiopian national, are also new members of the Human Evolution Research Institute (HERI). The faculty's deputy dean for transformation, **Professor Rebecca Ackermann**, a member of the Department of Archaeology and the deputy director of HERI, added, "This achievement is especially notable in a discipline that researches the deep past and heritage of Africa, yet has been dominated historically by white, mostly male, academics." **Dr Deano Stynder**, the new interim head of the Department of Archaeology and also a black staff member, endorsed the importance of diversity to innovation – the lifeblood of universities and research. "Archaeology is a notoriously untransformed field and over the years this has stymied progress. With the appointment of these two outstanding young academics, we have not only managed to consolidate our position as one of the leading archaeology departments on the continent, but also to strengthen the field in general."



Following the appointments of Dr Vuyiswa Lupuwana (left) and Dr Yonatan Sahle, the Department of Archaeology has become the first majority black department in the Faculty of Science at UCT.



Vuyiswa Lupuwana : I am a historical archaeologist. Broadly speaking, this means that I focus on the archaeology of the last 500 years. I am interested in how indigenous communities in southern Africa experienced and negotiated the processes of contact, interaction and colonisation. My research has largely been based in the Northern Cape, a region of South Africa [where the] frontier interactions provide fertile ground to explore issues of interaction, and the change and continuity of belief, cosmologies and society. Consequently, I've focused primarily on frontier communities such as the Khoekhoe, San, Xhosa and Trekboers [nomadic pastoralists; forerunners of the Voortrekkers].

My work is further situated around the period of industrialisation and the spread of capitalist monopolies in southern Africa. The period of industrialisation is key to understanding contemporary South Africa, in terms of race and identity politics and the construction of our modern society. This kind of research is necessary to the processes of nation building. Historical archaeology is a powerful tool that enables one to interrogate micro-historical processes – and accessing and interrogating these processes offers a platform to address issues around social justice. As an undergrad, I majored in film and media production in addition to archaeology, and I've had a number of opportunities to combine these interests. One of my passions is to make sure that my archaeological research is actively available to the communities I work with and society as a whole, and so I work on documentaries around heritage and identity, as well as projects focused on bringing communities into the heritage storytelling process through digital film-making workshops.

Yonatan Sahle: I am a broadly trained archaeologist with research interests spanning different time periods and topics. My main research, however, revolves around understanding evolutionary contexts across the origin of our species. Specifically, my current research seeks to address the following questions: What role did environmental change have in the development of nuanced technologies and behaviours – and anatomical features recognised as uniquely *Homo sapiens* – across the later Middle Pleistocene? What do the trajectories of such technological, behavioural and anatomical shifts look like locally, sub-regionally and regionally?



I believe that the strength of our answers to these and related questions lies in our ability to closely study sites that sample the critical period dating to 500 000 to 300 000 years ago. Such sites are extremely sparse on the continent. Thanks to my focused surveying efforts over the past several years, we have recently discovered new sedimentary contexts that sample this period of interest. Our initial works there have already yielded exciting hominin, faunal and archaeological discoveries that are currently being closely studied. With these ongoing collaborative research efforts, we will soon be able to make major contributions to addressing important outstanding questions about the origins and evolution of our species and associated behaviours.

New equipment to bolster SA's ability to perform cutting-edge astronomy research



The National Research Foundation (NRF) has approved the funding of R35 million for the Hydrogen Intensity and Real-time Analysis eXperiment (HIRAX) which will be built as a guest instrument on the South African Radio Astronomy Observatory's (SARAO) site in the Karoo. This follows an intensive and rigorous review process involving international experts. The new equipment will bolster the country's ability to perform cutting-edge astronomy research in alignment with the Grand Challenge Astronomy National Strategy. This new investment by the Department of Science and Innovation, in partnership with the NRF, will provide funding for the telescope dishes, feeds, radio frequency over fibre system, and some backend hardware. This contribution represents a significant investment in the overall HIRAX project.

This state-of-the-art telescope will provide large astronomy data sets to the project's consortium members, international partners, and project collaborators. **Professor Amanda Weltman**, of UCT's Department of Mathematics, who is part of the project shared: "This is a major milestone for HIRAX, a locally led experiment that holds the potential to solve some of the most challenging and interesting problems in cosmology and astrophysics today." South Africa has a long history of successful astronomy telescopes, and the future Square Kilometre Array (SKA), which will be hosted by both South Africa and Australia, is set to be the largest radio telescope in the world. HIRAX will provide training and skills development in anticipation of the SKA era while studying cutting-edge questions in the fields of dark energy, fast radio bursts, and pulsar science. The telescope is currently funded to be an interferometer array of 256 closely packed dishes that will provide an unprecedented peek into the history of our universe. There are also plans for possible future expansion to 1 024 dishes.

Reflecting on the NRF's University Flagship Programme which aims to provide customised, innovative solutions and institutional support in a way that recognises the unique strengths and niche research areas of public universities, Dr Gansen Pillay, the acting CEO said: "This investment in Strategic Research Equipment will further advance postgraduate student training, new knowledge generation and South Africa's standing as a global leader in the field of astronomy."

'Climate Frontiers' podcast: Connecting science and society

In their podcast series, *Climate Frontiers*, the [Climate System Analysis Group \(CSAG\)](#) at UCT presents an accessible perspective on topics often hidden behind academic language, connecting science and society for positive change. Through conversations with researchers at the CSAG, and occasionally with partners across Africa and internationally, the climate research centre discusses a range of topics from within physical climate science, through to social science and philosophy.

In the first episode, "[The Ethics of Climate Services](#)", PhD candidate **Jessica Lee** is in discussion with the CSAG's deputy director, Dr Christopher Jack; the Department of Environment, Forestry and Fisheries' Tlou Ramaru; and the South African Weather Services' Dr Tracey Laban. The three interviewees were all involved in a recent project exploring some of the challenges at the intersection of climate services and ethics.

The second episode, "[The Complex Challenge](#)", is a conversation between **Dr Anna Taylor** from [UCT's African Climate and Development Initiative](#), and climate scientists **Professor Bruce Hewitson** (CSAG director) and Dr Izidine Pinto (CSAG researcher). They discuss why climate change is such a complex problem and what the CSAG and others are doing to make sense of the complexity to help make climate information clearer, more accessible and usable or actionable by those confronting climate risks.

In the third episode, "[CORDEX-AFRICA](#)", the focus is on Coordinated Regional Downscaling Experiment (CORDEX) – and, in particular, CORDEX-Africa and the role it has played in developing the capacity of African scientists to conduct climate-related research in Africa. It features CSAG researcher **Dr Chris Lennard**.

