UNIVERSITY OF CAPE TOWN
IYUNIVESITHI YASEKAPA • UNIVERSITEIT VAN KAAPSTAD

DECEMBER
2017

GIVE US FEEDBACK

CONTACT

Newsletter for Faculty of Science



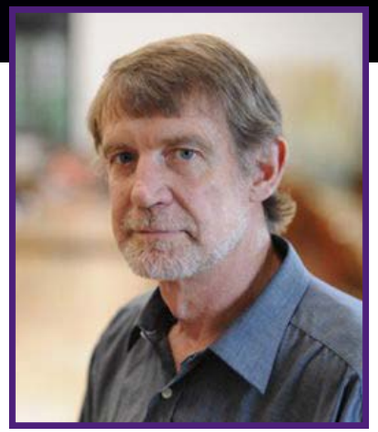






CONTENTS

DISCOVER A WORLD OF OPPORTUNITIES



Message from the Dean

Welcome to this 2017 edition of our Faculty newsletter, "Contact". We hope through this newsletter to maintain contact with our alumni, and keep you informed of activities and developments in the Faculty over the year. This past year has been eventful on a number of fronts, not least the late start to the academic year, which has meant that we are only now finishing off with the end-of-year examination processes. Despite the late start, we nevertheless had a record number of applications, admitted a strong cohort of first year students in March, and completed the academic year successfully in early November. The traditional December graduation dates have been changed, and undergraduate students will now attend their graduation ceremony in April of 2018, but a large number of Science Doctoral and Master's students did graduate at a ceremony in late December this year.

Staff and students continued to garner prestigious national and international recognition over the course of the year, and short summaries of some of these achievements are captured in the following pages. Professor Peter Ryan became our latest staff member to be A-rated by the NRF, i.e. is considered by his peers to be an international leader in his field. Four of our staff were inducted into UCT's College of Fellows in recognition of their research achievements, viz. Peter Dunsby (Maths & Applied Maths), Bruce Hewitson (Environmental & Geographical Science), Chris Reason (Oceanography) and Peter Ryan (Biological Sciences). We are particularly proud that three of our staff received UCT Distinguished Teacher Awards – David Erwin (Maths & Applied Maths), (Jonathan Shock (Maths & Applied Maths) and Miguel Lacerda (Statistical Sciences).

Research continues to flourish in the Faculty, and staff and postgraduate students have been successful in raising significant funding to facilitate their research programmes. The range and number of research projects are too many to report on individually, but a selection are captured for interest, together with some general Faculty activities. It is gratifying that much of the research being undertaken by our staff and students, some of which is reported on in these pages, addresses issues of importance to Africa, its people and its biodiversity, balanced by the blue sky research that is competitive in the international arena. An important development for the future is that we are well on our way with plans to build a Science Learning Centre for our students, and we now urgently need to raise the necessary funding. The Science Learning Centre will be central to improving our student throughput. We hope to contact alumni in the near future to assist us with raising the necessary funds.

Finally, this is my last year in office as Dean of Science and I am pleased to advise you that Professor Susan Bourne will be taking over from me from January 2018. The Faculty will be in good hands.

I hope that you enjoy this 2017 edition of Contact, and I wish you every success in 2018.

Anton le Roex
DEAN OF SCIENCE

Back to contents page

Staff Achievements and Awards

NEW A-RATED SCIENTIST IN THE FACULTY

Professor Peter Ryan, Director of the FitzPatrick Institute of African Ornithology, in the Department of Biological Sciences, was recently awarded an A-rating by the NRF for the quality and impact of his research outputs. Peter is a well-respected seabird biologist who also works on island conservation and restoration, and the impacts of power infrastructure and other threats to birds. He is perhaps best known for his research on plastics in marine systems, and particularly their impacts on seabirds. This is the first A-rating for a FitzPatrick director and the first for an ornithologist in South Africa.

Four New UCT Fellows in the Science Faculty

Four of the eleven new Fellows inducted into UCT's prestigious College of Fellows are from the Faculty of Science.

They are: **Professor Bruce Hewitson**, Department of Environmental & Geographical Science; **Professor Chris Reason,** Department of Oceanography; **Professor Peter Dunsby,** Department of Mathematics and Applied Mathematics and **Professor Peter Ryan**, FitzPatrick Institute of African Ornithology.

Young Researcher Awards

The College of Fellows Young Researcher Awards honour the significant contribution that UCT's young researchers have made to research in their particular fields. Two of the six recipients of the Young Researcher Award in 2017 were from the Science Faculty.

They are:
- **Dr Alvaro de la Cruz-Dombriz**
- **Dr Juana Sanchez-Ortega**,

both from the Department of Mathematics & Applied Mathematics.

Three Claude Leon Merit Awards for Science

The Science Faculty congratulates three staff members who have been awarded Claude Leon Merit Awards, which recognise early-career researchers of distinction.

They are:
- **Dr Sahal Yacoob** - Department of Physics
- **Dr Sarah Fawcett** - Department of Oceanography
- **Dr Katye Altieri** - Department of Oceanography

Marine Scientists honoured

UCT marine scientists **Professors Peter Ryan** and **John Bolton**, Department of Biological Sciences, and **Dr Sarah Fawcett**, Department of Oceanography, were recently honoured at the South African Network for Coastal and Oceanic Research (SANCOR) triennial awards ceremony at the Southern African Marine Science Symposium.

The awards recognise distinguished scientists, technicians, communicators and emerging researchers in the marine and coastal sciences. Professors Ryan and Bolton received the Gilchrist Memorial Medal, which recognises the contributions of distinguished scientists to marine science who foster excellence in South African marine sciences and prioritise the country's marine and coastal environments. Dr Fawcett was one of only two recipients of the SANCOR Young Researcher Award.

Dr Sheetal Silal, (pictured left) from the Department of Statistical Sciences was awarded an Honorary Visiting Research fellowship at Nuffield Department of Medicine, University of Oxford.

Dr Silal also recently received a recognition award by the Operations Research Society of South Africa at their Annual Society Conference in September 2017. This award is made to individuals who have served the profession of *Operations Research* in an exemplary fashion and Sheetal's citation recognised her *"high-calibre research as well as her excellent service rendered to the local profession of operations research in general, in her capacity as lecturer and mentor of a new generation of operations researchers"*.

NSTF AWARD FOR EMERGING RESEARCHER

Dr Robyn Pickering, from the Department of Geological Sciences, was awarded the TW Kambule-NSTF Award for Emerging Researchers at the annual National Science and Technology Forum (NSTF) Awards Ceremony.

