CONTACT

NEWSLETTER OF THE FACULTY OF SCIENCE • DECEMBER 2013
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SOME ARTICLES IN THIS ISSUE

MESSAGE FROM THE DEAN

The year 2013 ended with the sad loss of our iconic past president – Nelson Mandela, who passed away peacefully on 5 December after a protracted illness. The subsequent 10 days of mourning provided staff and students in the Faculty the opportunity to reflect on the immense positive changes to the country, including university access, brought about by Mandela's powerful and respected leadership. For the Science Faculty it was a productive year, with numerous staff and students receiving prestigious awards of recognition, the Faculty's new Extended Degree Programme was initiated with success, postgraduate numbers continued to grow, and research activity in the Faculty flourished, despite pressure on funding for basic research.

This 2013 edition of *Contact* – our formal Science Faculty publication aimed at maintaining contact with our alumni, contains news and information on many of the year's highlights in research and teaching. A number of our staff (young and older) were rewarded for their excellence in research with prestigious national and international awards, and it is particularly gratifying to see the strength of our younger staff in this regard. Equally satisfying were the number of international awards our undergraduate and postgraduate students garnered, which bodes very well for the future of Science in the country.

The Faculty remains proud of the increasing numbers of registered postgraduate students, which aligns well with the new UCT Size & Shape strategy of growing primarily at the postgraduate level. In 2013 the Science Faculty capped the number of first time entering undergraduates at 450 to ensure that our facilities – class room and laboratories, were able to comfortably house our classes and provide for a high quality learning experience. Registered PhD students reached a record number of 391 in 2013 – of whom 55 graduated, and together with some 470 Master's degree students, our overall postgraduate numbers showed a modest growth in comparison to 2012. It is particularly pleasing to note that our postdoctoral fellows also continue to grow despite funding pressure, and at 130 now constitute over half the total number at UCT. At staff level, there was something of a changing of the guard, with 9 senior staff retiring in December 2013. Collectively, and individually, they represent an immense loss to the Faculty – in performance, impact and wisdom; a loss that I am confident will be filled by the many outstanding younger staff we are privileged to have in our ranks, including some new appointees.

In the following pages, we report on some of the awards received by staff and students, and thereafter a few short articles capture some of the interesting scientific research that is being done by members of the Faculty. In pursuit of answers to research questions, staff and postgraduate students alike travelled to interesting locations across the globe, and some short highlights are captured. The final sections reflect on some of the outreach activities of the Faculty, the newly launched "Winter School" aimed

at enthusing first year students into the excitement of scientific discovery, and we say a sad farewell to a long standing staff member, and Director of the Percy FitzPatrick institute of African Ornithology, Phil Hockey, who passed away prematurely earlier in the year.

I hope that you enjoy this 2013 edition of *Contact*, and please remain in touch with us.

Anton le Roex
Professor of Geochemistry
Dean of Science

HIGHLIGHTS OF 2013

A number of Faculty staff and students were recognised locally, nationally and internationally in 2013 for their achievements in Science.

RESEARCH AWARDS – 2013

» **Professor William Bond**, the Harry Bolus Professor of Botany from the Department of Botany, was recently elected as a foreign Associate of the National Academy of Science in the USA, in recognition of his distinguished and continuing achievements in original research. Professor Bond is only the third South African ever to receive this honour and we congratulate him on this prestigious award.

» **Professor Kelly Chibale** received the MRC Young Scientist Award (Silver Medal) in recognition of the excellence of his research in the area of Drug Discovery. He was commended for leading the project team that discovered a potential new drug treatment for malaria.

» **Professor Daya Reddy** has been elected as president of Academy of Science of South Africa (ASSAf) - a reflection of the high esteem in which he is held by the South African research community.

» **Dr Maano Ramutsindela**, from the Department of Environmental and Geographical Science, received the prestigious NRF award for Transformation of the Science Cohort, for his efforts to transform science in South Africa through attracting more black scientists to academia and helping them become leaders in their respective fields.

» The World Academy of Science (TWAS) awarded their Regional prizes for the "Public Understanding and Popularization of Science" to five researchers from different regions of the developing world, who have worked creatively to popularize science. The TWAS Sub-Saharan Africa prize was award to **Professor Anusuya Chinsamy-Turan**, Head of the Department of Biological Sciences.

» **Emeritus Associate Professor Jenny Day** was awarded the South African Society of Aquatic Scientists Gold Medal – awarded on rare occasions in recognition of an exceptionally high standard of research in the aquatic sciences, or an exceptionally valuable contribution to the management, conservation or development of aquatic ecosystems or resources, over an extended period.

» **Dr Deena Pillay** from the Department of Biological Sciences, received the Claude Leon Merit award for young lecturers.

» **Dr Amanda Weltman** from the Department of Mathematics & Applied Mathematics was awarded the Jubilee Silver medal from the South African Institute of Physics.

» **Professor Graham Cumming**, from the Depatment of Biological Sciences, won the T W Kambule NRF Awards: To an Individual for an Outstanding Contribution to SETI through Research and its Outputs over the last five to ten eyars.

» **Associate Professor Patrick Woudt**, from the Department of Astronomy was co-author on the first scientific paper based on the observations performed with South Africa's new KAT-7 telescope. Cape Town is currently the hot spot with regard to radio astronomy and UCT is becoming a hub for astronomical and astrophysics research in Africa.

» **Professor Mino Caira**, from the Department of Chemistry, presented a lecture at the 1st Latin American Meeting on Crystallography at the National University of Cordoba and was awarded honorary membership of the Society. The award was made in recognition of his contributions to supramolecular beneficiation of organic compounds.

» **Dr Andrew Hamilton**, from the Department of Physics is the recipient of the College of Fellows Young Researcher Award, for his research in high energy particle physics, working in the ATLAS Collaboration at the European Centre for Nuclear Research in Geneva .