The UCT Mathematics Competition 2020-2021: Overcoming Covid-19 Challenges By John Webb

For the first time since it began as a school-based event in 1977, the annual UCT Mathematics Competition could not be held in 2020. Covid had locked down the campus and schools were closed. Towards the end of 2020 a hopeful date was set to host the competition at UCT: Tuesday 4th May 2021. The date looked ideal: it was in the UCT midterm vacation and also in the school term. All the usual venues at UCT were booked, and the unused 2020 papers had only to be lightly edited for use in 2021. However, UCT was still restricting social contact by severely restricting the numbers allowed in its venues, and accommodating over 7000 high school students was impossible. The suggestion of taking everything online was quickly dismissed, since it would have excluded many township and rural schools with inadequate internet and IT access. The decision was reluctantly taken to move the competition into the schools.



Worcester Gymnasium

Many schools were sorry that their pupils would not experience visiting UCT, exploring the campus to find their venues and enjoying the buzz of discussion with thousands of other maths enthusiasts afterwards. There were, however, some advantages: on-campus participation has always been limited by the capacity of UCT venues, and in-school participation meant that schools could be allowed to double the number of their entries. Another plus was that some of the more remote country schools who could not afford to bus their school teams to UCT were able to take part in the competition for the first time.

The question papers were couriered to schools on Monday 3rd May, and next day nearly **7000 pupils in 133 schools** across the Western Cape wrote the papers at the same time. Their answer forms were couriered back to UCT the next day and processed by UCT's data capture office. All courier charges were paid by UCT. With all answer forms captured, marked and analysed, schools were sent their results. The next step was organising the follow-up rounds. The top 150 participants (30 per grade) were invited to take part in the UCT Mathematics Challenge. The Challenge paper consisted of just 10 problems, at a level above the multiple-choice competition problems, but requiring only numerical answers and no working. Restrictions on social gatherings were still in force, preventing hosting the Challenge at UCT, and the papers were written in the schools on Thursday 24th June. Answer forms were scanned and emailed back to UCT where they were quickly marked, with full results announced on Monday 31st May. It was just in time. Tighter Covid restrictions were announced, and schools were closed for early school holidays two days later.

The top achievers in the Challenge will be invited to write a traditional full Mathematics Olympiad paper, requiring written solutions with full reasoning for six difficult problems, at a level way above school exams. The 3-hour Olympiad paper is usually written on a Saturday afternoon at UCT, and although the number writing will be between 50 and 100, the most difficult problem of all is to work out if and when and where to host the Olympiad. The Prize Giving will follow the Olympiad round, when we hope to welcome some 500 prize winners, parents, teachers and sponsors to the Baxter concert Hall to applaud the recipients of certificates, prizes and trophies.



Qhayiya Secondary School, Hermanus

Since 1980, a core feature of the UCT Mathematics Competition, Challenge and Olympiad programme has been the social impact of bringing together top young mathematicians in friendly competition at UCT, getting to know the campus over their five high school years and meeting staff of the Department of Mathematics. For UCT, it has always been a most successful exercise in public relations and recruitment of top students.

Thanks go to the Problem Committee chaired by Thomas van Heerden and comprising schoolteachers Francois du Preez, Bronwyn Adonis and Neil Eddy, and UCT staff Renee Rix, Haris Skokos and John Webb and new member Neil Eddy. Overall financial support by the Capitec Foundation ensures that participation in the Competition, Challenge and Olympiad is free.

EVENTS IN THE FACULTY

Inaugural Lectures:

Professor Isabelle Ansorge: Teaching the many (50) shades of blue – while the world is changing its shade”

Oceanography’s first woman head of department **Professor Isabelle Ansorge** delivered her inaugural lecture on 14 April. In 1983 Professor Isabelle Ansorge’s father took the 14-year-old out of school for six months to join him aboard a Polish barquentine and “class afloat”, the RV Pogoria, on its voyage around Africa. Amid billowing sails and spume, she tackled maritime chores, cleaning and painting. So began a love song to the sea. “That changed my life, and I sit where I am because of that one experience,” Professor Ansorge said in her inaugural lecture.



*Shades of blue: Professor Isabelle Ansorge
Photo Lerato Maduna*

Ansorge’s oceanographic research had become “the focus of a remarkable academic career”, Vice-Chancellor Professor Mamokgethi Phakeng said in her welcome. Ansorge was the first woman at UCT to obtain a PhD in oceanography and the first to head the department in this male-dominated field, Dean of Science Professor Maano Ramutsindela added in his introduction. “Isabelle has a long association with UCT, since 1993—in those formative years of our democracy, Isabelle was busy creating a niche in oceanography” he said. Through a career in observational oceanography, that niche in research is creating a greater awareness of the ocean’s physical, biogeochemical and ecological response to climate change; the first part of her lecture.

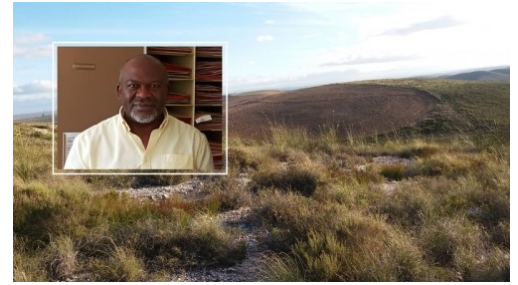
The second part introduced the audience to the SEAmester programme aboard the ice-breaker and research vessel the SA Agulhas II, South Africa’s flagship marine and polar research vessel. SEAmester’s floating university offers all earth system postgraduates across South Africa a free and fair opportunity to gain access to this research platform. It’s an unforgettable experience, said Ansorge, with a nod to some formidable storms they’ve braved in the past when the ship’s 12-metre-high bow has disappeared under rolling breakers

Prof Ansorge highlighted how a knock-on effect of climate change is going to be a gradual cooling in the Northern Hemisphere around Europe and North America, because of the Greenland melt. She said that this situation highlights the importance of monitoring oceans and explained that as an oceanographer you need to get instruments into the ocean to measure the physical and chemical changes. In 2013 South Africa deployed a long-term monitoring array: an observation network of instruments that form the South Atlantic Meridional Ocean Circulation (SAMOC-SA) system. The initiative is led by Ansorge, Marcel van den Berg and UCT honorary research associate Dr Tarron Lamont, both of the Department of Environmental Affairs’ Oceans and Coasts division in Cape Town.