The awards, known in the South African research community as the 'Oscars of Science', recognise and reward excellence in science, engineering and technology, and innovation in South Africa.

Dr Pickering, who is an isotope geochemist, has successfully adapted uranium-lead dating techniques to provide the first set of direct ages for the South African caves in which early human fossils were found.

"My dream since undergraduate days was to date local cave sites, and I had to go away (to Europe and Australia) to learn how to do that," Pickering told the Mail & Guardian.

"But I'm excited to be back and help train and inspire a new generation of scientists. Married and with two small children, I am aware that I can be a positive role model for young women. I also want to help ensure that expertise and funding come to South Africa and stay here."

DISTINGUISHED TEACHER AWARDS

The Faculty of Science is proud to have three staff who received Distinguished Teacher Awards this year. They are:

DR DAVID ERWIN:
Department of Mathematics & Applied Mathematics

David Erwin has enjoyed a lengthy career in teaching mathematics. He comments: "Teaching is itself a learning process. We get better at it – if we want to. Good teachers learn from their students and, through a process of self-reflection and critical engagement, decide what worked and what needs to be done better, or completely differently, next time".

His philosophy is that of creating a comfortable classroom, keeping students focused and developing the structures they need to succeed.

DR JONATHAN SHOCK:
Department of Mathematics & Applied Mathematics

Within a short space of three years, Jonathan Shock has developed a reputation of excellence. One student remarks that an infamous first-year mathematics course is like diving into the Atlantic Ocean without a wetsuit, but that Dr Shock makes it clear why the metaphorical sea has so much to offer – he encourages deep understanding and a level of inquiry past the curriculum. He is renowned for his technological innovation, academic development and support, and consistently outstanding evaluations across many levels of teaching in the discipline. His ability to change students' perceptions of infamous courses is put down, by many, to the fact that he simply cares, going beyond to develop a rapport with students to enable access to the discipline of mathematics.

DR MIGUEL LACERDA:
Department of Statistical Sciences

Dr Miguel Lacerda comments that he attempts to make content meaningful and accessible. He acknowledges a student audience that is diverse in terms of academic ability, learning style and cultural background, all of which inform his approach to teaching. He strives to stimulate interest, and to develop sound reasoning and independent learners. He is methodical in his approach, mending shaky foundations that students may have had in the daunting discipline of Statistics, and developing in them a mindfulness about the 'bigger picture'. He is renowned for his innovation and curriculum development in the discipline, and has developed links between the curriculum and industry.

WORLD RANKINGS

When the Centre for World University Rankings (CWUR) recently released their inaugural subject rankings, UCT was placed in the top five of over 26 000 higher education institutions in two subjects, one of which was Ornithology.

Based on the number of research articles in top-tier international journals, these rankings highlight the world's elite universities in the sciences and social sciences.

Dr Will Horowitz, Department of Physics, was awarded the Meiring Naude Medal, in Recognition of Outstanding Early Career Contributions to Science. He received the award for his internationally recognised contribution to the theory of high energy/ elementary particle physics, his significant contributions to the development of the UCT Centre for Theoretical & Mathematical Physics as a world-renowned research facility, and his passion for sharing knowledge and expertise with students.

ASSOCIATION OF COMMONWEALTH UNIVERSITIES AWARD FOR ARCHAEOLOGIST

Associate Professor Shadreck Chirikure, Department of Archaeology, was awarded an Association of Commonwealth Universities (ACU) Fellowship award. The fellowship is aimed at bringing leading scholars from amongst the members of the ACU network to the University of Oxford, to develop collaborations. Associate Professor Chirikure's work focuses primarily on the metallurgy of major southern African archaeological sites and this research collaboration will see the use of advanced techniques and theoretical frameworks to understand farming, inequality and other issues at Great Zimbabwe and other important sites in Africa.

FAMELAB: SCIENCE COMMUNICATION

Dr Sheetal Silal, senior lecturer in the Department of Statistical Sciences, was first runner up in the Famelab national competition. "It's helped me think about how to communicate abstract mathematical topics in a universally understood manner and has highlighted the importance of making our research known to the public", Sheetal said.

MULTIPLE AWARDS FOR PROFESSOR CLAIRE SPOTTISWOODE

Professor Claire Spottiswoode, Pasvolsky Chair of Conservation Biology, from the FitzPatrick Institute of African Ornithology, was the recipient of three major awards in 2017. She received the Bicentenary Medal of the Linnean Society of London, awarded annually in recognition of research done by a biologist under the age of 40 years.

She was also awarded the Scientific Medal of the Zoological Society of London, for distinguished work in Zoology.

In a third major achievement, Professor Spottiswoode recently received a Consolidator Grant from the European Research Council, held jointly at UCT and the University of Cambridge, UK, to the value of € 2 million, in order to support research on the honeyguide-human interactions in Mozambique.

STUDENT AWARDS AND ACHIEVEMENT

Ecologist and MSc student **Gabriella Leighton** won a British Ecological Society Young Investigator prize. The prize – one of only five awarded each year – recognises the best research papers published in BES journals by early career scientists. Gabriella won the Robert May Prize for the best paper in the BES journal *Methods in Ecology & Evolution* in 2016 for her paper 'Just Google it: assessing the use of Google Images to describe geographical variation in visible traits of organisms'. In her study, Gabriella analysed online image data across a range of species, from black bears in western North America to black sparrowhawks in South Africa. She compared data on their colour, collected by fieldworkers, with data from Google images, and found that the online images are a very reliable source of data. **Dr Arjun Amar**, from Biological Sciences, co-authored the paper.

Zander Venter, a doctoral candidate from Biological Sciences entered the NRF SAASTA young science communicators competition in the video category and came second. His video, *Our footprint from space* was stitched together with free online software "and quite a few hours of cutting and pasting video segments to create a smooth finished product", says Zander. Venter's PhD in agroecology is focused on livestock grazing management. He measures grass and soil in the field and uses satellite imagery to detect the path of cattle on vegetation.

PhD candidate **Megan Lukas**, from the Department of Environmental & Geographical Science, was one of 25 young scientists honoured with a Green Talents award at the International Forum for High Potentials in Sustainable Development, which took place in Germany during October.

Lukas was recognised for her research on how people connect to their environment within the under-resourced township setting of Nyanga, in Cape Town. Her work is concerned with how pro-environmental behaviour, sustainable living and attachment to place unfold in such settings, where green space, trees and recycling facilities are often lacking.

Nyasha Chimhandamba, an honours students in the Department of Molecular & Cell Biology, who is working on creating a luminescent biosensor that will let off a blue light to indicate when plants are salt-stressed, won the UCT Famelab finals.