» Three faculty members were honoured by the prestigious Alexander von Humboldt Foundation at the Annual General Meeting of the Foundation in Berlin in June this year. **Professor Daya Reddy** (Mathematics and Applied Mathematics), **Emeritus Professor Cesario Dominguez** (Physics), **Dr Heather Marco** (Biological Sciences) all received awards.

STUDENT AWARDS & ACHIEVEMENTS

» **John Woodland** an MSc student in the Department of Chemistry, took second place in South Africa's first Science Slam that took place in Johannesburg. The brief was to 'make the lay audience understand and get excited about the scientific research topic you are passionate about'. John also presented his research on accelerating the development of more effective and more efficient antimalarial agents at the Falling Walls Lab in Johannesburg, where participants were given three minutes to present their research. He won this competition and was invited to participate in the international Falling Walls Lab in Berlin, where he won third place in the "Young innovator of the Year" competition.

» **Michelle Knights**, a PhD student in Cosmology and Astrophysics, was the winner of South Africa's first ever FameLab competition and represented South Africa at the FameLab International semi-finals where she talked about the use of pulsars to demonstrate gravitational waves, postulated by Einstein, and one of the areas which will be studied by the SKA project currently under development in South Africa.

» **Hayley Evers-King**, a PhD student in the Department of Oceanography was voted winner of her zone in "I'm a Scientist, get me out of here" – an online outreach programme bringing science to schools in the UK. The initiative gives students an opportunity to interact with scientists online: in forums and fast paced live-chats.

» **Sizwe Ndlovu**, from the Department of Computer Science won an internship in Europe as a prize at the International Business Game. This competition targets final year and post graduate students. Sizwe and fellow UCT students Thembeka Setlogile and Tetlanya Lekalake represented South Africa in the finals in Paris. He will take up his internship in 2014 after finishing his studies at UCT.

HIGHLIGHTS OF 2013

» **Banothile Makhubela,** a Postdoctoral research fellow in the Department of Chemistry, whose field of work is organometallic chemistry with applications in catalysis, medicine and nanomaterials, was selected to attend the meeting of Nobel Laureates in Lindau, Germany. The 2013 meeting was dedicated to chemistry and involved young researchers from 78 different countries.

» A brilliant UCT mathematics team *(pictured above)*, flew the UCT flag high in Bulgaria and came 18th out of 72 participating universities, at an international mathematics competition. The university's ranking at 18th saw it ahead of Yale (25th) and Cambridge (32nd). The team representing UCT in Blagoevgrad, a city in south western Bulgaria, consisted of L**iam Baker**, a maths honours student, first-years **Robert Spencer** and **Dylan Nelson**, and **Sean Wentzel** a second-year student. The four team members are no strangers to international competitions – as school boys they represented South Africa at the International Mathematics Olympiads on more than one occasion. Wentzel and Baker were awarded first prizes and given gold medals after being ranked overall 30th and 33rd, respectively. Spencer got an honourable mention in the competition, which took place over two days, and in which 321 students from 72 universities participated.

» **Dr Hilkka Njaula a Ma-Re** post doctoral student in the Department of Biological Sciences and founder and director of Dried Fish Company (DFC), and in partnership with the Women's Enterprise Development Initiative (WEDI), won the 2013 SEED (Supporting Entrepreneurs for Sustainable Development) Award. The SEED Initiative supports entrepreneurial and innovative ideas that are locally-driven and have great potential to contribute to sustainable development.

STAFF ACHIEVEMENTS

» **World IT Breakthrough** – A Cape Town technology company has rocked the international technology world with the unveiling of the first new type of transistor in 65 years. The invention is called the "current switching transistor" by is inventors PST Sensors. PST Sensor chief technology officer **Professor David Britton**, professor in UCT's Department of Physics and NanoScience Innovation Centre, describes the transistor as a major breakthrough. Electronic devices, such as computers, often need millions of transistors—semiconductor devices used to amplify and switch electronic signals needed to perform calculations for the function of electronics. **Margit Harting**, Department of Physics and PST Sensors chief strategy officer and director of research and development in the NanoSciences Innovation Centre, explains that the new switch transistor does the work of several transistors, freeing up space and potentially increasing the output of the device and improving power management.

The innovation has also been hailed for its potential to open up a new field on the use of transistors.

Britton described the reaction at the European exhibition as "gobsmacked". "You could have heard a pin drop. I believe the audience was in shock and disbelief because of the implications to transistor technology, the simplicity of it, and why it had never been done before," he said.

Prof Nicci Illing with Dr Lynne Shannon, Dr Tony Verboom Professors Anton le Roex and Ed Rybicki

MORE RESEARCH AWARDS IN THE SCIENCE FACULTY

Three members of the Science Faculty received awards at the annual Science Faculty Research Awards Ceremony, which celebrated outstanding papers published in the period 2009-2013, which report on research led by UCT scientists.

Professor Ed Rybicki from the Department of Molecular and Cell Biology received an award for his paper titled, "Plant produced vaccines: promise and reality", published in Drug Discovery Today in 2009, which has already been cited 61 times. Ed's expertise in this field is confirmed with the publication in 2010 of a second review, "Plant-made vaccines for humans and animals" in Plant Biotechnology Journal, which has received over 50 citations.

The Department of Biological Sciences boasts two awards. **Dr Tony Verboom** received an award in the lecturer/senior lecturer category for his first authorship on a paper titled, "Origin and diversification of the Greater Cape flora: Ancient species repository, hot-bed of recent radiation, or both?" which was published in Molecular Phylogenetics and Evolution in 2009 and has already been cited 45 times. Tony's top papers in this period under review, also include "The importance of nutritional regulation of plant water flux" published in Oecologia in 2009, co-authored with **Associate Professor Michael Cramer**, with 41 citations.