Thanks to the SA Agulhas II, an array of eight Current Pressure Inverted Echo-Sounder (CPIES) moored instruments were deployed into the South Atlantic as part of the SAMOC-SA system. This completes a network of eight bottom-moored CPIES and four deep-ocean moorings that record vertical acoustic travel time and near-bottom pressure and velocity. From these, measurements such as temperature, salinity and north–south velocity throughout the water column can be inferred. “It’s a huge international programme aimed at measuring the volume and rate of flow of water moving northwards,” said Ansorge. “While the dataset is relatively young (since only 2013), we need to get started with these measurements to understand better how this flow is changing over years and eventually decades. Of interest is to quantify the salt leakage coming from the Indian into the Atlantic and try to understand whether that is changing, and what the variability scale is: Are we looking at a timeframe of one year, 10 years, or more than two, three decades?” Because of the long-term nature of this project, universities like UCT need to train new generations of postgraduates to continue this work; people who have the same passion for the ocean that ignited Ansorge years ago. This is SEAmester’s role.

Professor Muthama Muasya: A safari across the African savannah and into the Cape

Prof Muthama Muasya took to the virtual stage to present an inaugural lecture fitting for the time, and suited to the continent. His research focuses on the taxonomy and evolution of plants with a special emphasis on Africa and the Cape region. The lecture, titled “Biodiversity studies in the Anthropocene: from species discovery in fragmented landscapes to unravelling the origin of iconic African flora” was hosted by Vice-Chancellor Professor Mamokgethi Phakeng on Wednesday, 26 May.

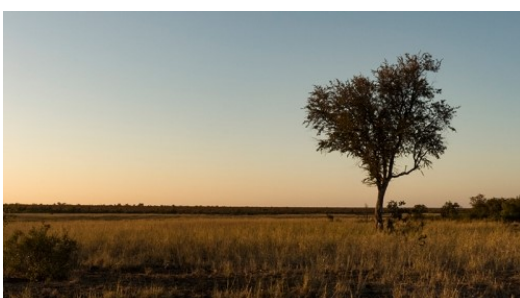


“It’s humbling to have been invited to talk to you this evening. I find it a good coincidence that I am speaking about biodiversity and African heritage in the week and month that we are celebrating Africa, and where the theme for this year is ‘Africa’s arts, culture and heritage’,” said Professor Muasya, referring to the African Union’s 2021 Africa Day theme. A recurring theme in his research relates to documenting the region’s diversity and seeking explanations to what underpins the evolution of plants over space and time. During his lecture, he discussed species discovery in the Cape flora, and presented several highlights on the evolution of the African savannah known as the Cradle of Humankind.

“Africa has a rich biodiversity, whether it’s ecosystems, species kinds or species variations. Five major biomes occur [and] the vegetation is determined by rainfall, temperatures, seasonality, elevation and soils,” he said. The African Savannah ecosystem is a tropical grassland with year-round warm temperatures, and distinct wet and dry periods. The savannah is characterised by grass and small or dispersed trees that do not form a closed canopy and allows sunlight to reach the ground.

The process to identify and document the world’s biodiversity has progressed over the past 300 years and herbarium (: the process of preserving pressed plant species with accompanying field data) plays an essential part in this process. “The collection of herbarium specimens in the Cape began in the 1600s,” said Muasya. He further explained that UCT’s Bolus Herbarium, which includes the Bolus Herbarium Library, was bequeathed to the university 150 years ago and is the oldest functioning herbarium in South Africa. With close to 500 000 specimens, the herbarium boasts one of the largest university collections in the world. In the past decade alone it has played a significant role in helping scientists understand the Cape flora.

Muasya pointed out that flora found in southern Africa has a complex biogeography, built in response to a range of drivers. He focused part of his lecture on the Eastern Overberg Renosterveld – one of the most unique vegetation types in the Cape Floral Region. He said that this vegetation is “highly fragmented” by agriculture and has produced a number “novelties” recently. The quartz habitats in the region host more than 25 narrow-ranged species among 70 red-listed species. Furthermore, the Cape fynbos also contributed to and received taxonomy from other biomes and received long-distance dispersal all the way to Australia. Muasya said he remains humbled and privileged to serve diverse communities of practice and to contribute to taxonomic plant science expertise in Africa. “In my journey I have [received] knowledge and goodwill from others and I enthusiastically share it. In the words of the African theologian and philosopher Professor John Mbiti, ‘I am because we are and, since we are, therefore I am’,” he said.



Research Bytes

New study suggests falcons have natural ‘eye makeup’ to improve hunting ability

Dark ‘eyeliner’ feathers of peregrine falcons act as sun shields to improve the birds’ hunting ability, a new scientific study suggests. Scientists have long speculated that falcons’ eye markings improve their ability to target fast-moving prey, like pigeons and doves, in bright sunlight. Now research suggests these markings have evolved according to the climate; the sunnier the bird’s habitat, the larger and darker are the tell-tale dark ‘sun-shade’ feathers. The distinctive dark stripes directly beneath the peregrine falcon’s eyes, called the malar stripe or ‘moustache’, likely reduce sunlight glare and confer a competitive advantage during high-speed chases. It’s an evolutionary trait mimicked by some top athletes who smear dark makeup below their eyes to help them spot fast-moving balls in competitive sports.



The dark malar stripe directly beneath the peregrine falcon’s eyes likely reduce sunlight glare, an evolutionary trait mimicked by some top athletes who smear dark makeup below their eyes to help them spot fast-moving balls in competitive sports.

Photo (left): – [Peregrine Falcon by Greg Hume \(Greg5030\) – CC BY-SA 3.0](#); Photo (right): [Tom Brady by Jeffrey Beall – CC BY 3.0](#)

Until now, there had been no scientific study linking solar radiation levels to the dark ‘eyeliner’ plumage, which is common to many other falcon species. A study, published recently in the journal *Biology Letters* was conducted by researchers from the University of Cape Town and the University of Witwatersrand. The scientists used photos of peregrine falcons from around the world posted on the web by bird watchers and scored the size of the malar stripe for each bird. They then explored how these malar stripes varied in relation to aspects of the local climate, such as temperature, rainfall, and strength of sunlight. The study involved comparing malar stripe characteristics, including width and prominence, of individual peregrine falcons, by using over two thousand peregrine photographs stored in online citizen science libraries. Researchers examined samples from 94 different regions or countries. Results showed that peregrine falcon malar stripes were larger and darker in regions of the world where sunlight is stronger.

“The solar glare hypothesis has become ingrained in popular literature, but has never been tested empirically before,” said **Michelle Vrettos**, an MSc student from the Department of Biological Sciences at UCT who carried out the research. Vrettos added: “Our results suggest that the function of the malar stripe in peregrines is best explained by this solar glare hypothesis.” **Associate Professor Arjun Amar** from the UCT FitzPatrick Institute, who supervised the research, said: “The peregrine falcon represents the ideal species to explore this long-standing hypothesis, because it has one of the most widespread distributions of all bird species, being present on every continent except Antarctica – it is therefore exposed to some of the brightest and some of the dimmest areas around the globe”.