Astronomy PhD student **Khaled Said** - a recipient of the Science Faculty PhD scholarship, was awarded the Gruber Foundation Fellowship by the International Astronomical Union (IAU). The annual fellowship, for young astronomers, is for the amount of US$50 000 and is awarded to an extremely promising young investigator working in any field of astrophysics.

Khaled studies cosmology, looking at galaxies located in the region of the sky obscured by the Milky Way, known as the Zone of Avoidance, with the aim of gaining better insight into the distribution and dynamics of galaxies in the local Universe.

PhD student **Sabre Didi**, from the Department of Computer Science, received the Best Student Paper Runner up Award at the Symposium Series on Computational Intelligence (SSCI) held in Athens, Greece. Sabre, with his PhD supervisor **Dr Geoff Nitschke**, investigated the impact of coupling transfer learning with behaviour diversity methods on controller evolution in multi-robot tasks.

Also in the Department of Computer Science, **PhD students Amreesh Phokeer** and **Josiah Chavula's** paper about the African Internet was awarded an "Outstanding Paper Award" at the 13th IEEE AFRICON 2017 International conference. The paper, entitled, "An Insight into Africa's country-level latencies" reports on a large scale measurement study of the African Internet. It focuses on mapping the performance and topological characteristics of intra-Africa connectivity.

Hannah Simon, an honours student in Biological Sciences, broke rare ground when she had an article about the tension between social and environmental justice published in the *South African Journal of Science (SAJS)* late last year. All the more impressive is the fact that Simon was a third-year undergraduate student, studying Biological and Environmental & Geographical Science, when the paper was published. The paper is titled "Understanding the polarisation of environmental and social activism in South Africa".

SCIENCE SHINES
AT INAUGURAL UCT PHD 3 MINUTE TALK COMPETITION

5.

Nineteen PhD researchers recently stood up in front of an audience and panel of judges, to condense years of research, culminating in a roughly 80,000 word thesis, into a three-minute oral presentation. They were competitors in UCT's first Three Minute Thesis (3MT®) competition.

"Scientists tend to huddle in their own research communities and never tell other people what they're doing. 3MT highlights the importance and impact of communication," says the winner of the Science category, Kerryn Warren, from the Department of Archaeology.
The winners were:

- **Kerryn Warren** - 1st Prize Winner - Department of Archaeology
- **Isobel Kolbe** - Runner-up (SET) - Department of Physics
- **Elias Aydi** - Overall People's choice winner (both Science and Social Sciences)
  - Department of Astronomy

Kerryn Warren then went through to the National competition where she won the first prize – we are proud of having such excellent Science communicators!

Science Post Grad Student Committee with Science winners: L to R: Elias Aydi, Sabina Omar (PRO), Isobel Kolbe, Kerryn Warren, Temitope Egbebiyi (Chair) & Roxanne Openshaw (Deputy Chair)

Research in the Faculty

SHARK SPOTTERS SUCCESSFULLY BALANCING WATER USER SAFETY WITH SHARK CONSERVATION

The City of Cape Town boasts one of the world's most progressive programmes for reducing the chances of a negative interaction between white sharks and recreational water users – Shark Spotters.

The goal of the programme is to visually detect sharks swimming along the inshore region of popular beaches and use a system of auditory and visual signals to encourage water users to get out of the water when a shark is considered too close. But does it work?

Yes, suggests the findings of a new study by UCT PhD student, **Tamlyn Engelbrecht** which was published in *PLoS ONE*. The programme employs thirty spotters operating on eight beaches in Cape Town, made possible by funding from the City of Cape Town and the Save our Seas Foundation.

> ***"In 2010, the Save our Seas Foundation saw tremendous potential in the Shark Spotter's ability to find non-lethal or invasive ways of managing the human-shark coexistence in Cape Town - an area notorious for its great white sharks",***

says Save Our Seas CEO, Michael Scholl. "We're thrilled to continue our long-term support and collaboration with this innovative community drive project, which is raising awareness for shark conservation and promoting beach safety".

Spatial overlap between white sharks and recreational water users, and consequently the risk of a shark encounter, is significantly lowered by the efforts of shark spotters, and further, water users (swimmers, surfers and kayakers) adjust their behaviour in response to rare (on average only one every two years) negative incidents between sharks and people.

"This is an important finding", says **Professor O'Riain,** Director of the Institute for Communities and Wildlife in Africa(iCWild), "*as the program has been in operation for over a decade but its efficacy had yet to be measured".*

The study also reveals that white sharks and water users have similar patterns of presence along the beaches in False Bay, with both preferring the warmer summer months and the middle of the day.

> ***"Rather than killing the sharks or excluding them from all beach habitats, the water users of Cape Town are asked to work together with the Shark Spotters and their non-invasive warning system to continue the positive results seen to date for the benefit of both people and sharks",***

says Gregg Oelofse (Manager of the City of Cape Town Coastal Management Department).

The Shark Spotters program is an example of a proactive, environmentally responsible and sustainable shark safety program that effectively increases safety at beaches where there is potential for people and sharks to come into contact.

The conservation conflict around how this overlap in water use by people and sharks is managed,is one of the core research themes of the Institute for Communities and Wildlife in Africa (iCWild).

PLOTTING ENEMY MOVEMENTS:

Mathematical modelling's powerful contribution to eliminating malaria

It is a scene in just about every war movie: the generals stand around a table moving miniature armies on a map. They are locked in a deadly battle. They need to predict the movements of the enemy troops accurately so they can cut them down with minimum fatalities to their own side. The stakes are high – a miscalculation can result in the deaths of thousands. She may not be dressed in military fatigues, and she may not be working from a tent on a battlefield, but this is effectively what **Dr Sheetal Silal** does every day. Her enemy is malaria. Her secret weapon is mathematical modelling.

