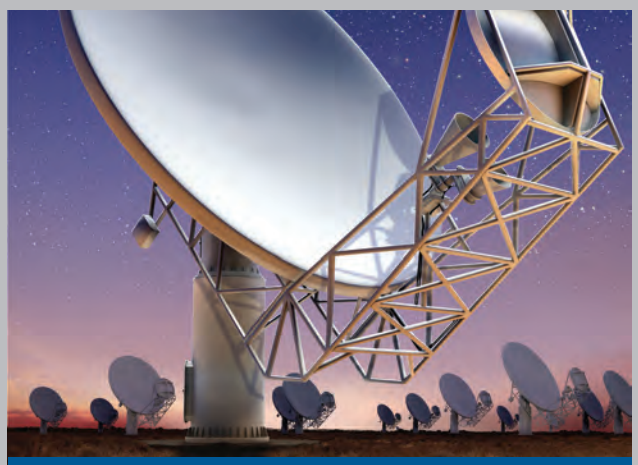
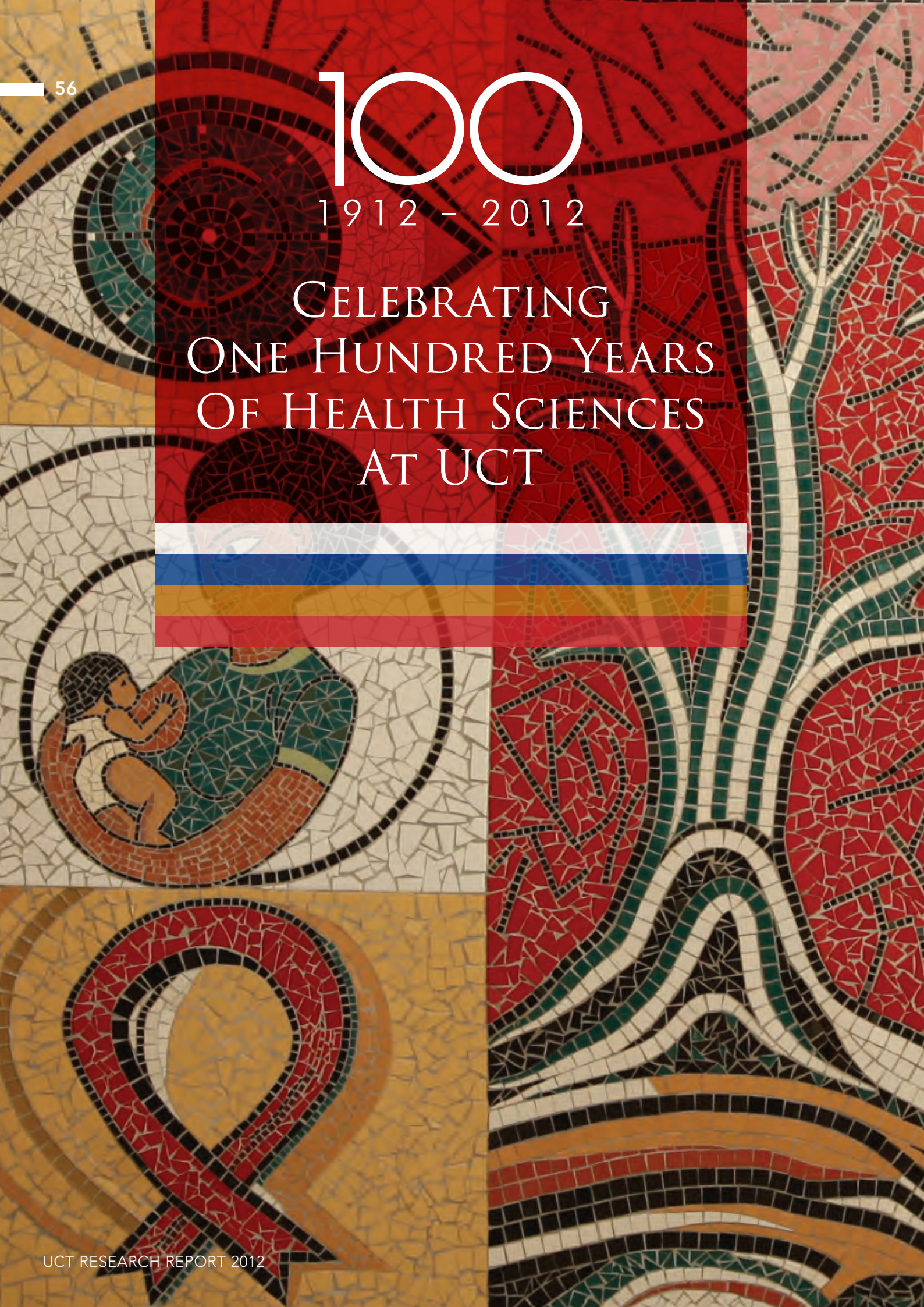
RESEARCH THEMES





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1912 - 2012

Celebrating One Hundred Years Of Health Sciences At UCT

In 2012 the Faculty of Health Sciences celebrated a century of extraordinary growth, achievement and excellence in advancing health, nationally and globally. This milestone marked the passing of one hundred years since the opening of the first medical school buildings on the Hiddingh Campus on 6 June 1912. UCT has the oldest medical school in sub-Saharan Africa, and has educated some of the finest minds in the country. We have also produced some of the greatest medical advances to arise from Africa, such as the first test of its kind for pregnancy, the first successful heart transplant, and the research that led to the development of the computerised tomography (CAT) scanner.

The Medical School of 1912 has grown into a 21st-century Faculty of Health Sciences, comprising a range of health disciplines including basic, clinical, rehabilitation and public health sciences. The current-day mission of the faculty is to address health challenges by promoting quality and equity in healthcare services, educating health practitioners for life and undertaking cutting-edge, relevant research. The reach and impact is extensive as the faculty keeps pace with global approaches to academic health sciences, accelerating efforts to improve health on our continent, and building a future through which we will sustain our contributions to health throughout the world. With a modernised curriculum, the demographic profile is transformed and the admissions of students from all corners of our country and beyond have increased substantially. Increasingly, the faculty's staff, like that of the rest of the university, enjoys an international reputation for excellence, and graduates continue to make their mark in the world.

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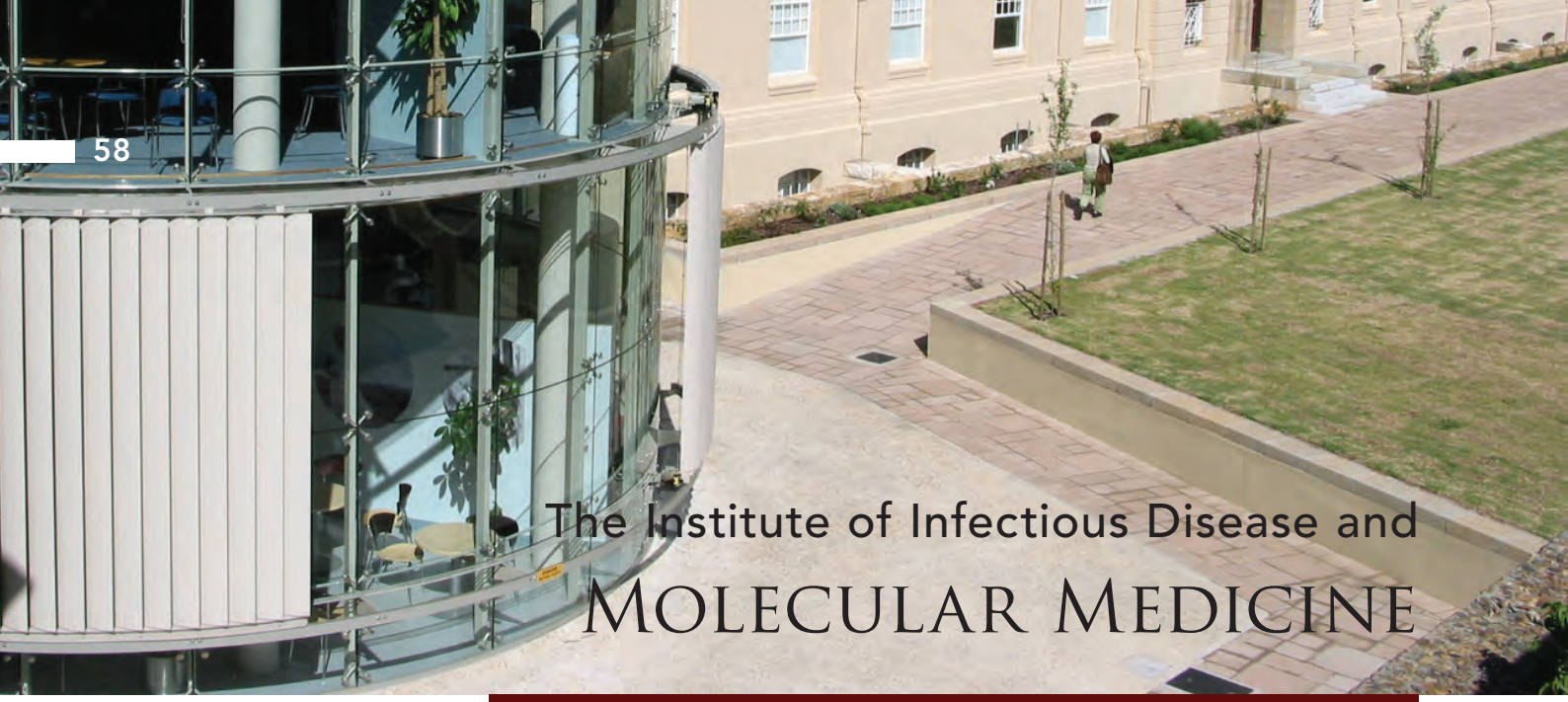
Amongst the more than 70 centenary-branded events held during 2012 were a number of research-related activities. These included the inaugural Wolfson Memorial Colloquium, with a keynote address titled *A New Agenda for Global Health* by Baron Peter Piot, Professor of Global Health and Director of the London School of Hygiene and Tropical Medicine. A centenary academic debate was held on the topic '*Cholesterol is not an important risk factor for heart disease and current dietary recommendations do more harm than good*', with arguments from UCT's Professor Tim Noakes (proponent) and Dr Jacques Rossouw of the National Institutes of Health in the USA. A a community partnership event and a more focused community-collaboration event highlighting the faculty's work with the Masiphumelele region, titled *Masiphumelele – Bringing science to the community*, and hosted by the Desmond Tutu HIV Centre. A centenary edition of the *South African Medical Journal* was created to showcase some of the academic highlights from the faculty over the last century, as well as its more recent research.

The late Emeritus Professor Chris Barnard who performed the world's first successful heart transplant in 1967 at Groote Schuur Hospital.

One of the key messages that the centenary celebrations conveyed was that the faculty has 'a prestigious reputation for medical achievement and cutting-edge research that has impacted on health globally'. Over the next pages, we share achievements of the Faculty of Health Sciences and flagship university health-related research initiatives.



The Institute of Infectious Disease and Molecular Medicine

The Institute of Infectious Disease and Molecular Medicine (IIDMM) is the largest research entity at the University of Cape Town. As a trans-faculty postgraduate research institute, its focus is on infectious diseases, particularly HIV/AIDS and tuberculosis; non-communicable diseases, such as prevalent cancers; genetic medicine; and molecular medicine, including drug discovery. In 2012, the IIDMM was home to 27 full members, nine associate, 12 affiliate (early/mid-career researchers) and nine adjunct members. 150 master's and PhD students were hosted, as were 76 postdoctoral research fellows and 140 research-funded staff.

The goals of the institute are focused on high-quality, internationally competitive research, relevant to Africa. Additionally, the institute aims to influence health policy and practice, and to be a major training hub in Africa for biomedical, clinical and public health researchers. It is particularly important that the work of the institute is translational – that the discoveries and pursuits are taken from the laboratories and applied in our communities. Importantly, the IIDMM's research themes, which are determined by members' specific interests, align closely with national health priorities.

Consistent with its established reputation, the IIDMM has continued to grow in research excellence and output. Journal publications for the institute at the end of 2012 totalled over 200, and included papers published in *Nature Medicine* (impact factor 22.5), *Lancet* (impact factor 38) and *American Journal of Respiratory and Critical Care Medicine* (impact factor 11). Collaborative research continued with colleagues based at 15 South African institutions, 17 African institutions in 12 other countries, and 122 institutions in 27 countries further afield, and included 42 consortia.

The vision of the IIDMM is to be a centre of excellence where researchers work together to tackle diseases of major importance in Africa. As a postgraduate research institute that fosters world-class research at the intersection of the basic, clinical and public health sciences, the IIDMM has become home to some rising stars whose work is attracting major attention in the global arena.

Tackling Critical Questions in TB Vaccine Research in SATVI

To implement the mission of the South African Tuberculosis Vaccine Initiative (SATVI) – "Innovative and high-quality TB vaccine research in Africa, to impact the global epidemic" – a research group, led by Professor **Willem Hanekom** and Dr **Tom Scriba**, has been testing six new TB vaccine candidates in 15 completed or ongoing clinical trials. SATVI also addresses other critical clinical, epidemiological, immunological and human genetic questions in TB vaccine development.

A large focus of the latter research is identification of markers in blood to indicate whether a person is at risk of developing TB disease, or protected against TB disease: so-called correlates of risk of disease or of protection. SATVI has emerged as a world-leading research group in this area, evidenced by multiple grants awarded from the National Institutes of Health, the European and Developing Countries Clinical Trials Partnership (EDCTP), and the Bill and Melinda Gates Foundation. For example, in 2012, the Director of SATVI, Professor Willem Hanekom, was awarded a $4.77 million grant from the Gates Foundation, while SATVI's Deputy Director for Immunology and Human Genetics, Dr Tom Scriba, was awarded an EDCTP Senior Fellowship. The longitudinal correlates studies focus on correlates of risk of TB disease in various settings: after BCG and novel vaccination against TB in infants, after community-wide TB exposure in adolescents, and after household exposure to a person with lung disease in adults. Preliminary results point to marked heterogeneity in mechanisms of risk of TB disease and, secondly, to importance of inflammation. These results have already challenged current paradigms in TB pathogenesis.

Research at the Intersection of TB and HIV

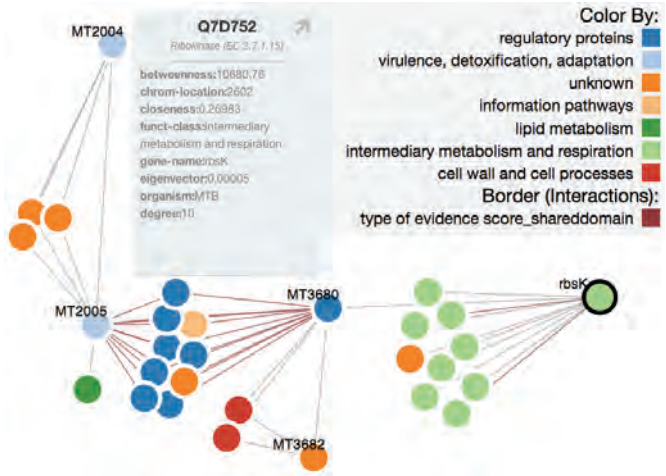
HIV has driven a dramatic resurgence of the TB epidemic and a quarter of all HIV-associated TB cases globally are diagnosed in South Africa.

The research of early- career scientists **Graeme Meintjes** and **Wendy Burgers** is focused at the intersection of HIV and TB. Associate Professor Graeme Meintjes is an infectious-diseases physician whose research is targeted at improving understanding and clinical management of conditions affecting patients with advanced HIV disease. He was awarded a five-year Wellcome Trust Intermediate Fellowship in 2012 that will support a prospective cohort study of 660 patients admitted to hospital with HIV-associated TB. This study is aimed at defining contributors to the high mortality in these patients and improving treatment strategies. He is also principal investigator of a randomised controlled trial of prednisone for the prevention of the TB-associated immune reconstitution inflammatory syndrome, a frequent complication occurring during early antiretroviral therapy in patients with HIV and TB. This trial is funded by an EDCTP Strategic Primer Award made in 2012. Dr Wendy Burgers is a UCT and University of Cambridge-trained immunologist who holds a five-year Wellcome Trust Intermediate Fellowship. She leads a growing research group of three postdoctoral research fellows and four postgraduate students, seeking to understand why HIV infection leads to a greater susceptibility to TB. Also funded by a Senior Fellowship Award from the EDCTP, her work takes the unique perspective of attempting to understand immunity to TB and the effect of HIV at the site of disease, the lung. She is also principal investigator on an NIH grant focusing on identifying the mechanisms of excessive immune activation during HIV infection, a process that drives progression to AIDS. These studies could reveal important new targets for immune intervention during HIV infection.

Research Projects

Building Capacity in Bioinformatics and Computational Biology

In 2012 Associate Professor **Nicola Mulder** and Dr **Darren Martin** from the Computational Biology (CBIO) Group at the IIDMM together published 27 papers or chapters in the international peer-reviewed literature.

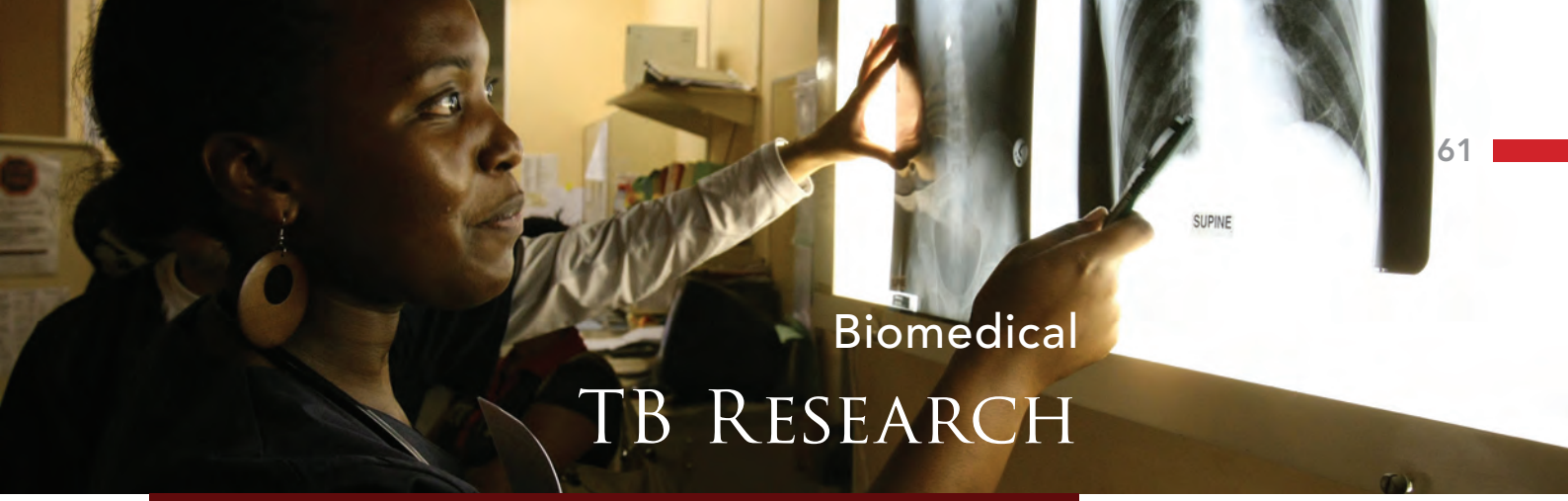


These papers covered a remarkable diversity of topics, from the development of advanced computational methods for analysing bacterial and viral protein and nucleic acid interaction networks to the application of these and other computational tools to detailed analyses of many of Africa's most prevalent infectious diseases. While the foundation of CBIO's research strategy has been the development of extensive networks of local and international collaborators (many of whom work at the cutting edge of either infectious disease or computational biology research), its success has been primarily based on the training and excellent work of a constant stream of top master's and PhD students and postdoctoral research fellows from across Africa. A particular highlight for the group in 2012 that enables this is the award to Associate Professor Mulder of a $12-million NIH-funded Human Heredity and Health in Africa (H3Africa) grant aimed at nurturing and growing computational biology-based research collaboration and student training networks across Africa. The CBIO group is co-ordinating bioinformatics groups in more than 30 institutions across 15 African countries through the H3ABioNet project. (Also see page 65.)

Tackling Critical Questions in HIV Prevention and Pathogenesis

In 2012, Professor **Carolyn Williamson** (HIV Diversity and Pathogenesis Group) and Associate Professor **Jo-Ann Passmore** (HIV Mucosal Immunology Group) together published 20 papers in international peer-reviewed journals and one book chapter focusing on HIV prevention and pathogenesis.

A highlight was a paper in *Nature Medicine* which demonstrated that HIV mutation, in an attempt to avoid host immune detection, was required for the evolution of potent HIV-specific broadly cross-neutralising antibodies. Understanding how to elicit broadly cross-neutralising antibodies though vaccination is a major question in Professor Williamson's field and her laboratory played a leading role in this discovery. She and Associate Professor Passmore also co-authored two important studies in the *Journal of Infectious Diseases* highlighting the failure of the syndromic management approach to adequately treat sexually transmitted infections in women in communities with high HIV incidence rates. After the acquisition of HIV, genital inflammation remained a significant predictor of worse clinical HIV disease outcome. In recognition of their notable track record in mucosal immunology and HIV transmission, Professor Williamson, Associate Professor Passmore and four other members of the IIDMM were awarded a competitive R5-million EDCTP Strategic Primer grant aimed at bringing together a multicentred mucosal immunology consortium of investigators committed to establishing scarce skills capacity for mucosal research surrounding HIV prevention trial sites in South Africa.



Biomedical

TB Research

The major focus of the UCT node of the DST/NRF Centre of Excellence for Biomedical TB Research (CBTBR), which was established in 2011, is on strengthening the node's research thrusts in fundamental research in the physiology and metabolism of *Mycobacterium tuberculosis* of relevance to drug discovery and drug resistance. The node is engaged in three inter-related drug-discovery projects. Two of these form part of large international TB drug consortia funded by the Bill and Melinda Gates Foundation and the European Union Seventh Framework Programme respectively. The third project is being carried out under the auspices of the South African Tuberculosis Research and Innovation Initiative, funded by the Technology and Innovation Agency. This project has formed the basis of a new university-wide collaborative partnership with Professor Kelly Chibale's group in the H3-D Centre for Drug Discovery.

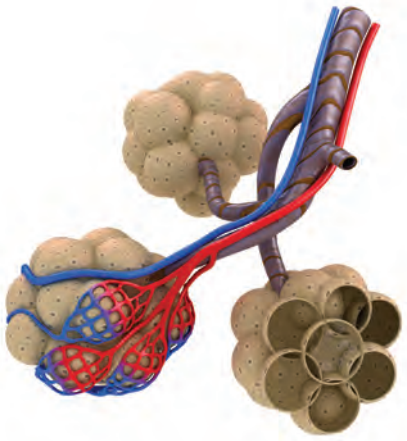
Further efforts in 2012 have focused on identifying opportunities for new collaboration with other TB research groups in the IIDMM, including the Desmond Tutu HIV Centre, the Clinical Infectious Diseases Research Initiative and the South African Tuberculosis Vaccine Initiative, in studies that can capitalise on the CBTBR's expertise in mycobacterial genetics, genomics, biochemistry and physiology. Encouraging progress has been made in this area, with several new projects under discussion.

A major research output in 2012 was a publication in *Chemistry & Biology* by Dr Garth Abrahams, Professor Valerie Mizrahi and international collaborators at the US National Institute of Allergy and Infectious Diseases, Seattle BioMed and Cambridge University describing the development and application of engineered strains of *Mycobacterium tuberculosis* as novel tools for TB drug discovery. In another important development, Dr Krishmoorthy Gopinath and Dr Digby Warner succeeded in identifying the protein responsible for uptake of vitamin B12 by *Mycobacterium tuberculosis*. This work, which was carried out in collaboration with colleagues at the Swiss Federal Institute of Technology in Lausanne with funding from the Swiss-South Africa Joint Research programme, was presented at two international conferences in France, and has been submitted for publication.

Professor Mizrahi was selected as a Senior International Research Scholar of the Howard Hughes Medical Institute (HHMI) in 2012. Her five-year grant from the HHMI will support programmes in fundamental TB research and advanced postgraduate training at the UCT node.

Research in
Child Lung Health

Driven by the large burden of childhood respiratory illnesses in South Africa and Africa, Professor Heather Zar of UCT's Department of Paediatrics and Child Health has built a strong clinical translational research programme focused on developing strategies to improve child lung health. This has been underpinned by the growth of a busy clinical research unit at the Red Cross War Memorial Children's Hospital and training of several master's and doctoral students. She is currently leading a new initiative that will see an expanded paediatric clinical research unit completed this year, with satellite sites in community settings, enabling growth of clinical research and building much capacity in child health in South Africa and Africa.



This research addresses the leading causes of childhood illness and death in African children – tuberculosis, pneumonia, HIV-associated respiratory illness and asthma. A strong focus has been on evolving new strategies for diagnosis, prevention and treatment of pneumonia – the major killer of children under five years of age – including those for HIV-infected children. A recently completed project included a study of the impact of the new pneumoccocal conjugate vaccine (introduced in 2009 in South Africa) on hospitalisation for childhood pneumonia and on the cause of pneumonia. Tuberculosis, the major cause of death in South Africa and a relatively neglected, important cause of childhood illness, has been another focus, particularly the development of better ways to diagnose and prevent childhood TB. This work has been supported by grants from the National Institutes of Health (NIH) and the European Developing Country Clinical Trials Partnership.

Together with Professor Mark Nicol (Head of Microbiology at UCT) and a research team, Professor Zar recently published the first landmark papers showing the usefulness of GeneXpert – a rapid way to diagnose TB that simultaneously diagnoses drug-resistant disease – when used in children. The studies, published in the leading journals *Lancet Infectious Diseases* and *Clinical Infectious Diseases*, showed that TB could be rapidly detected on induced sputum or on nasal mucus in 75% of children with culture-confirmed disease. Such findings have changed global practice, with potential major impact for improving diagnosis and treatment of childhood TB; the World Health Organisation has recently recommended this as the standard of care for children with suspected TB living in areas of high HIV prevalence or drug resistance.

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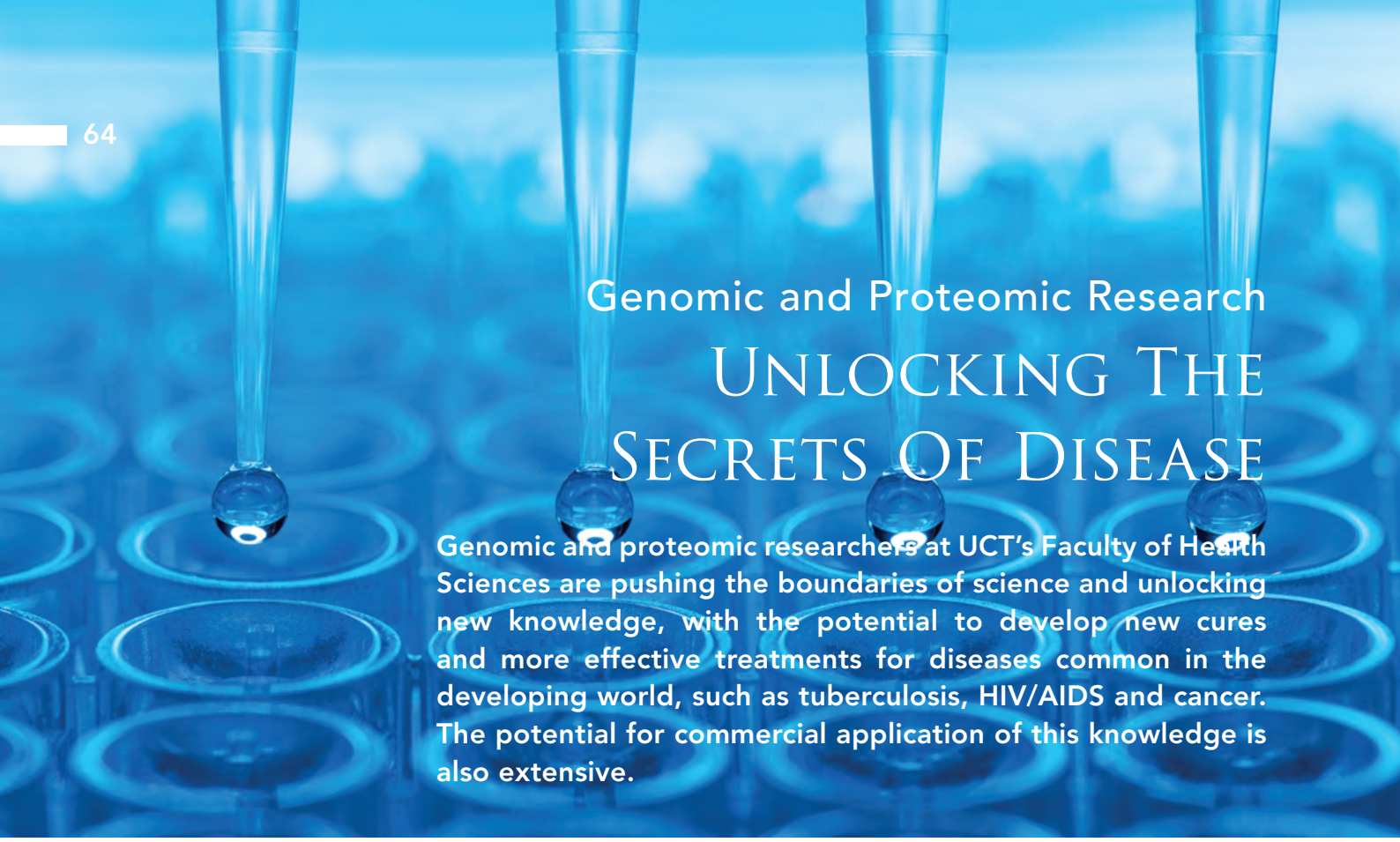
Prevention of TB in HIV-infected children has been another strong area of research. Professor Zar and her group have previously shown that isoniazid (INH), a drug used to treat TB, was highly effective in reducing mortality and preventing TB in HIV-infected children with advanced HIV/AIDS. Building on this, a key recent publication showed that INH had an additive effect to antiretroviral therapy in preventing TB in such children. In 2012, Dr Lisa Frigati, a MMed student supervised by Professor Zar, received the best-publication award in the Department of Clinical Sciences for a young investigator for this work, which was published in the prestigious journal *Thorax*.

In a first for the African continent, Professor Zar recently set up a birth cohort study (the Drakenstein Child Lung Health Study), which is funded by the Bill and Melinda Gates Foundation. This multidisciplinary study investigates the determinants of pneumonia and the long-term impact on child health with focus areas including nutrition, infectious diseases, environmental exposures, psycho-social factors, maternal and paternal health, and genetic and immunological factors. To date, almost 500 pregnant women have been enrolled and 260 babies born. There are 13 postgraduate students working on different aspects of the study; several have been awarded prestigious

national and international grants for sub-studies nested in the Drakenstein cohort. Exciting preliminary results have emerged from some of these areas, particularly those led by Professor Mark Nicol (microbiology aspects), Professor Landon Myer (epidemiological aspects), Professor Dan Stein (psychosocial aspects) and Dr Aneesa Vanker (environmental aspects). Another first for the African continent is the use of infant lung function in this study, which has been led by Dr Di Gray, a PhD student, for which she received a Wellcome Trust training award. The pilot results from infant lung-function testing indicate excellent success in performing this, and substantial differences in lung function in six-week-old infants compared to their European or North American counterparts, suggesting an innate vulnerability to pneumonia.