Orchid sexually exploits male beetles – a world first from Africa

Dr Callan Cohen, a research associate at the FitzPatrick Institute of African Ornithology, has discovered a world pollination first: an orchid that sexually exploits longhorn beetles. The near-extinct *Disa forficaria*, known from a single remaining plant in the mountains near Cape Town, mimics a female beetle so convincingly that the male beetle mates with the flower, thus pollinating it. Dr Cohen and a team of local and international researchers discovered an entirely new chemical system involved in this deception, and they are pioneering the process of using pollination to survey for the presence of critically endangered plants. These discoveries stem from Cohen's search for rare African orchids in the mountain ranges near Cape Town. *Disa forficaria* – a relative of the iconic Red Disa – was last seen in 1966, and only 11 of these plants have been found in the last 200 years, making it one of the rarest plants in the world. In an attempt to document the last known plant, Cohen aimed to take detailed photographs of it.



This African orchid, “Disa forficaria”, mimics a female beetle so convincingly that the male beetle mates with the flower, thus pollinating it. Image: Callan Cohen

Deceived beetles

Incredibly, while I was observing, a beetle flew to the plant and clearly mated with it,” he recalled. Orchids are known as deceivers; they mainly utilise food deception, by imitating plants with nectar despite having none. They have been found to use sexual deception on bees and wasps. But while beetles are the oldest known pollinators of plants, and the most diverse group of plant pollinators, this was the first clear case of a plant sexually deceiving a beetle.

Proving sexual deception

Cohen assembled a joint South African and international team to investigate the phenomenon, including UCT alumnus and world-famous pollination researcher **Professor Steven Johnson**; Adam Shuttleworth; UCT's Centre for Statistics in Ecology, Environment and Conservation associate **Dr Jonathan Colville**; and orchid experts William Liltved and Benny Bytebier. Noticing that the beetle had a small, penis-like organ which it inserted into the modified lip of the flower, Cohen took several macro photographs of the flower just before the moment he predicted the beetle would get to the flower. Once it had, he found that it left something behind; the substance was tested, and conclusively showed sperm. “This is only the second time in the world that an insect has been found to ejaculate on a plant during pollination,” said Cohen.

A new chemical system

Following this discovery, the researchers wanted to find out what chemical was attracting the beetle to the flower. They took a sample from the flower and caught a beetle to test in the laboratory. They found that the active chemical in the flower was what had attracted the beetle. The team sent the plant extract to a top chemist in Germany, the Max Planck Institute's Dr Ales Svatos, who identified the chemical involved and whose colleague, Dr Jerrit Weissflog, synthesised possible forms of its molecular structure. The chemical was a previously undiscovered macrolide, which the team named ‘disalactone’. After testing the synthesised molecules in the field, the team found that the beetles all came to a particular form of the synthesised component, believed to be a mimic of the female beetle pheromone produced by the orchid.

A conservation world first

During their experiment with the synthesised molecules, they discovered that some of the beetles were carrying pollen (confirmed by genetic barcoding) from at least two other individuals of the *Disa*, proving the plant is not extinct. The team realised that they could now survey for the flowers by using the synthesised chemical to attract beetles that might carry evidence of the real orchids. “This resulted in narrowing down the area where the rare plants exist, and allows for a concentrated search for the orchid. Using pollinators to see if an endangered plant is present in the area is also a world first,” said Cohen. “This discovery can help save the critically rare orchid, on the edge of extinction, with a novel chemical survey technique.”

Way forward

Following these multiple discoveries, and the recent publication of Cohen and the research team's findings in Current Biology, pollination experts from around the world are studying the consequences and implications. The research findings of Cohen et al. also provide insights into long-horned beetle pheromones; the beetle's larvae burrow in wood and are thus important commercially. Finally, the research provides further perspectives into the biological function of macrolides, which are important components of many antibiotics.

Science and the making of My Octopus Teacher

The news that *My Octopus Teacher* had won an Oscar for the Best Documentary at the 93rd Academy Awards was met with elation in the Cape Peninsula's Deep South where naturalist, film-maker and co-star Craig Foster lives and freedives. But underpinning the film was his relationship with two University of Cape Town (UCT) marine biologists, Foster's science and marine tracking mentors. They are friend and fellow seashore explorer **Charles Griffiths**, now an emeritus professor in the Department of Biological Sciences, and UCT alumnus **Dr Jannes Landschoff**, who is listed as scientific advisor on *My Octopus Teacher*. Some years before Foster encountered his octopus co-star, he'd learned how to track and understand marine life in False Bay's rich intertidal region in the company of the scientists.



Jannes Landschoff, Charles Griffiths and Craig Foster in False Bay. Photo Michelle Carpenter.

Foster is involved in the Sea Change Project, a not-for-profit organisation with a mandate to conserve the oceans and human origin heritage. In an interview with UCT News in 2017, Foster recounted how his job as a wildlife film-maker and advocate for the oceans came from his ability to communicate science in 'pictures and stories'. "But I wasn't able to speak that science language very well and Charles kindly offered to let me join him and Jannes," he said.

Foster had turned to the sea after suffering a burnout. He learned to freedive; to connect with something greater than himself: the underwater world. By 2017 when he spoke with UCT News, he had been freediving in the sea below his home for six years. It took three years to develop his underwater tracking skills and system, with the help of Griffiths and Landschoff. "In the first two years I found almost nothing," Foster said. "And then I started noticing little signs and little tracks. Sometimes you watch incredible behaviour, but you don't know it's amazing because you don't know what it is! And then the different things start to speak to you." That happened with the octopus.

It took six months for the female cephalopod to trust him in her predator-dense environment. Eventually she took him on hunting expeditions. From her, Foster learned how to move so that he did not give off pressure waves. Eventually, she allowed him into the front part of her den where he placed a camera. Footage showed her as a rigorous housekeeper, using her siphon to jettison sand and debris that the tide had washed in. Surprisingly, she didn't eject the camera that she allowed Foster to place in her den.

What *My Octopus Teacher* could not include were other scientific discoveries. Griffiths noted that although it was not the film's focus, the trio discovered "at least half a dozen" species new to science during filming. One of these was a species of shrimp that Foster noticed was cohabiting with the octopus in her lair. Foster filmed the shrimps, unaware of the scientific implications. After Griffiths asked him to collect a sample from the den, it was confirmed that the shrimps were new to marine science and the species was subsequently named *Heteromysis octopodis*. However, Foster found another shrimp in False Bay, also new to science, which was named after him: *Heteromysis fosteri*.