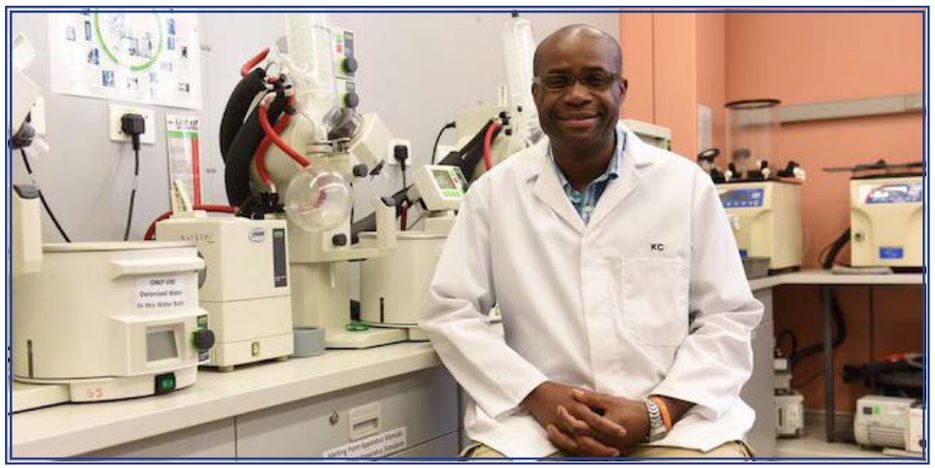
Mathematical modelling of malaria.

"This is a deadly serious battle we are facing," says Silal, senior lecturer in the Department of Statistical Sciences. According to the World Health Organisation (WHO), nearly half the world's population is at risk of malaria, with an estimated half a million deaths from the disease in 2015. To help achieve the global goal to eliminate malaria by 2030, Silal builds simulations that show how the disease spreads in order to help policymakers control and fight the disease.

In order to stop a disease you need to understand its biology and how it spreads, explains Silal. To use malaria as an example, not everyone who has malaria feels ill. Many carriers are asymptomatic and have no idea that they are spreading the disease. "This iceberg scenario, observing only a small proportion of cases, poses a major challenge to policymakers trying to battle a disease. It means that the infectious reservoir is almost always out of reach because you're not going to seek treatment if you don't feel sick." This is where mathematical modelling can help, because it seeks to predict and plot out the behaviour and spread of these infectious diseases. With this information, policymakers can then be proactive about which populations to target, who to vaccinate, when to vaccinate and other proactive measures to pre-empt the situation, and/or react effectively.

This is revolutionary.

"Twenty years ago this would never have been possible: it would have been the stuff of science fiction," she says. "But today, through science and technological advancements, mathematical modelling of diseases plays an integral part in shaping policy and saving lives."



NEW ANTIMALARIAL DRUG SHOWS PROMISE

A new paper published this year in the prestigious journal *Science Translational Medicine* describes the discovery and biological profiling of an exciting new antimalarial clinical drug candidate. MMV390048 is effective against resistant strains of the malaria parasite and across the entire parasite life cycle, and it has the potential to cure and protect in a single dose.

The research was conducted by UCT's Drug Discovery and Development Centre (H3D) and Medicines for Malaria Venture (MMV), in collaboration with a team of international researchers. The paper is the first full disclosure of data demonstrating the antimalarial promise of MMV390048, a compound discovered by an international team led by **Professor Kelly Chibale**, Department of Chemistry at UCT and MMV.

"The ability of MMV390048 to block all life-cycle stages of the malaria parasite, offer protection against infection as well as potentially block transmission of the parasite from person to person suggests that this compound could contribute to the eradication of malaria, a disease that claims the lives of several hundred thousand people every year," said Professor Chibale, founder and director of H3D, founding director of the South African Medical Research Council (SAMRC) Drug Discovery Research Unit at UCT, and senior author of the paper.

In 2014 MMV390048 became the first new antimalarial medicine to enter phase I human studies in Africa. Today, preparations are being made to begin phase IIa human trials on this promising compound as a single-dose cure.

Photo: Rene van der Schyff

AFRICA'S LARGEST EAGLE IN FREE FALL

The population of Africa's largest eagle species is in freefall in South Africa, and may be soaring towards extinction, according to a new study based on changes in sighting rates over the last twenty years. The research was conducted by **Dr Arjun Amar** and PhD student **Daniël Cloete** from the FitzPatrick Institute of African Ornithology, in the Department of Biological Sciences, using two Southern African Bird Atlas Project (SABAP) surveys carried out twenty years apart. Their previous research showed that comparing these surveys provided an accurate way of measuring changes in the population size of this eagle species.

Martial Eagle sightings have dropped by as much as 60% since the late 1980s, in stark contrast to human population growth across their shared natural habitat, said the study published recently in the scientific journal *Bird Conservation International*. Although the exact reasons for the decline remain unclear, researchers say their findings point to an urgent need to better understand the threats to this iconic bird.

Worryingly, the study also highlighted a marked decline in Martial Eagle sightings within protected areas, including those in the world famous Kruger National Park and the Kalahari Gemsbok National Park. However, declines of the species in protected areas were not as severe as elsewhere, suggesting that these areas could act to buffer the factors leading to declines.

Martial Eagle total population figures are still relatively inexact, but their conservation status was uplisted in 2013 from Near Threatened to Vulnerable – which means they are recognised to be globally threatened. The study published recently provides the most accurate assessment for the decline of the species in any African country and was only possible due to an army of volunteer bird watchers who contribute their sightings to the SABAP database.

The study found significant declines in three provinces; these were Kwa-Zulu Natal, Mpumalanga and Limpopo. Changes differed across the biomes (distinct regions with similar geography and climate), with the species faring worst in the Grassland, Savannah, Indian Ocean Coastal Belt and the Nama Karoo biomes. However, there was better news in the Fynbos biome of the Western and Eastern Cape, where reporting rates remained more stable over the last 20 years.

"Despite having full legal protection in South Africa, this species is known to be targeted and killed by farmers who blame the species for predation of their livestock, or may be accidentally killed by poison left to kill other predator species," the authors noted. Another major threat for the Martial Eagles, may be electricity infrastructure such as power lines, particularly among juveniles which have a wider territorial range.

Dr Amar, the lead author of the study said "this analysis was only possible thanks to the efforts of many hundreds of dedicated volunteer bird watchers who contribute their records to the SABAP survey database". Dr Amar added "we have now quantified the decline of the species in South Africa, but that is the only the first step. We now need urgent research to better understand the factors which are responsible for causing this iconic species to be lost from our countryside, so that these factors can be better controlled".

Chinese jade teapot found from the renders ruin at Great Zimbabwe

LESSONS ON SUSTAINABILITY FROM THE ANCIENT SOCIETY OF GREAT ZIMBABWE

At its peak, the population of Great Zimbabwe was far sparser than previously believed – with a total population of no more than 10 000 concentrated in 2.9 square kilometres (half the size of earlier estimates). This low population explains how the inhabitants of Great Zimbabwe lived sustainably in the region without negative consequences for the environment.

These are the recent findings of a team of researchers, led by **Associate Professor Shadreck Chirikure** of the Department of Archaeology at the University of Cape Town, and detailed in a paper published recently in the prestigious PLOS ONE journal.