More recently, the research focus has expanded to include a study of the health of HIV-infected adolescents, a growing population with unique, but poorly understood, health needs. Together with co-investigator Professor Landon Myer, Professor Zar was awarded a large five-year grant from the NIH to study the development and progression of respiratory, cardiac and neurocognitive disease in a cohort of HIV-infected adolescents. This multidisciplinary research involves collaborators in the Departments of Paediatrics and Child Health, Medicine, Public Health, and Psychiatry, and the IIDMM, and has the potential to identify mechanism of disease and novel preventative and treatment strategies.



Genomic and Proteomic Research

Unlocking The Secrets Of Disease

Genomic and proteomic researchers at UCT's Faculty of Health Sciences are pushing the boundaries of science and unlocking new knowledge, with the potential to develop new cures and more effective treatments for diseases common in the developing world, such as tuberculosis, HIV/AIDS and cancer. The potential for commercial application of this knowledge is also extensive.

Functional genomics research has the potential to yield the sort of information, discoveries, and inventions that translate into future biomedical advances and commercial activity. For instance, a functional genomics programme that studies patterns of protein and lipid expression in peripheral fluids taken from a group of tuberculosis (TB) patients could lead researchers to discover molecular markers that diagnose TB. These would then form the basis of a new point-of-care diagnostic test for TB that works in low-resource settings. This would be a major healthcare innovation in the developing world, and generate commercial activity worldwide.

This field of speciality requires state-of-the-art, high-throughput analytical technologies. Fortunately, these are now available locally and Department of Science and Technology investments in the Centre for Proteomic and Genomic Research, along with capital equipment acquired by UCT and partner universities, is transforming the Western Cape into an oasis of genomic and proteomic research.

The future prospects for major breakthroughs at UCT in both infectious and non-communicable diseases are bright, even though it is a long and often rocky road that leads to discovery and validation of the sort of disease-associated biomarkers that can be translated into lifesaving health care innovation.

Research programmes in this area are heavily dependent on the availability of sophisticated bioinformatics tools and the expertise to analyse and make sense of the vast quantities of raw experimental data generated – an area of increasing strength for UCT.

South Africa provides a remarkable wealth of clinical resources, including a population that represents more than 95% of the world's human genetic diversity, along with

a heavy burden of existing and emergent diseases. However, programmes are notoriously expensive, due to the scale of research – many thousands of genes, proteins, or small molecules are measured in parallel, through time and under different environmental conditions, in a large number of biological samples, in order to enable statistically significant quantitative conclusions.

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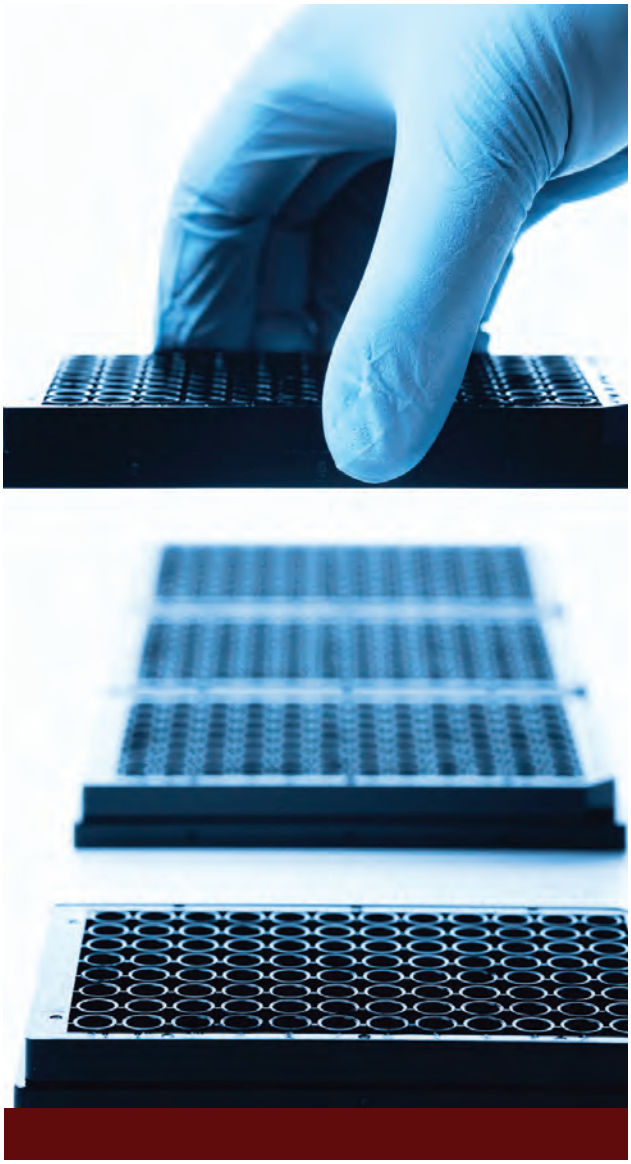
This is beyond the scope of traditional South African funding agencies. Fortunately, major international donors are increasingly committing to funding functional genomics research at UCT. Examples of these partnerships include the National Institutes of Health and the Wellcome Trust that, together with the African Society for Human Genetics, fund the Human Heredity and Health in Africa initiative (H3Africa); the Bill & Melinda Gates Foundation (BMGF); the European and Developing Countries Clinical Trial Programme (EDCTP); and the Canadian Institutes for Health Research (CIHR).

South Africa provides a remarkable wealth of clinical resources, including a population that represents more than 95% of the world's human genetic diversity, along with a heavy burden of existing and emergent diseases.

The H3Africa initiative studies the genomic and environmental determinants of disease in Africa, supporting African population-based genomic studies of common, non-communicable and communicable diseases. It also aims to build capacity for genomics research; create and expand genomics research infrastructure on the African continent, by supporting the development of a bioinformatics network and pilot biorepositories; and fund studies of the societal implications of genetic and genomics research.



African population-based genomic studies of common, non-communicable disorders, such as heart and renal disease, and communicable diseases like tuberculosis, is critical and is being led by African scientists – many of whom are at UCT.

Researchers typically work in multidisciplinary collaborations across a number of experimental platforms, which are made possible through established collaborative networks within UCT and beyond.

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Brain Behaviour

Given the complexity of human psychology, research on brain and behaviour requires a multidisciplinary approach, spanning molecular biology, cognitive and affective neuroscience, and public mental health. Women in a number of different departments across the university have made a significant contribution to the efforts of the Brain and Behaviour Initiative (BBI), one of UCT's signature themes. The BBI initially focused on psychological trauma and resilience, but over time these scientists have also addressed other questions that are particularly relevant to South Africa, including neuroHIV/AIDS and addiction.

Professors Nicola Illing and Vivienne Russell investigate the molecular aspect of brain-behaviour studies. Professor Illing has a particular interest in gene expression, with an interest in how psychological stress changes gene expression in the brain. In order to begin to address this question, she mentored a student project that focused on comparing gene expression in white cells and in the brains of rodents exposed to stress. The data were the first to be published in this area, and have led to a patented test. She is currently working with a postdoctoral research fellow on gene expression in white cells in people who abuse methamphetamine.

Genes are ultimately translated into proteins. Professor Russell and postdoctoral research fellow Dr Jacqueline Dimatelis have focused on protein expression in animal models of stress and of substance use. Their work suggests that the combination of early-life adversity and later methamphetamine use results in more alterations in protein concentration in a key area of the brain – the nucleus accumbens – which is involved with reward

processing. Ultimately, the hope is that, by understanding such molecular processes in more detail, new targets for treatment can be developed.

Professor Ernesta Meintjes is the DST/NRF SARChI Chair in Brain Imaging, and has played a particularly important role in conducting clinical research relevant to the BBI mission. Her work has included studies of children with fetal alcohol syndrome, as well as children with neuroHIV/AIDS, and involves collaborations with clinician-scientists abroad and locally. Much of her research is funded by the National Institutes of Health. As children are not easily able to lie still during imaging, she and her collaborators at the Massachusetts General Hospital have developed new MRI sequences, which facilitate motion correction during the analysis of scans.

Professor Dan Stein, Director of the BBI, says that he is pleased that women scientists are making such a large contribution to the BBI, and notes that, when it comes to BBI postdoctoral research fellows and doctoral students, women are again taking the lead.

Dr Katherine Sorsdahl, the project manager of the BBI, represents the public health aspect of brain-behaviour studies. Together with her mentor, Honorary Associate Professor Bronwyn Myers, she has been involved in intervention studies for people suffering from substance-use disorders. Given the resource constraints that local mental-health services face, she has focused on using lay counsellors to provide the interventions, an idea known as "task-shifting". Her preliminary findings indicate that such interventions can make a large difference. Dr Sorsdahl is enthusiastic about continuing to study treatments that are simple and inexpensive enough to be rolled out to the public on a large scale.

Professor Dan Stein, Director of the BBI, says that he is pleased that women scientists are making such a large contribution to the BBI, and notes that, when it comes to BBI postdoctoral research fellows and doctoral students, women are again taking the lead. Their research projects range from those focusing on molecular science (Shareefa Dalvie, Nastassja Koen and Jacqueline Womersley) to neuroimaging (Samantha Brooks, Jacqueline Hoare, Anne Uhlmann, Sarah Cotton, and Daniella Vuletic) and clinical and public mental-health aspects (Sonja Pasche, Nicole McAnda, Taryn Amos, Maxine Spedding, and Claire van der Westhuizen).

A number of young scientists have focused on translational science in particular, moving between "the bench and the bed": Dr Fleur Howells, for example, has undertaken a series of animal and human studies in order to address the role of particular neurotransmitter systems in mental disorders.

"Our aim," Professor Stein says, "is to go from bench to bed and beyond, in order to begin to address key questions in the brain-behaviour sciences, and to find new approaches to the diagnosis and treatment of mental disorder." The BBI is keen to attract more staff and students to work in this area.

The importance of EXERCISE

Physical activity and exercise are the fulcrums around which the UCT/MRC Research Unit for Exercise Science and Sports Medicine (ESSM) research is conducted, and the unit adopts an integrated approach to research. Broadly, the unit's research falls into three focus areas, covering the spectrum from physical activity for health, to clinical sports medicine, to exercise for performance. These focus areas are inter-linked by a multidisciplinary approach that borrows from the disciplines of, among others, genetics, molecular science, nutrition, physiology, biochemistry and biomechanics to better understand every aspect of physical activity and exercise. That broad strategy, delivered through the application of basic and applied sciences, has resulted in a number of key research projects in 2012.

The Study and Promotion of Physical Activity for Health

The goal of this project is to study barriers to and factors that facilitate health-seeking behaviours such as physical activity, in various settings and populations, in order to develop and then measure the effectiveness of interventions aimed at improving these lifestyle behaviours and health status. This project is led by Dr Tracy Kolbe-Alexander, who leads ESSM's public health and physical activity research, along with Professor Vicki Lambert.

Working in conjunction with Discovery Vitality, academics from the University of the Witwatersrand, and Emory University, Dr Kolbe-Alexander has helped to develop and evaluate the Healthy Company Index in South African companies. The first in a series of peer-reviewed publications was published in the *Journal of Occupational and Environmental Health*. In recognition of her research in this area, Dr Kolbe-Alexander was asked to serve as a panelist and speaker at the recent Global Healthy Workplace Awards and Summit in London. A similar project is the South African Fittest City Index, which compares the health and fitness profiles of eight metropoles. Finally, in an African first, Dr Kolbe-Alexander investigated the relationship between the built environment and physical activity in older adults, finding that neighbourhood safety was one of the main barriers to physical activity while the neighborhood aesthetics played a role in increasing activity among those over the age of 60 years.

Professor Lambert and her team have been focusing on the ecological determinants of adult and childhood obesity, as part of the five-country, NIH-funded, Modelling the Epidemiological Transition Study, spearheaded by the Department of Epidemiology and Community Health at Loyola University in Chicago, and including the Seychelles, Ghana, Jamaica, USA and South Africa. More recently, Professor Lambert has served as the in-country PI for the 12-country ISCOLE Study (International Study of Childhood Obesity, Lifestyle and the Environment). Data from this study will be used to formulate the third in a series of Healthy Active Kids South Africa Report Cards (2007, 2010, and now 2014), and forms the basis of two doctoral studies. Finally, Professor Lambert was a member of a prestigious writing group for *The Lancet's* Physical Activity Series of five scholarly peer-reviewed manuscripts which appeared in July 2012 in conjunction with the London 2012 Olympics, and had as the primary focus the global evidence for physical activity and health.

Prevention and Management of Chronic Diseases

South Africa faces enormous challenges as a result of the rising prevalence of obesity and associated disease such as cardiovascular disease and diabetes. Paradoxically, these diseases of "excess" occur against a South African context of poverty, and the combination has significant implications for the health of our country.

For the last couple of years, Dr Lisa Micklesfield and Dr Julia Goedecke have explored various methods to measure visceral adipose tissue (VAT), the fat around the organs associated with metabolic disease. Waist circumference can be used as an indirect measure of VAT; however, there are a number of limitations with this method, and for this reason they have assisted with developing a method to more accurately estimate VAT using dual x-ray absorptiometry technology.

This work was subsequently published in the *Journal of Obesity*, and has subsequently received a fair amount of attention both internationally and locally. This methodology has since been included in the dual energy x-ray absorptiometry software (DXA) to allow for more accurate measurement of VAT using this technology. Future research will include examining the association between this DXA-derived measure of VAT and disease outcomes in different populations and hopefully will increase our understanding of this association.

Research Project

Sporting Performance, Medicine and Sports Injuries

The Paralympic Games of London in 2012 were the biggest, most successful and, by virtue of a comprehensive series of research studies conducted by ESSM in partnership with the International Paralympic Committee, the most researched Paralympics in history.

The 2012 London Paralympics showcased the performances of over 4,000 athletes from 164 nations. It was also the opportunity for a comprehensive evaluation of injury and illness from a team of ESSM researchers, led by Professors Wayne Derman and Martin Schwellnus, in collaboration with the International Paralympic Committee.

The research, published in a series of papers in the *British Journal of Sports Medicine*, described a web-based surveillance system that captured statistics of 3,565 athletes, from 160 nations, to provide a goldmine of data involving 49,910 athlete days.

Among the intriguing findings was that the patterns of injury and illness are different from those of able-bodied athletes – more upper-limb injuries (shoulder, hand, wrist and elbow) occur in Paralympic athletes than in able-bodied athletes. "Interestingly," explains Professor Derman, "this is true even in lower-limb amputees, and is likely because normal daily activities like getting in and out of cars places a greater load on the upper limbs, making them more susceptible to injury as a result of sports participation."

The research also found that one in nine athletes developed an illness during the Paralympic Games, and that non-respiratory tract illnesses, including urinary tract and skin conditions, are more common than respiratory tract infections in Paralympic athletes. "The implication is that medical care for Paralympic athletes is very different from that of able-bodied athletes, and team physicians must be mindful of these differences when planning their intervention strategies for both prevention and treatment of illness and injury," explains Professor Derman.

Sporting performance and injury research also has a genetic slant through the work of Professor Malcolm Collins and Drs Alison September and Mike Posthumus. Having previously identified various DNA sequence variants associated with tendon and ligament injuries, the group has continued this but with the ambition of expanding into a more mechanistic understanding of genes and injury. "It is important for us to move beyond simply associating gene variants with injury. We want to determine how these variants are involved in altering risk," explains Professor Collins. This means borrowing from other techniques, including cell and molecular biology, to add to world-leading genetic research already conducted by ESSM.

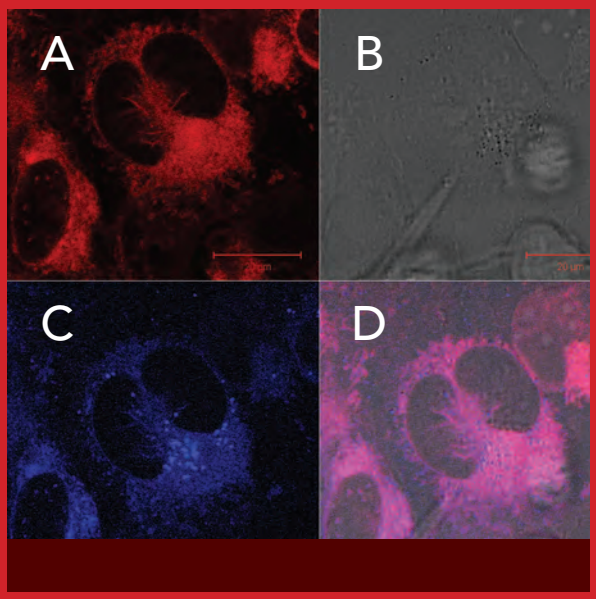
ESSM have also, over the last year, developed a research-consultant relationship with SA Rugby's safety programme, BokSmart, directed by Dr Wayne Viljoen, an ESSM graduate. "SA Rugby has set up an excellent infrastructure to log and monitor cases, and we are helping analyse the data to identify how to improve implementation and direct future policy," explains Professor Mike Lambert, who has overseen the project from ESSM's side, along with PhD student James Brown.

Developing the Potential of Garlic to Fight Cancer

Garlic *(Allium sativum)* has been used in folk medicine for centuries both as a food flavour-enhancer and for its beneficial health effects. Although the pungent garlic taste is not universally loved, the beneficial medicinal properties are widely known to fight infections, heart disease and cancer. These medicinal properties are attributed to the organosulfur compounds found in crushed cloves, of which the compound *E/Z*-ajoene is one of the major constituents ("ajo" comes from the Spanish for "garlic").

Traditional garlic extracts have yielded low amounts of ajoene as part of a mixture of products. Professors Roger Hunter and Iqbal Parker and Dr Catherine Kaschula have developed the first synthetic route to ajoene analogues, which has been patented by UCT. The researchers identified the ajoene anti-cancer "pharmacophore" (the group of atoms in the molecule of a drug that are actually responsible for the drug's action) to be the disulfide, with the vinyl and sulfoxide groups further enhancing activity. This facilitates the design and synthesis of more-potent ajoenes than the natural product. These are currently undergoing pre-clinical evaluation.

Recently, a fluorescent-tagged ajoene has for the first time enabled the UCT researchers to track ajoene's activity within the cancer cell, as shown in the photomircographs. It is now thought that ajoene interferes with protein-folding in the cancer cell, which induces programmed cell death (apoptosis). This novel anti-cancer mechanism can be used in a multi-pronged approach with current anti-cancer therapeutics to kill cancer cells.



Fluorescent images of MDA-MB-231 breast cancer cells treated with a blue fluorescing-ajoene. Breast cancer cells (B) were stained with a dye which causes the endoplasmic reticulum (ER) of the cell to fluoresce red (A) and then treated with the blue-fluorescing ajoene (C). An overlay of both red and blue fluorescent signals shows a "pink" signal (D) indicative of the fluorescing ajoene localising to the ER (red + blue = pink).

Research Groupings
associated with this theme

Lung Infection and Immunity Unit

The Lung Infection and Immunity Unit (LIIU) comprises approximately 40 students and staff embedded within the Division of Pulmonology in the Department of Medicine at UCT. The research focus is on lung infections and diseases of poverty, including tuberculosis, pneumonia and HIV. The unit also has a clinical trials division, which is located within the UCT Lung Institute. The unit's research focus areas include the pathogenesis, diagnosis and outcomes of multi-drug-resistant pulmonary infections, the development and evaluation of field-friendly diagnostics for TB and other pulmonary infections, and the immunology of pulmonary infections with special emphasis on regulatory T-cells and innate immunity.

The LIIU is a WHO-associated African Network for Drugs and Diagnostics Innovation Centre of Excellence. The work of the unit has informed policy documents on drug-resistant TB and diagnostics, and seminal work has been published about the immunology of pulmonary TB.

Capacity-development activities have included the organisation of several popular annual courses attended by researchers from all over Africa, the establishment of clinical recruitment infrastructure at clinical trial sites in Cape Town, and the training and mentorship of clinician scientist PhD students. A recently filed patent has spawned a UCT spin-off company that is developing a diagnostic test for extrapulmonary tuberculosis.

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Hatter Institute for Cardiovascular Research In Africa

The aims of the Hatter Institute for Cardiovascular Research in Africa are to facilitate national and international research collaborations, to consolidate and expand existing efforts to combat the most serious cardiovascular threats to health, and to improve overall prosperity in the region. Major research areas are cardiac disease and maternity, cardioprotection, cardiovascular genetics and Heart of Africa projects. In Africa, cardiovascular disease is the most common cause of maternal death in pregnant women. The objective of the institute's Cardioprotection Group is the delineation of novel cardioprotective pathways that can be activated to limit cell death in various pathophysiological conditions such as heart failure, myocardial infarction or diabetes. The Cardiovascular Genetics Group aims to discover the genetic basis of inherited heart diseases that cause sudden death. This work involves the study of rare families with monogenic disease (that is, inherited cardiomyopathies and arrhythmogenic disorders), and the delineation of the genetic architecture of complex traits associated with sudden death (such as cardiac hypertrophy). These studies hold promise of discovering the critical biological pathways that can be targeted by drugs to prevent sudden cardiac death. The Heart of Africa Pan-African Hypertension Cohort was established in 2010 to describe the epidemiology and characteristics of pulmonary hypertension in Sub-Saharan Africa.

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Members of the Lung Infection and Immunity Unit

Adolescent Health Research Unit

Adolescents face a wide range of health problems, owing to a combination of biological, social, and psychological factors. There is thus a niche for a research facility that focuses specifically on the health needs of adolescents. The Adolescent Health Research Unit at UCT builds on existing research and collaborations to co-ordinate, promote and facilitate research into all aspects of adolescent health. The specific aims of the unit are to facilitate cutting-edge inter-disciplinary research that addresses key national public adolescent health priorities; to promote networking among adolescent health researchers, practitioners, and policy makers; to increase the profile of the Faculty of Health Sciences in the arena of world-class adolescent health research; to provide policy consultation at local, provincial, national, and international levels; and to increase and improve educational offerings in adolescent health at undergraduate and postgraduate levels.

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MRC/UCT Cape Heart Centre

This combined research entity is the largest heart research group in South Africa and forms part of the Cape Heart Group, which links research between UCT and the other universities in the region. The Hatter Institute, which is part of the MRC/UCT Cape Heart Centre, is involved in the study of the molecular and cellular biology of ischaemic heart disease, as well as the molecular and cellular pathophysiology of cardiac hypertrophy and heart failure. The goal of the research programme is to contribute to the fundamental understanding of the mechanisms in the development of ischaemic heart disease, cardiac hypertrophy, and heart failure. The Cardiovascular Research Institute, to which is allied the Medtronics Institute, is studying biocompatible materials for vascular and valvular prostheses. Lipidology is concerned with research into lipid and lipoprotein disorders in patients in the region and novel treatment strategies for these disorders. Its research also includes new diagnostic assays for local problems in health care and lipid peroxidation.

Director: Professor P Zilla
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Cardiovascular Research Unit

The core research pursuit of the Cardiovascular Research Unit centres around the concept of regenerative medicine, with the goal of engineered regeneration of diseased structures through co-ordinated and site-directed signalling to facilitate gradual in-situ remodelling of surgically replaced hybrid biosynthetic devices. These offer patients an immediate dramatic improvement in quality of life through return to functionality of these diseased structures.

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Centre for Infectious Disease Epidemiology and Research

The Centre for Infectious Disease Epidemiology and Research (CIDER) aims to be an African Centre of Excellence in infectious disease epidemiology and related research. The centre has a strong base that spans a number of disciplines and conducts public health research, integrating laboratory, clinical, epidemiological, social science, and health systems research into infectious diseases that have high priority in Southern Africa (in particular, HIV and tuberculosis) in order to improve the prevention and management of these diseases. The centre maintains strong links with health services at all levels in order to identify research priorities, and assists policy makers, programme managers, and services managers with the implementation of the results of research. The centre aims to be a centre of excellence in the surveillance and monitoring of infectious diseases and infectious disease programmes and services, and in the conduct of robust observational research, based on routine data sources. CIDER provides extensive postgraduate level teaching and supervision in epidemiology.

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MRC/NHLS/UCT Molecular Mycobacteriology Research Unit

The Molecular Mycobacteriology Research Unit (MMRU) was established in 2000 as an extramural research

Research Groupings
associated with this theme

unit of the MRC, hosted jointly by the National Health Laboratory Service and the University of the Witwatersrand. In 2011 the MMRU was transferred to the University of Cape Town, where it is now based in the Institute of Infectious Disease and Molecular Medicine. The mission of the MMRU is to carry out fundamental research on aspects of the physiology and metabolism of relevance to tuberculosis drug resistance and drug discovery. By adopting a research strategy that is based on investigating specific aspects of the metabolism and physiology of Mycobacterium tuberculosis, the MMRU has positioned itself at the front-end of TB drug discovery research.

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Desmond Tutu HIV Centre

The activities of the Desmond Tutu HIV Centre (DTHC) are underpinned by research and evaluation. It aims to impact on policy and practice, both nationally and internationally, through relevant research, peer-reviewed publications, and feedback to government, civil society, and the community at large. DTHC is driven by a passion for humanity and a vision of South Africa without AIDS. Over the years, it has become a source of advice for medical practitioners, support for people seeking testing or treatment, and leadership in preventative education. With an experienced and dedicated team of more than 165 doctors, nurses, researchers, and community-trained field workers, the Desmond Tutu HIV Centre offers a holistic approach to the HIV epidemic.

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Institute of Infectious Disease and Molecular Medicine

Concentrating our research efforts on infectious diseases, particularly HIV/AIDS and tuberculosis, and on non-communicable diseases prevalent in Africa, the Institute of Infectious Disease and Molecular Medicine aims to be a centre of research excellence in Africa, and a major training hub for biomedical, clinical, and public health researchers. The institute provides its members, affiliates, and visiting scholars from around the world with an environment that is highly interactive,

allowing complex scientific problems framed in a public health context to be tackled in a multidisciplinary way. Collaborations, partnerships and networks contribute to our world-class scientific endeavours. Our strong scientific base spans many areas of modern, molecular-based enquiry, including molecular and cell biology, immunology, virology, microbiology, genetics and genomics, biochemistry, pharmacology, vaccinology, molecular epidemiology, and structural, high-throughput and computational biology. Our aim is to apply scientific discovery from the bench to the bedside and to the community through a dynamic interplay between basic, clinical, and public health research.

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Drug Discovery and Development (H3-D) Centre

The Drug Discovery and Development Centre (also known as H3-D) was founded in 2010. The centre aims to bridge the gap between basic and clinical studies, and to train a new generation of African scientists with the key skills required for drug discovery

and development, thereby integrating medicinal chemistry, biology and pharmacology, as well as drug metabolism and pharmacokinetics studies, as reflected in the processes of absorption, distribution, metabolism and excretion. H3-D also focuses on the beneficiation of clinically used drugs, including generic medicines. Drug beneficiation, among other things, involves the selection of the optimum form of a solid drug candidate for pharmaceutical development and (re)formulation.

Director: Professor K Chibale
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MRC/UCT Immunology of Infectious Diseases Research Unit

Human infectious diseases are a high-priority area for South Africa and Africa, where they continue to be a leading cause of childhood and adult morbidity and mortality. Thus the MRC/UCT Immunology of Infectious Diseases Research Unit focuses on the understanding of host-protective immune responses and the development of effective vaccine strategies for the eradication of diseases that are identified as priority areas by the World Health Organisation: tuberculosis, leishmaniasis, helminthis diseases (bilharziosis) and African trypanosomiasis (sleeping sickness). The unit's mission is to be relevant as an excellent multidisciplinary and international team, embracing both basic and applied research, in order to improve capacity, teaching, and training in the immunology of infectious diseases.

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MRC/UCT Oesophageal Cancer Research Group

The MRC/UCT Oesophageal Cancer Research Group is an inter-disciplinary and inter-institution group (UCT, MRC and the University of Stellenbosch), established by the MRC in 1997. Squamous cell carcinoma of the oesophagus is one of the eight most common cancers worldwide. High-incidence areas include China, Japan, and certain hot spots in France, Iran and South America. More important is the fact that the incidence of squamous cell carcinoma of the oesophagus is very high in Southern and Eastern Africa, but virtually absent in West Africa. This group is investigating the environmental and genetic factors that predispose Africans to this disease.

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MRC/UCT Receptor Biology Research Group

The mission of the group is to study the structure and function of G protein-coupled receptors and to apply the research to understanding and treating diseases that have major effects on the social and economic welfare of South Africa. The group focuses on the gonadotropin-releasing hormone receptors and on the kisspeptin receptor, which are central regulators of the reproductive function, on the prostaglandin receptors and their role in cervical cancer, and on the CCR5 chemokine receptor and its role in Human Immunodeficiency Virus (HIV) entry and infection.

Co-Directors: Associate Professor AA Katz, Dr CA Flanagan and Professor RP Millar
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UCT Leukaemia Unit

The UCT Leukaemia Unit was established with the objective of fostering basic and clinical research in the area of haematological stem cell disorders and blood malignancies. Some of the current interest includes the marrow microenvironment in multiple myeloma, molecular genetics of acute or chronic leukaemias, and clinical studies in lympho-proliferative disorders. As a consequence, a laboratory with a comprehensive array of equipment is available where honours, master's and doctoral students are running research projects. Based on these studies, a number of clinical and laboratory programmes have been developed. In this regard, the only university-based haematopoietic stem-cell transplantation programme in the country is located at Groote Schuur Hospital. Parallel studies focusing on haematopoietic stem-cell biology and immune reconstitution after transplantation are ongoing.

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Research Groupings
associated with this theme

Albertina and Walter Sisulu Institute of Ageing In Africa

The Albertina and Walter Sisulu Institute of Ageing in Africa is a cross-disciplinary group within the Department of Medicine in the Faculty of Health Sciences and incorporates the divisions of Geriatric Medicine, Geriatric Neuropsychology, Geriatric Neurosciences and Geriatric Psychiatry, and a Gerontology programme. The institute strives to be an academic and research centre of excellence that addresses critical issues of ageing in Africa, and serves as a catalyst for local, national, and regional expertise and a focal point for the development of research services and training. Its mission is achieved through inter-disciplinary and cross-national partnerships and research collaboration, human-resource development, and policy information in the national context and on the African continent. Areas in which research projects are currently conducted at the institute include physical, cognitive and social functioning, and quality of life; vascular risk factors and stroke; falls in older persons and quality of care; and dementia and risk factors for cognitive disorders.

Director: Dr S Kalula
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MRC/UCT Human Genetics Research Unit

The group's current focus is on the genetics of colorectal cancer, inherited forms of blindness, and neuropsychiatric diseases. Recent breakthroughs include identifying the genetic basis of retinitis pigmentosa and developing therapeutics to stem loss of vision in individuals shown to carry the disease-causing mutation. A greater effort is being put into engaging with high-throughput technologies and the mapping of genes for common chronic disorders.

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MRC/UCT Medical Imaging Research Unit

The mandate of the Medical Imaging Research Unit (MIRU) is to conduct world-class research in medical imaging that specifically addresses the healthcare needs of Africa. Although located in the Western Cape, the MIRU sees itself as a national facility, with the responsibility of providing an imaging platform that is available to the wider research community in the country. Our research focuses on the role of medical imaging in addressing problems such as trauma, cancer, tuberculosis, HIV/AIDS, neuromuscular disorders, cardio-vascular disease, and alcohol abuse, all of which pose serious threats to public health in South Africa. In addition to using established techniques to address local healthcare needs, we are developing novel imaging methods in areas such as magnetic resonance imaging, mammography and microscopy, which are appropriate for our national context but will also find application in the rest of the world. The unit has strong collaborative links with Western Cape hospitals, the local medical device industry, and international institutions.