Griffiths is suitably chuffed with the film's award, for what had at first appeared to be "a delightful but fairly niche natural history production about the unusual relationship".

Gigantic galaxies discovered with the MeerKAT telescope

Two giant radio galaxies have been discovered with South Africa's powerful MeerKAT telescope. These galaxies are amongst the largest single objects in the universe and are thought to be quite rare. The discovery has been published online in the Monthly Notices of the Royal Astronomical Society.

The detection of two of these monsters by MeerKat, in a relatively small patch of sky suggests that these scarce giant radio galaxies may actually be much more common than previously thought. This gives astronomers vital clues about how

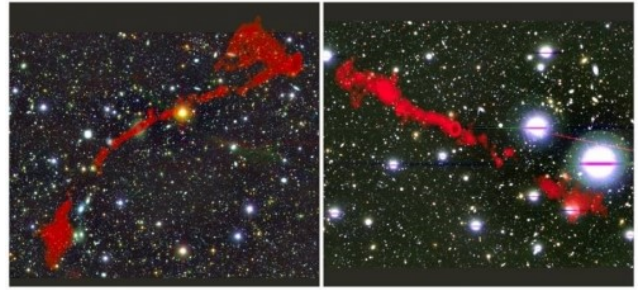
galaxies have changed and evolved throughout cosmic history. Many galaxies have supermassive black holes residing in their midst. When large amounts of interstellar gas start to orbit and fall in towards the black hole, the black hole becomes 'active' and huge amounts of energy are released from this region of the galaxy.

In some active galaxies, charged particles interact with the strong magnetic fields near the black hole and release huge beams, or 'jets' of radio light. The radio jets of these so-called 'radio galaxies' can be many times larger than the galaxy itself and can extend vast distances into intergalactic space. **Dr Jacinta Delhaize**, a Research Fellow at the University of Cape Town (UCT) and lead author of the work, said: "Many hundreds of thousands of radio galaxies have already been discovered. However, only around 800 of these have radio jets exceeding 700 kilo-parsecs in size or around 22 times the size of the Milky Way. These truly enormous systems are called 'giant radio galaxies'." Delhaize said: "We found these giant radio galaxies in a region of sky which is only about four times the area of the full moon. Based on our current knowledge of the density of giant radio galaxies in the sky, the probability of finding two of them in this region is extremely small." "This means that giant radio galaxies are probably far more common than we thought!"

Dr Matthew Prescott, a Research Fellow at the University of the Western Cape and co-author of the work, said: "These two galaxies are special because they are much bigger than most other radio galaxies. They are more than 2 Mega-parsecs across which is around 6.5 million light years or about 62 times the size of the Milky Way. Yet they are fainter than others of the same size. We suspect that many more galaxies like these should exist, because of the way we think galaxies should grow and change over their lifetimes."

Dr Ian Heywood, a co-author at the University of Oxford, said: "The MeerKAT telescope is the best of its kind in the world. We have managed to identify these giant radio galaxies for the first time because of MeerKAT's unprecedented sensitivity to faint and diffuse radio light. "This made it possible to detect features that haven't been seen before. We found largescale radio jets coming from the central galaxies, as well as fuzzy cloud-like lobes at the ends of the jets." He continued: "We know that these galaxies are several billion light years away, and so it was the discovery of these jets and lobes in the MIGHTEE map that allowed us to confidently identify the objects as giant radio galaxies."

"The existence of the two MIGHTEE giant radio galaxies provides tantalising evidence that a large population of faint, very extended giant radio galaxies may exist," said Delhaize. "In the past this population of galaxies has been hidden from our 'sight' by the technical limitations of radio telescopes. However, it is now being revealed thanks to the impressive capabilities of the new generation of telescopes." "We hope to uncover more of these giant galaxies in the MIGHTEE survey as it progresses. We also expect to find many more with the future Square Kilometre Array (SKA) telescope. The SKA will reveal larger populations of radio galaxies than ever before and revolutionise our understanding of galaxy evolution."



The two giant radio galaxies found with the MeerKAT telescope. In the background is the sky as seen in optical light. Overlaid in red is the radio light from the enormous radio galaxies, as seen by MeerKAT. Left: MGTC J095959.63+024608.6. Right: MGTC J100016.84+015133.0. Image: I. Heywood (Oxford/Rhodes/SARAO)

Ancient southern Kalahari was more important to human evolution than previously thought..

By Benjamin Schoville, Jessica von der Meden, Robyn Pickering and Wendy Khumalo

UCT researchers from the Departments of Archaeology and Geological Sciences are among an international team of researchers who studied and described a new archaeological site, Ga-Mohana Hill and found evidence for complex symbolic behaviours 105 000 years ago. The Kalahari is a huge expanse of desert in southern Africa, stretching across Botswana and into the northernmost part of South Africa's Northern Cape province.

The international team, made up of researchers from South Africa, Canada, the UK, Australia and Austria, has found evidence for complex symbolic behaviours 105,000 years ago. Humans use symbols as a shortcut to communicate important ideas. Identifying the ancient roots of symbolism is limited to what preserves over time. Large calcite crystals from several kilometres away were found in the cave alongside stone tools. Why the crystals were brought there is unknown; they are not modified and do not seem to have a functional purpose. They may have been collected for their aesthetic properties, or included in ritual activities.

Crystals are collected by many people around the world to this day for ritual purposes. Early humans bringing crystals into Ga-Mohana suggests innovation in how people interacted with each other and their environment. But such ancient innovation didn't occur in a bubble: there is context to when and where innovation occurs. What brought people there in the first place, at that time, to begin using those tools and collecting those crystals? Reconstructing past environments allows us to understand this context. And so, a major part of our research centred on working out what the area's climate was like 105,000 years ago. To do so, we looked at Ga-Mohana's rocks.

The southern Kalahari is often considered too arid to be important for human evolution. Our work contradicts the idea of an arid and empty interior. At some points, Ga-Mohana was much wetter than today, with pools of standing water and waterfalls tumbling down the hillside. The fact that the climate was very different then opens up possibilities about why this previously under-appreciated region must have played an important role in our species' evolutionary history. Archaeological and geological fieldwork allowed us to piece together this story.

Some kinds of rocks preserve traces of the past environment. The Ga-Mohana hillside is draped in deposits called tufa; these form from water leaking out of cracks in the bedrock. This occurs when underground aquifers are recharged with rain water and begin to overflow. Over time, these waters precipitate calcium carbonate and form tufa. The tufa system is no longer active, apart from small drips during the rainy season. But the fossil tufas represent periods in the past when there was more water available. To find out how old the tufas are and when these wet periods occurred, we used a method called uranium-thorium dating. Uranium is radioactive, meaning that it decays at a constant rate over time and produces 'daughter' elements; thorium is one of them. When tufa forms, uranium is 'locked' into the crystal structure and begins to decay to produce thorium.