"*This low population tells us that the economy of Great Zimbabwe was organised around households, with trade and exchange providing the surplus,*" says Chirikure. *"Furthermore, it tells us that you do not need big populations to trade and exchange. Great Zimbabwe, despite its low population, had exchange relationships with areas in different parts of the world.*" This finding also debunks the theory that overpopulation led to the eventual decline and collapse of Great Zimbabwe.

"It is unlikely that the abandonment of Great Zimbabwe was an outcome of the negative ecological consequences stemming from high populations," says Chirikure.

"*Archaeological evidence suggests that Great Zimbabwe was never abandoned, but its longevity and resilience was likely based on maintaining a good ecological balance between low population and available resources: water, land and pastures. Mineral wealth would have been obtained through redistribution mechanisms such as tribute collection, and normal trade and exchange relationships.*"

Prior to this discovery, archaeologists believed that, at its peak, Great Zimbabwe had a fully urban population of 20 000 people concentrated in around 2.9 square km (40% of 720 hectares). This translates to a population density of 6 897 per square kilometer, which would be comparable with that of some of the most populous regions of the world in the 21stcentury.

For comparison, in 2016, the population density of Hong Kong was 6 996 per sqm, while the 2013 population density for New York City was 10 292 people per sqm. Khayelitsha, a populous low-income township in Cape Town, had a 2016 population density of 7 748 people per sqm.
The study used techniques from ethnography – based on average household sizes of agricultural communities and the make-up of average Shona households – and non-invasive archaeological techniques such as measuring settlement and house remains, to conclude that the population size was in fact much lower than previously thought and in total unlikely to have exceeded 10 000 people. This finding is key to explaining the lack of environmental degradation within and around Great Zimbabwe. Low populations are essential to achieve ecological sustainability. "*If the population of Great Zimbabwe was as high as previously believed, there would have been evidence of associated environmental consequences, such as intensified erosion within the site's resource catchment area,*" says Chirikure.

In fact, low population pressure meant that forests for wood, fields and pastures could be rotated, giving them a chance to recover. Low populations also affect hygiene and sanitation: it is impossible to have 20 000 people living in one place for over a hundred years without a huge increase in diseases. Thus, while the population of Great Zimbabwe was comparatively high by local standards, it would still have been low enough for a vigorous economy and general health of the population. Chirikure notes the significance of this finding for modern-day planning and policy: "*African examples from the past are essential for learning about sustainability and resource exploitation by societies. The low population of Great Zimbabwe resulted in a good ecological balance. The urbanisation that we are witnessing in Africa today is based on a concentration of many people in one area, with unsustainable consequences.*"

More about Great Zimbabwe: The Great Zimbabwe ruins are located between the Zambezi and Limpopo rivers in southern Africa. They stand today as testament to a society of great wealth and skill that thrived in this area between the 11th and 16th centuries. Great Zimbabwe was the capital of a powerful state and ruled a sizeable territory in this sub-region. It was the hub of direct and indirect trade, which connected various areas of southern Africa internally and linked them externally with East Africa and the Near and Far East. Today, its size, imposing drystone walled architecture (built without any mortar or binder) and evidence of local and international trade all make it attractive to researchers and the public alike.

Chinese blue on white porcelain found in the Lower Valley enclosures at Great Zimbabwe

Palaeoenvironmental snapshot of the track-bearing surface at the Lephoto dam site showing some of the trackways made by two different tridactyl bipedal trackmakers that walked near the shoreline of a shallow desiccating pond.

SCAMPERING, TROTTING, WALKING TRIDACTYL BIPEDAL DINOSAURS IN LESOTHO

Miengah Abrahams, an MSc student in the Department of Geological Sciences, together with **Dr Emese Bordy**, recently published in an international journal of paleobiology, on dinosaur trackways in Lesotho. In Gondwana, Early Jurassic dinosaur track sites are especially concentrated in Lesotho, however, despite intensive investigations during the third quarter of the twentieth century, only a limited number of these vertebrate track sites were studied with rigorous ichnological and sedimentological methods. (Ichnology is a branch of geosciences that bridges sedimentology & palaeontology and studies the traces left behind by organisms in sediments. Such fossil tracks can provide unique insights into an animal's behaviour).

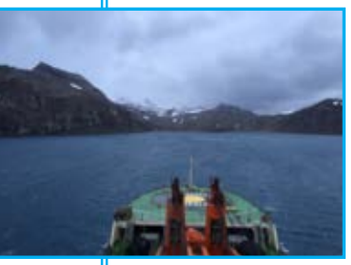
In this paper, a previously undescribed track site in Lesotho, is presented. Fifty-two individual tridactyl tracks were found on the Lephoto palaeosurface, which were generated by three-toed bipedal dinosaurs (tridactyl bipeds) that moved towards or away from the shoreline of a shallow pond. Two track morphologies were recognised. The first is identified as ***Grallator-like***, an ichnotaxon common in the Lower Jurassic of both Laurasia and Gondwana that can be attributed to small and medium-size carnivorous theropod dinosaurs. The second ichnotaxon is reminiscent of ***Trisauropodiscus***, which, in contrast, is a rare ichnotaxon that resembles tracks of birds and is known with certainty from only a few places in the world.

Their work provides further evidence that the ichnological record of the Elliot Formation of southern Africa is in a unique position to shed light not only on Early Jurassic biostratigraphy and palaeoenvironments but also on the biodiversity and palaeobiology of early dinosaurs. They reconstructed the behaviour of the various tridactyl bipedal trackmakers in terms of locomotion speed. The gait analysis of the five trackway makers at the site range from a walking gait to a running gait. While it is established that larger theropods walked more slowly than smaller theropods, this is not directly observed at the Lephoto dam site. The largest trackmaker is more than three times the size of the smallest trackmaker but both have similar gaits and speeds.

In summary, the Lephoto tracksite preserves a snapshot into life some 200 million year ago. The area was very active with small and medium sized dinosaurs, of different species, walking, trotting and running across a 4m² area of saturated sand, perhaps heading to a nearby water source. In addition to the vertebrate track traces, invertebrate worm-like trails are preserved throughout the surface. Pitted surface textures suggest that microbial algal mats, which were formed by micro-organisms exploiting the wet conditions, aided in preserving these shallow track impressions.

Amazing what a set of footprints in sandstone can tell about dinosaurs and the land they walked on!