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Women's Health Research Unit

The Women's Health Research Unit, established in 1996 in the School of Public Health and Family Medicine, is involved in research, teaching, technical health service support, and advocacy in the areas of women's health, and gender and health. It is made up of a multidisciplinary team of researchers with expertise in public health, epidemiology, sociology, and anthropology. The unit works closely with the national, Western Cape provincial, and City of Cape Town Departments of Health, as well as with other academic institutions and NGOs, in sexual and reproductive and women's health. Key research areas include HIV and reproductive health, gender and HIV, health systems research (reproductive health), female cancers, contraception, and termination of pregnancy.

Director: Dr J Harries
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UCT/MRC Research Unit for Exercise Science and Sports Medicine

The UCT/MRC Research Unit for Exercise Science and Sports Medicine is part of the Department of Human Biology, within the Faculty of Health Sciences. The

primary functions of the unit are to research factors influencing physical performance and health, and to disseminate knowledge and skills through education. Specifically, the research aims to develop a novel understanding of integrated human function during exercise and to use this knowledge to promote health and well-being; to treat and prevent specific chronic diseases; to treat and prevent injuries and medical conditions associated with sport and exercise; and to optimise exercise performance.

Director: Professor TD Noakes
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Centre for Supramolecular Chemistry Research

Located in the Faculty of Science, this group was constituted in 1997 and focuses on the physical chemistry of supramolecular systems. Various host-guest compounds are synthesized, their structures analysed by means of powder and single crystal X-ray diffraction, as well as thermal and spectroscopic techniques, and the results related to their physical properties. Our research efforts concentrate on the beneficiation of drugs through investigation of their polymorphs, solvates, co-crystals, and cyclodextrin inclusion complexes; on the synthesis and characterisation of open framework transition metal structures and purely organic porous materials, and on the synthesis and characterisation of large supramolecular assemblies and the study of guest selectivity in organic host-guest systems.

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Structural Biology Research Unit

The Structural Biology Research Unit co-ordinates and promotes the experimental determination of biological structure at the University of Cape Town. The Unit is a grant funded entity, operationally located in the Division of Medical Biochemistry, Department of Clinical Laboratory Sciences, that employs staff, provides a home for post-graduate students and post-doctoral fellows and conducts research. It has members who are UCT academics who wish to conduct structural research and who are prepared to apply for grants to fund research in the Unit. The Unit also has affiliates, either from South Africa or abroad, who participate in the activities of the Unit in a variety of ways – including but not limited to: providing advice and expertise, exchanging materials, providing resources and using the resources of the Unit.

The visualization of the structure of biological objects ranging from cells to macromolecules with microscopic or atomic detail is essential for understanding how living systems work. The knowledge of the structures can be exploited to produce medicines and vaccines, ecologically friendly industrial processes and agricultural products. The unit specializes in determining structures experimentally by electron microscopy and X-ray crystallography and makes extensive use of computer based modelling to extend the results. The unit has access to unique resources for the purification and preliminary characterization of proteins, cryo-electron microscopy and X-ray diffraction at a synchrotron beamline. It plays a pivotal role in South Africa's BioEconomy strategy by providing the core expertise for establishment of the discipline of Structural Biology in the whole country and applying the technology to a wide range of problems of scientific, medical and industrial interest.

Director: Professor BT Sewell
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Gender, Health and Justice Research Unit

The Gender, Health and Justice Research Unit at the University of Cape Town's Faculty of Health Sciences (Division of Forensic Medicine and Toxicology) conducts progressive research in the area of women's rights. Faced with staggering levels of violence against women in South Africa, the unit is dedicated to improving access to health and justice services for survivors of gender-based violence. The unit uses inter-disciplinary methods from various academic fields, including law, the social sciences, and public health, to contribute to policies and laws, and to advocate for social justice. Among its current projects are monitoring legislation relating to sexual and domestic violence, as well as inter-disciplinary research relating to women in prisons, domestic and rape homicide, access to post-exposure prophylaxis after rape, "conflicting laws" and torture in post-conflict African states.

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DST/NRF SARChI Chairs
associated with this theme

Professor Jonathan Blackburn

Applied Proteomics and Chemical Biology

Professor Jonathan Blackburn holds the SARChI Chair in Applied Proteomics and Chemical Biology and is head of the ANDI Centre of Excellence in Proteomics and Genomics. He obtained his DPhil degree in Chemistry from the University of Oxford, and carried out postdoctoral research at the Medical Research Council (UK). Professor Blackburn serves on a number of national and international committees, including the National Health Research Committee, the Biotechnology committee of the International Union of Pure and Applied Chemistry, and the Nominations and Election Committee, Human Proteome Organisation. He sits on the editorial advisory boards of the *Journal of Proteome Research*, *Journal of Proteome Science and Computational Biology,* and *Expert Review of Proteomics*. He also sits on the Scientific Advisory Board of GenTel BioSciences (USA), and on the Research Advisory Panel of the Council for Scientific and Industrial Research Biosciences.

Associate Professor Ernesta Meintjes

Brain Imaging

Associate Professor Ernesta Meintjes completed her undergraduate studies at the University of KwaZulu-Natal, Pietermaritzburg, and master's and PhD degrees in Physics at Oregon State University, USA. Since July 2000, she has been employed as a research officer and lecturer in the Department of Human Biology and in 2007 she was awarded the South African Research Chair in Brain Imaging. Her current research focuses on both magnetic resonance imaging methods development and application. She has significant expertise in prospective motion correction and application of these methods to study brain development in children with fetal alcohol spectrum disorders and HIV infection, and in the study of cardiac disease.

Associate Professor Marc Combrinck

Clinical Neurosciences Research

Associate Professor Marc Combrinck is a neurologist who trained in medicine and biochemistry at the University of Cape Town and Groote Schuur Hospital. He was a research fellow at the University of Oxford before returning to South Africa in 2004. His research interests lie in dementia, neuro-inflammation and mechanisms of neuro-degeneration. He continues this work in Cape Town, using clinically based observational studies of cognitive impairment in the elderly and in HIV-associated brain disorders. In March 2011, Associate Professor Combrinck was also appointed to the prestigious William Slater Chair of Geriatric Medicine, the first endowed chair in the sub-specialty of geriatric medicine in South Africa.

Professor Kelly Chibale

Drug Discovery

Professor Kelly Chibale obtained his PhD in Synthetic Organic Chemistry from the University of Cambridge in

the UK with Stuart Warren (1989–1992). This was followed by postdoctoral stints at the University of Liverpool in the UK as a British Ramsay Research Fellow with Nick Greeves (1992–94) and at the Scripps Research Institute in the USA as a Wellcome Trust International Prize Research Fellow with K.C. Nicolaou (1994–96). He was a Sandler Sabbatical Fellow at the University of California San Francisco in the USA (2002), a US Fulbright Senior Research Scholar at the University of Pennsylvania School of Medicine in the USA (2008) and a Visiting Professor at Pfizer in the UK (2008). Professor Chibale's current research interests include discovery of potential drugs that fight malaria, tuberculosis and helminth (parasitic worm), as well as cardiovascular and fibrosis diseases.

Professor Frank Brombacher

Immunology of Infectious Diseases in Africa

Professor Frank Brombacher, a NRF A1-rated researcher, holds the SARChI Chair in Immunology of Infectious Diseases in Africa, and heads up an extramural MRC Research Unit in addition to his ICGEB Scientific Co-ordinator position for Immunology and Infectious Diseases. His group investigates immunological mechanisms, regulation and protective host effector functions in experimental murine infectious disease models that are relevant to Africans, such as tuberculosis, African trypanosomiasis, leishmaniasis and helminthic infections, including bilharzia – four of the top ten WHO-declared human threats. In addition, he and his group are interested in chronic diseases, including allergic asthma and colitis, that cause high morbidity and mortality in humans.

Infection and Immunity of Poverty-related Diseases

Keertan Dheda is Professor of Respiratory Medicine and Director of the Lung Infection and Immunity Unit within the Division of Pulmonology, Department

Professor Keertan Dheda

of Medicine. He is the recipient of several prestigious awards, including the 2010 International Union Against Tuberculosis and Lung Disease Scientific Award, and holds several large local and multinational grants, including those sponsored by the EU. His main research interests are the study of the immunopathogenesis, epidemiology and diagnosis of tuberculosis, including drug-resistant TB. He is the co-author of more than 100 peer-reviewed publications, holds patents that are being commercialised, and serves on the editorial boards of several peer-reviewed international journals.

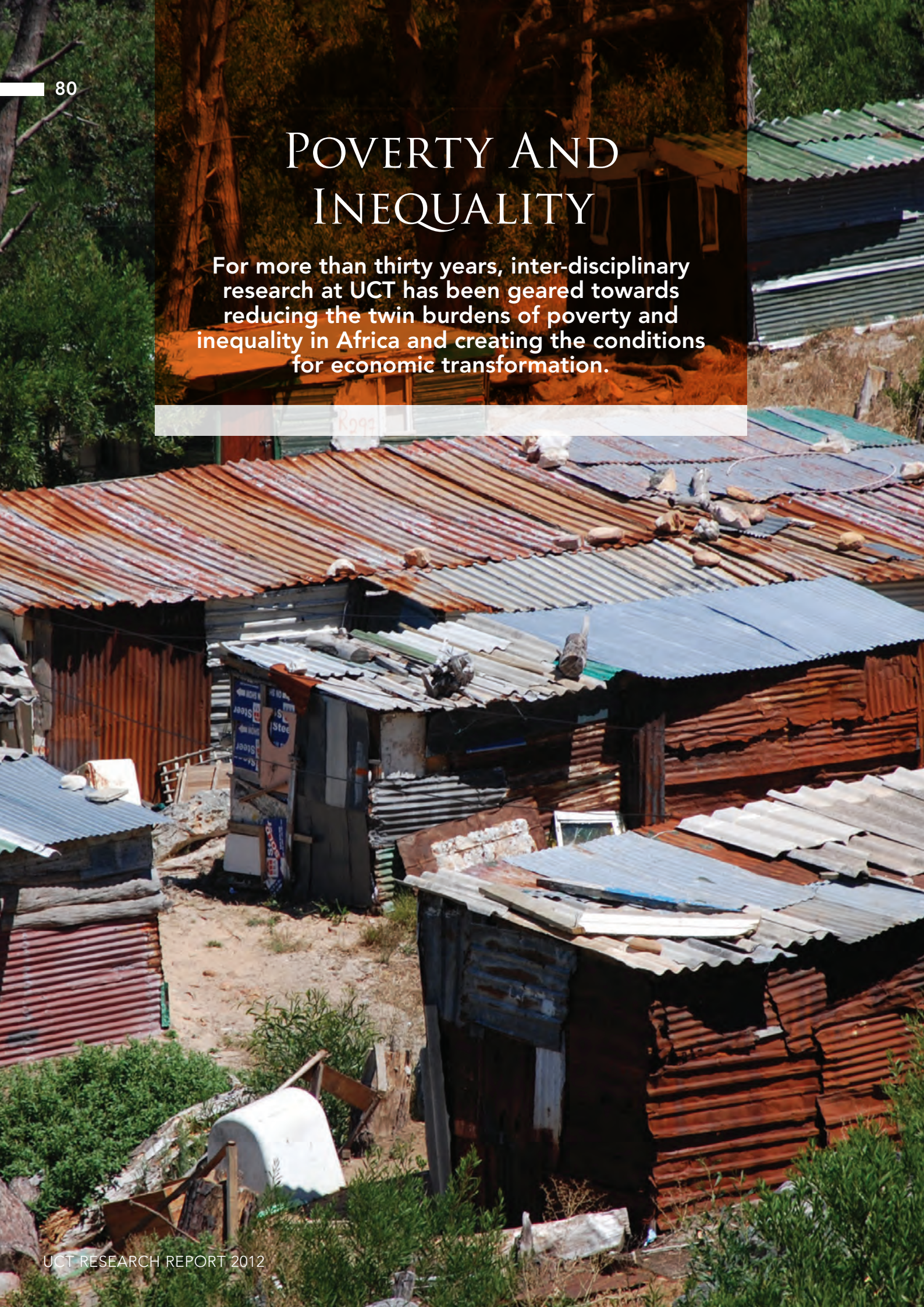
Professor Anne-Lise Williamson

Vaccinology

Professor Anne-Lise Williamson is a virologist on the joint staff of the University of Cape Town and the National Health Laboratory Service (NHLS). As she is a full member of the IIDMM, her research activities are housed in this Institute. She is internationally recognised for both her HIV vaccine and Human Papillomavirus (HPV) expertise. She has headed the South Africa AIDS Vaccine Initiative-funded vaccine development team since 2000. This team of people has been responsible for the development of two vaccines currently in Phase 1 clinical trials in the USA and South Africa, and the ongoing potency assay for one of the vaccines is currently performed in the UCT Vaccine Research Group Good Laboratory Practice Facility. Professor Williamson is head of the World Health Organisation's HPV Labnet lab for the Africa Region and joint head of the Molecular Epidemiology Laboratory (UCT/NICD/NHLS).

Poverty And Inequality

For more than thirty years, inter-disciplinary research at UCT has been geared towards reducing the twin burdens of poverty and inequality in Africa and creating the conditions for economic transformation.



"On the best side, South Africa has continued to surprise even the biggest sceptics with its ability to maintain relative stability and economic calm through stormy financial periods and a larger-than-life World Cup. Yet poverty and inequality, in coldly economic terms, continue to threaten every aspect of the social and economic well-being of the vast majority of South Africans. The reality is as stark as the Gini coefficient. Although so much is already being done, the rift between the top 20% and the bottom 80% of the population isn't getting any smaller." - Francis Wilson

The causes of both poverty and inequality lie deep within South African history, and can be traced through the long process of conquest as it fused with the country's race-biased industrial revolution in the century after the mineral discoveries of the late nineteenth century. This history cannot, of course, be rewritten but it is important to understand and acknowledge it if the country is to find ways of overcoming this dimension of its heritage.

UCT is home to a long and eminent tradition of basic and applied inter-disciplinary research into the challenges posed by poverty and inequality in South Africa. For more than thirty years, this research has been linked to the goals of political, social and economic transformation. The Southern Africa Labour and Development Research Unit (SALDRU), established by Professor Francis Wilson in 1975, organised the landmark 1984 Carnegie Conference on Poverty and Development in Southern Africa and – in association with the African National Congress and its allies – the 1993 household living standards survey. The Development Policy Research Unit was founded in 1990 with the goals of providing evidence-based advice to then extra-state actors on public policy with respect to development and labour. The Centre for Social Science Research (CSSR) was established in 2001/02 to build on the growing strengths of economics in deepening capacity in systematic basic and applied research in the other social sciences. Research in the units that make up the CSSR has spanned diverse disciplines, including not only the social sciences but also collaborations with scholars in the humanities and law, and in the natural and medical sciences. In much the same way that the CSSR fosters cross-faculty collaborations, so too does SALDRU nurture its partnerships.

DataFirst was originally established, under Professor Francis Wilson's leadership, as part of the CSSR, before later becoming a freestanding centre that has pioneered in Africa easy access to user-friendly and high-quality survey data. The Children's Institute was

also established in 2001, with the goal of contributing to policies, laws and interventions that promote equality and realise the rights and improve the conditions of all children in South Africa, through research, advocacy, education and technical support. Another of the key research groups working in this area is the Health Economics Research Unit (HEU), which was established in 1990 in the School of Public Health and Family Medicine. The HEU works to improve the performance of health systems through informing health policy and enhancing technical and managerial capacity in sub-Saharan Africa.

The following pages reflect key achievements of the last year within some of these research groups, in moving towards reducing the twin burdens of poverty and inequality in South Africa and the greater African continent.

Southern Africa Labour And Development Research Unit (SALDRU)

In the contemporary world, researchers are being called to provide evidence-based policy research in the context of rapidly changing societies. Those working on post-apartheid South Africa have faced this challenge for close to two decades and SALDRU's 2012 work programme evidences recognition of the fact that this has prepared us to make a significant contribution to the international research enterprise.

The National Income Dynamics Study (NIDS) is SALDRU's largest ongoing project, undertaken on behalf of the Presidency. The project, which commenced in 2008, aims to track income, consumption and expenditure of approximately the same 28 000 individuals and their households over time. Surveys, or waves, are conducted every second year. In mid-2012, Wave 2 data were released to the research community via DataFirst, which was subsequently downloaded more than 1 000 times by the end of the year. Downloads of the Wave 1 data are approaching the 2 000 mark. The release of the data was accompanied by presentations of preliminary results to the Inter-ministerial Cluster on Poverty Alleviation chaired by the Deputy President and to a full sitting of the National Planning Commission. In 2012 the fieldwork for Wave 3 was successfully completed; this massive process required a third visit to each of the 28 000 individuals that make up the NIDS sample, many of whom have relocated. The release of the NIDS Wave 3 data will take place in 2013.

This is a dream research agenda as it combines maximum social relevance with the possibility of frontier social science.

After NIDS, the largest SALDRU project is J-PAL Africa, which works to improve the effectiveness of social programmes in sub-Saharan Africa. 2012 was a remarkably busy year in the J-PAL Africa office, with a highlight being a large national initiative that saw the piloting of a number of potential labour market policy interventions. In addition, a number of other pilot projects evaluating education and health interventions were trialled in 2012. After this period of careful pre-testing, J-PAL Africa will be looking to fund full-scale evaluations of a number of the interventions in 2013.

For SALDRU, producing NIDS panel data as well as its core participation in the Cape Area Panel Study, a longitudinal study of the lives of youths and young adults in metropolitan Cape Town, is a means to the end of enabling SALDRU researchers (and the researcher community in general) to investigate South Africa's evolving

social dynamics. This is a dream research agenda as it combines maximum social relevance with the possibility of frontier social science. Quantitative analysis of social dynamics is SALDRU's particular strength in both the South African milieu and the international one and 2012 reflected this well:

- SALDRU won a large, three-year NRF/DST grant under a "Grand Challenges" call to undertake research and training on South Africa's unfolding human and social dynamics: Evidence from longitudinal data.
- SALDRU joined a 19-country consortium that won a European Union "NoPoor" competition to undertake a five-year research programme on effective poverty alleviation policies.
- A research proposal on the impact of fertility on education and employment outcomes was one of eight successful proposals at the end of a two-round international call for research on population and poverty by a group of funding agencies from the USA, the UK, the Netherlands and Norway.
- Canada's International Development Research Centre funded an eighteen-month project on the impact of social grants on youth labour supply.

All of these opportunities require the application of international best practice in evidence-based policy-making from SALDRU's researchers and those who work with this group.

A major event in 2012 was the Carnegie3 national research initiative *Strategies to Overcome Structural Poverty and Inequality in South Africa*, which was led by Professor Francis Wilson, the founding director of SALDRU. In addition to the extensive conference programme, special sessions were run by NIDS and by J-PAL Africa on the use of evidence in policy-making. (see project insert).

Furthermore, in a programme that is highly complementary to the Carnegie3 process, SALDRU was tasked by the National Treasury to lead a three-year research initiative that focuses national research energies on issues of employment, income distribution and inclusive growth and creates a national dialogue in these areas. This research project was launched at the Carnegie3 conference, and the associated Econ3X3 online forum was launched in November (see project insert).

The Children's Institute's *Child Gauge 2012* focused on inequality and SALDRU was privileged to partner with the Institute in this Gauge. Associate Professor Ingrid Woolard was one of the editors and there were a number of SALDRU contributors. During 2012, SALDRU also undertook research for the Organisation for Economic Co-operation and Development and the World Institute for Development Economics Research.

Apart from SALDRU's role in national and international research initiatives, the unit was active in a number of capacity-building programmes in 2012. J-PAL Africa undertook an ambitious training agenda for researchers and senior policy makers in South Africa, Malawi, Kenya and Ghana. In addition, SALDRU's UCT Training Programme in Social Science Research Using Survey Data ran for the 14th year in January, and trained 140 researchers from Southern Africa in basic survey analysis. This was replicated in Ghana in July. Subsequently, two courses were held in South African and one in Uganda in advanced panel data analysis, thereby extending the reach of the unit to the continent.

Deputy President Kgalema Motlanthe speaking at the Carnegie3 conference hosted by UCT

Emeritus Professor Francis Wilson

Towards Carnegie3

Professor Francis Wilson, the founding director of SALDRU, was appointed as UCT's Acting Pro-Vice Chancellor, Poverty and Inequality, with his major task being to launch the three-year Carnegie3 national research initiative *Strategies to Overcome Structural Poverty and Inequality in South Africa*. More than 500 delegates attended the September 2012 launch conference, which was hosted by UCT and supported by the Carnegie Foundation and the National Treasury.

The Carnegie3 conference sought to focus attention on understanding the lived experiences of inequality and the causes and dimensions of persistent inequality, and considered policies and actions that are aimed at significantly reducing inequality and poverty in both the short and long term. The conference focused less on describing the problems of poverty and inequality, and more on practical strategies to overcome them. The emphasis was on practical strategies to mobilise the energies of people at all levels of society in creative and effective ways which address structural poverty and inequality and shifting power relations. It sought to provide a platform for serious and deep debate about difficult policy choices that must be made in tackling these issues of poverty, inequality and the underlying facts of massive unemployment.

Appropriately, for a conference that was jointly organised by UCT and the National Planning Commission, participants reflected the full spectrum of those involved in implementing, designing or evaluating the diverse set of policies that are needed to tackle the social ills of poverty and inequality. They included senior policy makers, NGOs, community groups, researchers, participants from government at national, provincial and local levels, and representatives of trade unions, faith-based organisations and the business sector.

A 'Rough Guide' draft report providing an overview of some key themes addressed in over 300 presentations from researchers representing 19 different institutions, with particular focus on identifying gaps and areas in need of further research and sharing effective models, is currently being circulated to authors and presenters. The final conference report will be published by the end of 2013.

REDI3x3 (Research Project on Employment, Income Distribution, and Inclusive Growth)

Launched in 2012, the Research Project on Employment, Income Distribution and Inclusive Growth (REDI3x3) is a multiyear collaborative research project that intends to address the triad of unemployment, inequality and poverty currently gripping South Africa.

The project is designed to generate an independent, rich and nuanced knowledge base and expert network that could, inter alia, contribute to co-ordinated, consistent and effective policies directed at these three critical problem areas. Managed by SALDRU and supported by funding from the National Treasury, the project comprises three focus areas (unemployment and employment, income distribution, and inclusive growth), each of which is led by an academic convenor. UCT's Professors Murray Leibbrandt and Haroon Bhorat convene income distribution and inclusive growth respectively, while the unemployment focus area is led by Professor Frederick Fourie of the University of the Free State.

The project seeks to advance an integrated response to unemployment, inequality and poverty.

The research agenda therefore has a strong focus on generating cross-discourse engagements, drawing on insights from several methodologies, data types and sources, sub-disciplines and disciplines, including labour economics, macroeconomics, development economics, poverty studies, sociology, political science, and law.

The project aims to inspire and develop a community of researchers from an inclusive network of South African universities and research entities. Through this inclusive approach it has started to involve South Africa's leading researchers on labour markets, inequality, poverty, development, growth and social policy (including several DST/NRF Research Chairs), support postgraduate work in the focus areas, and build the capacity of students and researchers from historically black universities.

Another explicit aim is to improve public understanding of, and public discourse on, these complex problems. Critical debate will be stimulated through an online forum (www.econ3x3.org), workshops, seminars, conferences, publications and books, and effective media liaison.

Health Economics

Policy And Systems Research

A wide range of socially relevant research is undertaken by two divisions in the School of Public Health and Family Medicine, both of which have a particular focus on health-system work: the Health Economics Unit (a university-accredited research unit), which is home to the DST/NRF South African Research Chair in Health and Wealth, and the recently established Health Policy and Systems Division.

Tackling the complex challenges of health-system development demands an inter-disciplinary knowledge base, and research that is applied (addressing real-world policy and practice issues) and disseminated in ways that inform and support decision-making. Research focuses on supporting current efforts to transform the health system, both at the national policy level (particularly in terms of healthcare financing reform), and through a focus on policy implementation at the district and service delivery level.

A more recent area of work, which falls directly under the DST/NRF Chair in Health and Wealth, is exploring the social determinants of health within the South African context.

There is a strong emphasis on equity in the research being undertaken, particularly on identifying ways of promoting health-system equity. Another area that is contributed to on an ongoing basis is the evaluation of cost-effectiveness of alternative diagnostic and treatment interventions for diseases of major public health concern, including TB, HIV, malaria and cervical cancer. A more recent area of work, which falls directly under the DST/NRF Chair in Health and Wealth, is exploring the social determinants of health within the South African context.

Finally, the Heath Policy and Systems Division houses the International Religious Health Assets Programme, which seeks to develop systematic evidence about religious health assets and their role within health systems, as well as being actively engaged in deliberately learning through doing, in several projects, about the challenges and opportunities of field-building for this area of research.

Strategies for Health Insurance for Equity in Less Developed Countries (SHIELD)

The SHIELD project, funded by the European Commission and the Canadian International Development Research Centre, aimed to identify the major equity challenges in the health systems of three African countries (Ghana, Tanzania and South Africa) through an understanding of financing incidence (which socio-economic groups pay for which aspect of health care) and benefit incidence (who benefits from health care and to what extent).

It also modelled the equity and sustainability implications of alternative health financing options in each country and evaluated the political feasibility of these options from a stakeholder-analysis perspective. This research has provided a unique evidence base for health-system reform in African (and other low- and middle-income) countries. It has confirmed that paying for health care out of one's earnings is not indicative of a progressive society, and that health schemes which require contributions from individuals who are not formally employed could have dire consequences. Instead, in lower-income countries, consideration should be given to charging taxes as a healthcare-funding mechanism. Results from the study also highlighted that the benefits from using health services are not distributed across socio-economic groups in line with their relative share of need for care (or burden of ill-health) and that the access factors influencing this benefit incidence constitute the greatest challenge facing many health systems in Africa.

The modelling of alternative financing structures has informed reform policies in the study countries. A large number of publications have arisen from this work, including a special issue of *Health Policy and Planning* and an overview paper in *The Lancet*. Four SHIELD researchers (two from Ghana, one from South Africa and one from Tanzania) graduated with PhDs based on aspects of the project, three of whom were supervised at UCT.

Collaborating partners have included UCT's Health Economics Unit and the Centre for Health Policy, University of the Witwatersrand, in South Africa; Navrongo Health Research Centre and Health Research Unit, Ghana Health Service in Ghana; Ifakara Health Institute in Tanzania; London School of Hygiene and Tropical Medicine; Koninklijk Instituut voor de Tropen in the Netherlands; Karolinska Medical Management Centre in Sweden; and Antwerp Institute for Tropical Medicine in Belgium.

Researching Equity in Access to Health Care (REACH)

Over a five-year period (2007–2012), the REACH project explored access barriers to health care.

Focusing on three healthcare interventions (maternal health deliveries, tuberculosis care and anti-retroviral therapy for HIV), the project mapped inequities in service utilisation and access nationally, conducted in-depth studies in four health 'sub-districts' (rural and urban), and identified relevant responses in the policy and practice environment. Funded by a Teasdale-Corti Team Grant, which was administered by Canada's International Development Research Centre, the project was a collaboration between UCT's Health Economics Unit, the Centre for Health Policy (University of Witwatersrand) and McMaster University in Canada. The research team comprised a multidisciplinary team of economists, anthropologists, clinicians, and health-systems and policy researchers within each stage of the research programme.

A mixed-methods programme of research that specifically focused on developing a multidimensional understanding of access inequities in South Africa's public health system was implemented. Triangulating findings across methods, interventions and sites, this approach afforded numerous insights into access inequity in South Africa. An understanding of the access dynamics underlying inequitable access fed into, and was shaped by, the active engagement of user partners across the course of the project. Additionally, report-back meetings, seminars and workshops allowed the research team to sensitise a number of stakeholders (researchers, academics, public-sector managers, front-line health workers and civil society groups) to the range of access constraints that need to be addressed, providing insights into practical strategies for doing this, and creating opportunities for taking the research into action.

Universal Coverage in Tanzania and South Africa: Monitoring and Evaluating Progress (UNITAS)

UNITAS is a five-year research partnership project funded by the European Commission. Launched in 2011, it is a collaborative project with partners from UCT's Health Economics Unit, the Centre for Health Policy, University of the Witwatersrand, and the Africa Centre, University of KwaZulu-Natal (in South Africa), Ifakara Health Institute (in Tanzania), the London School of Hygiene and Tropical Medicine, and the Institute of Tropical Medicine Antwerp (in Belgium).

The goal of universal health coverage is receiving increasing international attention. South Africa is introducing a system of universal healthcare entitlements to be funded from general tax and additional dedicated tax revenue. Tanzania is integrating existing health-insurance schemes for formal and informal-sector workers under the management of a single insurer. In both countries, financing reforms are being supported by wide-ranging efforts to improve the delivery and management of health services. Combined, these reforms intend to reduce existing health-system inequalities and improve population, health service and healthcare-cost coverage.

South Africa is introducing a system of universal healthcare entitlements.

Translating such health financing, service delivery and management reforms into intended changes 'on the ground' requires a well-functioning monitoring and evaluation system which provides data that allow policies to be improved over time, and consequently strengthen their potential to achieve universal health coverage. While many questions about the most appropriate design of universal coverage reforms in different contexts remain, even less is known about how to implement reform policies effectively. There is an urgent need to gain detailed insights into reform implementation processes to improve the likelihood of successful health-system reform. The UNITAS project aims to support the implementation of reforms intended to achieve universal coverage in South Africa and Tanzania by monitoring and evaluating the policy processes.

District Innovation and Action for Health Systems Development (DIALHS)

The DIALHS project is an action-learning partnership between the Provincial Government of the Western Cape, the City of Cape Town and researchers from the Schools of Public Health at the universities of Cape Town and the Western Cape.

Initiated in 2010 within the Mitchell's Plain sub-district in Cape Town, this collaborative project applies iterative cycles of learning, reflection and action, with the aim of better understanding how to act to support strengthened functioning within the district and primary healthcare system.

The focus of work to date has centred on issues of governance and governing, including understanding the complexity of the sub-district, as well as the organisational and personal capacities needed to support primary health care. Identifying the particular importance of the tangible and intangible software elements of organisational capacity, the work so far has focused on the soft skills needed by sub-district and primary healthcare managers, and mechanisms to support these managers in their work, the role of formal and informal (tacit) knowledge in routine healthcare decision-making processes, the identity-transition process undergone by primary healthcare nurses when becoming facility managers, and approaches to implementing meaningful community participation in health and health care. While the project has included some formal data collection elements (largely through in-depth interviews and facility observations), the key approach to learning has been through participation. In distilling lessons, partners have drawn on reflective practice and theories of change approaches and have sought to work with colleagues in the system to learn lessons together.

Social Determinants of Health

In 2005, the World Health Organisation launched the Commission on Social Determinants of Health (SDH). This was intended to explore ways of tackling increasing health inequalities both within and across countries, through actions around the social determinants of health.

Broadly, the SDH include the social, political, economic, environmental and cultural factors that affect health status. In order to address social determinants, there is a need to compile scientific evidence on the SDH both within and across countries. In South Africa, as in many other African countries, such evidence is sparse. The Health Economics Unit is currently compiling existing global and domestic evidence on social determinants of health (broadly defined) both at disease-specific level and for health in general. Specific disease conditions that are currently being explored include malnutrition in children, obesity, diabetes, hypertension and mental health. Based on this synthesised evidence and the broad WHO framework for SDH, the HEU is developing a conceptual framework for more fully understanding the causal pathways and mechanisms through which SDH operate within the South African context. The ultimate goal is to inform domestic policy actions that can address key social determinants (e.g. through macro-economic and social policies) and improve population health status.