A special award for research staff who are not GOB-funded was given to **Dr Lynne Shannon**, a member of the Marine Research Institute. Lynne has published a suite of papers including first authorship on a 2009 paper titled, "Exploring the dynamics of ecological indicators using food web models fitted to time series of abundance and catch data", in Ecological Indicators and cited 23 times. She has also co-authored several high profile papers, including two in Science in 2011. (Global Seabird Response to Forage Fish Depletion: One-Third for the Birds, and Impacts of Fishing Low-Trophic Level Species on Marine Ecosystems) which have been cited 32 and 25 times, respectively.

FEATURES

A closer look at some current research projects at the Science Faculty.

Evidence of oldest stone-tipped throwing spears in the world discovered in Ethiopia

An international team of researchers working in the Ethiopian Rift Valley has just published new results of studies on 280 000-year-old pointed stone artifacts which are shown to have been used as the tips of throwing spears. The first author on the paper, in the journal *PLOS ONE*, is Yonatan Sahle Chemere, a PhD student from the Department of Archaeology at UCT, who conducted the study as part of his doctoral dissertation resesarch. Co-authors on the paper are Dr David Braun and Professor Judith Sealy from the Department of Archaeology at UCT.

The conclusion that hominids in Africa threw stone-tipped spears at their targets in deep antiquity was drawn from analysis of speak points made on volcanic glass called obsidian at the Ethiopian Stone Age site known as Gademotta. The analysis combined a traditional assessment of overall spear point shapes and breakage patterns alongside newer microscopic methods able to establish that the obsidian points had been broken by high velocity impacts.

Throwing spears provided their makers the advantage of wounding/ killing at a distance. Therefore, they reduced dangerous confrontations, and possibly fatal scenarios, during hunting and combat. In addition, making stone-tipped throwing spears requires attachment of the stone tip to the spear's shaft. Bringing different components together in a single tool is considered by archaeologists to be evidence of sophisticated technological behaviour.

The present discovery provides crucial evidence that hominids actually threw stone-tipped spears at their targets tens of thousands of years before the emergence of our species *Homo sapiens* in eastern Africa. Fossils of the world's earliest *Homo sapiens* are known from nearby sites in Ethiopia that are 85 000 years younger than the spear points.

Evidence for early hunting with hafted spear points was recently reported at a site in South Africa called Kathu Pan. However, inferences are that these South African spears had been thrust into prey, not thrown from a distance. The Gademotta finds provide the earliest conclusive evidence for hafted, hand-thrown spears.

Certain views about the emergence of what are known as "complex behaviours" hold that this was a relatively swift advance that took place over 100 000 years after the earliest *Homo sapiens* had appeared in Africa. The results of this study indicate that the earliest members of our species and their immediate predecessors already possessed some behaviours considered to be "complex". As a result, our understanding of the lines of evidence that are considered to be markers of becoming *human*, will need adjustment.

Mandibular remains support taxonomic validity of Australopithecus sediba

Head skeleton of Au. sediba. (Credit: Brett Gloff)

Close examination of the lower jawbone and teeth of the hominin species Australopithecus sediba proves conclusively that it is uniquely different from a closely related species, Australopithecus africanus, according to a paper authored by a scientific team that includes two UCT researchers. Australopithecus sediba is a hominin species, described in 2010, whose fossil remains were originally found at a site near Johannesburg, and dated to 1.98 milion years ago.

Rebecca Ackermann *(right)*, associate professor in the Department of Archaeology, and her PhD student, **Lauren Schroeder***(left)*, looked specifically at growth within this species, comparing this to other living and extinct species. They demonstrated that the growth trajectory from a juvenile to an adult form was unlike that of any other hominin species known, though it does share features with older australopiths, as well as later specimens referred to as Homo erectus. Combined with additional analyses of size and shape variation, this research supports the unique, possibly transitional, appearance of Australopithecus sediba.

FEATURES

Mysterious 'Fairy Circles' in African Desert Get New Explanation



Fairy circles are circular patches of perennial grasses with a barren center that emerge in the deserts along the southwest coast of Africa. The bizarre circular patches of bare land called "fairy circles" in the grasslands of Africa's Namib Desert have defied explanation, with hypotheses ranging from ants to termites to grass-killing gas that seeps out of the soil. New research suggests that the patches may be the natural result of the subsurface competition for resources among plants.

Grasslands in the Namib Desert start off homogenous, but sparse rainfall and nutrient-poor soil spark intense competition between the grasses, according to the new theory. Strong grasses sap all of the water and nutrients from the soil, causing their weaker neighbors to die and a barren gap to form in the landscape. The vegetation gap expands as the competition ensues, and the grass-free zone becomes a reservoir for nutrients and water. With the additional resources, larger grass species are then able to take root at the periphery of the gap, and a stable fairy circle develops.

Michael Cramer, from the Biological Sciences department is the lead researcher of the current study, published recently in the journal PLOS ONE, also thinks the termite theory falls short. "I think the major hurdle that explanations have to overcome is explaining the regular spacing of the circles, their approximate circularity and their size," Cramer told LiveScience. "There's no real reason why termites would produce such large circles that are so evenly spaced."