Connections across the Globe



ANTARCTICA ADVENTURE:

Three UCT scientists. **Professor Peter Ryan** from the FitzPatrick Institute of African Ornithology, and **Dr Sarah Fawcett** and postgraduate student **Heather Forrer** from the Department of Oceanography, jumped at the chance to join one of the biggest and most ambitious scientific expeditions in history. The Antarctic Circumnavigation Expedition (ACE) drew dozens of scientists from around the world and swung them round Antarctica on the Russian research vessel *Akademik Treshnikov*.

The goal was to see first-hand, through a broad range of scientific disciplines, what impact climate change is having on the Southern Ocean and what it means for us landlubbers.

Ryan, an ornithologist, not only spotted a pleasing abundance of birds and whales, but a disturbing density of synthetic microfibres in the waters around Antarctica. There was little other debris floating about and Ryan believes that the origin of the fibres could be washing machine waste water.

"The sea is the ultimate sink for anything that goes into the environment," said Ryan.

"This, of course, heightens fears that marine creatures will ingest these synthetic fibres," said Fawcett.

For Forrer, befriending scientists from all over the world was just one of the reasons the trip was "unforgettable". That, and as Fawcett reminded her, "You got to land [in] a helicopter on an iceberg!" More than 100 scientists working on 22 projects were jockeying for ship-time throughout the trip.

A FIRST FOR THE SCIENCE FACULTY– A VISIT TO LIBYA

Emeritus Professor Graham Jackson, from the Department of Chemistry, was invited to attend the 2nd Libyan Conference on Chemistry and its Applications. He went to the conference with his Postdoc student **Dr Ahmed Hammouda**, who originally comes from Libya. The theme of the conference was "The role of chemistry in applied research and sustainable development". The conference was attended by approximately 150 delegates, but Professor Jackson was the only western delegate and gave a plenary lecture entitled "In vitro Studies of Dermally Absorbed Cu(II) Tripeptide Complexes as Potential Anti-inflammatory Drugs for the treatment of rheumatoid arthritis."

LEAD MARINE AUTHOR FOR GLOBAL BIODIVERSITY REPORT

Dr Lynne Shannon, Chief Research Officer in Biological Sciences, was asked to be a lead marine author of a chapter of the Global Assessment of Biodiversity and Ecosystem Services report (Global Assessment of the Intergovernmental Platform on Biodiversity and Ecosystem Services—IPBES). She and a group of 30 natural and social scientists from across the globe, drawing on terrestrial, freshwater and marine expertise in multiple disciplines, met at the German Centre for Integrative Biodiversity Research (IDIV) in Leipzig to examine the status and trends in nature, nature's contributions to people and drivers of change. The multi-national, high-level report aims to examine global patterns, develop global maps and be a basis to advise decision-making. It will strive to put things in perspective on regional levels and examine key trends, drivers and characteristics of biomes.

BRU FEATURES AT INTERNATIONAL PAPILLOMAVIRUS CONFERENCE, HELD IN AFRICA FOR THE FIRST TIME.

Professor Ed Rybicki and **Dr Inga Hitzeroth** of the Biopharming Research Unit (BRU) in the Department of Molecular & Cell Biology were involved in the organisation of the 31st International Papillomavirus Conference (IPVC) held in Cape Town.

This is the first time the conference has been to Africa and it attracted more than 1300 delegates from across the world, including 200 from Africa—the largest contingent from the continent at any IPVC in its history.

The theme of the conference was ***"Basic Science to Global Health Impact"*** and this was addressed in three parallel streams, namely: Basic Science, Public Health and Clinical Research. The Honourable Mrs Naledi Pandor, South Africa's Minister of Science and Technology opened the conference and commented that South Africa was the first African country to fund national vaccination against HPV and that South Africa needed to boost their own manufacture of drugs and vaccines.

Firsts for the Science Faculty

Mpati Ramatsoku, studied for a joint UCT - University of Groningen PhD in Astronomy. She is the first person to receive this joint PhD and graduates this year. Her thesis was based on observations and analyses of a large concentration of galaxies, mostly belonging to a bright X-ray 3C 129 galaxy cluster that had remained hidden behind the thick dust layer of the Milky Way in the so called Zone of Avoidance.

Mpati has subsequently received a postdoctoral fellowship with a leading researcher at the Italian National Institute for Astrophysics Cagliari.

Zubeida Khan, has just completed her PhD in Computer Science at UCT and she is the first black female PhD graduate in the Department of Computer Science. Her research interests include improving the current state of the web by using ontologies, which are logic-based representations of reality and the concepts and relations between them.

While working on her PhD, Zubeida had two children (now 2 years and 4 months old), so she had to do some serious juggling! For the immediate future, Zubeida will be working as a senior researcher at the Council for Scientific and Industrial Research (CSIR) in the Defence, Peace, Safety and Security group, in the Cyber defence subgroup.

Sharing research on a massive scale – Professor Anusuya Chinsamy-Turan goes global with her MOOC Extinctions: Past and Present

Professor Anusuya Chinsamy-Turan, Department of Biological Sciences, whose research interests lie in palaeo biology and specifically fossil bones (including those of dinosaurs), is an enthusiastic communicator of science. This led to her creating a MOOC (Massive Open Online Course) to share her work with people across the world. **Extinctions: Past and Present** is the free online course she created, which piloted in March and ran for a second time in June 2017.

> ***"My research is immensely satisfying, but sharing it with the wider public is even more so... in addition to the work that is essential for progressing in an academic career, and despite the lack of clear professional rewards for communicating with the public, I have always felt a deep commitment to spreading the joy of science"***, says Anusuya.

The free five week online course takes participants on a journey of exploring how life on Earth has been shaped by five mass extinction events in the distant past and examines how biodiversity is facing a crisis, with the prospect of a sixth extinction event today.

Professor Chinsamy-Turan interviews guest scientists about how their research informs us about the biodiversity of the planet, including the very first life forms; fish and tetrapod diversification; the radiation of reptiles and dinosaurs; and the rise of mammals. During the course, there is an opportunity to 'eavesdrop' on interesting conversations between Anusuya and 15 scientists, including **William Bond, Ed Rybicki, Peter Ryan, Muthama Muasya, Becky Ackermann, Lindsey Gillson and Timm Hoffman**, from the Science faculty.

Over 3300 participants from 120 countries around the world signed up for the first run of the MOOC Extinctions: Past and Present. The top number of participants signed up from the UK and South Africa, followed by the USA, Australia, India, Mexico, Canada and Brazil. The participants ranged from highly qualified professionals learning alongside postgraduates, teachers, grandparents and school learners. Many enrolled for general interest and enjoyment as well as sharing a concern for understanding human impact on biodiversity.