Economics of Tuberculosis

Over the years, the HEU has undertaken various economic evaluations of interventions to address key public-health challenges.

At present, a major focus is on TB interventions. The XTEND study is evaluating the cost-effectiveness of the new TB diagnostic technology Xpert MTB/RIF in the context of the national roll-out of this technology in South Africa. This study will determine the cost-effectiveness of Xpert MTB/RIF from a patient and programme perspective, and will use mathematical modelling to predict the likely population-level impact on TB transmission. A sub-study, called XPHACTOR, will identify an evidence-based algorithm, which is feasible to implement within HIV clinics, to guide the utilisation of TB diagnostic investigations. The results will complement the XTEND study, and provide evidence to guide the rational use of Xpert MTB/RIF in South Africa and other settings where HIV and TB are both prevalent. Another study under way explores the cost-effectiveness of adding the MVA85A vaccine to the BCG vaccine in children from the perspective of the South African government. The recently published results of the Phase IIb clinical trial conducted in Worcester, South Africa, showed the efficacy of the MVA85A vaccine in preventing TB in infants to be 17.3%, making the vaccine essentially ineffective. This has a noticeable effect on the outcomes of the cost-effectiveness analysis. However, a Markov model that has been developed for this vaccine could also be used to determine the cost-effectiveness of other new TB vaccines being tested in infants.

Research Groupings
associated with this theme

Development Policy Research Unit

The Development Policy Research Unit (DPRU) specialises in socio-economic research with a focus on labour markets, poverty and inequality. The DPRU's mandate is to undertake academically sound, high-quality policy relevant research; to maintain and develop effective networks with government, civil society and the research community in Southern Africa; to engage in training and teaching activities; and to participate directly in the process of formulating, implementing and evaluating policy. The DPRU further aims to train a new generation of research economists within the unit. During 2012 the DPRU continued its engagement with labour-market issues, and its partnership with the Africa Growth Initiative (AGI) at the Brookings Institution has also been highly successful. The AGI aims to raise the African voice in global policy debates on Africa and the partnership has resulted in the publicationof two labour-market policy papers. The Labour Market Intelligence Partnership, was formally launched in September 2012 by the Minister of Higher Education and Training, and focuses on creating a credible labour-market intelligence framework to ensure better information-gathering, analysis and overall systems synergy.

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Southern Africa Labour and Development Research Unit

The Southern Africa Labour and Development Research Unit (SALDRU) conducts research directed at improving the well-being of South Africa's poor. It was established in 1975 and played a central role in documenting the human costs of apartheid through conferences and the Second Carnegie Enquiry into Poverty and Development in South Africa (1983–1986). From 1992 to 1994 SALDRU co-ordinated South Africa's first non-racial national living standards sample survey and, in the post-apartheid period, it has continued to gather data and conduct research directed at informing and assessing anti-poverty policy. SALDRU hosts the J-PAL Africa, the regional office for Africa of J-PAL. SALDRU's largest contemporary project is the running of South Africa's first national longitudinal survey of well-being, the National Income Dynamics Study, on behalf of the Presidency. Every year SALDRU offers extensive training in the analysis of survey data to a broad array of South Africa's academics, graduate students and researchers from NGOs and government.

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Health Economics Unit

The Health Economics Unit (HEU) was established in early 1990 in the School of Public Health and Family Medicine and was accredited as a formal research entity in the university in 2007. The HEU works to improve the performance of health systems through informing health policy and enhancing technical and managerial capacity in sub-Saharan Africa. Its foundation is academic excellence in health economics and management. The core objectives of the HEU are to conduct high-quality research in health economics, health policy, and systems; to develop capacity in health economics, health policy, and systems research in Africa through postgraduate training and related capacity development initiatives; and to translate research findings into policy and practice.

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Centre for Social Science Research

The Centre for Social Science Research (CSSR) is an inter-disciplinary research centre dedicated to conducting and building capacity for systematic, evidence-based, policy-relevant, replicable social science research in South Africa and across Africa. CSSR projects are usually team-oriented, bringing together multiple local and international researchers, and offering postgraduate students significant opportunities for hands-on training. Substantively, the CSSR conducts research in the broad areas of globalisation, industrialisation, democratisation, development, poverty, and public health. The four units that comprise the CSSR conduct research on a range of social dynamics, using survey data (especially the Cape Area Panel Survey and the Cape Area Survey) and related qualitative data, a range of issues around democratisation in South and Southern Africa, using public-opinion data but also creating new systematic databases on elections, legislatures and local government, the social impact of HIV/AIDS, including issues of parenting, disclosure, sexual behaviour and public welfare, and on globalisation, industrialisation, innovation, and the dynamics of global value chains on developing-country industrial sectors.

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Professor Haroon Bhorat

Economic Growth, Poverty and Inequality: Exploring the Interactions for South Africa

Haroon Bhorat is Professor of Economics and Director of the Development Policy Research Unit and holds the DST/NRF South African Research Chair in Economic Growth, Poverty and Inequality. His research interests cover labour economics, poverty and income distribution. He has co-authored two books on labour-market and poverty issues in South Africa, and has published more than 150 academic journal articles, book chapters and working papers. Professor Bhorat has undertaken extensive work for several South African government departments, most notably the South African Department of Labour, the Presidency and the National Treasury. He consults regularly with international organisations such as the International Labour Organisation, the World Bank, and the United Nations Development Programme.

Professor Murray Leibbrandt

Poverty and Inequality Research

There is widespread recognition of the importance of ensuring that South Africa's growth processes embrace the poor and those in the bottom half of the income distribution. The appointment of Professor Murray Leibbrandt, Director of the Southern African Labour and Development Research Unit (SALDRU), to this Chair facilities a sustained programme of research to measure and analyse South Africa's unfolding poverty and inequality dynamics. For the last thirty years, SALDRU has been conducting large social surveys to generate the data needed to inform such analysis of poverty and inequality.

Professor Diane McIntyre

Health and Wealth in South Africa

Professor Diane McIntyre is a professor in the School of Public Health and Family Medicine and was the founding Director of the Health Economics Unit in the Faculty of Health Sciences.

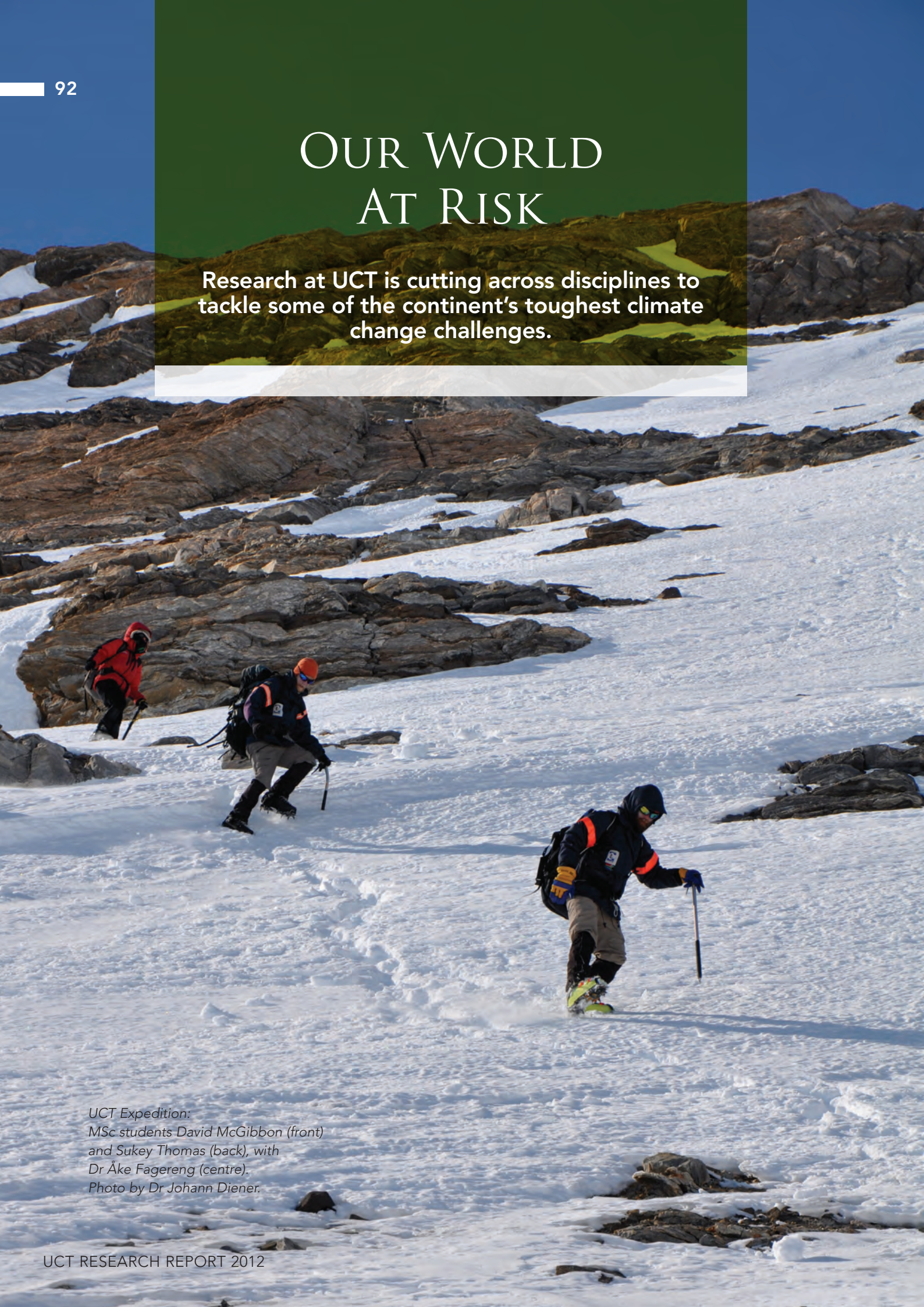
Her current focus is on conceptual and empirical research centred around how to achieve universal healthcare coverage in low- and middle-income countries.

Professor McIntyre has provided extensive and high-level policy inputs within South Africa and other African countries, particularly in relation to healthcare financing issues, including currently contributing to the development of the National Health Insurance policy.

Her current focus is on conceptual and empirical research centred around how to achieve universal healthcare coverage in low- and middle-income countries. She has also been centrally involved in developing health economics capacity within the African region. She holds the SARChI Chair in Health and Wealth in South Africa in recognition of her pioneering work in this area.

Our World At Risk

Research at UCT is cutting across disciplines to tackle some of the continent's toughest climate change challenges.



UCT Expedition: MSc students David McGibbon (front) and Sukey Thomas (back), with Dr Åke Fagereng (centre). Photo by Dr Johann Diener.

There is growing urgency across the globe to address the effects of climate change. Academic research at the University of Cape Town is rising to the challenge by spearheading cutting-edge and proactive programmes and projects on regional and local issues where climate change is of concern.

Climate change has become a critical global concern affecting all countries and continents. Developing nations are particularly at risk as rising temperatures, floods and droughts have more devastating effects in areas afflicted by poor infrastructure, inadequate housing, poverty and a lack of resources. Because of the complexity of the problem, the University of Cape Town has been working to stimulate cross-disciplinary research and teaching to address a range of dilemmas raised by climate change.

Principal amongst these initiatives is the university's flagship African Climate and Development Initiative (ACDI), launched in 2011 with the aim of advancing inter-disciplinary research and graduate training on climate change from an African development perspective. ACDI harnesses the research being undertaken across the university under a unified umbrella and takes a holistic approach towards all research projects.

A ground breaking new postgraduate course at UCT offers an integrated approach to climate change topics.

The past year represents the first full year of ACDI being in operation, after the appointment of Professor Mark New, in mid-2011 as Pro-Vice-Chancellor and director of the initiative. The aims of ACDI in 2011/2012 were to establish the ACDI master's programme, to enhance activities and exchanges within the university's many departments, to pilot deeper research enquiries, and to develop research partnerships with external stakeholders.

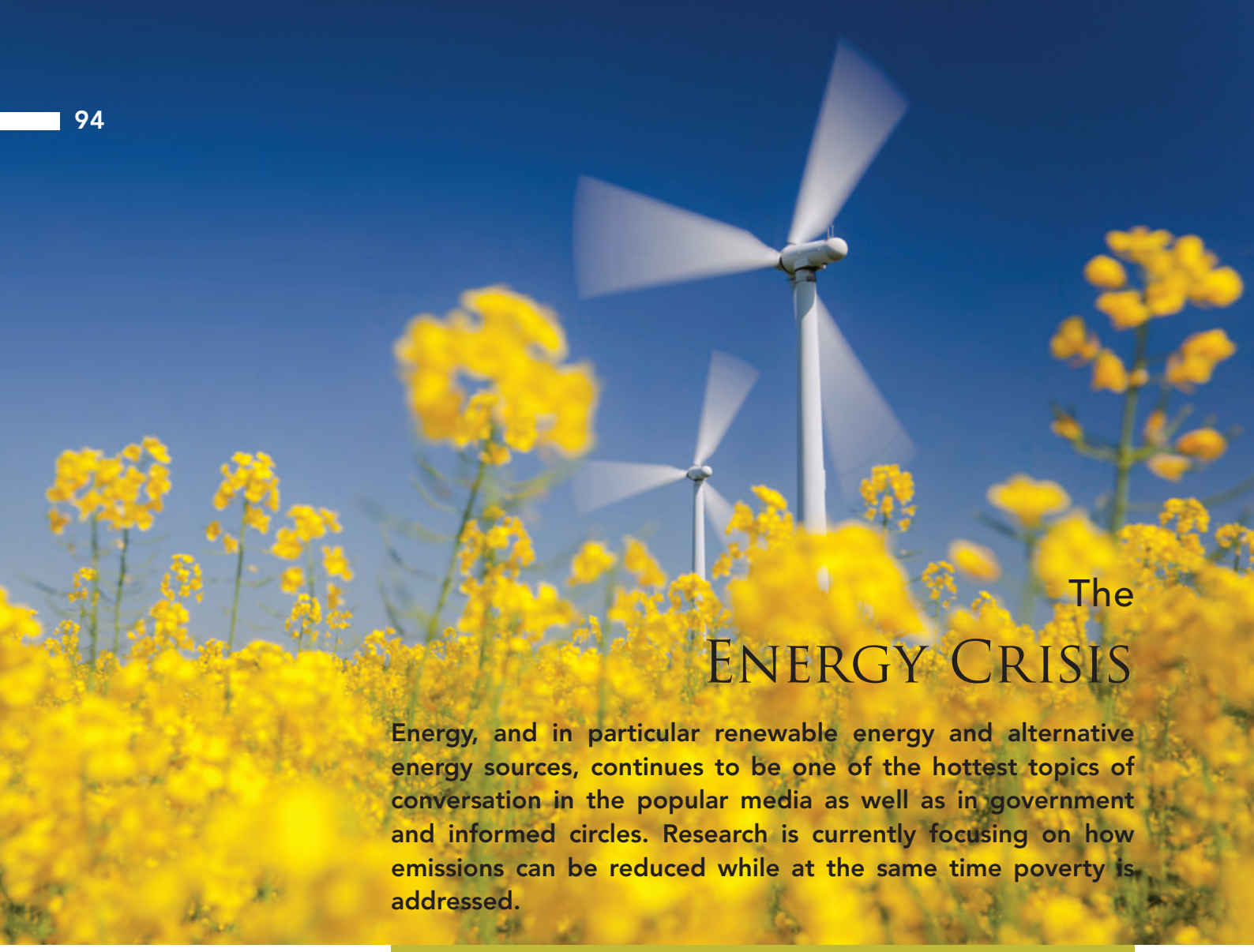
ACDI accepted its first cohort of nine students on the master's in Climate Change and Sustainable Development; all of whom will graduate in June 2013. This MSc programme breaks new ground at UCT, offering an integrated approach to climate-change topics, with contributions to core and elective courses from a number of departments representing all UCT faculties.

An ACDI highlight in 2012 was the initiation of research exploring climate and development issues in the Berg River area of the Western Cape, supported by the Carnegie Corporation. This project is unique in bringing together UCT researchers from seven departments and a range of actors in the Berg River municipal area – from regional and local government, commercial agriculture and industry, to nature conservation. In addition, serving as a laboratory to explore the success, challenges and opportunities that inter- and transdisciplinary research presents to the university, the project has facilitated the "bottom-up" development of several collaborative research projects, where the research questions and methods are co-produced collectively between researchers and practitioners.

Undoubtedly, climate change is both a global and a very personal phenomenon. It affects just about every area of our lives. This interconnectedness is what is driving UCT's inter-disciplinary approach to climate-change studies. From the economics of poverty and inequality to energy security, palaeosciences and marine and bird research, there is a wide range of research at UCT that, impacts upon and feeds into the work of ACDI.

ACDI research projects undertaken by students

- Climate risks and constraints to adaptation for sustainable livelihoods of the rural poor
- The co-benefits of environmental job-creation projects in Cape Town
- The University of Cape Town's food system and its relation to the institutional carbon footprint
- Socio-economic implications of the implementation of coastal development setback lines
- Urban agriculture in Cape Town and the City of Cape Town Urban Agriculture Policy 2007
- Measuring, reporting and verifying mitigation actions at the municipal level: City of Cape Town
- Energy efficiency and environmental performance of the South African cement industry since 1980
- Mechanisms encouraging transport modal shifts from private to public transport to reduce transport emissions in the City of Cape Town
- Public perception of climate change in Lavender Hill, Cape Town



The Energy Crisis

Energy, and in particular renewable energy and alternative energy sources, continues to be one of the hottest topics of conversation in the popular media as well as in government and informed circles. Research is currently focusing on how emissions can be reduced while at the same time poverty is addressed.

The accumulation of greenhouse gases (GHGs) in the atmosphere is a long-term problem, but immediate action needs to be taken. The impacts caused by climate change potentially threaten any development and especially affect poorer members of society. Climate change may be an environmental issue but it deeply affects our society and economy – in particular the energy sector.

Changing how we use energy and finding new technologies and systems to produce low- and zero-carbon energy require rigorous evidence, based on research.

In South Africa and globally, most emissions come from the use and supply of energy, in particular the burning of fossil fuels. Changing how we use energy and finding new technologies and systems to produce low- and zero-carbon energy require rigorous evidence, based on research. This involves quantitative analysis, including modelling, policy analysis, stock-taking through inventories and carbon accounting, analysis of climate-friendly technologies, and understanding how to change behaviour – with a view to living well while using less energy. UCT's Energy Research Centre (ERC) has worked on climate-change mitigation – reducing GHG emissions – since the 1990s. The ERC's Energy, Environment and Climate Group, working with others at UCT and beyond, is engaged in a number of projects that focus on energy modelling, poverty, efficiency and renewables.

Mitigation Action Plans and Scenarios

UCT is actively involved in climate-change mitigation research, which focuses on concrete actions aimed at reducing or limiting damage caused by climate change. Mitigation action plans and scenarios (MAPS) is a collaborative research project between developing countries like Colombia, Chile, Brazil, Peru, Argentina and, more recently, India. Particular research streams include poverty, economy-wide and sectoral modelling, and possible mitigation actions in the energy, transport and agriculture sectors. The MAPS programme is being undertaken by the ERC and the organisation SouthSouthNorth.

The collaboration aims to link climate-compatible economies with similar economic-development and poverty-alleviation programmes. MAPS builds on the experience of South Africa's long-term mitigation scenarios, and will crucially include a participative process with stakeholders from all sectors. In this sense, MAPS is not simply another research study – the information will be produced in partnership with the best indigenous and international research. Through strategic collaboration, MAPS offers an opportunity to establish synergies and share lessons with participating developing countries as well as the broader climate-change and development community.

Particular research streams include poverty, economy-wide and sectoral modelling, and possible mitigation actions in the energy, transport and agriculture sectors.

The ERC's Professor Harald Winkler is one of the directors of MAPS, with Professor Marta Torres (Oregon State University, USA) co-ordinating research, and MAPS includes a long list of researchers involved in a wide range of research activities and products.

In addition to continuing engagement with in-country researchers and facilitators in Peru, Chile, Colombia and Brazil in 2012, a number of research papers were completed and a knowledge platform was established.

Reducing Poverty and Emissions

This project investigates how developing countries can reduce emissions and poverty at the same time. ERC researchers Dr Britta Rennkamp, Anya Boyd, Holle Wlokas and Tara Caetano and doctoral student Loveline Che are approaching this big question in two research projects. In the first, funded through the Climate Change Capacity Development Network, the ERC developed a South African Mitigation Action Impact Matrix in 2012, based on the country's low-carbon development goals.

The matrix helped to establish how the different electricity-generating technology options such as wind, solar and nuclear power impact on the country's development goals as stated in its recent development and energy plans: emissions reductions, poverty and inequality reduction, GDP growth, job creation and increasing renewable energy in the overall energy mix. The innovative research design combined a quantitative modelling exercise with qualitative case studies and a participative rating with experts. Results showed that solar and wind energy technologies contribute better to the development goals than nuclear technologies.

At the same time, large parts of the population live below the national poverty lines.

The ERC's research on poverty and climate-change mitigation is ongoing. In a new project funded through the Volkswagen Foundation, the question asked is how low-carbon development interventions such as carbon taxes, renewable energy programmes and green housing programmes impact on poverty and income distribution in three developing countries: South Africa, Mexico and Thailand.

Each of the three countries has a semi-industrialised economy and a substantial portion of their emissions derives from industrial processes, coal burning and oil refining. At the same time, large parts of the population live below the national poverty lines. In this multi-disciplinary research project, the UCT team collaborates with five research institutions and structures the research in a comparative design with Mexico and Thailand.

Looking towards
Our Oceans

Marine ecosystems are extremely vulnerable and sensitive to climate change. UCT's Marine Research Institute is conducting various programmes and research projects across the African continent that focus on the effects of human activity on marine ecosystems, fish populations and health as well as other related topics.

The University of Cape Town has gained an international reputation for its cutting-edge marine research. The location of the Marine Research Institute (Ma-Re) at the tip of the African continent and its proximity to three major oceans has contributed to its importance.

There are two South African Research Chairs with close ties to Ma-Re: Marine Ecology and Fisheries, headed by Associate Professor Astrid Jarre, and the Chair in Ocean Climate Modelling, which is hosted by the Oceanography Department and is currently vacant.

Under the leadership of Honorary Professor Larry Hutchings and Associate Professor Astrid Jarre and in collaboration with the Department of Environmental Affairs, St Helena Bay has been the focus of research into ocean change. St Helena Bay is a very productive ocean region and a nursery ground for many juvenile fish. The results from this research have highlighted variability and changes in the Benguela region, and the importance of human activity on observed ecosystem changes. This project is funded by the SARChI Chair in Marine Ecology and Fisheries, the Department of Environmental Affairs, and NansClim.

One of the outcomes of UCT's long-standing association with the Council for Scientific and Industrial Research (CSIR) was the awarding of the ACCESS Centre of Excellence in 2010. This is hosted by the CSIR but is a joint initiative with UCT and several other partner institutions. In 2012 UCT received R4.65 million from ACCESS across seven themes, of which R3 million was earmarked for bursaries. Many of the ACCESS students funded by ACCESS are affiliated with Ma-Re.

St Helena Bay is a very productive ocean region and a nursery ground for many juvenile fish.

Also working in this area is the Nansen-Tutu Centre for Marine Environmental Research, which was established in 2010 with the founding partners including Ma-Re and the Department of Oceanography, ACCESS, the Nansen Environmental and Remote Sensing Centre (NERSC), the Institute of Marine Research Centre for Development Co-operation in Fisheries, the University of Bergen (Norway), and Princeton University.

The centre's aim is to contribute to developing and implementing operational oceanography and data-assimilation methods around Southern Africa, including the South Atlantic and Indian Oceans, and the Southern Ocean. Its main focus areas are ocean state, marine environmental and ecosystem modelling (including climate and global teleconnections), research and capacity building.

One of the outcomes of UCT's long-standing association with the Council for Scientific and Industrial Research (CSIR) was the awarding of the ACCESS Centre of Excellence in 2010.

In 2012 the Nansen Tutu Centre funded two African MSc Students (Joseph Amollo and Francisco Francisco) and two postdoctoral research fellows (Drs Bjorn Backeberg and Issufo Halo). The Nansen Tutu Centre also contributed to the MESOBIO project, which is a multinational collaboration on marine research in the Mozambique Channel.

The centre contributes to various successful programmes and projects, such as the African Coelacanth Ecosystem Programme, and personnel also teach in the Applied Marine Science and Ocean Climate Dynamics master's degrees and the Oceanography Honours course.

Exploring Deep Waters

Ma-Re BASICS is the focal research activity of Ma-Re. The four-year initiative began in mid-2010 and is funded from a number of sources, the main one being the Vice-Chancellor's strategic initiative fund for the project *Marine multi-scale data and models: the key to predicting climate variability in Africa and its biological and social consequences.* It is structured as a network of research across multiple disciplines, departments and faculties at UCT. BASICS provides the umbrella framework to link diverse projects on marine social and ecological systems. Some of these are listed in this section to give an indication of the breadth of research under way.

The initial aim of Ma-Re BASICS was to provide students and researchers with a common identity, a common goal and a supportive, stimulating and informative research environment. During 2011 and 2012 a number of events were organised to stimulate and encourage communication, awareness and collaboration among staff and students undertaking diverse individual projects. Ma-Re held a series of focused discussions, such as the "themed lunch" on a marine law theme, led by Professors Jan Glazewski and Loretta Feris of the Institute of Marine and Environmental Law. The discussions during this first themed lunch resulted in further discussion and a collated response to the recent Green Paper on the *National Environmental Management of the Ocean.*

The Air We Breathe

One of BASICS's projects looked at bromoform – a chemical compound found in the air above the sea surface produced by marine plants. Most bromoform is produced naturally and readily crosses the sea-air boundary into the marine-boundary layer. Once in the atmosphere, bromoform is broken down by light energy into bromine radicals, which destroy ozone in the lower and upper troposphere.

Brett Kuyper and the Applied Marine Science master's students at the South African Weather Services.

Brett Kuyper and colleagues developed a simple, cost-effective method to detect and quantify bromoform in environmental air samples. They then measured bromoform concentrations at the Cape Point Global Atmospheric Watch station. These concentrations were found to be 5–7 times greater than in most other studies, although they fell within the range reported for similar marine environments.

The high concentrations are probably caused by the extensive kelp beds that occur in close proximity to the measuring station, although a possible anthropogenic influence from the nearby urban areas of Cape Town could not be excluded. This project is funded by ICEMASA and Ma-Re.

Postdoctoral research fellow Dr Laura Blamey.

Monitoring Marine Species

Over the past two decades, several marine species have changed their distributions in waters off the South African coast. One of the species that has moved its population centres is the commercially important rock lobster (*Jasus lalandii*), which has decreased in abundance on the West Coast and increased on the South Coast, east of Cape Hangklip. The reasons for the shift are not fully understood, but are probably linked to changes in environmental conditions.

Postdoctoral research fellow Dr Laura Blamey and colleagues applied three different statistical methods to environmental and biological data sets to try and identify what factors might have contributed to the shifts. They found that rock lobsters grew much more slowly from the mid-1980s and progressively moved eastward during the early to mid-1990s, at a time when summer winds strengthened and coastal upwelling was very variable.

From the mid to late 1990s there were fewer Bank Cormorants (which eat rock lobsters) on the West Coast and more on the South-West coast, probably in response to the movement of their prey. Rock lobsters eat sea urchins, so increased numbers of rock lobsters on the South Coast have also caused sea urchins to virtually disappear. In turn, sea urchins provided shelter from predators for juvenile abalone, and when the sea urchins disappeared many more juvenile abalone were eaten, impacting the adult populations at a time when they were being affected by uncontrolled illegal fishing. The results of this research are part of the effort under Ma-Re BASICS to develop environmental indicators to act as early warning signals for long-term ecosystem-scale changes. This project is funded through the SARChI Research Chair in Marine Ecology and Fisheries, and BASICS.

Many Fish in the Sea

Postdoctoral Research Fellow Dr Hilkka Ndjaula used long-term historical records of lengths and weights of fish to develop an index that can be used to assess changes in the health of fish populations. An average fish of any species will weigh a standard amount for a given length, but will weigh less when it is in poor condition and more when it is in good condition.

Fish will typically be in good condition when food is plentiful, as might occur when fish population sizes are small or when food sources have increased. Dr Ndjaula used enormous historical data sets to identify periods of good and bad fish condition for three species of fish: sardine (*Sardinops sagax*), anchovy (*Engraulis encrasicolus*) and redeye round herring (*Etruneus whiteheadi*). She adopted a new statistical method to analyse the historical length and weight data, in collaboration with Dr Ken Gerow from the University of Wyoming, USA, and found a consistent decrease in the index for all three species over the past decade.

These results indicate common environmental conditions experienced by the fish on a system-wide basis. The index is being used in a knowledge-based system developed by a current PhD student, an example of cross-pollination across projects within BASICS. This project is funded by SARChI Research Chair in Marine Ecology and Fisheries, and BASICS.

Marine Collaboration

A joint initiative between several laboratories in South Africa and France, that emerged from collaboration between UCT, Marine and Coastal Management and the French Institut de Recherche pour le Développement (IRD), has resulted in the International Centre for Education, Marine and Atmospheric Sciences over Africa (ICEMASA) collaboration.

ICEMASA focuses on Marine Sciences (marine ecosystems, resources management, physical oceanography, ocean-atmosphere exchanges, and biogeochemistry) over the Southern African coasts and the Southern Ocean. Its approach is richly multidisciplinary and is designed to attract collaborators from the Department of Environmental Affairs (Oceans and Coasts), the Department of Agriculture, Forestry and Fisheries (Fisheries Branch), UCT (Ma-Re and the Departments of Oceanography and Biological Sciences), Laboratoire de Physique des Océans, Centre de Recherche Halieutique Méditerranéenne et Tropicale – Ecosystèmes Marins Exploités, Laboratoire des sciences de l'environnement marin, the IRD, the Institut National des Sciences de l'Univers, and Université de Bretagne Occidentale (UBO, France).

ICEMASA works closely with the African Centre for Climate and Earth Systems Science (ACCESS), a DST/NRF Centre of Excellence that is hosted at the Council for Scientific and Industrial Research. ACCESS offers various educational programmes that include workshops and advanced seminars, research projects and computer modelling.

Under ICEMASA, the IRD provides funding for postdoctoral research fellows and postgraduate students as well as for foreign students. Linked to the ICEMASA initiative, Ma-Re and the IRD received funding from the PEERS programme for the joint execution of a research and training project entitled *South-African/French Co-Masters in Marine Sciences* (SAFCOMS). The purpose of this project is to provide bursary funds to students in marine science master's programmes at UCT and UBO for 2012/13.

Under the banner of ICEMASA and hosted by Ma-Re, five scientists from the IRD presented a postgraduate course on end-to-end marine ecosystem modelling at UCT. The course was attended by 25 participants from all over the world, including Seychelles, France, Kenya, Senegal, Peru and Holland, as well as South Africa.

How are Birds Affected?

The impact of climate change on bird populations in South Africa is a key research field for UCT researchers. Birds are particularly sensitive to changes in their habitat, with a rise in temperature of only a few degrees contributing to the extinction of some species.

Although the conservation of rare species is to some degree reactive, studies of the conservation issues related to global change, especially climate change, are more proactive in nature. We know that the world's climate is changing: we also know that many species, birds included, are already responding to these changes. The key challenge is predicting how these nascent biological changes will manifest themselves in the future in terms of changing biological communities, and what the larger ramifications of these changes might be.