Scientists have previously proposed that fairy circles are an example of a "self-organizing vegetation pattern," which arises from plant interactions. In 2008, researchers developed a mathematical model showing the vegetation patterning of fairy circles could depend on water availability. To test this theory, Cramer and his colleague Nichole Barger from the University of Colorado at Boulder first measured the size, density and landscape occupancy of fairy circle sites across Namibia, using both Google Earth and ground surveys. They then collected soil samples at various depths from inside and outside the circles, and analyzed them for water and nutrient content. Finally, they plugged the information, along with climate data such as seasonal precipitation and temperatures, into their computer models. "We found that the size of the circle, the density and degree to which they occupy the landscape are all associated with the amount of resources available," Cramer said. Specifically, fairy circles are smaller if they have more resources, such as soil nitrogen and rainfall. This makes sense, Cramer explained, because the taller grasses won't need a large reservoir of resources to get started and survive if water and nutrients are already available in the environment. On the other hand, the grasses require a large reservoir to sustain themselves if the soil is poor in water and nutrients.

The researchers discovered that rainfall strongly determines the distribution of the fairy circles across Namibia, with circles only appearing in areas where there is just the right amount of rain (not too little, but not too much). If there's too much rain, the bountiful resources would "relax" the competition for resources and the circles would close up; but if there's too little rain, the competition would become too severe and the circles would again disappear, Cramer said. Because the circles can only occur in this narrow moisture range, differences in rainfall from year to year may cause them to suddenly disappear and reappear in an area over time. With this information, they found that they could predict the distribution of the fairy circles with 95 percent accuracy. Additionally, the regular spacing between fairy circles may be the result of inter-circle competition, with grasses from each circle "battling" with other circle grasses for resources, Cramer said. Cramer notes that termites may still be involved in fairy circles. "What sets up the circles is the competition between plants," he said. "Termites are a secondary phenomenon, and their role is to serve as a maintenance for the circles by killing off the grasses that spring up in the center of the circles."

FEATURES

HOT BIRDS: the effects of high temperatures on the breeding success of a desert bird

A paper, written by Drs Susan Cunningham and Rowan Martin (UCT post docs in the Percy FitzPatrick Institute of African Ornithology), together with Carryn Hojem (Percy FitzPatrick field assistant) and the late Prof. Phil Hockey (FitzPatrick director), concerning the effect of high temperatures on breeding success of a desert bird species in the southern Kalahari, was recently published in *PLOS ONE*. The threat of climate change has led to an enormous increase in research on how species are likely to respond to higher temperatures and changing precipitation patterns. Much of this research has been based on modelling of species' current favoured climatic zones ('climate envelopes') and where these are likely to occur in future. We are still short on knowledge of the mechanisms linking species to their climate envelopes, however. Such knowledge is crucial to our understanding of the extent to which animals and plants will be able to adapt to new climates, or track the movement of climates across the landscape.

In their study, the authors addressed this shortfall using a widespread species, the southern fiscal (*Lanius collaris*, also known as the fiscal shrike or common fiscal). These birds are sit-and-wait predators, perching on exposed branches and dropping down to catch unsuspecting invertebrates, reptiles and even small mammals and birds. They studied these birds near the edge of their range in the Kalahari Desert in order to understand how their breeding success is affected by high temperatures. It is worth noting that average temperatures in the Kalahari are expected to increase by up to 4°C by 2080. The study focused on how the provisioning behaviour of parent southern fiscals changes, with rising temperature. They investigated how this change in parental behaviour, together with direct effects of temperature on the nestlings themselves, affected nestling growth rates. They also investigated the knock-on consequences for the chicks as they left the nest on their way to becoming independent adults.

It is a well-documented tenet of animal behaviour that when the going gets tough, long lived parents (those capable of producing multiple litters or broods within their lifetime) may focus on their own well-being at the expense of their current offspring. In keeping with this, we discovered that hot temperatures during the day caused shrike parents – particularly those with large broods of offspring – to reduce the rate at which they brought food to the nest. Combined with direct effects of high temperatures on the nestlings themselves, this caused reductions in growth that were very significant for young nestlings (6-day old chicks could gain ~40% body mass during a cool day with air temperatures in the high 20s, but this dropped to around 5-10% on a hot day when temperatures approached 40°C).

Should we be worried that increasingly hot weather might cause some birds to leave the nest smaller and later? With regard to leaving the nest smaller, it's hard to say. There is a lot of evidence that smaller individuals in bird populations survive less well over winter, and breed less successfully as adults. So there could be a disadvantage for southern fiscals unlucky enough to experience a heat wave while in the nest. If sufficiently large proportions of each cohort of individuals suffer heat waves as nestlings, then population-level effects may occur. Alternatively two studies from Israel and Australia have both found that desert birds across a wide range of species have been getting smaller through time in response to climate change. There is even some suggestion this may be advantageous, as smaller birds might be able to better manage heat load in a warming environment. However, delays in fledging caused by hot weather

are unequivocally a problem for nestlings because remaining in one place for a long time is dangerous: each day spent in the nest carries an increased risk that the whole brood will be found and destroyed by a predator. At our study site, the daily predation risk was 4%. In areas with lots of predators, short nestling periods are an imperative for survival.

This study was undertaken in the context of a larger programme of research: the "Hot Birds" programme, where researchers seek a greater understanding of precisely how climate change is likely to affect our birds through investigation of the mechanistic links between climate, physiology, behavior, and ultimately population processes.

FEATURES

Robots record changes in Southern Ocean

Off the coast of South Africa, ocean robots are sending back information to help us understand how climate is changing. The recent report by the United Nations' Intergovernmental Panel on Climate Change (IPCC) paints a bleak picture, in which the days are getting hotter and the ocean is becoming more acidic. But the Southern Ocean, where you are most likely to see the change, is one of the most understudied, says Pedro Monteiro, the head of the Southern Oceans Carbon-Climate Observatory in Cape Town and Research Associate at UCT.