The uranium-thorium system acts like a clock that starts when the tufa is formed. By precisely measuring how much uranium and thorium is in the tufa today, we use the known decay rate to calculate when the 'clock' started. This method is routinely applied to cave deposits like stalagmites and flowstones but has not been used very much on tufa. In the end, we dated two layers from an ancient tufa waterfall to between 110,000 and 100,000 years old. People were drawn to Ga-Mohana for many reasons. Surface water would have been one. The many ostrich eggshell fragments we also found were probably used as water carriers 105,000 years ago. Perhaps these were being filled with water as it flowed down the hillside. One possibility is that water carriers allowed our ancestors to travel further distances. There is still more to be learned from Ga-Mohana, its artefacts and its rocks. This will allow scientists to understand the role this space played in human evolutionary history better.



Jess von der Meden standing next to large tufa flow at Ga-Mohana. Photo Robyn Pickering.

Uncovering the mysteries of manta ray communication

Based on brain-to-body size ratio, manta rays could be considered the most intelligent fish species in the ocean. But does their behaviour confirm this physiological hypothesis? A collaborative study conducted by researchers at UCT, Macquarie University, the University of Papua and the Marine Megafauna Foundation suggests that the answer to this question may lie in the devil fish's horns.



When they were first described in the late 1700s, manta rays were given the unfortunate moniker of 'devil fish' as a result of the horn-like protrusions on either side of their mouths—presenting a stark contrast with their rather gentle temperament and unassuming social behaviour. Despite the sinister connotations, these horns - known as cephalic fins/lobes - are typically used for the simple task of funnelling zooplankton into the manta's mouth while feeding. However, a study recently published in *Behavioural Ecology and Sociobiology* suggests that cephalic lobe movements may also be important in social communication or sensing the local environment.

Michelle Carpenter, a PhD student in the Department of Biological Sciences, and one of the lead researchers on the project, has spent the past four-going-on-five years becoming closely acquainted with these rays. "My first interaction with a manta in Africa was in 2016 at Tofo in Mozambique," she recalls. "It was really far away, but when it spotted me, it came right up close and looked straight into my eyes. I just remember thinking 'This animal is really smart.'" Carpenter was instantly hooked and decided to dedicate her postgraduate studies to finding out more about this particularly charismatic species, which it turns out, is still relatively understudied. This has meant spending hundreds of hours closely scrutinising their behaviour – both in the field and by watching video recordings.

Michelle collaborated with Dr Rob Perryman, a manta behavioural biologist. His previous studies had revealed, among other things, that reef manta rays are social animals, with individuals recognising and remembering their preferred 'friends' and mates. Importantly, Perryman has also built up a formidable library of manta ray footage that has proved invaluable to the study. Together, Carpenter and Perryman developed a standardised method to assess manta ray behaviour in the wild via focal sampling and frame-by-frame video analysis. "Small flicks of the lobe tips were performed more frequently when rays were facing another individual, while tight rolling of the lobes was associated with being followed by others. Some lobe movement types were also made more frequently when interacting closely with cleaner fish and may be used to attract their attention." While the study shows strong evidence for mantas using their cephalic lobes for sensing, Carpenter says that they still require further evidence to confirm their use in communication. "I believe we will be able to confirm this eventually," she says. "The thing with animal behaviour is there's so much going on, so much stimuli around them. So, the challenge is isolating certain stimulus." The next step in this regard would be acquiring footage of manta rays when they aren't feeding or being cleaned, which is no mean feat.

Carpenter will continue this research by focusing on the behaviour of manta ray populations in Mozambique and has enlisted the help of UCT honours student, Hannah Stewart.

Although the connection between a manta ray's cephalic fins and conservation of the species may seem tenuous, Carpenter believes that discovering more about the intricacies of animal behaviour is key to inspiring a sense of curiosity about and respect for other species among humans.

"If people realised how smart and complex animals are, they'd be more inclined to protect them," she says.

Ships are illegally dumping plastic bottles on South African beaches, study finds



An exceptionally high density of mainly PET bottles stranded near the mouth of the Riet River in the Milnerton study site following a heavy rainfall event. Almost all of these bottles come from Cape Town. Photo: Peter Ryan

A new study by researchers at the UCT's FitzPatrick Institute of African Ornithology and Nelson Mandela University found that ships are a major source of plastic bottles littering South African beaches. The findings, just published in the journal *Environmental Pollution*, also show that some bottles drift across the Indian Ocean from countries in southeast Asia, especially Indonesia.

The researchers collected bottles and other single-use containers at 32 beaches around the South African coast to infer their sources based on their age and country of manufacture. Most bottles were plastic, despite well-developed recycling initiatives for polyethylene terephthalate (PET) and high-density polyethylene (HDPE) bottles in South Africa. "The problem is that we produce so many single-use

bottles in South Africa that even the relatively high recovery rates achieved translate into billions of bottles not being recycled" said lead researcher **Professor Peter Ryan**. Bottle densities were greatest at urban beaches, where most come from local, land-based sources. Street litter in Cape Town and Gqeberha was dominated by bottles made in South Africa (99%), with foreign-manufactured bottles increasing from urban (4%) through semi-urban (24%) to remote beaches (45%).

Foreign bottles were most common at beaches in De Hoop Nature Reserve and the Namaqualand National Park, where more than 70% were from other countries. "Almost all foreign bottles were PET water bottles from China and other Asian countries, with smaller numbers from South America and Europe. This fact, coupled with their recent manufacture dates, indicates that most foreign bottles are dumped illegally from ships," said Ryan. "Bottles from nine countries on four continents were found within three months of the date of manufacture – they simply couldn't have drifted here that quickly."

Dumping of plastics at sea has been banned since 1989, but clearly many ships are still ignoring these regulations. The study calls on the International Maritime Organisation to tighten regulations to ensure that ships use port reception facilities for such waste, rather than dumping their rubbish at sea.

Unlike PET drink bottles, foreign HDPE bottles were more common along the southeast coast of South Africa than along the west coast, consistent with many of these bottles arriving by long-distance drift across the Indian Ocean from southeast Asia. The most common country of origin for these bottles was Indonesia, and most newly-arrived HDPE bottles were 4–6 years old.

Ryan said the study confirms that the east coast of Africa and adjacent island nations receive large amounts of buoyant litter leaking into the sea from southeast Asia, and especially from Indonesia.