We know that the world's climate is changing: we also know that many species, birds included, are already responding to these changes.

To date, much climate-change research has remained the domain of modellers, and there has also been significant documentation of biological changes, especially for specific species. However, what is lacking is a good understanding of the mechanisms that lead to such changes. The FitzPatrick Institute is contributing to filling this niche and building the bridge between modelling and empiricism.

Climate Change and Fynbos Birds

South Africa's most dramatic global biodiversity hotspot is the Cape Floral Kingdom or fynbos biome. Its remarkable biodiversity is one of its strategic advantages for tourism, rural economic development and human well-being. Fortunately much of the mountain fynbos is protected for water catchment, and the threat posed by invasive plants is well understood. However, it is crucial to assess the vulnerability of the biome and its avifauna to climate change.

The project to assess the vulnerability and adaptation of fynbos endemic birds to climate change explores how the six passerine species endemic to mountain fynbos are impacted by climate change and changing fire regimes. Fynbos birds are increasingly threatened by the unravelling of plant-pollinator mutualisms, invasion by woody plants and too-frequent fires.

The key questions pertain to the vulnerability of fynbos-endemic birds to climate and land use change, how the endemic birds disperse across ecosystems and how conservation planning and management can help birds adapt to global change. The research team includes ornithologists, pollination ecologists, population and stress ecologists, behavioural ecologists, a veterinarian, a small network of volunteer observers and amateur bird-ringers.

Catching 3000 Birds

Postdoctoral research fellow Dr Alan Lee initiated a biome-wide fynbos-endemic bird survey at the start of 2012. Summer and winter surveys were conducted at 900 points from the Cederberg to the eastern Baviaanskloof. This data has been used to calculate density estimates for the endemic birds, allowing the first robust estimates of their global populations. Cape Sugarbirds (*Promerops cafer*), Orange-breasted Sunbirds (*Anthobaphes violacea*) and Victorin's Warblers (*Cryptillas victorini*) appear to be vulnerable to changes in vegetation structure expected to occur if predictions of a warmer, drier and more fire-prone environment come about.

A ringed Cape Sugarbird

In addition to a broad overview of the biophysical limits on the ranges of endemic birds in the biome, the project has various study sites. Given the potential importance of habitat fragmentation, birds were mist-netted and ringed during 2012 at sites of varying distances apart in the Kouga, Outeniqua and Kammanassie mountains. More than 3000 birds have been captured with no evidence of movement between sites. At a fine scale, researchers are assessing the extent to which urbanisation creates opportunities and poses novel threats for fynbos birds. For example, birds might be able to seek refuge in urban gardens during fires, hot dry winds or rainstorms, but at the same time be exposed to commensal predators and pathogens. The research will increasingly cast light on conservation planning, policy and land management. As attention is paid to the security of biodiversity in the fynbos, this project will help guide landowners to make more robust conservation-planning decisions based on fine-scale understanding of the implications of climate-driven change in this very special biodiversity hotspot.

Hot Birds

The "hot birds" project, initiated in 2009, seeks to predict how climate change will affect birds living in hot, arid environments such as the Kalahari Desert. During 2012, a team of researchers led by Professor Phil Hockey and Professor Andrew McKechnie (University of Pretoria) examined the role of body size in determining susceptibility to heat stress, the links between physiology and behaviour, and how temperature affects the fitness of breeding birds. The team also expanded the project to investigate the heat tolerance and evaporative cooling capacity of Kalahari birds.

A White-browed Sparrow-weaver panting to dissipate heat

Using data for 35 Kalahari species, PhD student Ben Smit showed that activity levels and body mass played a major role in heat dissipation and found data providing exciting insights into how species cope with very high temperatures, shedding new light on how populations inhabiting climatically distinct regions may vary in their biology. In related research, Postdoctoral Research Fellow Rowan Martin used heat-transfer models to predict how birds of different sizes use thermal landscapes in the Kalahari.

And as part of the project's Southern Hemisphere scope, Grace Russell, a BSc Honours student at the University of Western Australia, examined behaviour among bird species in the Upper Gascoyne region of Western Australia to establish whether the same relationships between heat-dissipation behaviour, body mass and ecological variables occur in Australian species.

Postdoctoral Research Fellow Susie Cunningham completed her study of the links between temperature and breeding success in Common Fiscals (*Lanius collaris*) at Tswalu Kalahari Reserve. As temperatures increase, breeding adults spend more time in shaded sites, reducing their foraging efficiency and thus their provisioning rates to nestlings. High maximum daily temperatures also compromise nestling mass gain.

During 2012, PhD student Tanja van de Ven initiated a study of how temperature affects fitness, and the threshold temperatures above which fitness costs begin to increase in the Southern Yellow-billed Hornbill (*Tockus leucomelas*). Hornbills are vulnerable to high maximum daily temperatures because the female seals herself into the nest cavity as a protective mechanism against predators. She spends most of the chick-rearing period inside the cavity, and this places high demands on the male as he is solely responsible for food provisioning.

In 2012, researchers collaborated with the South African Weather Service to assess how patterns of hot weather events have changed over the last five decades in the north-western regions of South Africa. Results showed temperatures increasing, with more heat waves as well, paving the way for the use of the technique as a conservation planning tool.

And, lastly, MSc student Maxine Whitfield investigated evaporative cooling and body- temperature regulation in a variety of species. While resting and inactive, all species appear able to avoid hyperthermia even at air temperatures higher than those that currently occur in the Kalahari.

Karoo Birds on a Line

The open, arid Karoo is home to six bustard species and South Africa's national bird, the Blue Crane (*Anthropoides paradiseus*). Unfortunately, bustards and cranes are relatively cumbersome in flight, and are unable to react rapidly when they encounter unexpected aerial obstructions. Historically, they have had the freedom of open skies, but the proliferation of power lines and the future installation of wind turbines pose a real threat to these birds. FitzPatrick Institute students have been investigating the implications of power-line collisions in the Karoo, particularly for the endemic Ludwig's Bustards (*Neotis ludwigii*).

Jess Shaw recently graduated with a PhD for her research into the impact of power-line collisions on large Karoo birds. By regularly surveying hundreds of kilometres of high-voltage power lines in her Mazda Wildlife Fund vehicle, she was able to count bird carcases, and noted that many were not found because they were overlooked, or were removed by scavengers. Shaw also regularly looked for dead birds along low-voltage power lines, finding that these are nearly as lethal for Ludwig's Bustards as the larger power lines. Considering that the low-voltage line network is nearly four times the size of the high-voltage grid, this is of great concern. She estimates that power lines kill tens of thousands of Ludwig's Bustards annually.

The proliferation of power lines and the future installation of wind turbines pose a real threat to these birds.

But, surprisingly, she also found little population decrease compared with 20 years ago, suggesting that Ludwig's Bustards may be more productive breeders than previously thought.

Marking power lines with devices to make them more visible is the standard international mitigation for collisions, but evidence that it works for the Ludwig's Bustards and Blue Cranes is lacking. In the autumn of 2011, together with staff from the Endangered Wildlife Trust and Eskom, the researchers put up a large-scale line-marking experiment over 70 km of high-voltage power lines from a helicopter in the eastern Karoo.

This will test whether the marking devices reduce bird-collision mortality, particularly for Ludwig's Bustards and Blue Cranes.

Avian Malaria in the Western Cape

We are familiar with malaria as a human disease that is almost unavoidable in sub-Saharan Africa, and indeed across several other regions of the globe. But human malaria has many counterparts in the animal kingdom, one of which is avian malaria. Unlike the human form, which is caused by parasites of the genus *Plasmodium*, avian malaria is caused by three genera: *Plasmodium*, *Haemoproteus* and *Leucocytozoon*.

Avian malaria is capable of devastating impacts on its hosts, with the best-known case study of what can occur when an alien infectious disease is introduced into a region having taken place in Hawaii. Following the introduction of a mosquito vector, several forms of avian malaria contributed to the extinction of several honeycreepers, and had serious consequences for many other endemic Hawaiian birds. There is evidence that rising temperatures in Africa and elsewhere may facilitate the expansion of the range for avian malaria.

Avian malaria prevalence varies among bird species, with weavers, wagtails and canaries having higher infection rates than other bird families.

The Western Cape is blessed that it remains free of human malaria. However, the same cannot be said for avian malaria, which causes isolated fatalities in chickens, penguins and ostriches, with resultant socio-economic impacts. Many wild African birds can act as natural carriers of the disease without succumbing to its effects. In spite of this, not much is known about the ecology of avian malaria, especially in an African context. Former PhD student Sharon Okanga and her colleagues investigated the incidence of avian malaria in Western Cape passerine birds. She assessed which bird species were more susceptible to infection and looked for signs of preference in the malaria parasites. Blood samples were taken from 1 000 birds at 26 wetlands in the Western Cape. Avian malaria prevalence varies among bird species, with weavers, wagtails and canaries having higher infection rates than other bird families. Research continues into various areas of avian malaria.

The Threat to Penguins

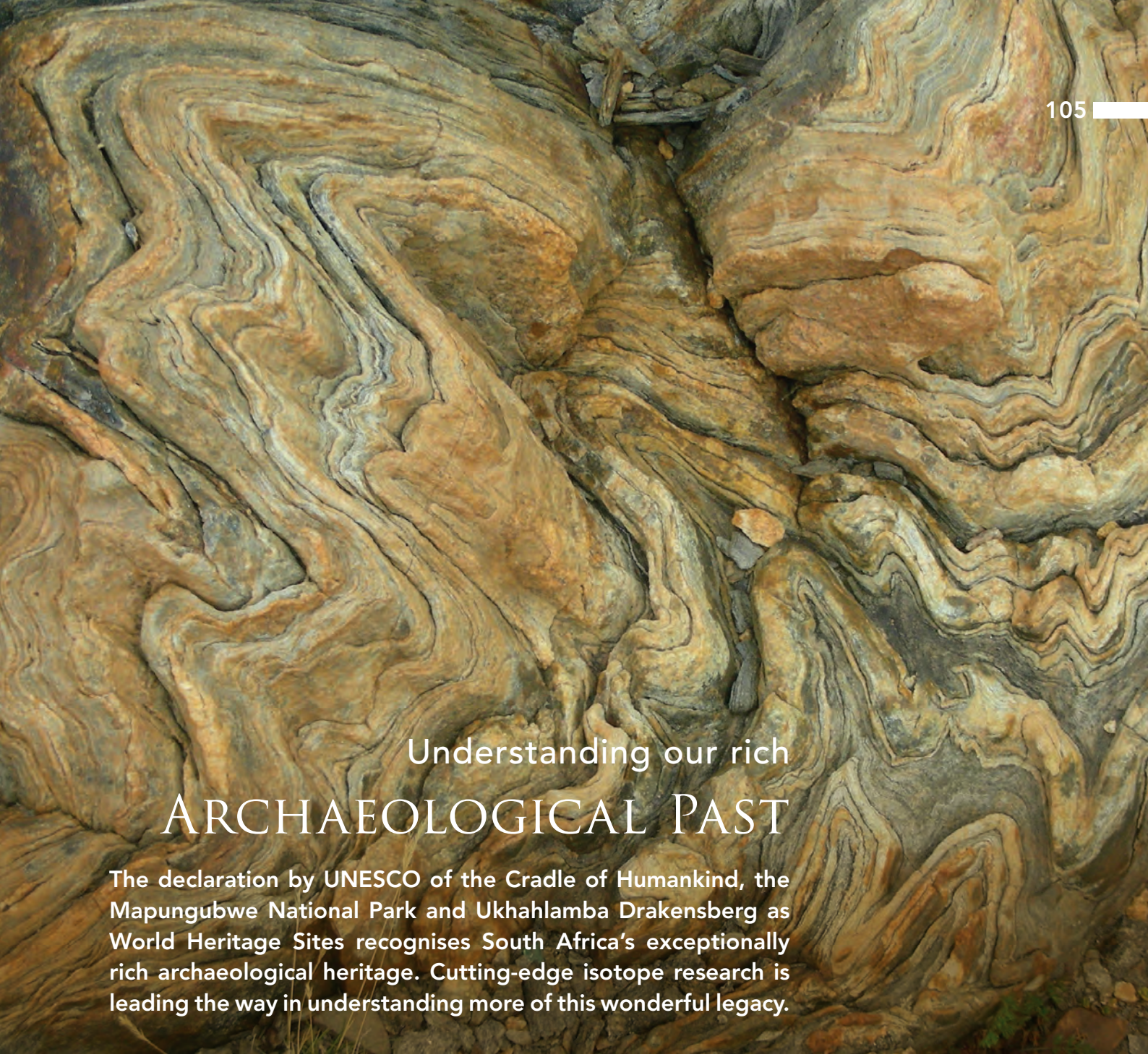
Research by the FitzPatrick Institute, in collaboration with the Department of Environmental Affairs, SANParks and the Centre National de la Recherche Scientifique, revealed that relatively small no-fishing zones can be of great benefit to breeding African Penguins (*Spheniscus demersus*), which rely on highly mobile pelagic fish prey.

Postdoctoral Research Fellow Dr Lorien Pichegru replacing a penguin chick in its nest on St Croix Island

African Penguins were upgraded to *Endangered* in February 2010, following a 60% decrease of their global population between 2001 and 2009, leaving only 26000 pairs in the wild. The dramatic drop in their numbers is attributed mainly to a lack of food, after the distribution of anchovies and sardines shifted 500km eastwards. Purse-seine fisheries exploiting the remaining pelagic fish stocks off the West Coast increase this food shortage.

During 2009, Marine and Coastal Management, the South African government agency responsible for fisheries management, closed an area of 20 km in radius to purse-seine fishing around the world's largest African Penguin colony at St Croix Island in Algoa Bay, Eastern Cape.

After the fishing ban, penguins on St Croix spent less time foraging for food and needed to spend less energy each day looking for food. This showed the immediate benefits of no-fishing zones for breeding penguins, which seem to respond extremely rapidly to concomitant changes in pelagic fish distribution. Appropriately designed Marine Protected Areas therefore benefit threatened top predators, even those relying on mobile prey over a small area.



Understanding our rich
ARCHAEOLOGICAL PAST

The declaration by UNESCO of the Cradle of Humankind, the Mapungubwe National Park and Ukhahlamba Drakensberg as World Heritage Sites recognises South Africa's exceptionally rich archaeological heritage. Cutting-edge isotope research is leading the way in understanding more of this wonderful legacy.

South African researchers are fortunate in having easy access to a treasure trove of fossil and archaeological collections and the natural environments from which they came, providing local researchers with a special advantage. UCT researchers in particular have been able to use the South African environment as a natural laboratory in which to explore questions about isotope systematics – how stable isotopes are distributed through ecosystems. This type of approach is not possible in more polluted or ecologically degraded parts of the world.

Palaeontological research aims to understand how and why humans evolved as they did as well as why certain climatic events occurred in some parts of the world and not in others.

The *Ten-Year Plan for Science and Technology* of the Department of Science and Technology (DST) identifies palaeontology (together with earth systems and environmental sciences) as being among South Africa's Science Missions, in which it advocates the

exploitation of "South Africa's 'living laboratories'" of local resources and geographic advantage.

The South African Strategy for Palaeosciences, approved in 2012, furthermore recognises the importance of and the need for archaeological and palaeontological research. The appointment in 2012 of the DST/NRF South African Research Chair in Stable Isotopes in Archaeology and Palaeoenvironmental Studies was UCT's response to this national imperative to prioritise and revitalise research in the palaeosciences.

Stable light isotopes reflect primarily the types of foods consumed in life, while heavy isotopes can be used to track movement across geological zones.

Stable isotopes are a key tool in the earth and life sciences. They are also essential in the palaeosciences that underlie and enhance our understanding of our human past, especially palaeoecology (including palaeodiets), palaeoenvironments and palaeoclimates. These fields form the foundations for the interpretation of the hominid fossil record and associated archaeology from the earliest stages of human evolution up until the last few hundred years.

Collaborations in palaeoscience research are nurtured with several research units and departments at UCT, as well as other institutions around the country. The Department of Archaeology at UCT pioneered aspects of stable isotope research and its applications to human palaeosciences.

Climate changes during our current geological era are well documented in some parts of the world (mainly in the northern hemisphere) but poorly known in the south, including South Africa.

In other related research, palaeobiologist Professor Anusuya Chinsamy-Turan from the Zoology Department (now Biological Sciences) is an internationally recognised expert on the microscopic structure of the bones of extinct and extant vertebrates. Among recent highlights in her work has been the discovery of information recorded in the bones of duck-billed dinosaurs that lived in the Arctic about 70 million years ago, providing fascinating insights into the lives of these ancient creatures. This project was carried out with collaborators from Temple University (USA) and the Museum of Nature and Science (USA).

Stable Isotopes in Archaeology and Palaeoenvironmental Research

Understanding our past a little bit better is the focus of the South African Research Chair in Stable Isotopes in Archaeology and Palaeoenvironmental research. In these studies, stable-isotope techniques are the primary tool. Stable isotopes of light elements are a key tool in many areas of the earth and life sciences and are naturally occurring, non-radioactive atoms that allow for the study of detailed chemical reactions in certain processes – specifically the metabolisms of people and animals.

Isotopic analyses of archaeological and other remains can help us understand how and why humans evolved as they did, as well as why certain climatic events occurred in some parts of the world and not in others. Climate changes during our current geological era are well documented in some parts of the world (mainly in the northern hemisphere) but poorly known in the south, including South Africa. This work will link with other programmes at UCT on climate and environment, notably the African Climate and Development Initiative.

Isotopes also provide a powerful means of studying human behaviour. Stable light isotopes reflect primarily the types of foods consumed in life, while heavy isotopes can be used to track movement across different geological zones. A major focus of the research programme for this Chair is to study pre-colonial times which lack documentary records. Southern Africa is one of the areas of the globe that has been continuously inhabited for the longest time. For the majority of that time, it was occupied entirely by hunter-gatherers. Research in this area will expand on ways in which humans were able to live as hunter-gatherers.

The focus of the Chair is therefore strongly inter-disciplinary, with connections to both the humanities and the sciences. The intention is to build collaborative links across disciplines and departments at UCT and beyond.

Cold Dinosaurs

Dinosaurs are well known from all parts of the world, and from many different latitudes. However, the discovery of dinosaurs from areas that were well within the Arctic and Antarctic during the Mesozoic is fascinating. These so-called polar dinosaurs pose a biological enigma: how did they cope with the hostile polar winters? Did they migrate? Did they overwinter? And if they did stay, how did they survive? These questions have long plagued paleobiologists, and various theories have been put forward to explain these findings.

A recent study by a team of dinosaur palaeontologists from UCT, Temple University (USA), and the Museum of Nature and Science (USA) has uncovered information recorded in the bones of duck-billed dinosaurs that lived in the Arctic about 70 million years ago which suggests that they did not migrate, but rather endured the long, dark, polar night.

How did they cope with the hostile polar winters? Did they migrate? Did they overwinter? And if they did stay, how did they survive?

One of the collaborators in this study, Dr Anthony Fiorillo, and UCT palaeobiologist Professor Anusuya Chinsamy-Turan reasoned that perhaps clues pertaining to how these dinosaurs lived at such high latitudes might be recorded in the microscopic structure of their bones. This collaboration grew to include UCT postdoctoral researcher Dr Daniel Thomas and Temple University's Allison Tumarkin-Deratzian.

These researchers found that the bones of the polar dinosaurs had an unusual texture, similar to tree rings – the bones showed periodic changes in texture which suggest a fast and slower rate of bone deposition, which probably correspond to a summer and winter bone pattern and are likely to be related to the availability of food.

The research is particularly exciting because the data from the bone histology independently corroborates what researchers are seeing in the field. The results highlight the importance of both biological and geological evidence for interpreting the life habits of extinct organisms.

Studying Dwarf Elephants

Matthew Scarborough of the Palaeobiology Research Group in UCT's Department of Biological Sciences is a PhD student investigating the rather unusual evolution of fossil dwarf elephants and mammoths on Mediterranean islands (particularly Sicily, Malta and Sardinia) over the last one million years. Scarborough's research is aimed at gaining a better understanding of how elephants and mammoths adapted to different kinds of island environments.

1m high dwarf elephants (Palaeoloxodon 'falconeri') from Spinagallo Cave, Sicily. With kind permission of the Museo di Palaeontologia, Roma, Italy.

The research enables collaboration at an international level; he has spent time in Rome, Palermo and Basel studying the anatomy of the feet and limbs of Sicilian dwarf elephants. For the most part, his recent research has focused on explaining several unusual anatomical features in the feet of dwarf elephants, using a comparative approach to investigate to what extent dwarf elephant locomotion was adapted to the very hilly environment of Sicily. During the course of conducting fieldwork, he visited caves and a quarry in north-western Sicily where these dwarf elephants were found. Scarborough is attempting to date the age of the fossils from Alcamo Quarry using a radiometric dating technique (Uranium-Thorium dating), and is also planning to investigate the palaeogeography of Sicily.

A rather unexpected recent finding has been the documentation of dwarf elephant bones which fall outside the size ranges currently accepted for the two dwarf elephant species which inhabited Sicily. Research on the possible existence of a third species of dwarf elephant on Sicily and Malta is still ongoing.

Centres of Exellence
associated with this theme

DST/NRF Centre of Excellence at the Percy FitzPatrick Institute of African Ornithology, "Birds as Keys to Biodiversity Conservation"

The Centre of Excellence (CoE) at the Percy FitzPatrick Institute undertakes scientific studies involving birds that contribute to the theory and practice affecting the maintenance of biological diversity and the sustained use of biological resources. The centre continued to achieve its targeted number and quality of scientific publications, with 87 papers published in peer-reviewed journals in 2012, including 28 in journals with ISI science impact factor ratings of 3.5 or higher. Seven contributions to semi-technical books and 40 semi-popular articles were also published.

During 2012, the centre supported 13 postdoctoral fellows, 19 PhD and 40 MSc students, and one BSc Honours student, of whom 18% were black and 50% were women. Sixteen postgraduate students graduated during 2012 (three PhD, one MSc thesis and 12 MSc in Conservation Biology).

The CoE co-hosted and funded a local conference, *Frontiers in South African Ornithology*, with BirdLife SA and an *International Blue Swallow Action Plan Review Workshop* with the Endangered Wildlife Trust during 2012.

CoE members also presented seminars and illustrated talks at numerous universities, bird clubs, and membership-based societies. A broad range of close collaborative working relationships with scientific peers and a variety of conservation NGOs and governmental organisations exists both nationally and internationally. The CoE continues to build much-needed African capacity in the broad arena of biodiversity conservation. It also continues to be active in advising conservation organisations, government departments and industry on a variety of research projects. During 2012, CoE members served on 18 journal editorial boards, reviewed at least 158 papers for 64 peer-reviewed journals, and participated on 47 advisory boards.

CoE research projects have recently generated 29 full-time jobs and 93 part-time jobs, mostly filled by women. These include 19 full-time and 49 part-time jobs in previously disadvantaged communities in South Africa, 10 full-time and 40 part-time jobs in Zambia, and four part-time jobs in Angola.

Acting Director: Associate Professor P Ryan
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Remembering Professor Phil Hockey

Professor Philip Hockey, the Director of the Percy FitzPatrick Institute of African Ornithology, passed away in January 2013 after a long battle with cancer. Professor Hockey was instrumental in elevating the centre to one of the top three in the world and he was recognised as an expert in his field. During his career, he graduated 18 PhD and 33 MSc students, supervised eight Postdoctoral Research Fellows and some 30 honours projects. In addition to more than 120 scientific papers, Phil published over 150 semi-popular articles and 12 books and book chapters. He co-authored the best-selling regional field guide *Sasol Birds of Southern Africa*, and was editor-in-chief, along with Richard Dean and Peter Ryan, of the seventh edition of *Roberts Birds of Southern Africa*.

Marine Research Institute

The Marine Research (Ma-Re) Institute, one of UCT's signature themes, serves as an umbrella body to stimulate and co-ordinate marine research across all faculties and departments involved in research into the salty waters around Southern Africa. It also serves as a window between the outside world and UCT for marine research and marine contracts. It hosts the Marine Remote Sensing Unit and the Research Dive Unit.

The Ma-Re Institute has two SARChI Chairs associated with it, the Chair in Marine Ecology & Fisheries, and the Chair in Modelling of the Coupled Ocean-Land-Atmosphere (phenomena related to climate). It has been instrumental in getting the Applied Centre for Climate and Earth System Science (ACCESS) and the Nansen-Tutu Centre for Marine Environmental Research off the ground. Both the Marine Ecology & Fisheries Chair and the Ma-Re flagship research project BASICS (Benguela and Agulhas Systems supporting Interdisciplinary Climate-change Science) are inter-disciplinary programmes that aim to tackle aspects of climate-change research and an ecosystem approach to fisheries.

Photo of a sea snail taken by Ma-Re student Grea Wessels while diving.

Ma-Re co-ordinates and convenes a taught master's degree in Applied Marine Science (by coursework and dissertation), runs a weekly seminar series, and has initiated bilateral research and teaching exchange agreements with Norwegian, French, British, and other European Union institutions, as well as American ones. It has also played an important role in promoting marine research in the South African Global Change Grand Challenge and in the marine component of the India-Brazil-South Africa (IBSA-Ocean) trilateral agreement on science and technology.

Ma-Re is active in outreach to the public through interactive sessions at schools, the Two Oceans Aquarium and Science Centres. Ma-Re also participates in the national Science Festival (Scifest), and in developing curriculum-relevant educational resources concerning the role of the oceans in climate change.

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African Climate and Development Initiative

The African Climate and Development Initiative (ACDI) co-ordinates exciting inter-disciplinary research and training on the twin issues of climate change and sustainable development. ACDI brings together natural scientists, engineers, social scientists, lawyers, economists, and urban planners, among others, from UCT and beyond, to provide an African perspective, grounded in strong science, addressing issues relating to climate variability and global change affecting the African continent. It actively creates opportunities for African researchers and young scholars to contribute their own perspectives to these issues.

Through the establishment of strong partnerships throughout Africa, ACDI contributes towards developing African leaders of the future who have an intimate understanding of the physical and human needs of Africa, and who will contribute to address this all-important issue facing mankind.

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Research Groupings
associated with this theme

Energy Research Centre

The Energy Research Centre (ERC) conducts high-quality, targeted and relevant research, as well as offering postgraduate opportunities at master's and doctoral levels. The four main research areas are energy efficiency, energy, environment and climate change, energy poverty and development, and energy systems analysis and planning. ERC staff members have qualifications in engineering, natural and environmental sciences, urban and regional planning, economics, law, politics, sociology, and anthropology.

Director: Professor H Winkler
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Environmental Evaluation Unit

The Environmental Evaluation Unit (EEU) is an independent, self-funded research, consulting and training unit based at UCT. Founded in 1985, the EEU has established itself as a leader in the fields of integrated environmental and coastal management and sustainable development, responding to local, regional and global environmental challenges using an inter-disciplinary and participatory approach. During this time, the EEU has undertaken work throughout South Africa and Southern Africa, has participated in global research and policy initiatives, and has provided expertise to leading private and public corporations, research institutions, planning and development organisations, state departments, local authorities, and communities. The EEU has implemented a wide diversity of projects that have contributed to academic debates and informed policy while having practical impacts on the ground. The EEU works in five main thematic areas: integrated environmental planning, management and assessment; integrated coastal and small-scale fisheries management; biodiversity use, trade, livelihoods and social justice; sustainable business and cross-sector collaboration; and public participation.

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Nansen-Tutu Centre for Marine Environmental Research

The Nansen-Tutu Centre for Marine Environmental Research, under the patronage of Nobel Laureate Archbishop Emeritus Desmond Tutu, was set up in 2010 to assist in the worldwide need to develop the capacity to understand, model and predict the state of the ocean and its ecosystems, just as the meteorological services do for weather and climate. The founding partners of the Nansen-Tutu Centre in Norway and South Africa have the necessary complementary expertise and knowledge to address these challenges in the three oceans around Southern Africa. A central theme for the centre is to undertake research into the science underpinning operational oceanography, particularly in numerical ocean modelling, as well as continuing to develop skilled African postgraduate marine scientists. The centre actively contributes to the OceanSAfrica initiative, with partners from the Department of Environmental Affairs' Ocean and Coasts Branch, the South African Weather Service, the Council for Scientific and Industrial Research, and the South African Earth Observing Network.

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Plant Conservation Unit

The Plant Conservation Unit (PCU), established in 1993 and located in the Science Faculty, undertakes research and teaching directed at improving the conservation status of the vegetation of Southern Africa, with a particular focus on the winter rainfall region. Staff and students within the PCU investigate palaeoecological, historical, and current impacts on the vegetation of the region and work closely with land users to conserve and prevent further transformation of the region's biodiversity.

Director: Professor MT Hoffman
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Animal Demography Unit

The mission of the Animal Demography Unit (ADU) is to contribute to the understanding of bird populations, especially bird-population dynamics, and thus contribute to the conservation of avian biodiversity. The ADU achieves these goals through a variety of projects in which para-ornithologists throughout Southern Africa can participate. These projects range from identifying bird species, through undertaking census surveys, to making detailed observations on breeding productivity.

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DST/NRF SARChI Chairs
associated with this theme

Professor Bruce Hewitson

Climate Change

Professor Bruce Hewitson heads the Climate Systems Analysis Group focusing on climate modelling, variability, change, and regional projections. He is extensively engaged with capacity-building in Africa and with the communication of regional climate information supporting responses to climate change. He plays numerous roles internationally, including that of co-ordinating lead author in the Intergovernmental Panel on Climate Change (IPCC), and currently co-chairs both the IPCC Task Group on Scenarios for Climate and Impact Assessment and the World Climate Research Programme (WCRP) working group on regional climates. He is a lead co-ordinator in the WCRP global Coordinated Regional Climate Downscaling Experiment programme to develop regional climate projections.

Professor David Jacobs

Animal Evolution and Systematics

Professor David Jacobs holds a PhD in Zoology from the University of Hawaii, where he completed a thesis titled "Character release in the endangered Hawaiian hoary bat, Lasiurus cinereus semotus". He has been at the University of Cape Town since 1994, where his main research interests are focused on all aspects of evolutionary biology. He has conducted research all around the world, including Australia, Costa Rica, Belize, Israel, Canada, Namibia, and Zambia. He has supervised more than 20 postgraduate degrees and many of his students have won prestigious awards such as the Purcell Memorial Award for the best PhD thesis and the SA Association for the Advancement of Science – S2A3 Bronze Medal for the best master's degree thesis.