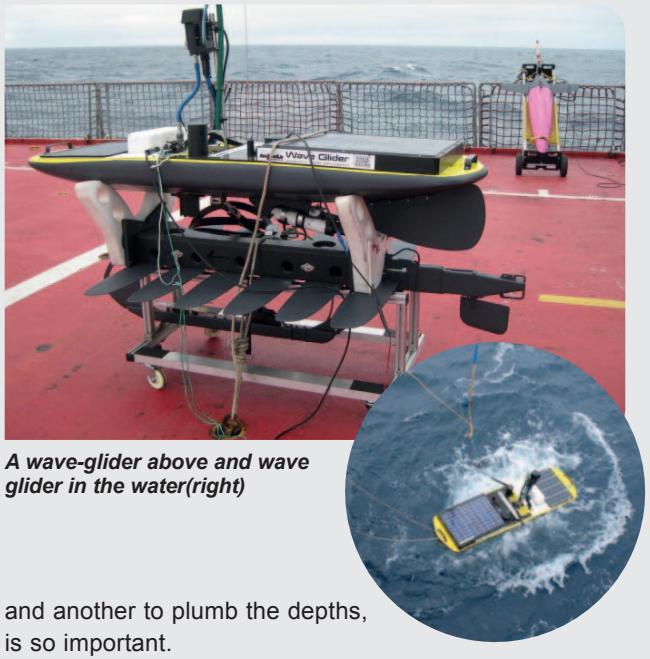
The world has always had a natural carbon cycle, with about 100 gigatonnes of carbon dioxide being exchanged between the atmosphere, the oceans and the land. Anthropogenic carbon dioxide emissions, those emitted by human activity, are magnitudes less than the total cycle at about nine to 10 gigatonnes but, "of that, half stays in the atmosphere … and a quarter goes into the oceans", says Monteiro, who is also research group leader for the ocean systems and climate research unit at the Council for Scientific and Industrial Research (CSIR).

"By adding carbon dioxide to the ocean, we're changing the ocean chemistry and that's giving rise to ocean acidification," he says.

The Southern Ocean is particularly important in determining how the world's oceans are changing. It is the only ocean that is surrounded by other oceans, not land. Although it has been described as the "lungs of the oceans", there is a paucity of data about seasonal variability in the Southern Ocean and its chemistry at different depths.

"The deep ocean has 50 times more carbon dioxide than the atmosphere," Monteiro says.

That is why robot deployment, one to surf the waves and another to plumb the depths, is so important.



A wave-glider above and wave glider in the water(right)

"For the first time, we are deploying a wave glider in the Southern Ocean but, of more significance to climate researchers, we have twinned it with a buoyancy glider that dives below the wave glider," says mission co-ordinator Sebastiaan Swart.

Both robots, which are remotely driven from Cape Town and resemble torpedoes, are equipped with sensors that measure variables such as temperature, salinity and ocean acidity, and these data is transmitted to the observatory every hour or, in the case of the buoyancy robot, when it comes to the surface.

"They are like satellites but in the ocean," says Monteiro, adding that they will be picked up in February next year.

Gliders are the future – they allow for collecting data over long periods of time without having to be there.

Major boost for biological control of black wattle

by John Hoffman, Department of Biological Sciences

Dasineura rubiformis—gall fly

Black wattle is rated as one of South Africa's most prolific invasive weeds, having colonised almost every province within the country, where it dominates the landscape and has negative impacts on biodiversity, agriculture and water resources. All of this could change with the sight of black wattle trees heavily laden with seed pods becoming a thing of the past, as a tiny insect starts to take command, thanks to a collaborative research project between the Agricultural Research Council and the Biological Sciences Department at UCT.

The insect is a minute gall fly (midge) native to Australia, which was introduced into South Africa as a biological control agent of black wattle a number of years ago. By 2006 a population of the midge was established in Stellenbosch, where it has become abundant and has spread to other sites in the Western Cape. Because its natural dispersal is relatively slow, the midge has been manually distributed to numerous sites in Mpumalanga, Kwa-Zulu Natal and the Western and Easter Cape provinces since 2010.

The adult midges are only 2mm long, do not feed and only live for about five days during late spring. Females lay their eggs within the open flower clusters of black wattle where the newly-hatched larvae feed on the florets causing the stigma to form gall tissue which encloses the midge larvae and prevents pod development.

At the sites where the midges are well established, seed production has declined dramatically and in some cases has virtually ceased, with only large bunches of galls evident on the trees, where seed pods once hung in abundance. Although this reduction in seeding will not cause an immediate decline in the density of existing thickets of black wattle, it will curb the invasiveness and rate of spread of the plants and thereby prevent the problem from escalating further.

FEATURES

The ups and downs of dust

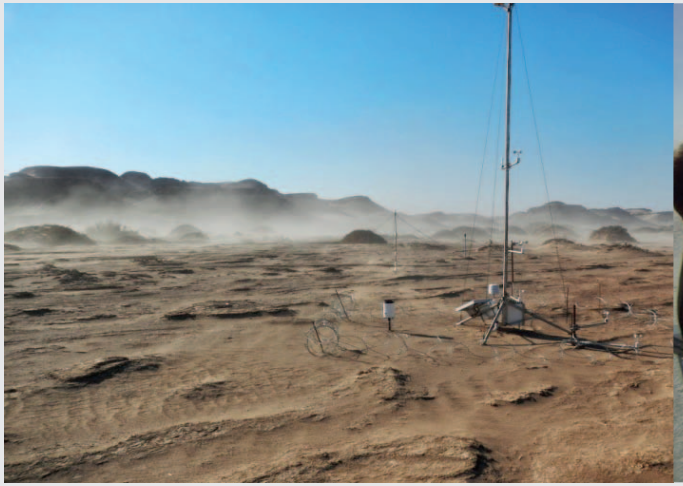
by Frank Eckardt

Just because dust is small does not mean it does not matter. Some areas such as desert pans liberate thousands of tons per annum, which affects regional air and soil quality and plays a role in ocean productivity and global climate forcing. Furthermore, current climate models are not able to resolve dust producing events. They have the capability to emulate the winds required to produce dust, but they are not able to capture the essential processes which govern dust producing desert surface.