Outreach: Growing Science in our Community

SCIENCE TEACHER'S WORKSHOP: A glimpse into Science at UCT

The Science Faculty Marketing Committee organised an afternoon of exposure to research in the Science Faculty for Science teachers from across the greater Cape Town area.

The aim of the event was to engage with teachers and inspire them to encourage their top students to study Science at UCT.

Professor Anusuya Chinsamy–Turan gave a talk on the history of life; **Dr Lara Sciscio** spoke about ichnology and ancient footprints preserved in stone; **Dr Dorit Hockman** showed the audience about foldscopes – low-cost handheld paper microscopes and **Ms Rageema Joseph** spoke about how plants know when to take up "arms".

The teachers also did a tour of the laboratories in the Departments of Chemistry, Physics and Biological Sciences.

PHENOMENAL PHYSICS

After a two year interruption, Phenomenal Physics, the Department of Physics' flagship, annual outreach afternoon for Grade 11 science pupils from local schools, was back with a bang (and a flash, and a whoosh!) in the RW James building in September. A team of nine lecturers, organised and led by **Dr Spencer Wheaton**, presented a slick 3-hour programme of physics demonstrations which included some old favourites (such as the smashed frozen thumb) and several brand new items (like the balloonterludes), aimed at whetting pupils' appetite for studying science (particularly physics) at UCT.

UCT's Admissions Office gave prospective students a clear idea of how to maximise their chances of being accepted at UCT, but the main focus of course was on the often interactive, sometimes hands-on, always intriguing welcome to the world of wonderful physics.

Students and their teachers were kept on the edge of their seats by demonstrations involving light, sound, air, magnetism, electricity and liquid nitrogen and, for the first time, blue, magnetic and highly reactive liquid oxygen.

New in the Faculty

A SCIENCE LEARNING CENTRE IN A NEW CHRIS HANI BUILDING

The Faculty of Science at UCT is arguably the leading Science Faculty on the continent, with a large proportion of its academic staff recognised as international leaders in their field, and able to attract a student body comprising the very best matriculants in the country. The Faculty is thus well placed to make an immense contribution to the country and the continent through production of graduates who are globally competitive and who will enter the world of work with badly needed S&T skills; skills that Africa is desperately short of. Despite the relative high quality of the students that we are able to attract, for many students in the Faculty, and particularly those from poor socio-economic backgrounds, throughput rates are poor.

It is clear from empirical evidence and from discussions with students, that the structure of the curriculum is not the only impediment to their success, but is a combination of factors including the teaching model, adjustment to life of a university student, and importantly the nature of the student experience outside of the formal class room. In particular, the provision of intervention programmes dealing with university life skills, as well as spaces conducive to formal and informal learning that can make a major difference to success.

Students in the Science Faculty currently contend with at least two important detractors to their success. The first is that they do not have access to suitable flat floor space for formal and informal teaching and learning, for collaborative learning, and student-led learning initiatives such as mentoring and peer-tutoring. The second detractor is perhaps ironically related to the flexibility of the Science curriculum and its range of choices, which, while having the advantage of catering to a breadth of interests and opportunities, also inadvertently prevents the development of a sense of community and common identity among Science students. It is now urgent that these crucial impediments to effective learning are addressed through the provision of a modern, creative learning environment.

The intention is to create a **Science Learning Centre** located within a repurposed Chris Hani Building that sits centrally to most Science Faculty Departments. The Science Learning Centre will provide the types of learning areas needed by our students that will enable them to engage with their studies outside of the formal class room. It will include informal (social) learning areas, attractive science displays, communication hubs, and formal flat floor venues for teaching and tutor/mentor-based cooperative learning activities. A 'think tank' with a digital virtual wall will provide an ideal location for more formal seminars and discussion groups at the senior undergraduate or postgraduate level. The proposed Science Learning Centre will thus go a long way to improving the quality of the Science student learning experience at UCT, and importantly will help provide them with a clear identity as Science students – an advantage that Engineering, Medical and Law students have. We are fully confident that a large modern learning space will not only contribute to enhancing the learning experience of our Science students, but will also stimulate innovative approaches to teaching and learning among academic staff. The combination of these and other initiatives should then result in markedly improved success rates and reduced drop-out rates, and contribute to diminishing of student debt. The further consequence would be that a more racially diverse cohort of graduates than at present will be equipped and empowered to enter the national and global arena with highly sought after S&T skills.

We hope to contact alumni in the near future to assist us with raising the necessary funds.

New Research Units in the Faculty

MeASURe - New Research Unit in Physics

Physics has a new research unit – MeASURe – the focus of which is on applications which require novel measurement techniques, and on research which advances the fundamental reference standards for measurement. *"It an appropriate time to launch MeASURe,"* says the Director, Professor Andy Buffler, "*since we are presently witnessing a redefinition of the System International (SI) base units which underpin all measurements."* In the new SI, four of the base units (the kilogram, the ampere, the kelvin and the mole) will be redefined in terms of fixed numeral values of four fundamental constants of nature: the Planck constant, the elementary charge, the Boltzmann constant, and the Avogadro constant. "*Within MeASURe, we are working with the National Metrology Institute of South Africa (NMISA) on instrumentation which will lead to new standards for current and mass for South Africa,"* adds Professor Buffler.

The recent acquisition of an 8mK dilution refrigerator by the Department of Physics allows the realization of the new quantum electrical standards right below the foyer of the RW James Building. We have also constructed a table-top Watt Balance which is the precursor to the new reference for mass for South Africa, replacing the arcane artefact, the International Prototype of the Kilogram, held in a vault in Paris." Another major activity within MeASURe is associated with the applications of neutron beams and gamma-rays. The Department of Physics operates a laboratory which uses PET scanners for fundamental studies of fluid flow, and is working with iThemba LABS and NMISA to establish the world's first fast neutron beam reference facility to be accredited by the ISO. Other current projects span medical radiation physics, nuclear engineering and physics-based simulations of radiation and materials.

We will be looking for new partnerships within UCT and beyond," adds Professor Buffler, ***"and we envisage the unit growing to become a portal into UCT for problems which require novel measurement-based solutions.***

iCWild
Institute for Communities and Wildlife in Africa

New Research Unit in Biological Sciences

iCWild was conceived following a competitive call by the University of Cape Town's Research Committee for "new flagship research areas in response to the abundant evidence of great potential at UCT to invigorate interdisciplinary research and to give such scholarship a higher profile". iCWild was nominated by the Faculty of Science and was subsequently selected by the University Research Committee as one of five new interdisciplinary Institutes at UCT. The unit's director is **Professor Justin O' Riain.**

iCWild, is a research led interdisciplinary team of academics, who in partnership with NGOs, local government and civil society are dedicated to understanding and mitigating conservation conflicts. They seek co-operative solutions at the interface between disciplines – biologists, sociologists and historians will work with agriculturalists, economists, philosophers, educators and engineers and many other disciplines, exploring new approaches to resolving chronic conflicts between society and wildlife. iCWild conforms to UCTs developmental model which seeks to actively grow a new cohort of research leaders in strategically identified areas, aligned to institutional, regional and national priorities.