Professor Judith Sealy

Stable Isotopes, Archaeology and Palaeoenvironmental Science

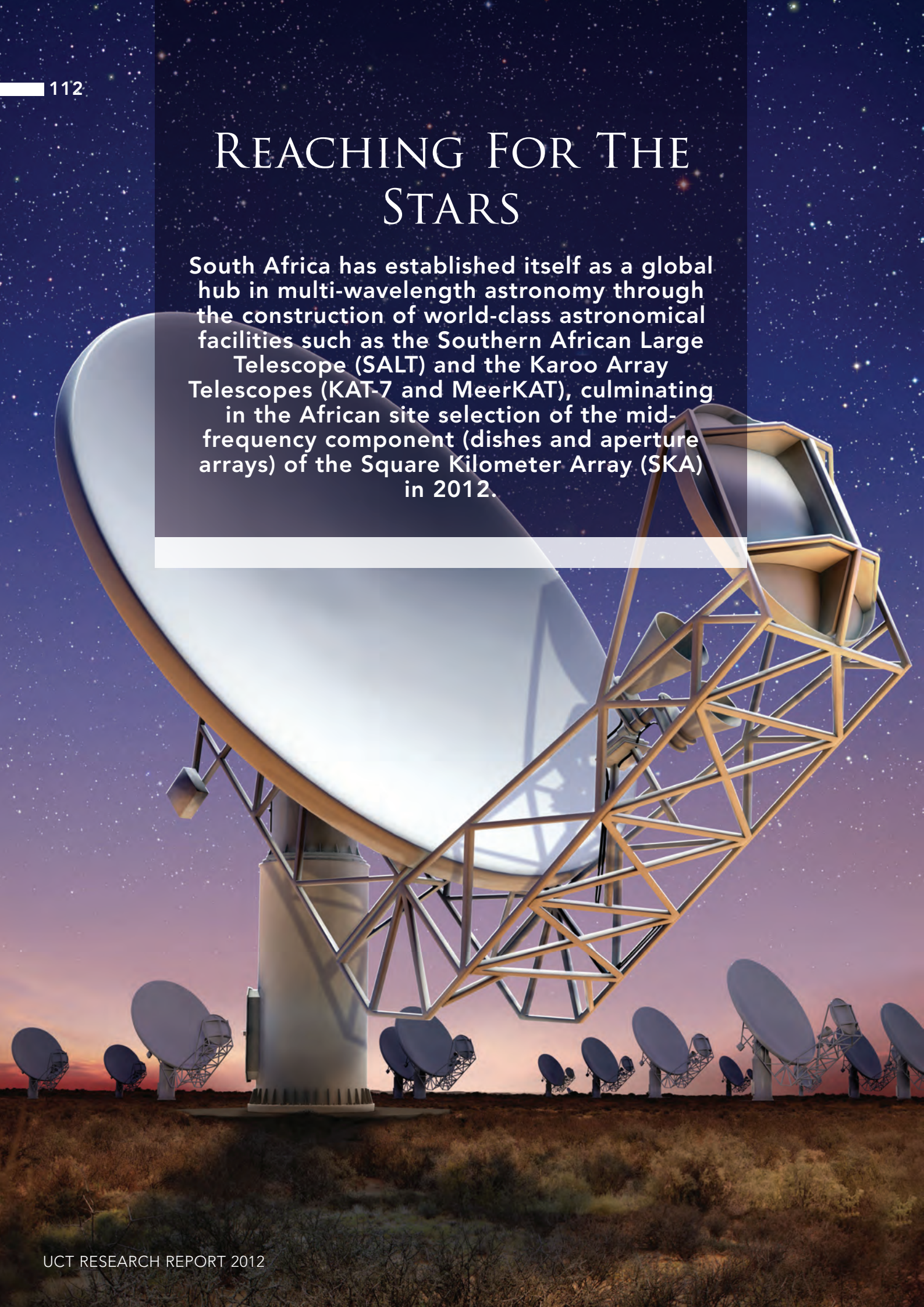
Judith Sealy is Professor of Archaeology and the former head of the Department of Archaeology at UCT. She also heads UCT's Stable Light Isotope Laboratory, a major facility housing analytical equipment. Professor Sealy obtained her PhD from UCT in 1989 for her thesis entitled "Reconstruction of Later Stone Age diets in the south-western Cape, South Africa: evaluation and application of five isotopic and trace element techniques". Her main research interests include the development and application of stable-isotope techniques for dietary reconstruction, hunter-gatherer archaeology across the period from the emergence of modern humans to the recent past, and the beginnings of food production in Africa. She has published more than 75 peer-reviewed journal articles and book chapters, including articles in *Nature* and *Science*.

Ocean Climate Modelling

The focus of this SARChI Chair (previously held by Professor George Philander) is multi-disciplinary and it is well poised to build research capacity in ocean-atmosphere studies, particularly with regard to satellite remote sensing of the oceans, numerical modelling, data assimilation, and forecasting of the coupled ocean-atmosphere ecosystem. The Chair will enable us to better understand and model the properties of the oceans around Southern Africa and its impact on climate change not only regionally but globally as well.

Reaching For The Stars

South Africa has established itself as a global hub in multi-wavelength astronomy through the construction of world-class astronomical facilities such as the Southern African Large Telescope (SALT) and the Karoo Array Telescopes (KAT-7 and MeerKAT), culminating in the African site selection of the mid-frequency component (dishes and aperture arrays) of the Square Kilometer Array (SKA) in 2012.



The site decision by the international SKA consortium was welcomed by UCT as a red-letter day in the development of science in South Africa. Astronomers at UCT and across the country celebrated the outcome of the site bid and congratulated Dr Bernie Fanaroff, head of the SKA South Africa project, on this achievement.

This is one of the biggest scientific research ventures ever undertaken and it confirms that developing nations can also be part of solving the big questions of our day. It will bring scientists from all over the world to South Africa (and to UCT in particular) and thus greatly enhance not only South Africa's but also UCT's international research collaboration.

Dr Bernie Fanaroff

Work on the South African SKA precursor array entered a new and exciting phase in 2012 with the commissioning of the seven-dish radio interferometer KAT-7. Across the various science teams involved with the MeerKAT SKA precursor array, the staff and postdoctoral research fellows of UCT's Astronomy Department in particular are actively participating in the commissioning phase of KAT-7.

The department is also leading the early science enabled by the KAT-7 array, exploring the unique capabilities that a combination of the world's largest optical telescope – the 10 metre Southern African Large Telescope (SALT) – and the SKA precursor offer in studying the universe.

Observations taken in 2012 with KAT-7 of the accreting neutron star binary Circinus X-1, and the nearby galaxy NGC3109, show the excellent potential of KAT-7 for long-term monitoring of actively varying binary stars in the Milky Way (Circinus X-1) and studying the extended emission from nearby galaxies respectively. Both observations have been accepted for publication in prestigious astronomy journals.

In 2012, the Department of Astronomy also welcomed Professor Thomas Jarrett from the California Institute of Technology, as the incoming DST/NRF SARChI Chair in Astrophysics and Space Science. Professor Jarrett works on the study of extragalactic large-scale structures, the Zone of Avoidance, interacting galaxies, star formation processes and galaxy evolution.

The research of Professor Jarrett dovetails with that of the DST/NRF SKA Chair in Extragalactic Multi-wavelength Astronomy, a position held by Professor Claude Carignan, who specialises in the study of stellar and gas motions in galaxies through radio and optical observations of nearby galaxies.

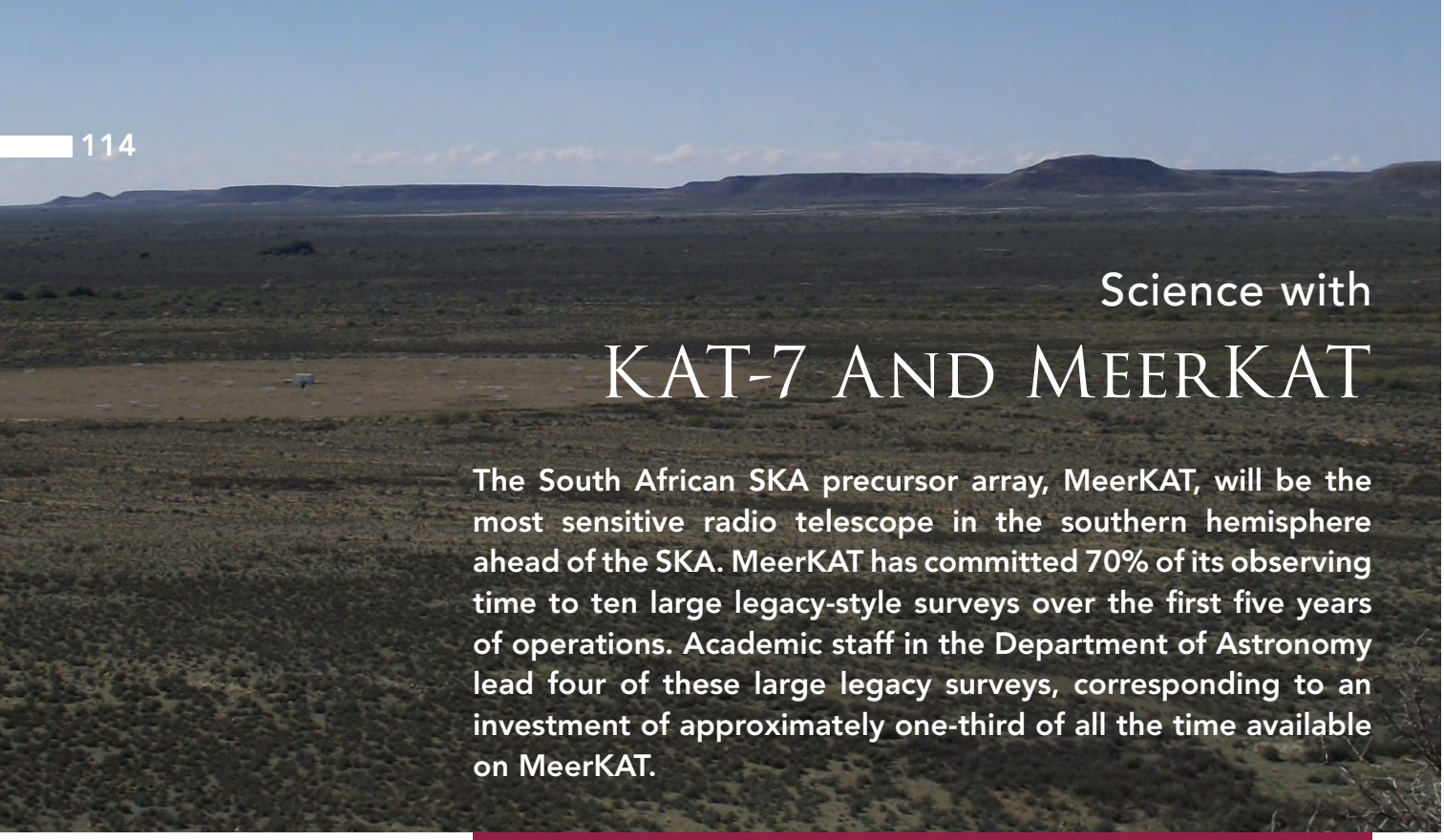
The number of postgraduate students in the Department of Astronomy reached new heights in 2012: 15 PhD and 19 MSc students were registered for their postgraduate research degrees in astronomy. These postgraduate students are predominantly from South Africa (22), with additional representation from amongst the SKA African partner countries – Madagascar (four), Mauritius (two) – and a range of other countries, including Uganda, Egypt, Ethiopia, France, India and the USA.

Through support from the DST/NRF South African Research Chairs Initiative, the National Astrophysics and Space Science Programme (NASSP), the Youth in Science and Engineering capacity development programme of the SKA South Africa project, UCT's Astronomy Department – often jointly with the South African Astronomical Observatory – is preparing the next generation of African astronomers to take on leading roles in the scientific exploration of the universe with SALT and the SKA.

The highest number of postgraduate research students in astronomy at UCT to date graduated in 2012. Of the eight students who graduated, four will continue their careers in astrophysics abroad: one student was selected as a Rhodes Scholar to pursue a DPhil at the University of Oxford, and three have gone to the Netherlands (to embark on PhD studies at the universities of Groningen and Nijmegen) and will be jointly supervised by UCT faculty.

On average, approximately 80% of UCT's astronomy graduates continue to postgraduate studies and about one-third go overseas after completing their UCT degree (MSc or PhD) to continue their academic careers. It is particularly heartening to see that many of them return to South Africa to take up postdoctoral research fellowships or even permanent academic positions.

Apart from the essential international experience, these young researchers bring back new research collaborations and networks to the South African astronomical community. It clearly demonstrates the success of the capacity-development programmes in astronomy that the astronomical community in South Africa embarked on in 2003 (NASSP) and 2005 (SKA South Africa).



Science with KAT-7 and MeerKAT

The South African SKA precursor array, MeerKAT, will be the most sensitive radio telescope in the southern hemisphere ahead of the SKA. MeerKAT has committed 70% of its observing time to ten large legacy-style surveys over the first five years of operations. Academic staff in the Department of Astronomy lead four of these large legacy surveys, corresponding to an investment of approximately one-third of all the time available on MeerKAT.

The LADUMA survey (Looking At the Distant Universe with the MeerKAT Array), co-led by Dr Sarah Blyth, aims to make the deepest observations of neutral hydrogen in emission before the SKA comes online. These observations will measure the evolution of the gas content in galaxies over half the age of the universe in order to probe galaxy evolution over cosmic time.

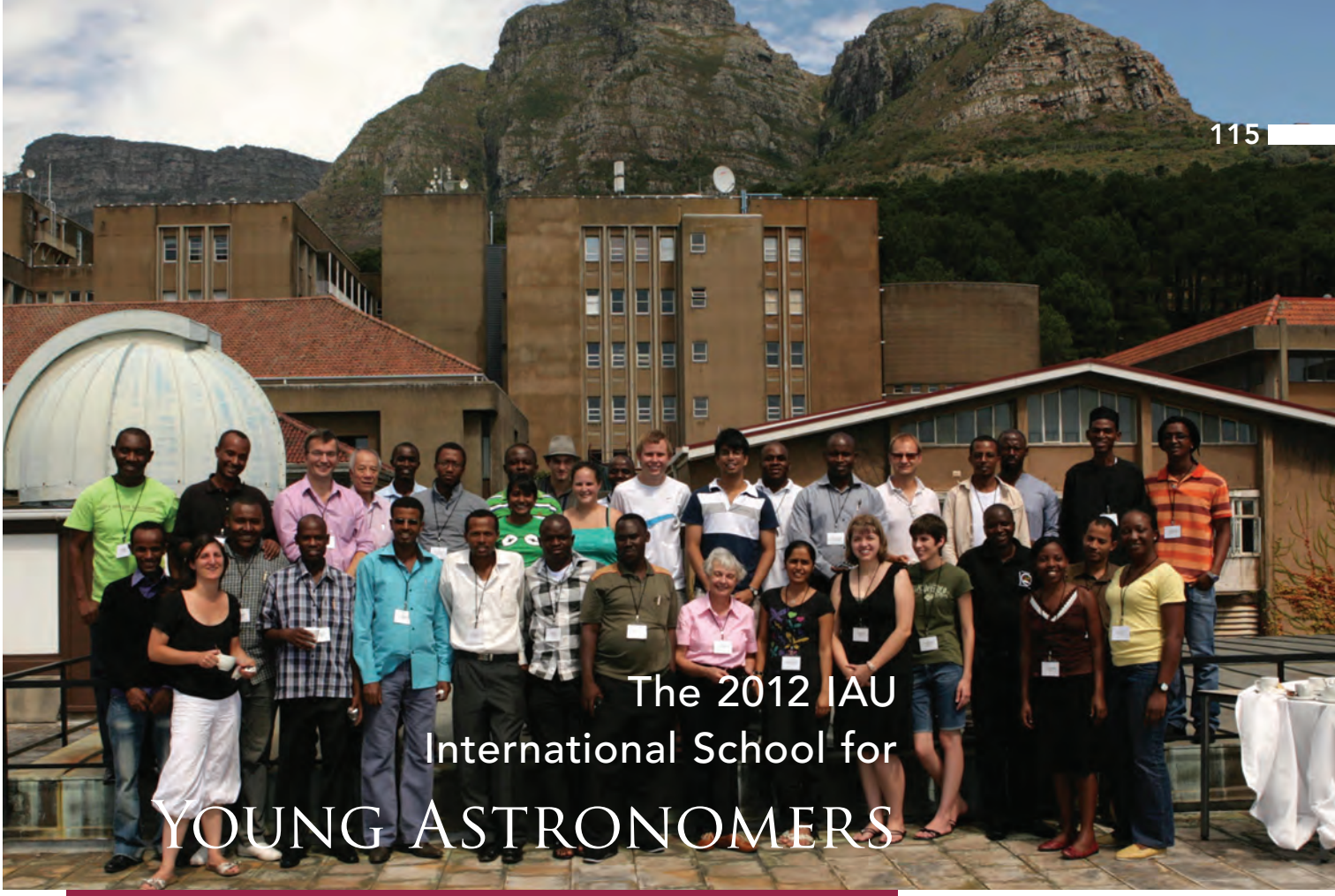
The MIGHTEE survey (MeerKAT International GigaHertz Tiered Exploration), co-led by Dr Kurt van der Heyden, is a deep radio continuum survey, which will investigate the relation of star formation to the growth of supermassive black holes as well as study galaxy evolution by detecting galaxy clusters as a function of look-back time in the universe.

The ThunderKAT survey (The Hunt for Dynamic and Explosive Radio Transients with MeerKAT), co-led by Associate Professor Patrick Woudt and Professor Rob Fender (SKA visiting professor), will study a wide range of transient phenomena in radio sources, through pointed observations of, for example, exploding stars and relativistic jets from compact stellar remnants, as well as blind searches for new kinds of transient sources.

A fourth MeerKAT large survey, MHONGOOSE (MeerKAT HI Observations of Nearby Galactic Objects: Observing Southern Emitters), led by UCT honorary Professor Erwin de Blok, will observe neutral hydrogen in nearby galaxies to investigate dark matter, properties of different galaxies, and the cosmic web.

The MeerKAT construction is ongoing and the full array of 64 radio telescopes is expected to be operational from 2016 onwards. KAT-7, a seven-dish radio interferometer built on the MeerKAT site and a precursor to the MeerKAT, is already fully operational and has started the engineering and scientific commissioning in 2012 of a wide range of observing modes.

The MeerKAT legacy surveys have been closely involved in the commissioning of the KAT-7 telescope, both to test newly developed software relevant to the surveys and to explore niche research areas enabled by KAT-7. Staff, postdoctoral research fellows and postgraduate students at UCT working on ThunderKAT and MHONGOOSE have made a number of observations during science commissioning of KAT-7 and first scientific results are being published in the international astronomical literature.



The 2012 IAU International School for Young Astronomers

From 5 to 26 February 2012, the University of Cape Town and the South African Astronomical Observatory (SAAO) jointly organised and hosted the 34th International School for Young Astronomers (ISYA), the first one held on the African continent, under the auspices of the International Astronomical Union (IAU).

This research school was aimed at MSc and PhD students from sub-Saharan Africa and attracted 32 young astronomers from a wide range of African countries (South Africa, Namibia, Ethiopia, Kenya, Nigeria, Tanzania, Uganda and Zambia). The theme for 2012 was "Observational astronomy in the optical and infrared".

Professor Anton le Roex, the Dean of the Faculty of Science, welcomed the participants to the University of Cape Town on the first day of the school, followed by welcomes by the Director of the SAAO (Professor Patricia Whitelock) and the IAU (represented by Professor Michèle Gerbaldi).

Following a week of lectures on the UCT campus, the participants continued the school at the SAAO, both in Cape Town and at the Sutherland station, where they spent one week on the various telescopes, training in aspects of observational astronomy. The observational projects were the backbone of the school, and were highly valued by the participants.

Observations by one of the lecturers (Professor Michel Dennefeld) and the IYSA students of a supernova candidate PSN J23255963-8154333 confirmed the nature of this object using the SAAO 1.9 metre telescope and spectrograph. This result was published during the school as an IAU Telegram (CBET 3028) and included the 13 IYSA students as co-authors.

Professor Renée Kraan-Korteweg elected vice-president of the International Astronomical Union

Professor Renée Kraan-Korteweg, Chair of Astronomy and Head of the Department of Astronomy at UCT, was elected Vice-President of the Executive Committee of the International Astronomical Union (IAU) at the 2012 General Assembly of the IAU in Beijing.

She becomes the third member of the Astronomy Department to have been elected to this position. This prestigious post was previously also filled by Honorary Professor Michael Feast (1979–1985) and Emeritus Distinguished Professor Brian Warner (2003–2009).

Professor Renée Kraan-Korteweg

Professor Kraan-Korteweg is a world-renowned expert in the mapping of large-scale structures hidden by the plane of our Milky Way, in relation to the dynamics and cosmic flow fields in the nearby universe. She is the principal investigator of various international collaborations and uses a multi-wavelength (combined optical, infrared, radio astronomy) approach in her research.

Her more recent efforts have focused on mapping the extent and mass of the Great Attractor, a gravity anomaly in intergalactic space that reveals the existence of a localised concentration of mass equivalent to tens of thousands of galaxies, each of which is the size of the Milky Way. A research highlight was the discovery of another major attractor hidden within the most obscured part of the Perseus Pisces Supercluster, the northern counterpart of the Great Attractor. In a project led by her, this structure is investigated in detail using new radio observations with the Westerbork Synthesis Radio Telescope in the Netherlands. The survey was designed in such a way that it will serve as a preparation for SKA Pathfinder HI surveys.

Professor Claude Carignan

Multi-wavelength Astronomy at UCT

Professor Claude Carignan currently holds the South African Square Kilometre Array (SKA) Research Chair in Multi-wavelength Astronomy in the Department of Astronomy. Recruited from the University of Montreal (Canada) in 2011, he is also an Emeritus Professor at the Laboratoire d'Astrophysique Expérimentale of the Département de physique of the Université de Montréal, and Associate Professor in the Laboratoire de Physique et Chimie de l'Environnement and in the Observatoire d'Astrophysique de l'Université de Ouagadougou, both in Burkina Faso. He has also been very involved in the development of astronomy in Burkina Faso and in the setting up of the African Astronomical Society (AfAS) in that country.

Professor Carignan is an expert on galaxy dynamics and dark matter and specialises in the study of the mass distribution in galaxies, using both radio synthesis and optical Fabry-Perot interferometric techniques. His primary contribution to research in Astrophysics has been the study of the mass distribution in late-type spiral and dwarf galaxies, carried out in the last twenty-five years. His research in this area has demonstrated that the contribution of dark matter to the total mass of dwarf galaxies (~90%) is much more important than in massive spirals (~50%). Moreover, contrary to the situation in spirals where dark matter contributes mainly in the outer parts, dark matter in dwarfs contributes at all radii. This is demonstrated for the galaxy DDO 154, now a prototype of its class. Most of this work was done using radio HI kinematical data.

Astrophysics and Space Science

Professor Thomas Jarrett has held the DST/NRF South African Research Chair in Astrophysics and Space Science in the Department of Astronomy since mid-2012. Professor Jarrett is an internationally renowned researcher who was based for more than 20 years in the United States as a mission scientist at the Jet Propulsion Laboratory of the California Institute of Technology, specialising in star-formation and extragalactic studies using space-borne instrumentation.

Leading or co-leading over 125 peer-reviewed articles in high-impact journals, his research efforts have focused on key elements of extragalactic science. Travelling to locations spanning the globe, he employs in his fieldwork ground-based, airborne and space-based observatories and remote-sensing instrumentation to gather data for analysis of the physical processes that govern the cosmos. His expertise with infrared astronomy spans the entire window: from the near-infrared (1 to 3 microns) that is used to study the stellar mass of galaxies, to the mid-infrared (4 to 50 microns) that is sensitive to star-formation and interstellar medium processes, and the far-infrared (50 to 500 microns) which traces the coldest and most massive gas and dust content of galaxies. His most recent article that highlights this research, entitled *A Cosmic Perspective, Multi-wavelength Astrophysics*, will be published in the Spring issue of the South African *Quest* magazine.

In anticipation of the SKA Era, Professor Jarrett's research has also exploited the unique capabilities of the radio window to study continuum (3, 6 and 20 cm) and 21 cm hydrogen line emission by galaxies. Combining information from a plethora of multi-wavelength instrumentation, he will explore the interconnection between the gas reservoir, as traced by HI (atomic hydrogen) observations, and the tracers of past-to-present galaxy evolution as measured using ultraviolet, visual, infrared and sub-millimetre observations. In conjunction with these themes, Professor Jarrett is a founding or key member of a number of large-science teams, including Spitzer (the fourth and final of the NASA Great Observatories programmes) and WISE (NASA's Wide-field Infrared Survey Explorer), and is an active science-team member of a number of studies, including the SKA-Pathfinder studies and MeerKAT key-science projects.

Professor Jarrett currently supervises three postdoctoral research fellows, one PhD student and two MSc students. He is currently actively involved in the development of a long-term strategy plan for astronomy in South Africa.

Professor Thomas Jarrett

Cosmology at UCT Tackling the

Mysteries Of The Universe

We live in a unique time in the history of science. Cosmological observations are able to pinpoint with great precision details of the universe on the largest scales, while particle physics experiments probe the nature of matter on the very smallest scales with equally astounding precision. Research in cosmology lives at exactly the dual point – developing the theory from a fundamental mathematical framework and testing it in a plethora of experiments and observations requiring sophisticated statistical knowledge. This is at the heart of the research undertaken by the different cosmology-related research groups at the University of Cape Town, which is striving to gain an understanding of our universe that to previous generations would have seemed perhaps unknowable.

The significant results of the Planck satellite, released in early 2013 by the European Space Agency, revealed the most precise map of the ancient universe ever made. Scientists believe these results are matched only by the groundbreaking discovery of the first fundamental scalar particle at CERN during 2012. The map has already led to new theories of the age, composition and future of the universe. The coming decades thus promise a great synergy between particle physics and cosmology as the international community at large grapples with some of the greatest unsolved problems of our time. These questions cannot be tackled by one discipline alone, and the move to interdisciplinarity is a global phenomenon. At UCT it has swept together key research groups who work together towards answering only the biggest questions about space and time. The synergies amongst these groups are generating a vibrant and interactive research culture.

At the heart of this research is the UCT-accredited Astrophysics, Cosmology and Gravity Centre (ACGC). The ACGC has 20 academic members from the faculty, and includes a DST/NRF SKA Chair held by Professor Claude Carignan and a DST/NRF SARChI Chair held by Professor Thomas Jarrett. The Centre is also particularly strong in its development of young scientists, with more than 20 postdoctoral research fellows and over 30 graduate students at any given time.

Within the ACGC, the Cosmology and Gravity Group, hosted in the Department of Mathematics and Applied Mathematics, focuses on both observational aspects of cosmology and theoretical cosmology. The Cosmology and Gravity Group is renowned for challenging the standard paradigm and proposing tests to the standard concordance model of cosmology. This is particularly pronounced in studies of the Dark Universe.

All of the substance making up planets, stars and oceans is fractional compared to the vast amount of the universe that is dark, quite literally – not observed through the electromagnetic field.

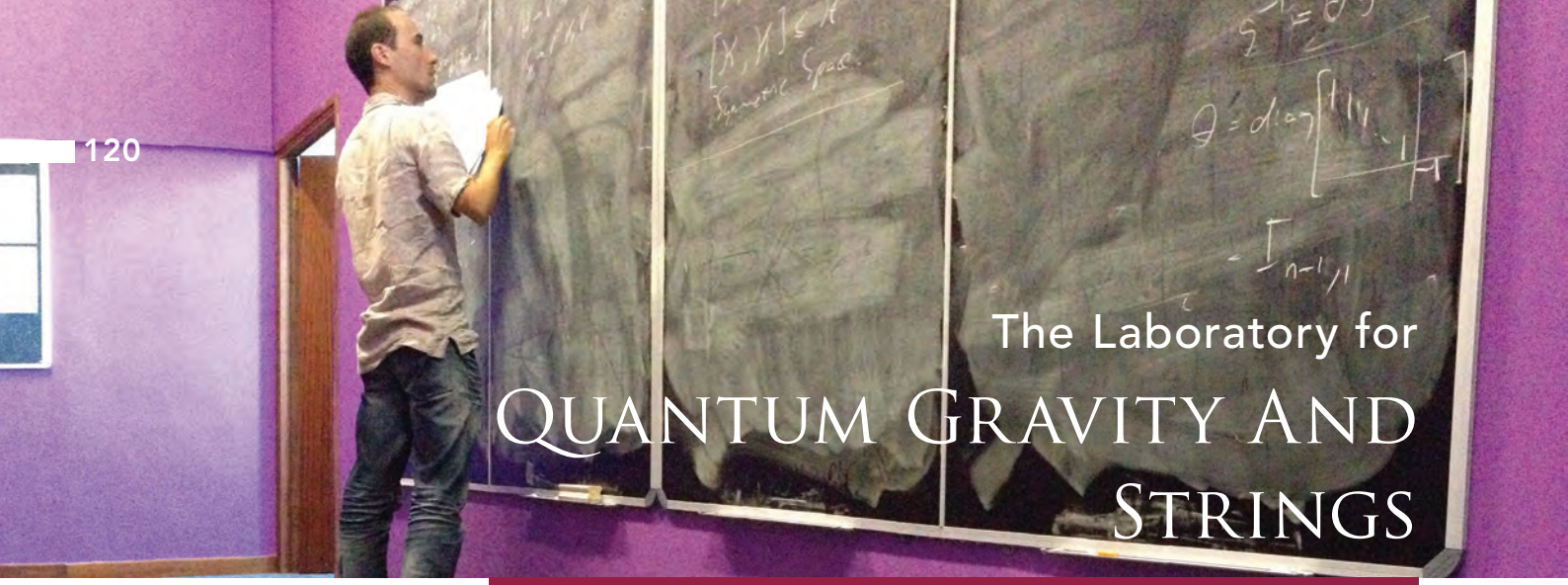
Everything we see and experience on all scales of human experience makes up less than 5% of the total matter in the universe. All of the substance making up planets, stars and oceans is fractional compared to the vast amount of the universe that is dark, quite literally – not observed through the electromagnetic field. The remaining 95% is split between Dark Matter (DM – 23%) and Dark Energy (DE – 72%).

DM clusters and DE clusters can be inferred from their effects on galaxy rotation curves as well as on gravitational lensing. DE drives the universe to expand ever faster with time – the observation of which earned scientists in the field the Nobel Prize for Physics in 2011. Remarkably, there is no convincing explanation of either the driving force behind DE or indeed the coincidental timing. DE seems to dominate our universe coincidentally around the era of humanity's existence, when we are here to observe it as such.

Explaining these observations and indeed challenging the status quo is all in a day's work for UCT's cosmologists. Alternative explanations to this concordance model are studied using a multipronged approach to test if our application of Einstein's General Relativity Theory is applicable on the scales considered by testing key assumptions underlying all of present day cosmology. UCT's Dr Chris Clarkson, Emeritus Professor George Ellis, Professor Charles Hellaby, Professor Peter Dunsby and Dr Amanda Weltman all study different approaches to this challenge.

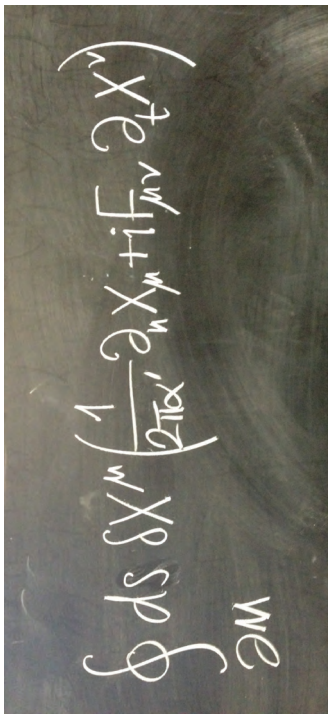
Collaborations between members of the Cosmology and Gravity Group (Professor Ellis) and the recently established Laboratory for Quantum Gravity and Strings (QGaSLab) (Dr Jeff Murugan) have resulted in a publication on the trace-free Einstein equations as a viable alternative to general relativity, selected by the journal *Classical and Quantum Gravity* as one of the 'Highlights of the 2011–2012 collection'. In addition, Professor Ellis contributed another highlight to this collection with his 2012 work 'Inhomogeneity effects in cosmology'. The group is renowned not just for challenging the standard paradigms of modern cosmology but also for offering viable alternatives. In particular, the Chameleon particle, a compelling and testable DE candidate that can be observed not only through its effects on the largest scales but also in purpose-built laboratory experiments, was pioneered by UCT's Dr Weltman. Research in this area has driven a new industry in DE testing with significant investment internationally. A flurry of experiments has ensued in the USA and Europe to test this theory, with Dr Weltman playing a key role in the GammeV and GammeV CHASE experiments at Fermilab, a US Department of Energy national laboratory specialising in high-energy particle physics.