The controlling factors which include moisture, roughness, crusting and mobile sand particles as well as human interference, are spatially and temporally rather variable but ultimately determine if plumes of dust, hundreds of kilometers in length can be generated during periods of strong wind. When and how dust sources, such as southern Africa's great salt lakes, become active, was at the heart of our work, which took us on three consecutive winters, to Botswana's Makgadikgadi Pan, as well as Namibia's Skeleton coast and the Namib Sand Sea.

Not only do you have to be at the right place, but you also need to have all the monitoring equipment up and running and ready to capture the critical wind and surface data. This required significant UK-NERC funding and coordinated field effort spear-headed from Oxford, Southampton as well as UCT CSAG, UNAM and Gobabeb. The fieldwork required shipping and driving approximately 15 cubic metres of equipment across borders into remote corners of Namibia and Botswana, using Hiluxes, trailers and roofracks, with permits and additional paperwork in tow. It can take up to three weeks just to set up the equipment, which measured dozens of parameters at each site, for months on end, with a resolution of less than a minute during actual events.

The dozen monitoring sites, sometimes hundreds of kilometers apart, were carefully identified by Kathryn Vickery an MSc student in the Department of Environmental & Geographical Science, who went through thousands of satellite images, looking for past dust plumes. Kathryn is now doing a PhD on the chemistry of the actual surfaces and resulting particles, examining tens of thousands of particles with unique characteristics and composition.



Active Dust Day in the Lower Huab.

Dusttrack measures suspended particles.

In addition we now have data that helps us fine-tune existing climate models and possibly even develop new ones, in the quest to capture the complex natural dynamics of our atmosphere - including its aerosol loading and associated radiative and chemical properties.

WHAT IS THE DUST PROJECT?

The project looks at the production of dust from some of the world's major natural dust sources which are the dry lake environments found in arid regions around the world. Atmospheric dust deposition has a local impact on people and soils, effecting human health and soil quality but also regulates the incoming radiation and global radiation budget. We know that CO2 is warming the atmosphere but dust particles are very diverse in nature and may both cool and heat the earth depending on their shape, composition and altitude.

WHAT ARE YOU DOING?

We are measuring wind and surface characteristics and their control on dust emission processes from pan surfaces.

WHERE ARE YOU WORKING?

We are currently working on the six thousand square km sized Makgadikgadi Pan in Botswana which features in the top ten of global dust producing areas.

WHAT ARE YOU HOPING TO ACHIEVE?

We want to collect baseline data that can be fed into global climate models which currently do not have a handle and constraint on dust production.

FEATURES: DISTINGUISHED ALUMNI LECTURE IN THE FACULTY OF SCIENCE

The Sex Life of Plants – New Revelations from the Field and Laboratory

Professor Steve Johnson from the University of KwaZulu-Natal gave this year's Distinguished Alumni lecture in the Faculty of Science at UCT. The topic of his talk was "The Sex Life of Plants – New revelations from the field and laboratory". Professor Johnson who did his undergraduate and PhD degree in the Faculty of Science at UCT, holds the SA Research Chair in Evolutionary Biology and is a Professor in the School of Biological & Conservation Sciences at the University of KwaZulu-Natal in Pietermaritzburg.

Prof Steve Johnson and Kathy Johnson, also a Science faculty alumnus.

The audience at this year's distinguished alumni lecture.

Prof Steve Johnson.

Using a humorous approach and parallels with human sexuality, he spoke about sexual selection and adaptations by plants and evolution – indicating evolutionary traits that improve mating success and have driven diversification of plants. He captivated the audience and gave substance and insight into what we see every day in our natural environment, but seldom stop to think about.

Professor Johnson revealed how plants are shifting and adapting to different pollination methods and highlighted how ecologically diverse plants tended to be hermaphrodites but that this can be dangerous for plants because of the risk of intrabreeding.

Professor Johnson said that plant sex is usually a ménage a trois and the third party acts as a courier service. In describing the pollen postal service, Professor Johnson explained how orchids glue pollen onto the body of insects and that as researchers they can stain pollen to track where it moves. Interestingly a species such as the Disa, has a relationship with only one butterfly which it relies on for pollination.

Just like humans who "dress for success" plants visually advertise to insects with their vibrant colours – the pigments – according to their preference for pollinators. Blue flowers tend to attract bees whereas white flowers tend to attract moths. Many plants have nectar guides which guide insects into the labyrinth of the flowers in order to transfer the pollen. If these guides are artifically removed from the petals, it was shown that the insects could not get their proboscis into the chamber. Researchers also utilised mimicry to attract pollinators by matching the spectral reflection of colours. They built plastic flowers out of overhead transparency sheets, in varying colours and these were just as attractive to the pollinator as the real flowers were. This indicated that pollination has nothing to do with the scent or shape of the plants, but that it is spectral reflection that actually matters. In contrast, moth pollination at night does require scent to guide it to the flowers.

Johnson gave a window into the fascinating world of plants and pollinators, highlighting, among other things, how plants with long tubes (which are difficult to access) give bribes to pollinators to encourage them to visit; how plants develop different ways of transferring pollen; the evolution of new species; how plants deceive pollinators through sexual mimicry; how gender conflict in plants impacts seed sets; the advantages and disadvantages of being hermaphrodite plants; how botanists remove the male part of the plant, emasculating it in order to increase seed production and avoid gender interference.