Conservation conflicts currently being focused on by iCWild include conflicts between wildlife and people within communities over limited resources (e.g. livestock, crops, natural resources) and between community members and other stakeholders on how best to manage or mitigate these conflicts. iCWild challenges the divide between the social and natural sciences and between local and scientific knowledge as it strives to understand and ultimately guide the realignment between humans and the natural systems we depend on.

Farewell to Dean of Science
– Professor Anton le Roex in the Faculty

Professor le Roex was appointed as Dean of the Science Faculty on 1 January 2011 and has served as Dean for seven years. Before that he was Deputy Dean of the Faculty of Science for ten years, and was Head of the Department of Geological Sciences for 15 years – from 1991 until 2005. Professor le Roex started his career at UCT in 1981 as a Research Officer in the Department of Geochemistry after returning from a research position in the USA. He was appointed to a permanent lectureship in the then Department of Mineralogy & Geology in 1986, and has now amassed a total of 37 years of service to UCT. He has been a member of the Senate at UCT since 1991 and was a student advisor in the Faculty of Science from 1986 until 2002.

Prior to working at UCT, Professor le Roex held a research post at the Woods Hole Oceanographic Institution in Massachusetts, USA, and in 1989-1990 he spent a year at the University of Hawaii as a visiting professor. During the course of his career he has also spent a number of short-term periods of research leave at academic institutions in the USA and the United Kingdom. Although Anton grew up in Pietermaritzburg, he travelled south to earn his BSc cum laude (Geology, Geochemistry) from the University of Stellenbosch (1975), his BSc Hons, first-class (Geochemistry) from UCT in 1976, and his PhD (Geochemistry) at UCT in 1980.

Some of the **highlights** of his tenure as Dean include working with staff in the Faculty to develop the new research strategy for the Faculty; developing a new BSc curriculum structure and extended degree programme; and developing a more aggressive equity strategy for the Faculty. The merger of the previously separate departments of Botany and Zoology into the new Department of Biological Sciences was an important moment in the Faculty's history. Other highlights include working with truly exceptional research leaders in their fields, the expansion of SARChI chairs in the faculty, and seeing the burgeoning academic strength of many young appointments in the faculty – a number of whom are now NRF P-rated researchers and who will become the next generation of research leaders in the Faculty. He has also found it encouraging to see the increased international recognition received by the faculty in the international ranking systems, with a number of departments and sub-disciplines in the faculty being ranked in the top 100 in the world. He has also been pleased that, although slow, there has been clear progress in the changing demography of, particularly, the academic staff in the faculty, and in the undergraduate and postgraduate student bodies.

Overall, Anton says that he greatly enjoyed his time as Dean and the opportunity it provided to work with an outstanding group of academic and PASS staff, and getting to know the wide range of exciting research projects and innovative teaching being undertaken by the staff of the faculty. In all, it had been a deeply rewarding experience heading up such a strong and dynamic faculty.

What was challenging during his time as Dean of Science was to remain active in research without compromising his responsibilities towards his role as Dean.

Back to contents page

In Memorium

The Science Faculty mourns the loss of **Dr Karl Wilkinson,** a lecturer in the Department of Chemistry. Karl came to the UCT in 2008 as a postdoctoral fellow with a coding talent that was instrumental in the initiation of a great project that brought about UCT's active participation in the field of quantum chemistry software development for next generation high-performance computers. He was a specialist in writing complex quantum code for graphical processing units. He did this despite suffering from intense bouts of migraines.

Associate Professor Neil Ravenscroft, head of the Department of Chemistry, said, "There are moments in the lives of even the most rational amongst us when we are reminded of our frailty and of the strength we draw from being amongst like-minded souls. Today is such a day for the colleagues and students in the Scientific Computing Research Unit and the Department of Chemistry. We have lost Karl Wilkinson, a friend, a colleague, a mentor, a young mind that gave us so much." Dr Kevin Naidoo, a colleague and former mentor, said, "Karl went about his teaching and research in a quiet but determined way that showed so much promise. As a researcher he threw everything he had at the most challenging problems; as a colleague he was always willing to share his talents and insights with students and staff alike. In the nascent field of scientific computing at UCT, he had started to make a mark that would without a doubt become large footprints over time. He will be missed very much by all who knew him."

Dr Wilkinson is survived by his wife, Amilinda Wilkinson, a staff member in the Land and Accountability Research Centre in the Faculty of Law.

It is with great sadness that we note the passing of **Associate Professor Mike Lucas**, from the Department of Biological Sciences. Mike has been at UCT since the late 1970's and during this time, many students at undergraduate and postgraduate level have passed through his very capable hands. He started his formal employment at UCT in 1982 as an "Antarctic Officer" involved in deep water marine research funded by the South African Antarctic Programme, before joining the academic staff of the then Department of Zoology. His love of the sea and all things marine biological are well known, and during his time at UCT he enthused many generations of students in the mysteries of the marine world and more recently, the link to climate change. His recent book, co-authored with Mary and Bob Scholes, entitled "Climate Change: briefings from southern Africa" is testament to his deep love for the oceans and their interaction with the climate.

Associate Professor Lucas spent a great deal of his professional life on research cruises in the oceans around South Africa and in the North Atlantic. He helped guide the education and careers of many undergraduates and postgraduates. Many generations were inspired by his lectures in class and on field trips. He will be remembered for his charm and ability to effectively communicate sciences to a wide audience. He will be missed by those who knew and worked with him.

Keep Connected - Stay in Touch - Keep Connected

We value regular contact with our alumni, so please emails us on **katherine.wilson@uct.ac.za** We would like to hear about what you are doing with your Science degree in order for us to inspire a young generation of potential scientists and build career profiles of opportunities for Science graduates.

We would also like to cover interesting initiatives you are involved in, in future *Contact* newsletters.

Contact is published by the Faculty of Science at UCT.
www.science.uct.ac.za

Editor: Katherine Wilson +27 (0) 21 650 2574

Design: Pixeltrees. tc@pixeltrees.co.za

Back to contents page