Dr Amanda Weltman and Dr Albert van Jaarsveld, CEO of the National Research Foundation



The Laboratory for Quantum Gravity And Strings

What if the world you take for granted around you, the air you breathe, the buildings, the trees, the universe, the very space and time you occupy were not real? Not "not real" as in a dream but "not real" as in not fundamental, not a permanent stage on which the cosmology of the universe unfolds. What if everything we perceive emerged from the billions and billions of quantum interactions that ultimately and collectively resulted in the classical world we see around us. Before one ridicules the idea as the philosophical ramblings of idle academics, it is worth noting that precisely this picture leads to the emergent macroscopic behaviour of water from its underlying microscopic, molecular constituents and more and more evidence points to a very similar picture of human intelligence as an emergent phenomenon arising from the billions and billions of interactions in the intricate synaptic circuitry of the human brain.



These questions of the fundamentality of space, time, geometry and topology are exactly the kind of mind-bending mental gymnastics that occupy researchers in the newly formed Laboratory for Quantum Gravity and Strings (QGaSLAB). Located in UCT's Department of Mathematics and Applied Mathematics, QGaSLAB forms the third node of the Astrophysics, Cosmology and Gravity Centre. The laboratory is currently headed by Dr Jeff Murugan with affiliate members Dr Amanda Weltman (joint with CGG) and Dr William Horowitz (joint with UCT's Department of Physics). They are joined by Dr Jonathan Shock, recently recruited from the Max Planck Institute for Gravitational Physics in Munich, Germany.

In addition to faculty members, QGaSLAB includes current postdoctoral research fellows Dr Per Sundin (Claude Leon Fellow, formerly of Humboldt University) and Dr Michael Abbott (formerly of the Tata Institute for Fundamental Research), Dr Sugumi Kanno (joining from Tufts University in late 2013 and joint with ACGC), as well as two PhD students, three MSc students and two honours students. The group is one of only two string theory groups in South Africa and is already well recognised internationally. It is currently, together with the University of the Witwatersrand and CERN, one of the only non-EU members of the EU COST network grant "The String Theory Universe".

Research in the group is focused on four major themes: integrability, the emergence of spacetime, strongly coupled Quantum Field Theory and string theoretic physics.

Astrophysics, Cosmology and Gravity Centre

The Astrophysics, Cosmology and Gravity Centre (ACGC) is a research centre incorporating members of the UCT Department of Astronomy and the Cosmology and Gravity Group from the UCT Department of Mathematics and Applied Mathematics. The ACGC aims to create a research environment at UCT in which South African-led cutting-edge science projects will be discussed, developed and taken to fruition. Maximising the opportunities for interaction between theorists and multi-wavelength observers is essential for stimulating new approaches to research. The centre also aims to become an attractive location for postgraduate students and postdoctoral research fellows, as well as international visitors.

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Centre for Theoretical and Mathematical Physics

The Centre for Theoretical and Mathematical Physics (CTMP) is an interdepartmental research unit devoted to the promotion of interdisciplinary research in these areas. CTMP is part of the National Institute of Theoretical Physics. CTMP has twelve local members from the departments of Astronomy, Mathematics and Applied Mathematics, and Physics. It also has five international members who visit the centre on a regular basis. Postgraduate students doing theses on related research fields are admitted to CTMP for the duration of their studies. An international advisory board of seven internationally acclaimed scientists was appointed in 2006.

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UCT-CERN Research Centre

The UCT-CERN Research Centre was established in 2003 out of a confluence of certain research programmes within the Department of Physics. As implied by the name of the centre, there is extensive collaboration with CERN, the European Centre for Particle Physics, which is one of the most prestigious research laboratories in the world. In particular, the UCT-CERN Research Centre has close collaboration with the next-generation ultra-relativistic heavy-ion experiment at CERN's Large Hadronic Collider (LHC), named ALICE (A Large Ion Collider Experiment).

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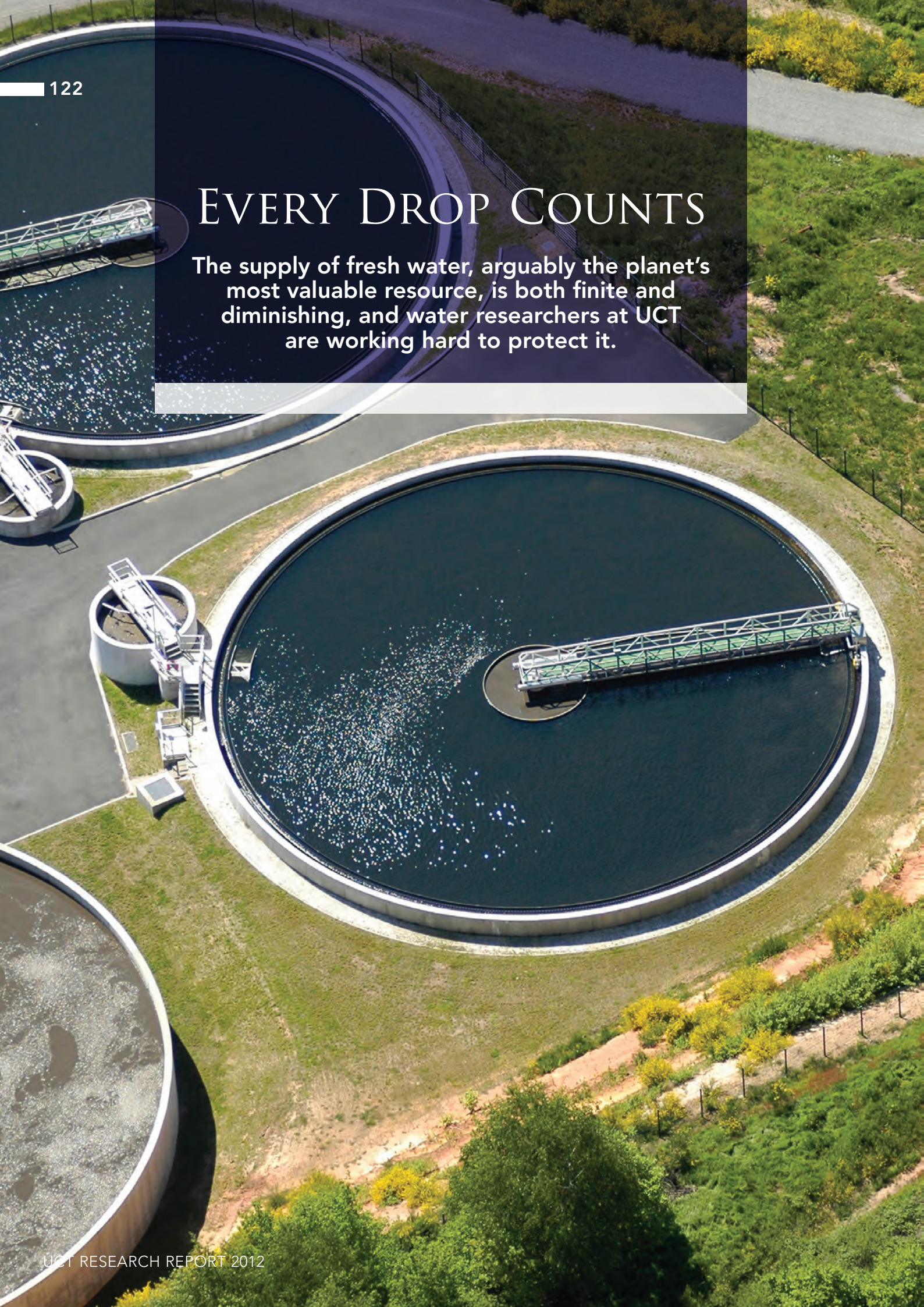
Every Drop Counts

The supply of fresh water, arguably the planet's most valuable resource, is both finite and diminishing, and water researchers at UCT are working hard to protect it.



As a rapidly urbanising country, South Africa faces multiple water challenges, including shortages, the growing burden of wastewater produced by the emergent and urbanising population, and the expanding and varying trajectory of the resource-based industrial sector, associated environmental issues, and fragmented and complex institutional structures.

Amongst the results of increased pollution are elevated salinity levels and nutrient enrichment (higher concentrations of nitrogen and phosphorus in water). The deteriorating quality of South Africa's surface and groundwater resources is particularly challenging as these supply systems underpin social and economic development in the country and impact directly on ecosystems. Water security is therefore of particular concern and climate change, water scarcity and water quality have the potential to worsen systemic water shortages over the medium to long term. Addressing these issues require ongoing inter-institutional and interdisciplinary research and the continuous improvement of the governance of water to ensure a successful transition towards water sensitivity, thereby building towards the nation's social, environmental and economic well-being.

Water research at UCT is a multidisciplinary endeavour, drawing in some of the highest-ranked academics across departments and faculties, many of whom have inspired postgraduate students to join them in working towards local water-management solutions. However, water research at the university is not limited to senior academics. Rather, the valuable mentoring that these leading researchers provide is creating rising research stars, with postgraduate students consistently achieving accolades for their contributions. This can be attributed to the sharing of a fundamental vision to optimally manage the survival of this precious resource.

State-of-the-art

Water Laboratory In The Pipeline

Recognising that water is a national resource under considerable stress, UCT is committed to ensuring that it is optimally managed in all sectors and at all levels within the country.

Demonstrating this commitment, the university will, through the Crystallization and Precipitation Research Unit (CPU), establish a new laboratory with the capacity to provide a comprehensive service to water researchers. The H2O (aq) laboratory is expected to open in the Department of Chemical Engineering, possibly in 2013, and will feature a combination of new and existing research practices. The nature of the water research undertaken by the CPU already focuses on novel techniques for water treatment.

H_2O (aq) will offer specialist water and brine analysis, as well as research. The intention is to be able to offer a service to researchers who are investigating various water-related questions; in other words, it is not a standard water-analysis laboratory. For example, the laboratory will accommodate a researcher looking at how different river contaminants affect the aquatic life, a researcher investigating the effect of trace metals on water-treatment processes, and yet another studying the effect of water composition on concrete corrosion of bridges. Over the last decade, water analysis has become increasingly technical and, as such, requires the use of state-of-the-art equipment and fewer wet-chemistry techniques (although wet chemistry does still have a place). H_2O (aq) will use Inductively Coupled Plasma-Mass Spectroscopy (ICP-MS) for metal analysis, High-Performance Liquid Chromatography (HPLC) and spectrophotometry for anion analysis, and total organic carbon for bacterial tests, but the basic tools, such as pH testing and conductivity, will also be utilised. It is expected that such analyses will lead to multidisciplinary research projects and also to collaborations across faculties and between the projects through the common theme of water.

Drinking Acid Mine Water

The philosophy of Professor Alison Lewis, Director of the Crystallization and Precipitation Research Unit, is that researchers need to consider both water and its contaminants as resources, and to design processes that recover both.

Master's student Michael Kapembwa

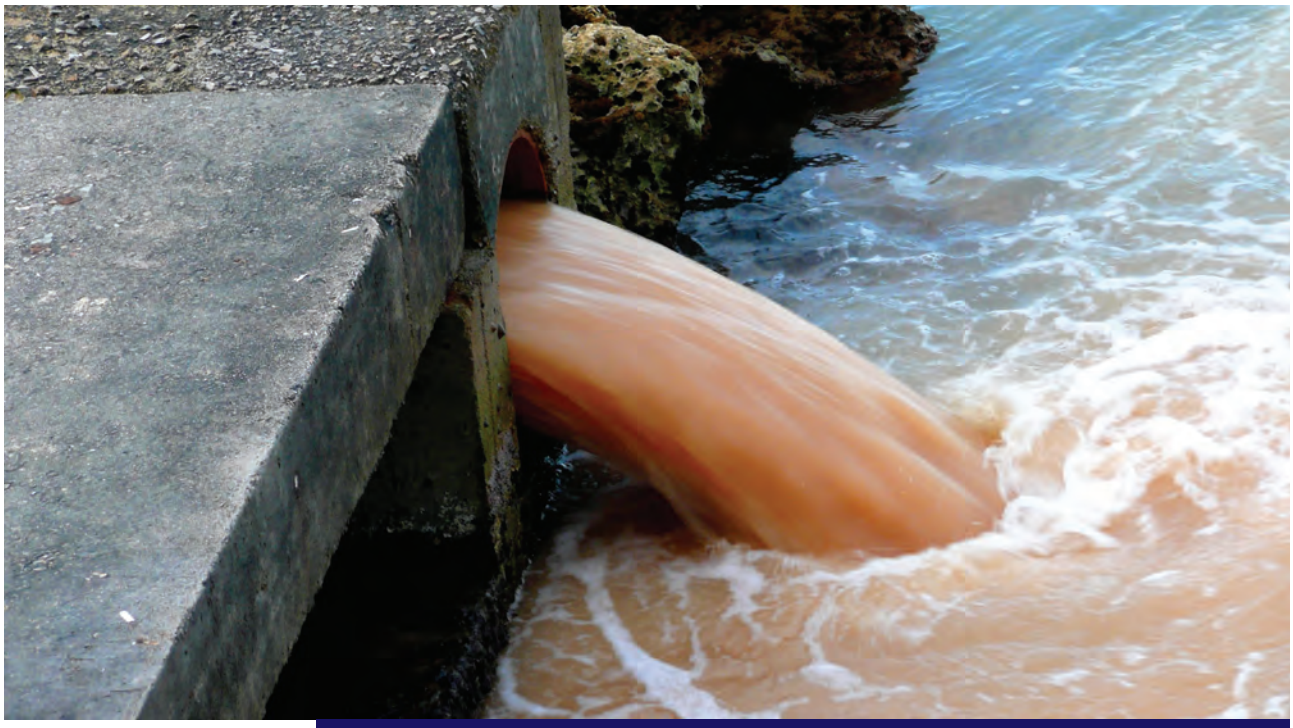
With this in mind, she and her team have devised a means of treating acid mine water so that it is 'good enough to drink', and are taking one step closer to achieving the goal of water security, one of the most significant challenges facing the country. In her technique, known as Eutectic Freeze Crystallization (EFC), the contaminated waste stream is frozen to a point where both ice and salt are formed – ice is the form in which water is recovered. For this reason, it is important that the ice formed is pure to ensure that good-quality water is obtained. The process, which is both environmentally friendly and cost-effective, also allows for usable salts to be extracted from the toxic acid mine water. It can, furthermore, be used in a broad range of industrial sectors that produce wastewater.

Master's student Michael Kapembwa won an award for the Outotec "Sustainability in Mineral Industry" best paper presentation at the Southern Africa Institute of Mining and Metallurgy-SAIMM MinProc 2012 workshop for his paper *Ice growth mechanisms in electrolyte aqueous solutions*. Michael was born in Luanshya, a small mining town in Zambia, and completed his primary and secondary education in Livingstone. In 2009 he graduated with a bachelor's degree in Metallurgy and Mineral Processing from the University of Zambia. After working at different mines in mineral processing and hydrometallurgy and in a full-time job with Non-Ferrous Africa Mining Cooperation as a Metallurgist (Foreman), he decided to join the Crystallization and Precipitation Research Unit to further his studies in chemical engineering with a focus on wastewater and mining brine treatment.

Research Project

Paying for Storm Water?

Professor Neil Armitage of the Department of Civil Engineering and director of the interdisciplinary Urban Water Management Group, is accustomed to pooling the perspectives and resources of academics from various departments to find integrated, sustainable solutions to water-management problems, particularly as they affect Southern African communities. Professor Armitage is also the only African representative on the joint committee on urban drainage of the International Association of Hydraulic Engineering and Research and the International Water Association.



In a recently completed project, Professor Armitage and PhD student Lloyd Fisher-Jeffes examined the possibility of charging for storm water in South Africa. While this may seem incomprehensible and possibly even nonsensical, it should perhaps be viewed in the context of the social, economic and environmental impacts of poor water quality on South Africa's urban aquatic systems, which are increasingly being highlighted by the media. Improving the water quality in these systems will require catchment-wide strategies, including the monitoring and management of point and non-point source pollution collected in storm water. Significant costs may be incurred; however, international experience suggests that these are outweighed by the benefits.

Municipalities across South Africa charge their citizens for potable water and sewerage. Storm-water management, however, is generally funded through municipal rates. Competition with other pressing needs frequently results in the storm-water departments being significantly under-funded – at times only receiving a tenth of what is required for water-quantity management. Internationally, an increasing number of cities have introduced a direct charge for storm-water management in order to secure the funding required to manage storm water and its associated water pollution, and to serve as a disincentive to polluting practices on the part of landowners. The study has found that, in order to ensure adequate funding for storm-water management in South Africa, municipalities will need to consider charging for storm-water management based either on an Equivalent Residential Unit or a Residential Equivalent Factor, combined with an appropriate discount scheme for on-site storm-water management. This project was supported by the Water Research Commission.

Urban Water Management

Urban water management – and the impacts that rapid population growth, industrialisation and climate change are having on it – is gaining increasing attention worldwide.

In South Africa, cities are under pressure to respond not only to the challenges of water availability and quality, but also to economic transformation and social division. New solutions for improving the sustainability of cities need to be found, including the development of tools to guide decision-makers. Several benchmarking initiatives have been implemented in the South African water sector – mostly in terms of performance measurement of specific water services for regulatory purposes – but none provide an integrated analysis to enable a deeper understanding of sustainability.

The research undertaken by Dr Kirsty Carden and Professor Neil Armitage focused on using a systems approach to create an understanding of, and measurement of the potential for, sustainability in a South African urban water context. The research resulted in the development and evaluation of a composite index, the Sustainability Index for Integrated Urban Water Management (SIUWM). The first step involved compiling a vision of sustainability for the South African water sector, and expanding it into a sustainability framework to help identify suitable indicators for the assessment process, as well as those which link with existing measurement initiatives. Key performance indicator results from the Department of Water Affairs' Regulatory Performance Management System and the Blue Drop/Green Drop schemes were used as partial input to the SIUWM, and scores were computed for the nine member cities of the South African Cities Network. The SIUWM links the results from the regulatory systems with a broader sustainability assessment process to provide a more detailed analysis which can be used to establish goals and inform strategic processes to leverage support for improved water services. In this way, the connections that link the different aspects of urban water management can be used to generate a greater awareness of the underlying issues by key decision makers and thus guide appropriate action.

Research Project

Social Norms and Moderation of Water Consumption in Cape Town

A study by master's student Grant Smith and Associate Professor Martine Visser of the Environmental Policy Research Unit involved testing a strategy of managing water consumption by delivering comparative norms-based reports on water use to households in the city of Cape Town.

In doing this, they assessed, by means of a randomised control trial, the various behavioural elements usually involved in such a strategy. The aim of the study was to influence consumer behaviour by using behavioural interventions rather than using price mechanisms. The results are encouraging in that they strongly suggest that behavioural elements may be leveraged in order to reduce household water consumption at the municipal level. Although the savings were roughly 1% of total water consumption, they were significant. Across a municipality, such savings would certainly be meaningful in relatively water-scarce months. Of the treatments considered, it was the method that utilised a simple comparative social-norms strategy which yielded the most consistent water saving. This is the first study that illustrates the impact of social norms on demand for water for a developing country.

Research Groupings
associated with this theme

Crystallization and Precipitation Research Unit

Industrial crystallisation research began in the Department of Chemical Engineering in 2000 and the Crystallization and Precipitation Research Unit was formally accredited by UCT in 2006. Although crystallisation and precipitation are some of the oldest unit operations known, understanding of these processes is still very limited. In this context, the main aim of the unit is to advance existing fundamental knowledge in the fields of crystallisation and precipitation, especially related to mineral processing and extractive metallurgy.

Although crystallisation and precipitation are some of the oldest unit operations known, understanding of these processes is still very limited. The main aim of the unit is to advance existing fundamental knowledge in these fields.

Particular interests of the research group are modelling and simulation approaches to industrial research, such as the particle-rate process approach for modelling of industrial crystallisation processes, aqueous chemistry modelling and computational fluid dynamics modelling. All these modelling techniques are aimed at deepening the understanding of these chemically complex, multiphase processes. The ultimate objective of furthering this scientific understanding is to optimise and control industrial crystallisation and precipitation processes, including treatment of effluent streams. Another interest of the research unit is the development of Eutectic Freeze Crystallisation for the treatment of hypersaline mining brines. The unit is also involved in the development and presentation of various continuing professional education courses that satisfy the demand for skills in this area, from both an industrial and an academic standpoint.

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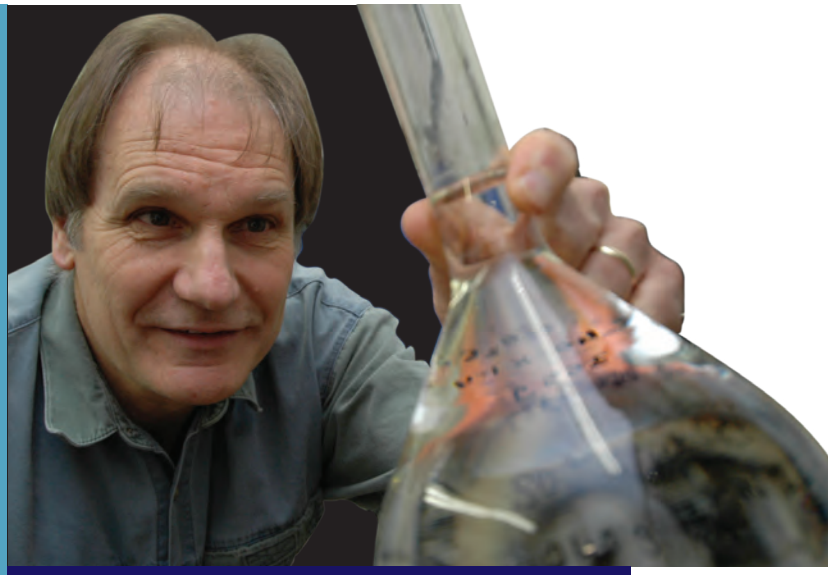
International Award for Professor George Ekama

Working in close collaboration with faculty members and postgraduate students, NRF A-rated Professor George Ekama has been recognised internationally for his research that has provided innovative solutions to enhancing and improving wastewater treatment and, in so doing, has helped South Africa find answers to its water-shortage problems. He lives by a simple research credo: "Locally inspired, globally relevant".

Professor George Ekama was part of an international team which received a Global Grand Honour Award in the Applied Research category at the 2012 Project Innovation Awards for their project "Making use of seawater as an alternative resource". His team members were representatives from Hong Kong University of Science and Technology, Hong Kong Airport Authority, Hong Kong Drainage Services Department, and Delft University of Technology. The Project Innovation Awards Programme was established by the International Water Association (IWA) in 2006 to recognise excellence and innovation in water-engineering projects throughout the world. The awards programme supports IWA's goal to "connect water professionals worldwide to lead the development of effective and sustainable approaches to water management".



Professor Ekama is to be awarded in Silver, the National Order of Mapungubwe, by the Presidency of South Africa in 2013. The Order will recognise Professor Ekama's research excellence and exceptional achievements which have benefitted communities in both South Africa and beyond.

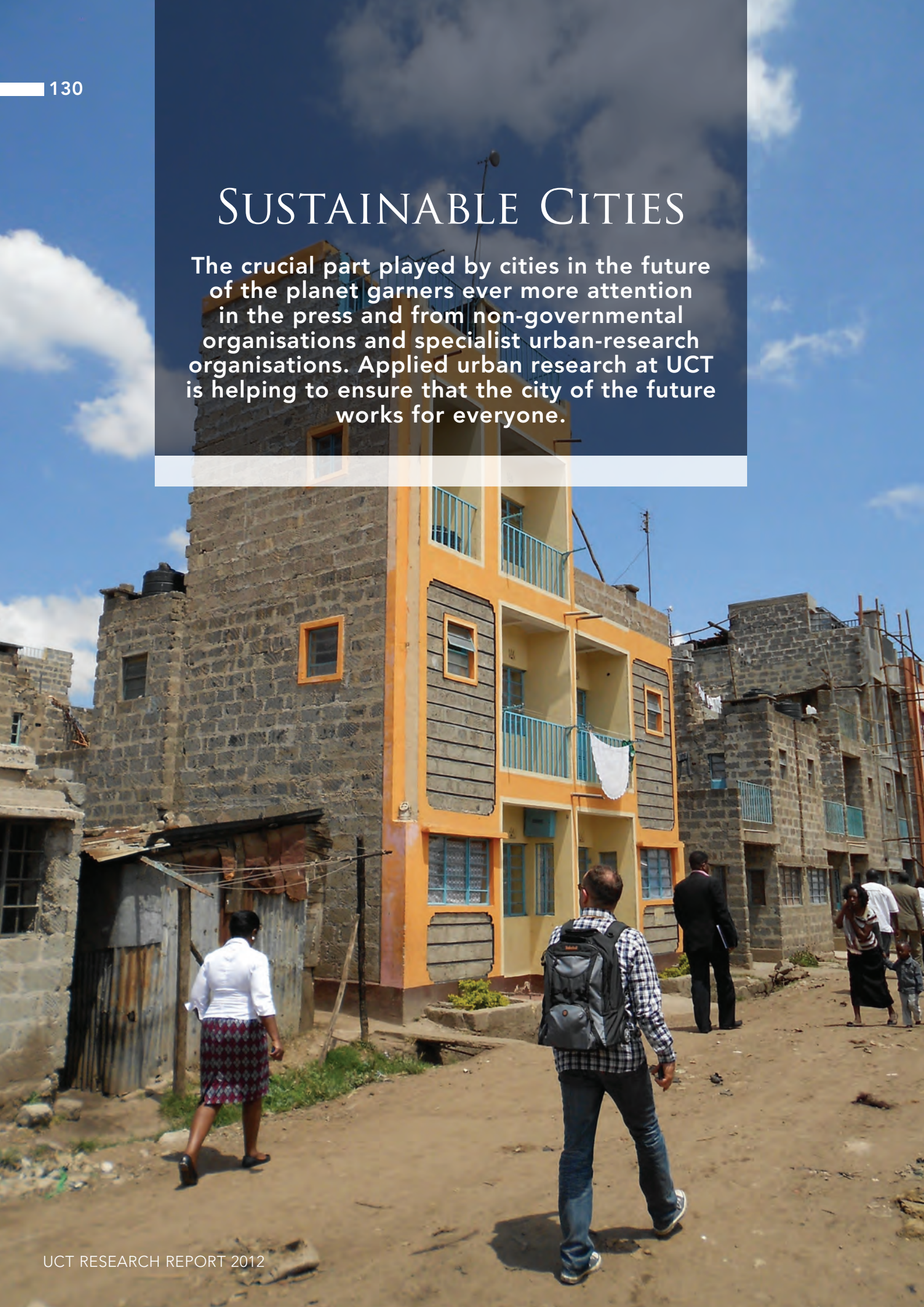
Water, food, energy and sanitation are basic humanity needs. Nevertheless, water scarcity, water pollution, global warming, and food shortages are affecting many parts of the world. Although the planet has plenty of water, 97% is in the ocean, which is too salty for human consumption. The aim of the research is to make use of seawater as an alternative resource of water, energy and fertiliser through an integrated Triple Water Supply (TWS) System, the SANI (sulfate reduction, autotrophic denitrification and nitrification integrated) Process and the Urine Phosphorous Recovery (UPR) System. The TWS System integrates freshwater supply, seawater supply for toilet flushing, seawater-based cooling and grey-water reuse as an integrated water-supply and sanitation system. This has been applied in the Hong Kong International Airport, saving 52% of its freshwater demand and 30,000 MWh of electricity annually.

Making use of sulfate originating from seawater, the SANI Process introduces a sulfur cycle into the carbon and nitrogen cycles for sewage treatment. Sulfur acts as the electron carrier for passing the electron from organic carbon to oxygen through heterotrophic sulfate reduction, autotrophic denitrification and autotrophic nitrification. As all the three biochemical reactions produce minimal sludge, the SANI process effectively minimises sludge handling and disposal, which can save 50% of cost and one-third of energy consumption. Making use of the magnesium ion in seawater, the new UPR technology recovers phosphorus from urine in the form of magnesium ammonium phosphate, a valuable phosphorus and nitrogen containing fertiliser, by mixing hydrolysed urine with seawater. While the TWS, SANI and UPR systems can be applied individually, the integrated system would provide the greatest financial and environmental benefits, especially for islands and coastal cities of developing countries.

Professor Ekama has published over 150 research papers together with his research group have been co-authors of four of the IWA Scientific and Technical Reports on activated sludge modelling, community analysis and secondary settling tanks. He has been a visiting professor at Virginia Tech, the University of Padua and the UNESCO-IHE Institute for Water Education in the Netherlands. He is one of only a few environmental engineering professors listed on Thomson Reuters (ISI) Highly Cited Research website.

Sustainable Cities

The crucial part played by cities in the future of the planet garners ever more attention in the press and from non-governmental organisations and specialist urban-research organisations. Applied urban research at UCT is helping to ensure that the city of the future works for everyone.



Urban issues are increasingly receiving attention in social media websites and blogs, including UrbanAfrica.net, a website managed by the 'State of Cities in Africa' programme hosted by UCT's African Centre for Cities (ACC). Urban affairs is one strand of UCT's suite of strategic research initiatives, this one firmly located in the ACC Signature Theme; careful scrutiny of city governance and urban livelihoods complements another strategic research thrust, the Safety and Violence Initiative. Urban affairs also resonate well with UCT's drive to research the urbanisation of poverty.

During 2012, the African Centre for Cities continued to spearhead applied urban research at UCT, and to be a forum for public and scholarly conversations about pressing urban issues. These include matters of public service delivery, climate change and urban resilience, informality, food security, safety, public housing, public art and public spaces, flooding risk, public health, and governance. Urban transportation is the focus of UCT's Centre for Transport Studies, and there exist multiple close linkages between the research of these two units.

The daunting range of livelihood and policy challenges in all cities of the global South creates an opportunity to reconsider conventional ways of intervening in urban affairs, as well as an opportunity to think differently about cities as places, and how to generate the appropriate knowledge to make them more liveable, sustainable and equal.

Issues include matters of public service delivery, climate change and urban resilience, informality, food security, safety, public housing, public art and public spaces, flooding risk, public health, and governance.

The ACC is passionately vested in all aspects of this work, notably through its published research, and CityLabs and Knowledge Transfer Programmes. As part of its advisory services, in 2012 the ACC Director, Professor Edgar Pieterse, was appointed convenor of the Urban Section of the National Planning Commission, an initiative of government chaired by the Minister in The Presidency. ACC staff, together with other researchers in the Faculty of Engineering & the Built Environment, work across faculties in a highly interdisciplinary research programme. This is illustrated in the strong collaborative links with Environmental Sciences, Planning, Sociology, the African Climate and Development Initiative, the Energy Research Centre, and the Association of African Planning Schools, and is given impetus by maintaining strong academic and research links with major urban research groups and funders in the UK, Europe, and the USA, while new ties are braiding into Africa, Latin America and India.

During 2012, ACC personnel and affiliates travelled extensively to speak at conferences and meet colleagues in Boston, Dakar, Gothenburg, Johannesburg, Lagos, London, Manchester, Nairobi, New York, Paris, Stockholm and Tokyo. A large delegation participated in the World Urban Forum in Naples, a professional 'shop window' for urban authorities and practitioners. Conferences hosted in Cape Town included one on 'Migration, Urbanization and Food Security in Cities of the Global South', with delegates coming from across Africa as well as from Canada, the Caribbean and India.