In conclusion, Professor Johnson posed the question of whether scientists need to be concerned that the complex relationship between plants and pollinators could break down as a result of influences in our changing world. He suggested that in order to preserve the relationship, we need to have a clearer understanding of these impacts. Furthermore he stressed the importance of finding new ways of observing the world around us. He highlighted how technology gives us an expanded set of tools for observing the natural world and emphasised that plants have highly specialised reproductive systems and that this has contributed to their evolution and diversification.

THE SCIENCE FACULTY TRAVELS AROUND OUR WORLD.....

To Antarctica – alongside Sir Ranulph Fiennes

by Emma Bone, PhD student in the Department of Oceanography

I made a shift from Cell Biology and working with tissue culture to exploring the wild Southern Ocean, focussing on phytoplankton photophysiology. Nutrient availability and various physical forcing mechanism greatly influence the Southern Ocean's participation in the global carbon cycle. Understanding these influences will help us ensure the Southern Ocean continues to act as a sink for anthropogenic carbon dioxide and not a source, which is vital in terms of global warming.

The SA Agulhas set sail with four scientists contracted by the CSIR, to sample the Southern Ocean and collect summer data sets. Their departure was spectacular—with cannon blasts and a brass-band, because Sir Ranulph Fiennes and his team were also heading south on the same polar vessel. On their first afternoon on board, engine trouble struck and engineers and mechanics spent 12 hours scrambling around while everyone pondered whether they would have to turn back or not! Finally however, they fixed the broken clutch and our team started sampling the ocean every four hours, measuring conductivity, temperature, depth, dissolved oxygen levels and chlorophyll, absorbance and pigments.

Students take on epic 480km hike along Kei River

Five UCT students embarked on an epic 480km hike along the Kei River, to document the river from source to sea, while undertaking sociological and economic research on people living on opposite sides of the river. Along the route they undertook water quality tests in the hopes of devising better ways to manage the precious resource.

The group used GPS technology to record the site coordinates of 200 water samples they collected during the hike. Adam West from the Department of biological Sciences analysed the samples, which were run through a spectrometer for hydrogen and oxygen isotopes and used to create a GIS map pinpointing ares of interest and concern.

The group described the trip as being 'multi-layered': conducting water research along the way, raising money for The Eluphindweni Community Crop Project and documenting the divide between rural villagers on the one side of the river and farmers on the other side.

Geologists explore Antarctica

The team: Anthony Hall, Ake Fagereng, Teboho Sebetlela, David Mc Gibbon, Sukey Thomas, Johann Diener

A team of geologists from UCT was part of the 2012-2013 SANAE takeover expedition to Antarctica. The group comprised Ake Fagereng and Johann Diener, with David McGibbon, Sukey Thomas and Teboho Sebetlela as research students and Anthony Hall as field guide. They departed Cape Town on the 6th of December aboard the Agulhas II, with the aim of investigating deep crustal processes exposed in the Maud Belt.

Traversing a slope

THE SCIENCE FACULTY TRAVELS AROUND OUR WORLD.....

First full eco-census of !Gariep

Source to sea: (From left) UCT's James Puttick, Sam Jack and Ian Durbach celebrate at the Orange River mouth, Atlantic Ocean, having completed their Senqu2Sea expedition, the first full-length ecological census of the river's vegetation and ecosystems. (Photo by Peter Jack.)

Researchers are wrapping up the first full-length ecological census of the vegetation and ecosystems of the !Gariep – also known as the Orange River – South Africa's longest waterway.

Three kayaks passed under the border control bridge linking Alexander Bay to Oranjemund 61 days and 2 125km after embarking on this epic journey from Qacha's Nek in Lesotho, slightly downstream from the source of the !Gariep River – or the Senqu, as it's known. The 3 UCT staff/ students, PhD student James Puttick, recent MSc graduate Sam Jack and Ian Durbach, a Statistical Science Lecturer made this epic journey—the first mega-transect of South Africa's longest waterway which forms the border with Namibia and provides critical water for irrigation and hydro-electric power.

Experiencing CERN

Claire Antel, a postgraduate student in the Department of Physics, went on an exchange to CERN. Here she shares her experience.

Chilufya Mwewe & Claire Antel in front of ATLAS

"Being at CERN is intriguing in the way that you meet the whole world but not one local. A simple form of English is mainly spoken, with a myriad of accents. CERN is a clean and high-tech place, as is expected from one of the world's largest research centres: auditoriums with microphones for every seat, countless meeting rooms with projectors and more microphones, larger-than-yourself Nespresso machines and the iconic Globe Of Science, inside which an interactive projection of the collider and its detectors glows on a round table and one can sit in space pods while an electronic voice whispers about science in your ear.

The CERN site also has its "slums" however: workshops with abandoned detectors, rogue sheep and a forlorn-

looking sanctuary (rabbit hatch) for retired/abandoned (computer) mice. There is an underground network of tunnels (not the actual beam tunnel!) that connects all buildings on site and is great fun to explore, as it holds many surprising items left there by former adventurers.

I had the good fortune of being accepted to the CERN summer school 2013, costs of which were entirely covered by CERN. The summer school was an 8 week-long school of lectures and work on a summer project with an assigned supervisor from CERN. My supervisor was Dr Heather Gray, a former UCT and CERN summer student herself. During the summer school I worked on developing algorithms for the reconstruction of particles that are detected in the ATLAS calorimeter. The school was a tough period, as you have to manage your time well. You constantly have to work on your project, concentrate in lectures (which were on a broad range of topics well-worth listening too), and additionally keep up with your social life and organise weekend adventures around Europe together with your summer school pals.

SCIENCE FACULTY OUTREACH

Equity Development Programme update

The Group of Equity Development Graduates

The Department of Chemistry hosted a celebration of the Equity Development programme, which has been running in the Department for the last 12 years. The initiative was started by former head of department, Professor John Moss, who recognised the need to overcome financial obstacles for disadvantaged students and allow them to pursue postgraduate studies and thereby meet the university's transformation goals. The Chemistry EDP was made possible through funding by the Atlantic Philanthropies , the Nuffield Foundation and the Leverhulme Trust.