"It is widely assumed that 80 per cent of plastic pollution in the sea comes from land-based sources. However, this figure is a very crude estimate and it is clear that the proportion varies depending on where you are. Our recent work has shown that much land-based litter doesn't disperse far from where it enters the sea. Bottles offer a useful way to track litter origins because they contain information on when and where they were manufactured," shared Ryan.

Beaches are key attractions for tourism and recreation, and considerable effort is made to keep beaches clean, yet many beaches still have substantial litter loads. To tackle beach litter in South Africa, Ryan says we need to greatly reduce plastic leakage from land-based sources, both locally and in southeast Asia, as well as improve measures to prevent the illegal dumping of plastics and other persistent wastes from ships.

UCT hosts SA team for International Olympiad in Informatics

by Michael Cameron, IITPSA Olympiads Liaison Officer

At the end of June, the Department of Computer Science hosted the South African team taking part in the International Olympiad in Informatics (IOI). This competition is for exceptional high school students to sharpen their informatics skills—such as problem analysis, design of algorithms and data structures, programming, and testing. Twenty-five years ago, UCT hosted the IOI for 250 participants from 63 countries. This year, in 2021, the South African team of four would have travelled to Singapore for the event, but as the Covid-19 third wave swept around the world, the 33rd IOI was run virtually in 88 countries at national venues. The Computer Science Department at UCT made special arrangements to accommodate this prestigious event despite pressure on the computer laboratories because of mid-year examinations. In addition to providing a superb venue, Virtual Machines were installed - both on PCs and, in case of load shedding, also on laptops. The technical staff gave incredible support to make this possible. The two five-hour contests were held on 22 and 25 June. Fortunately for the African and European teams competing in the IOI, the contests started from midday, while the Americas commenced before dawn and the Japanese started close to midnight.



South African 2021 IOI team
B Butkow, F Steenkamp, A Qu, J Weight

The team of four to take part in the IOI were announced in May by the Institute of Information Technology Professionals South Africa (IITPSA). The medal winners of the SA Programming Olympiad in September 2020 attended five weekend training camps up to June 2021. The Institute has run the SA Programming Olympiad for the past 35 years and a team from South Africa has attended every IOI since 1993. This year all four team members were in Grade 12 in 2020. Taking over from Bronson Rudner (UCT 2017-2020), the team leader was Tian Cilliers of Stellenbosch University, with Taariq Mowzer (UCT Computer Science 2nd year) as deputy leader.

The 2021 results showed the South Africa team managing to hold their own internationally. Andi Qu, participating for his third time, obtained a bronze medal, placing 137th overall. For the other three contestants, this was their first IOI. They attained positions 280, 287 and 342 out of the 351 contestants. The host country, Singapore, arranged fun events in addition to the serious IOI contest days. SA team member Faran Steenkamp was placed third in the sponsored Code Cup, and won a cash prize of 200 USD.



SA IOI team on Lion's Head
June 2021

For more than three decades, the UCT Computer Science Department has given its facilities and active support to the SA Programming Olympiad for schools and for the training of successive IOI teams. 'We are deeply grateful to UCT for this encouragement to top level informatics development' said Tony Parry, CEO of IITPSA, 'and we look forward to entering a fresh team from South Africa in the 2022 IOI - planned to be onsite in Yogyakarta, Indonesia from 7 to 14 August'.

The International Olympiad in Informatics is one of several international science Olympiads held annually around the world. Exceptional high school students from various countries compete in the prestigious algorithmic competition to sharpen their informatics skills—such as problem analysis, design of algorithms and data structures, programming, and testing.

The main aims of the event are:

- To discover, encourage, challenge, and recognise exceptional high school students for their talent in the field of informatics;
- To foster friendly international relationships among computer scientists and informatics educators;
- To bring the discipline of informatics to the attention of young people;
- To promote the organisation of informatics competitions for high school students;

COVID-19 and Science



SA must harness the power of human and veterinary medicine before the next deadly virus strikes by Profs Ed Rybicki, Anna-Lise Williamson and Baptiste Dungu

The kinds of emerging zoonotic disease agent that concern One Health include, among others, those that move from wild to domestic animals then go on to be transmitted long-term between humans. A One Health approach to vaccine development has many strengths, including for health and food security on the continent. But this country needs to boost its capacity now, write **Professor Ed Rybicki** and **Professor Anna-Lise Williamson** from the University of Cape Town and Baptiste Dungu, the chief executive of Onderstepoort Biological Products.

The need for next-generation animal vaccines coupled with the threat of future pandemics, points to the need for a One Health approach to developing jabs – besides, most major human vaccine makers owe their strength to having both human and veterinary vaccine capacity. The One Health initiative is “dedicated to improving the lives of all species – human and animal – through the integration of human medicine, veterinary medicine and environmental science”. The importance of the approach can be seen when one realises that six out of every 10 infectious diseases in humans are zoonotic (spread from animals) and seven out of 10 of emerging or re-emerging infections are vector-borne or zoonotic. There is particular interest in developing low-cost products for point-of-care diagnostics that could also be used as vaccines for animals and possibly for humans, since these diseases mainly affect people and animals in developing countries and resources to study them are often lacking. In addition, commercial reagents are frequently not available or excessively expensive for low-resource countries, and are not available in times of crisis such as the Covid-19 pandemic.

A One Health approach to vaccine development has several strengths. In fact, the majority of major human vaccine manufacturers owe their strength to having both human and veterinary vaccine capacity (Pfizer, before spinning out Zoetis; Sanofi and Merial, Bayer, Eli Lilly, Novartis). Furthermore, emerging economies such as India and China have been building their vaccine industries by capitalising on knowledge from the two sectors. It is quicker and cheaper to assess new vaccine technologies, adjuvants, toxicity and immunogenicity in animals before employing the technologies for the manufacture of human products.

One good example is the Indian biopharmaceutical organisation Indian Immunological. Its animal vaccine facility is also in a parastatal established by the Indian National Dairy Development Board and corporatised the same year (1999) as South Africa’s only veterinary vaccine manufacturer, Onderstepoort Biological Products. By leveraging these facilities and expertise, they established a very successful human vaccine capacity. Their rabies vaccine, which was initially veterinary, was subsequently developed into a human vaccine. They now produce a larger range of human vaccines, generating significantly more revenue than the animal vaccine unit – and are even working on a Covid-19 vaccine. The human vaccine unit has been established at a regulated distance from the animal vaccine facility, but on the same large property owned by the company. The research and development unit and other services are shared, with the agreement of regulatory authorities, which is the case in other parts of the world

South Africa has excellent capacity and facilities for advanced research on and laboratory-scale production of reagents and candidate vaccines. These include university- and parastatal institute-based research groups and their labs, and technology for live viral vectors, sub-unit protein production, and laboratory animal testing. What it lacks are large animal facilities for testing veterinary vaccines, and pilot-scale current Good Manufacturing Practice-compliant manufacturing facilities, and one or more facilities capable of producing human vaccines in the country. Given the need for next-generation animal vaccines for Africa combined with vaccine preparedness for the next pandemic, building One Health vaccine capacity makes sense, and will be to the advantage of health and food security in Africa. And we need to establish this capacity now, before “virus Y” comes along.