At the function, the Department of Chemistry welcomed back some of their 50 graduates, who celebrated with some of the students currently on the programme. Two of the lecturers appointed on this programme now have permanent academic positions in the Chemistry Department, namely Dr Greg Smith and Dr Clive Oliver.

Some notable achievements from this group are Dr Seannette Wilson, who won a Women in Science Award, Dr Greg Smith who won a SACI Raikes Medal for achievements in research and Thobela Bixa, who was voted one of the M&G's top 200 young professionals in South Africa.

Dr Emma Hager, one of the EDP graduates, spoke about how the programme had afforded her valuable opportunities to continue her studies, to travel to conferences and to do research, which she could not have done without being on the programme. She now works at Vital as a research chemist.

Science Day at Settlers High School

Science Day 2013 was held at The Settlers High in Belville—our first venture out into the Northern suburbs. Approximately 400 learners from 8 schools in the area enjoyed engaging with the interactive stands hosted by our departments and also enjoyed getting their hands dirty at workshops ranging from "Death on the Black Pearl—using Science to solve crimes", to "Hands-on astronomy" where the pupils made telescopes; "Life under the microscope" where they examined sea creatures and DNA DIY where they were 'forensic scientists'!

Annual Jack Elsworth Lecture – Harry Potter and the Molecule of Doom

The postgraduate students of the Department of Chemistry once again thrilled and delighted the younger (and older!) audience with their rendition of "Harry Potter and the Molecule of Doom" at the Jack Elsworth lecture. Written and directed by John Woodland, the show had the audience laughing and gasping with bangs, flashes of light and colour. Dr Margaret Elsworth, the late Jack Elsworth's wife, enjoyed the show as much as the children and recalled the many times her husband had taken items from her kitchen to use in the annual show.

IN MEMORIAM

Professor Phil Hockey

Professor Phil Hockey, Director of the Percy FitzPatrick Institute of African Ornithology died on 24 January 2013, a huge loss to the faculty. Professor Hockey was instrumental in elevating the PFIAO to one of the top three ornithology institutes in the world. His academic standing was impeccable and he was much loved by those whom he taught, supervised or lectured. He left an invaluable resource with his work as co-author of the best-selling regional field guide, Sasol Birds of Southern Africa, and as editor-in-chief of the seventh edition of Roberts – Birds of Southern Africa.

Most of Professor Hockey's research focused on coastal and estuarine bird ecology. He led research expeditions to Chile, the Canary Island, Mauritius, the Seychelles, Kenya, Madagascar, the Arabian Gulf and Namibia. His research included the ecology of bird movement and migration, as well as avian life history evolution, with the aim of analysing and predicting avian responses to climate change, as well as promoting appropriate conservation strategies.

Born in England in 1956, he obtained his BSc honours degree in Ecological Science at Edinburgh University in 1977. Shortly thereafter he moved to South Africa and joined the Percy FitzPatrick Institute in 1979. He obtained his PhD from UCT in 1983 for a study of the ecology of the African Black Oystercatcher.

Inaugural Science Winter School – July 2013

The Science Faculty hosted a Science Winter School, organised and run by the Assistant Dean, Associate Professor David Gammon, whose broader role in the Faculty this year has been to strengthen and augment the Faculty's interventions in supporting students in their studies in the sciences. The idea of holding a Winter School emerged from observations over the years that many students enter the Science Faculty without having a clear idea of what they want to do or why they are doing Science. For many students, Science is their second choice, having not secured a place in Medicine or Engineering, or simply not being aware of the range of options open to them. The Winter School was conceived to inspire and motivate, recognizing that we have a Faculty stacked with top scientists with interesting stories to tell and a region rich in scientific interest. Students were invited to apply for a limited number of places and were offered a week of accommodation, meals, and a scientific adventure, exposure to interesting science, and a chance for supervised revision of first semester work.

The week entailed excursions, talks and work sessions, such as spending a day at the Two Oceans Aquarium, where students received insight into the scientific and managerial issues facing this institution, listening to Emeritus Professor George Branch giving an account of the process of compiling his book "Living Shores of Southern Africa". They had animated lectures and a visit to the National Accelerator Facility in Faure; an introduction to "citizen cyberscience" from astronomers Kurt van der Heyden and Sarah Blyth (together with telescope viewing on the roof of RW James); a visit to the Planetarium; oceanographer Isabelle Ansorge introducing them to the new breed of oceanographer – female seals with devices attached to their heads for recording data on the southern oceans; geologist Emese Bordy providing the geological background and framework for engaging in the fracking debate; chemist David Gammon providing an overview of the challenges in the chemical and molecular dimensions of reality.

The students worked in groups, giving presentations on interesting problems or challenges, such as explaining why ozone is harmful to citizens in the city streets, but of great benefit to them when it's found in a layer in the stratosphere, the difference between petrol and diesel fuel and why you can't put diesel fuel in a petrol engine, how a cell-phone battery works, and what happens when you re-charge it every day. The students were unanimous in acknowledging the positive impact of the week and it's a concept that will be repeated: the reality is that young people today, particularly those from disadvantaged backgrounds, have very little real exposure to the world of science and its possibilities.

KEEP CONNECTED – STAY IN TOUCH – KEEP CONNECTED

We value regular contact with our alumni, so please email us on Katherine.wilson@uct.ac.za. We would like to hear about what you are doing with your Science degree in order to enable us to build career profiles of opportunities for Science graduates. We would also like to cover interesting initiatives you are involved in, in future *Contact* newsletter.

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

Design: karien@theearthisround.co.za