Even if Covid-19 vaccine IP is waived, Africa does not have the capacity to produce at scale



Professor Kelly Chibale, from the Department of Chemistry, says that if the intellectual property (IP) rights of vaccines are lifted, the African continent will still not be able to scale up the production of Covid-19 vaccines.

Countries and activists in the Global South have been asking pharmaceutical companies to waive IP rights on the Covid-19 vaccine for more equitable access. Professor Chibale, a professor of organic chemistry and founder of the integrated drug discovery and development centre H3D, said IP was necessary because it was an enabler of innovation. "First of all, when people talk about IP rights they are not just rights but also responsibility. If you file a patent on something, you have a responsibility to move that innovation. People need to have the know-how and means to move that innovation.

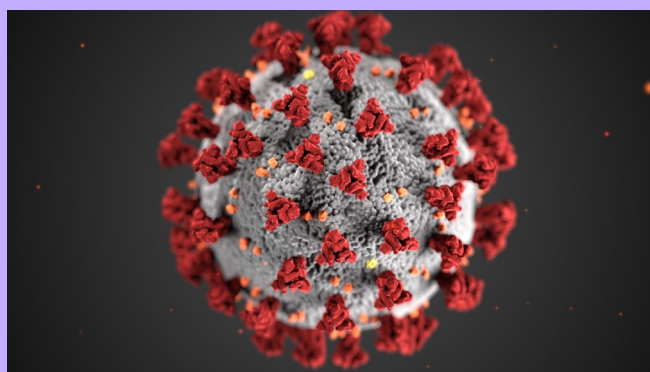
"Why is IP necessary? IP is actually an enabler. Something went into that innovation, someone paid cash [for it]. It really helps to create strong innovation systems. It provides incentives." Chibale said even if the IPs were waived immediately, the African continent would still not have the capacity to manufacture the vaccines for a fast rollout. "Even if the IP was waived, I guarantee to you that it would mean nothing. How are we going to do it? We don't have the facilities to do this at scale. We don't have the expertise, the knowledge, the infrastructure. People need to balance the IP issue with reality."

Vaccine manufacturing capacity

He added there were only about 10 African manufacturers that have the capability to produce vaccines. They are based in only five countries - Egypt, Morocco, Senegal, South Africa and Tunisia - and mostly fill and package the vaccines. He asked the question: How can the whole continent have less than 10 countries that can manufacture vaccines for different diseases? We have to address that. The challenge is that as long as you are not doing your own manufacturing, access is going to be a challenge. "If we can manufacture the vaccines in South Africa, it brings efficiency in terms of access." Chibale said by manufacturing locally, governments were able to prioritise their citizens. Chibale added that another challenge would be how to scale up production using existing infrastructure and getting the funding to do so. "It really is important that we remember that we already have infrastructure that has been used for decades to basically roll out vaccines. There's also a case for new ways of funding. How the Ebola crisis was handled has provided a blueprint of how we can come together."

He stressed that as long as not all countries vaccinated their populations, the pandemic would not end.

"South Africa is not safe unless all the countries on the African continent are safe. The sooner the vaccine can get here before the virus gets ahead of us, the better. If we don't do this quick enough as a global community, it'll have serious consequences."



Fire Damage to the Science Faculty Buildings

On Sunday 18th April the fire that started on the mountain above Philip Kgosana Drive soon blazed out of control and, driven by strong winds, reached UCT's campus, damaging the Jagger Reading Room (previously the JW Jagger Library), the HW Pearson Building, and the Fuller Hall and Smuts Hall student residences. The raging fire which destroyed so much of value on UCT property and the surrounding areas impacted the Science Faculty hugely.



The **HW Pearson Building** sustained considerable damage and impacted staff and students whose work and research. Two units in **particular sustained near total losses – the Plant Conservation Unit (PCU) and the Institute for Communities and Wildlife in Africa (iCWild)**. Although the rest of the building did not burn, there was extensive fire-related and especially water damage across multiple floors, and it is likely that the building will not return to full capacity until the end of the year. Both greenhouses also sustained some damage.



Professor Maano Ramutsindela said, “We also wish to acknowledge that the loss of the Jagger Reading Room, and the loss and relocation of many of its collections, also has a substantial effect on our faculty. Many of our colleagues depend on those resources, particularly those in disciplines that research the recent and deeper human past in Africa. But all was not lost in the fire, and indeed there were many incredibly brave acts that kept it from being worse than it might have been. We thank those colleagues who played a role in keeping UCT buildings safe. We also wish to thank members of our faculty who have helped to recover materials from Jagger Library following the fire. It has been a difficult time, and your acts are deeply appreciated”.



Senior Science Faculty staff inspecting the damage to Science Faculty Buildings soon after the fire

In Memoriam

Emeritus Professor Jean Cleymans: 1944–2021

At the time of his passing **Professor Jean Cleymans** was a senior research scholar within the Department of Physics at the University of Cape Town (UCT). He was appointed to UCT as a senior lecturer in 1985, and later became professor and head of the Physics department. He also served on a number of senior UCT committees. Those who attended his courses will remember the outstanding way in which he delivered a sequence of complex ideas through mathematical formalism, but always grounding them by reference to observation and experiment.



Professor Cleymans made considerable contributions to theoretical physics with a particular focus on relativistic heavy ion collisions, most recently at the Large Hadron Collider at the European Organisation for Nuclear Research (CERN) in Geneva. His research work mainly explored the phases of quark and nuclear matter at times very soon after the Big Bang. Professor Cleymans was instrumental in establishing the SA-CERN programme over a decade ago, which continues to support South African scientists at CERN.

An NRF A-rated researcher since 1985, Professor Cleymans was the recipient of a number of awards throughout his career including the Alexander von Humboldt Research Prize in 1999. He authored and co-authored more than 300 articles on theoretical physics and supervised more than 40 master of science students and PhD candidates, many of whom are making their own significant impact in physics today.

He will be remembered by the Department of Physics and the national and international physics communities more broadly as an outstanding physicist, a dedicated supervisor and lecturer, and above all someone who loved the academy and strived to make a significant and long-lasting contribution to South African science.

LAST LAUGH....