Co-produced KNOWLEDGE

A key plank in contemporary Cities research at UCT is the notion of 'co-produced knowledge'. The basis of this idea is that cities are now too large and complex to permit the conceit that any one profession – let alone any single university department – can marshal all the information, insight and resources necessary to deal with the diversity of urban problems.

Questions of sanitation, poverty alleviation, congestion, disease, pollution, physical degradation and unemployment are fundamentally inter-disciplinary; part of the reason for the failure to combat these problems is that they have been addressed as distinctive rather than as systemic issues. There has also been profound neglect of the processes of governance and civic leverage in rapidly changing urban formations. Equally, there has been too little attention given to the counter challenges of innovation, fulfilment, affirmation, dignity and hope in the slums that now characterise most of the world's fastest-growing cities in Africa, India, China and Latin America.

The Cities research agenda at UCT aims to keep abreast of these key urban fault lines and prospects by bringing regulators, legislators, scholars, practitioners, citizens and activists into regular contact via conferences, seminars, CityLabs, Think Tanks, and jointly produced research. Informal personal networks make crucial points of contact and knowledge sharing.

One instance of formally co-produced knowledge in our own backyard is the immensely innovative and successful programme of hosting selected City of Cape Town officials in the ACC for two months, and placing PhD students in the City for seven months a year. The students are working with the City on climate-change policy, the 'Green' economy, and land-economy models. Now in its second year, the mutual learning and exchange has exceeded expectations. Support from the

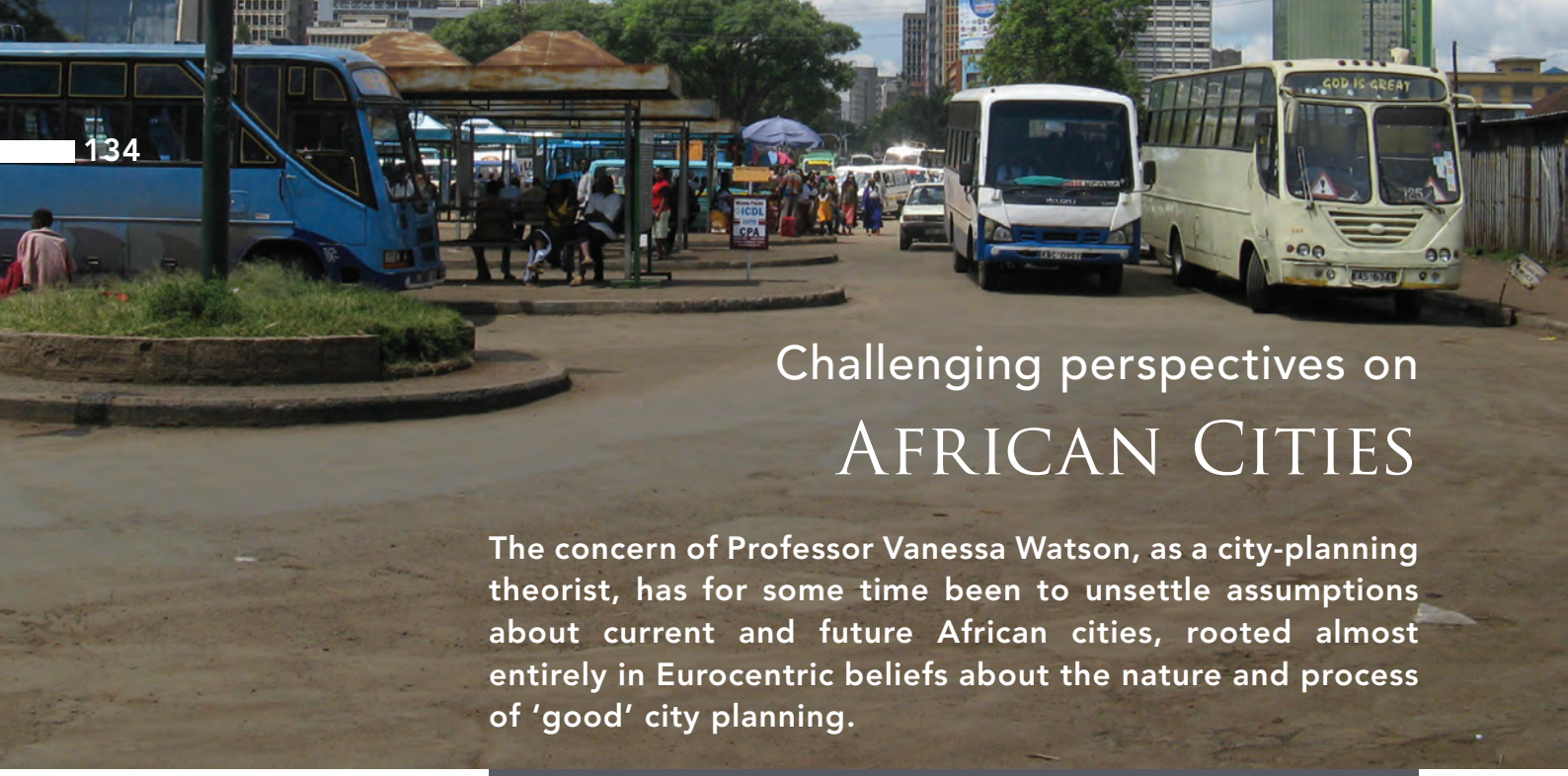
City and from Mistra Urban Futures, an international centre for sustainable urban development, has been vital. A bursary from Bigen Africa for a master's student to conduct research on sustainable settlements in resource-rich parts of South Africa complements the Department of Chemical Engineering's new Master of Philosophy course specialising in sustainable mineral resource development.

> There has been too little attention given to the counter challenges of innovation, fulfilment, affirmation, dignity and hope in the slums that now characterise most of the world's fastest-growing cities in Africa, India, China and Latin America.

Conscientising diverse publics and constituencies about critical urban conditions and inequalities is a key challenge. Likewise, publicising the results of research and inspiring students and citizens with new visions for our cities are crucial facets of any university research programme. The ACC at UCT also supports scholarship in conventional ways by publishing books, chapters and academic papers. Recent publications have covered topics such as urban governance, alcohol in the city, urban ecology, property law, and urban climate change. A research monograph about cultural entrepreneurship as an agent of urban change in West Africa is anticipated from Dr Jenny Mbaye, recipient of the prestigious Ray Pahl Fellowship allocated to the ACC in 2012.

The ACC also strives to communicate and provoke in unconventional ways, supported in part by a Rockefeller Innovation Award. The *Cityscapes* magazine and the *African Cities Reader* both aim to publish visually striking and innovative pieces that present cities and the lives of their residents in unfamiliar and provocative registers. In this spirit, too, ACC participated in UCT's 'Curate Africa' event in 2012. With support from the Goethe Institute, the ACC was also involved in tracking and reflecting on three public art projects in Johannesburg. In the context of Cape Town having been designated World Design Capital 2014, the ACC partnered with the Social Justice Coalition in convening the 5th annual Irene Grootboom Memorial Dialogues, held at two sites in Khayelitsha, as well as in Woodstock, in the Cape Town CBD, and on the UCT campus. Leading activists, designers, community leaders, academics and Cape Town residents debated how design might be used as an instrument for advancing social justice and reducing urban inequality.

Cities are here to stay. More than that, in the global South metropolitan areas medium-sized cities are home to an increasing number of people, and are the sites where some of the best social and environmental interventions can be made for sustaining economies, ecologies and societies. The diverse research on cities at UCT aims to co-ordinate and catalyse a fair slice of the inquiry, and to contribute significantly to policy that improves the prospects of cities and all their citizens.



Challenging perspectives on AFRICAN CITIES

The concern of Professor Vanessa Watson, as a city-planning theorist, has for some time been to unsettle assumptions about current and future African cities, rooted almost entirely in Eurocentric beliefs about the nature and process of 'good' city planning.

Planning, as an activity of the state (but increasingly also of communities and business), often appears to involve a purely technical set of decisions around the correct location of land-uses, movement routes and so on. Yet, as planning theorists argue, planning is also deeply political, involving usually contested decisions about the allocation of public resources across urban space and legal constraints which can fundamentally affect the lives of urban dwellers. Understanding the socio-technical interface generated by planning processes, how this is shaped by power and politics, and how it can be steered to promote goals such as social justice and sustainability has therefore been a focus of planning theory worldwide.

Visions of 'the good city' usually cite Amsterdam, Stockholm or Portland, taking for granted strong and resourced governments, organised civil society, manageable growth and little informality.

Professor Vanessa Watson

However, in both colonial and post-colonial times, African cities have been on the receiving end of planning theories and policies generated in the 'global North' and universalised to the rest of the globe based on assumptions that urban society and space everywhere is little different from that in Europe or the United States and, if it is, then the task of planning is to shift cities in this direction. Visions of 'the good city' usually cite Amsterdam, Stockholm or Portland, taking for granted strong and resourced governments, organised civil society, manageable growth and little informality. Professor Watson's research has challenged the underlying assumptions of this body of theory and has emphasised the importance of building planning theory from an understanding of context. Given that in years to come an increasing majority of the world's urban population will live in global South cities, and that in Africa the urban population is likely to increase threefold by 2050, she has stressed the urgent need for planning theory with a global South perspective, which takes as its starting point a very different set of assumptions and research methodologies from those currently informing planning thought. Much of her own research has been involved in exploring (with her PhD students) what these different starting points might be (both philosophical and practical) and how planning can re-conceptualise the urban socio-technical interface in global South and African contexts.

But re-theorising planning is unlikely to have sufficient impact on the impending urban crisis in Africa: other initiatives are necessary. Given the paucity of urban and policy research on the continent, Professor Watson formed part of the cross-faculty team that collaborated to establish the African Centre for Cities in 2007. The Centre has flourished and in 2013 will take the significant step of co-ordinating a meeting of the 16 most prominent urban-research centres on the continent, together with major donors, to collaboratively shape an urban research agenda for Africa.

A longer-term strategy has been to shift the nature of planning education at universities on the continent, given that many curricula are still strongly shaped by post-World War British planning ideas. Hence planning professionals are being produced who have little understanding of the real challenges of African urbanisation and are equipped only with planning ideas from a very different time and place. The ACC-hosted Association of African Planning Schools (AAPS) has grown significantly, and this network of 50 urban planning schools is now a recognised influence on planning education and practice in Africa, and has generated significant educational research amongst its members.

One reason why it is hard to shift planning curricula is that national planning laws in many African countries were inherited from British (and French) colonial administrations and persist to the present day. This binds planning schools to producing planners trained to operate these outdated legal systems, but the planning laws themselves are also unable to recognise or respond to the current drivers of African urban change. It has therefore been necessary to initiate a research project aimed at revealing the weaknesses of this legislation across the continent and developing both processes and outcomes to bring about planning-law reform

Planning Education and the Association of African Planning Schools (AAPS)

AAPS is a peer-to-peer network of African university programmes that educate and train urban and regional planners.

Its 50 members are drawn from 19 countries, located in all regions of Africa (Botswana, Egypt, Ethiopia, Ghana, Kenya, Lesotho, Malawi, Morocco, Mozambique, Namibia, Nigeria, Rwanda, South Africa, Sudan, Tanzania, Togo, Uganda, Zambia and Zimbabwe). As a knowledge network, AAPS aims to facilitate exchange on curriculum development and research areas between members, primarily through digital communication and social networking tools. With generous funding from the Rockefeller Foundation since 2007, and with the enthusiastic help of researcher James Duminy and his colleague Dr Nancy Odendaal, AAPS has held workshops on key research themes and methods related to planning issues in African cities, has facilitated co-publishing, has developed educational 'toolkits' for new planning courses, and has recently developed a master's curriculum for the University of Lusaka's new planning programme.

Nothing changes the mind-set of students more profoundly than these direct engagements, which also equip them with the sensitivities needed to promote inclusive urban planning practices.

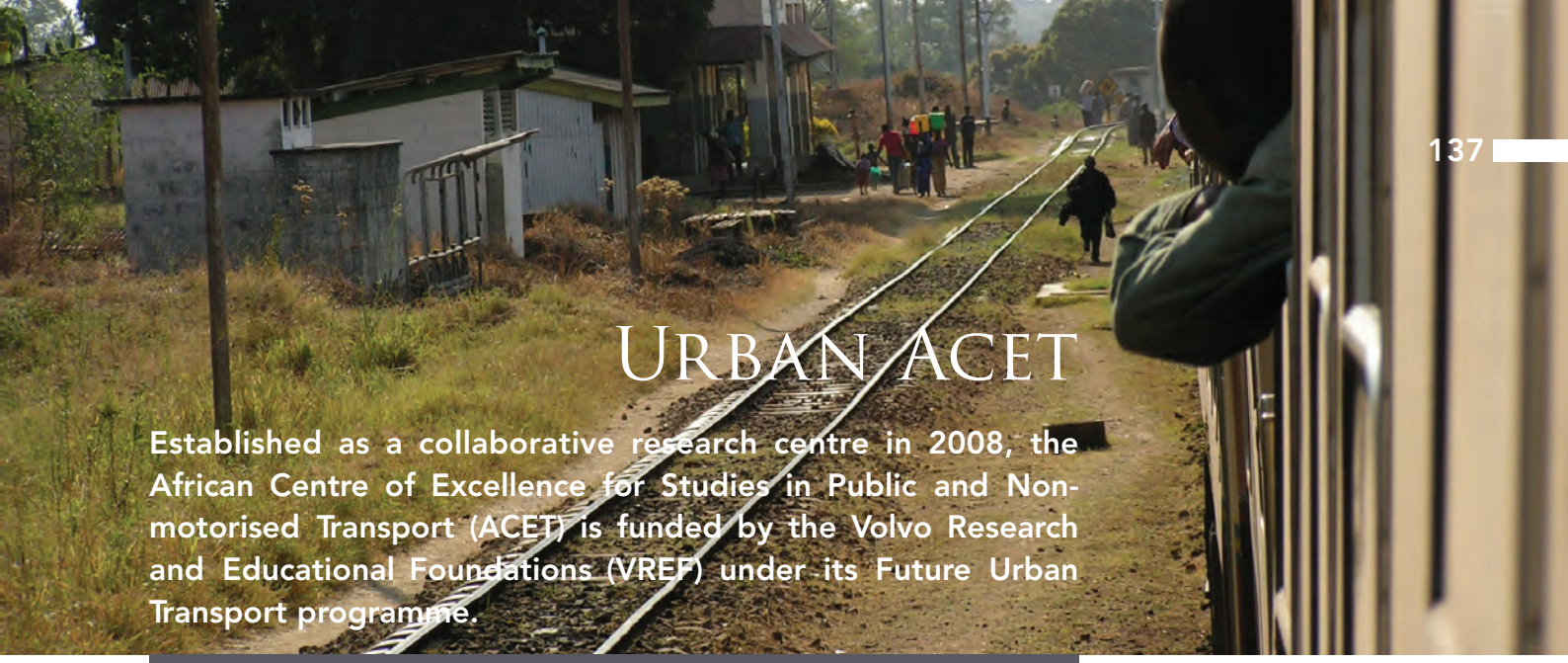
Particularly significant is the memorandum of understanding signed with Slum Dwellers International in 2010, committing planning schools to work with informal communities to expose their students to 'experiential' learning processes. Six studios have now been run on various parts of the continent, in which planning students work collaboratively with slum-dweller organisations on 'real-life' urban upgrade projects. Nothing changes the mind-set of students more profoundly than these direct engagements, which also equip them with the sensitivities needed to promote inclusive urban planning practices. The engagements have also stimulated research on planning pedagogy and how the education of planning professionals needs to respond to the particularities of the African urban context.

Building a Platform for Urban Legal Reform in Africa

Since 2010, and working through AAPS and the ACC, researchers have been building a policy argument for changing and improving urban laws in Africa and supporting a network of academics and practitioners contributing to these debates. The initiative is being led by Adjunct Associate Professor Stephen Berrisford, a land-law and planning expert with experience of planning-law reform in Africa.

The starting point for this research and lobby initiative is the belief that legal frameworks that govern urban development – especially urban planning, land and housing and urban governance – are outdated and inappropriate. Research has focused on identifying why it is so difficult to change planning law in Africa, leading to exploration of the entrenched nature of these laws, how power is derived from them, and how particular social groups tend to benefit from them. A journal special issue in 2011 was a first attempt to capture the experiences and difficulties of urban-law reform efforts in Africa.

The building of a platform to take forward urban-law reform in Africa has so far produced a major workshop of key political and international agency representatives, as well as a plenary dialogue at the 2012 World Urban Forum. Now, together with Cities Alliance, UN-Habitat, Urban LandMark and the World Bank, UCT researchers have initiated the process of compiling an *Urban Legal Guide*, a practical guide to support processes of urban legal reform in Sub-Saharan African countries.



Urban ACET

Established as a collaborative research centre in 2008, the African Centre of Excellence for Studies in Public and Non-motorised Transport (ACET) is funded by the Volvo Research and Educational Foundations (VREF) under its Future Urban Transport programme.

It is part of an international network of ten VREF-funded centres all focusing on the development and implementation of future urban transport solutions. ACET comprises academics and postgraduate research students from three main partner universities: the Centre for Transport Studies at UCT, the Department of Transportation and Geotechnical Engineering at the University of Dar es Salaam, and the Institute for Development Studies at the University of Nairobi. This Centre of Excellence is the primary collaborative network for the university's Centre for Transport Studies.

The ACET research programme is focused on the two main areas of public transport and paratransit, and non-motorised transport. Paratransit is defined as an alternative, flexible mode of passenger transportation that does not follow fixed routes or schedules (such as the minibus taxis that dominate the Cape Town public-transportation scene).

African cities have experienced a decline in scheduled public transport, and the emergence of weakly regulated and unscheduled paratransit. A major challenge facing authorities is the transformation of these services into integrated, regulated, safer and more efficient systems. Many previous attempts to do this have been developed without sufficiently grounded knowledge of 'real world' business, operating and regulatory conditions, and of governance capacities.

African cities, fairly ubiquitously, have inadequate infrastructure to support the non-motorised transport (NMT) modes upon which large impoverished populations depend. Poor levels of NMT accessibility and unsafe and uncomfortable travel conditions are the inevitable results. For many decades NMT has been ignored or underestimated, and treated as an add-on or afterthought. Both these research areas are situated in a context of responsible government agencies with low capacities, limited resources and poorly developed planning frameworks.

The spectrum of the ACET research programme includes projects focused on travel behaviour patterns, road safety, paratransit operations and regulation, public transport system assessment, non-motorised travel and infrastructure, intelligent transport systems, travel behaviour change, school travel planning, and city restructuring.

ACET's objective is to produce and disseminate knowledge on the development and governance of public and non-motorised transport in African cities, and to serve as a hub of research and capacity-building. The Centre of Excellence aims to empower researchers in Africa to set their own research agendas and engage directly with the transport challenges they face. An overarching objective is to facilitate an increase in journal publication, and greater involvement of African researchers in international conferences and in other forms of scholar interaction.

Associate Professor Roger Behrens

Paratransit Operations and Regulation in Cape Town

Led by Associate Professor Roger Behrens and funded by the Volvo Research and Educational Foundations, this ongoing project explores appropriate policies with respect to urban public transport system reform.

Public transport systems in contemporary sub-Saharan African cities are heavily reliant upon paratransit services. These services are typically poorly regulated and operate as informal businesses. Common results of weak public sector regulation, and a fare strategy in which owners claim a fixed daily revenue target and drivers keep the balance as income, are destructive competition and poor quality of service. There is a strong case for improving the quality, reliability and coverage of public transport systems, and some city governments have attempted to do so by initiating reform projects that envisage the phased replacement of paratransit operations with formalised bus rapid transit systems. There are, however, path dependencies and institutional and financial constraints that limit the possible extent of reform. Paratransit operations also have some inherent advantages with respect to demand responsiveness and service innovation. Attempts to eradicate paratransit may therefore be neither pragmatic nor strategic. It is hypothesised that two future scenarios are likely: hybrid systems comprising both paratransit and formally planned modes, and systems improved by upgrades and strengthened regulation of existing paratransit services.

Using information obtained from international case studies (e.g. Hong Kong, Jakarta, Recife, Santiago and Quito), the project is exploring appropriate regulatory frameworks for hybrid public transport systems in which formal and informal services coexist in a complementary manner. Drawing from engagement with minibus-taxi operators in Cape Town, the project is also uncovering the sources of paratransit resistance to the bus rapid transit (BRT) system implementation, and is developing an understanding of the heterogeneous nature of paratransit operator aspirations and the associated path dependencies these impose. The project researchers contend that policies that recognise paratransit, and seek contextually appropriate complementarity with formalised planned services, will produce greater benefits than policies that ignore their continued existence.

City Restructuring

This project focuses on exploring the potential to reduce the amount of motorised travel in the three main partner cities (Cape Town, Dar es Salaam and Nairobi) and investigating the impact of reduced commute distance travelled by workers.

Cities of the global South have relatively low car-ownership rates (between 18 [Kenya] and 144 [South Africa] vehicles/1,000 persons) compared to cities of the global North (between 400 and 700 vehicles/1,000 persons). The growing economies of the cities of the global South will translate into increased incomes and increased car-ownership rates. In parallel to this, the populations of these cities are also growing.

It might be argued that coal and nuclear power can be used to power electric public transport vehicles, but these resources are also limited.

These forces are likely to encourage the development of space economies and transport infrastructure suited to the motorcar. In contrast to this trend is the prospect of declining global fuel resources and increasing costs. This will reduce the number of persons and households that can afford to use a car to meet their transport needs. This will have a significant impact on the economies of cities and the well-being of their populations, more especially on those cities that have been structured to suit private motorised transport, and even more so on those that are poorer. (It might be argued that coal and nuclear power can be used to power electric public transport vehicles, but these resources are also limited. Oil, coal and nuclear power resources are forecast to peak in 2006, 2020 and 2040 respectively, resulting in serious shortages, and therefore very high costs, by 2025, 2070 and 2100 respectively).

The aim of this research is to estimate the positive and negative effects that would result from restricted private and even public motorised travel and the effect of informality in cities of the global South on these estimates. Project activities in 2012 focused on the administration of surveys in Cape Town to assess the consequences to employers and employees of restricting motorised commuter travel.

The project is led by Associate Professor Romano Del Mistro and funded by the Volvo Research and Educational Foundations.

Non-Motorised Travel and Infrastructure in Cape Town

This project focuses on the safety of non-motorised transport users (e.g. cyclists and pedestrians), and their interaction with other road users and infrastructure measures. Traditionally, road-safety assessments are conducted retrospectively.

The results of these investigations aggregate the causes of crashes under human, vehicular and environmental factors. The interaction between these factors is poorly understood, and safety counter-measures continue to be derived from historic crash statistics, or cluster analysis of incidents. Crashes are, however, random events and can occur anywhere and at any time. Historical crash-location patterns may not be the best indicator of future risks.

This project explores the use of microsimulation techniques to evaluate the relative safety of infrastructure and the interaction of road users through surrogate and proximal safety techniques, and contrasts the results with published findings. It also reviews road-safety assessment methods currently in use (e.g. traffic-conflict analysis and risk-assessment indices) and uses elements of these in conjunction with simulation to provide a sound basis for road-safety assessment. Test cases and analysis have been undertaken using some hazardous locations in Cape Town. Project activities in 2012 focused on completing the modelling work and initiating the write-up of results.

This project explores the use of microsimulation techniques to evaluate the relative safety of infrastructure and the interaction of road users through surrogate and proximal safety techniques, and contrasts the results with published findings.

The project is led by Associate Professor Marianne Vanderschuren and funded by the Volvo Research and Educational Foundations.

Signature Themes
associated with this theme

African Centre for Cities

Achieving well-governed and sustainable cities is becoming increasingly important to the future health of the planet. The African Centre for Cities partners closely with African universities and policy-making centres in order to provide an alternative perspective on dealing with critical urban issues. It provides an intellectual base and home for interdisciplinary, urban-related research at UCT, from which relations can be established with selected international think tanks, scholars, social movements, and funders.

Director: Professor E Pieterse
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Web: http://www.africancentreforcities.net

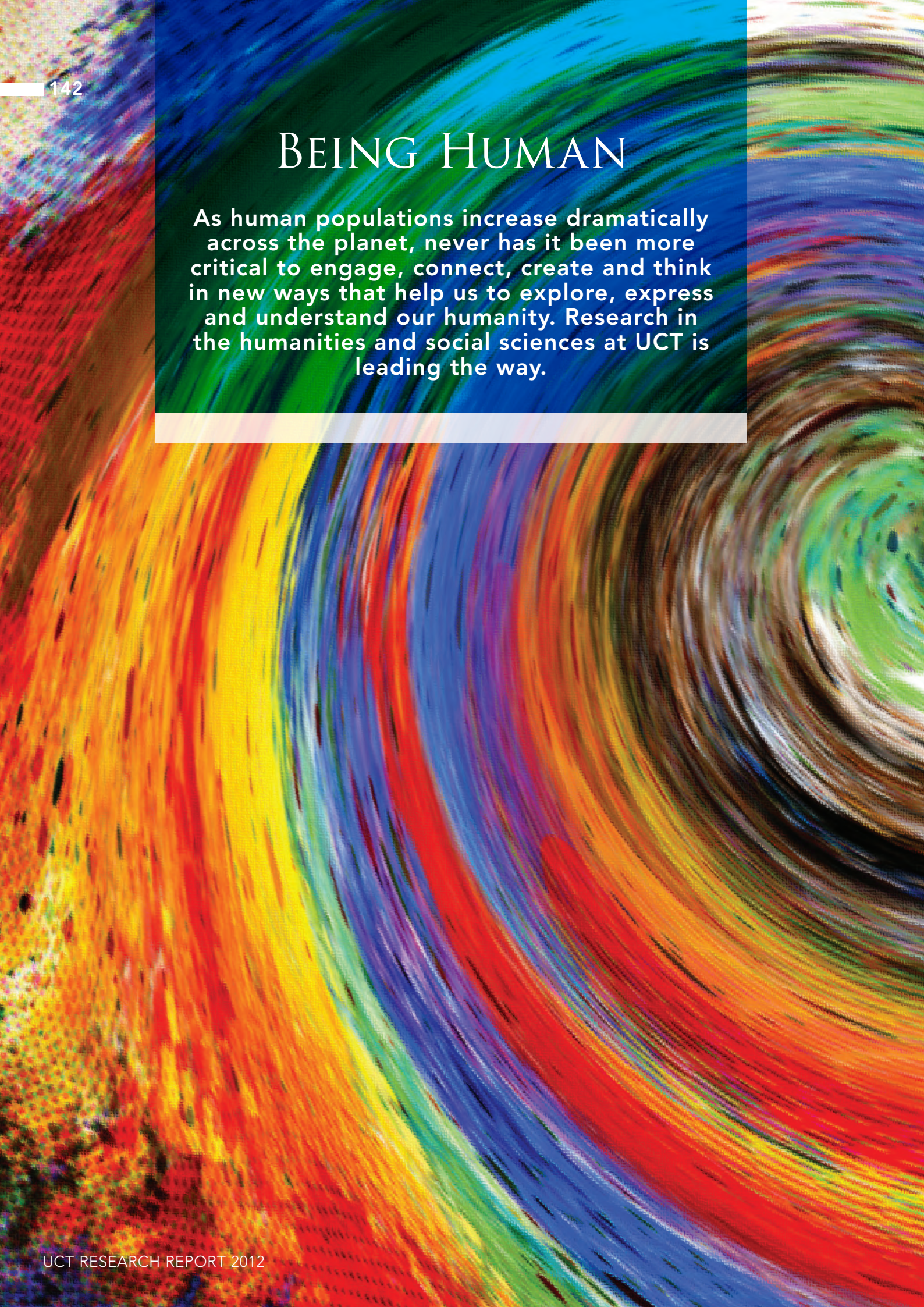
SARChI Chair
associated with this theme

Urban Policy

Professor Edgar Pieterse holds a PhD from the London School of Economics, a master's degree in Development Studies from the Institute of Social Studies (The Hague, the Netherlands) and BA-Honours from the University of the Western Cape. He is the holder of the SARChI Chair in Urban Policy and directs the African Centre for Cities at the University of Cape Town. His research is wide-ranging, covering themes such as African urbanism, cultural planning, regional development, governance, and macro development issues. He is a founder member of the Isandla Institute, serves on the boards of Magnet Theatre, the Sustainability Institute, and the Cape Town Partnership. He regularly provides advisory services to international development agencies such as UN-Habitat, African Development Bank, the Development Bank of South Africa, the Organisation for Economic Co-operation and Development, and the UN Environment Programme. Recently, Professor Pieterse was asked to serve on an international advisory committee for Cooper-Hewitt, the National Design Museum curating an international exhibition, *Critical Mass: Design and Urbanization.*

Being Human

As human populations increase dramatically across the planet, never has it been more critical to engage, connect, create and think in new ways that help us to explore, express and understand our humanity. Research in the humanities and social sciences at UCT is leading the way.



Relevance is key to UCT's research-led culture. Whether information proves of practical use to society at large depends on its frame – which is why all UCT research is framed within a contemporary South African context that seeks to successfully contribute to development and transformation in the country. Its strategy remains the identification of those vital attributes necessary for sustaining a research practice that continues to be globally competitive.

Recent investment by the university has focused on a broader-based development of research capacity with an emphasis on the humanities and social sciences. This invigoration is particularly relevant in light of the 2011 Academy of Science of South Africa report *The Consensus Study on the State of Humanities in South Africa,* and the *Charter for Humanities and Social Sciences,* which pointed to a worrying decline in the humanities and social sciences across the country, a trend that UCT is bucking.

The emphasis on humanities and social sciences at UCT has seen measurable growth in the area of research and publications, despite relative stagnation in these areas nationally.

This trend looks likely to continue, particularly as all three DST/NRF South African Research Chairs awarded in 2007 in the humanities were renewed in 2012. A fourth Chair, held by Professor Carolyn Hamilton in Archive and Public Culture Research Initiative, has also performed strongly in its first five years and looks set to be renewed in 2013. This Chair works closely with other humanities-based research initiatives at the university: the Centre for Curating the Archive, the recently established Institute for Humanities in Africa (HUMA) and the Gordon Institute for the Performing and Creative Arts (GIPCA).

These units provide direct and valuable intellectual support to a vibrant, thriving university research culture, whether individually, in collaboration, or through external partnerships. One such partnership extends northward into Africa – the Tombo*UCT*ou Manuscripts Project – led by Associate Professor Shamil Jeppie of HUMA. Its initial focus was on the research and translation of the Timbuktu Manuscripts in Mali, but it has broadened to include writing cultures from other parts of Africa.

UCT's contribution to the humanities endeavours to move beyond what is conventional. Just as the Michaelis School of Fine Art, the School of Drama and the College of Music create a rich and vibrant tapestry of work, so too the global revival of religion that impacts all forms and levels of individual and social life cannot be denied or ignored. A study of religious discourse is crucial for understanding modern religions, their sources of inspiration and their underlying structures.

The Department of Religious Studies, headed by the DST/NRF South African Research Chair in Islam, African Publics and Religious Values, Professor Abdulkader Tayob, offers an open and dynamic approach to the study of religion that recognises the importance of creative and critical thinking in a changing and culturally diverse South Africa.

Some credit can be claimed by the university for the national revival of linguistics research with a programme spearheaded by Professor Rajend Mesthrie of the DST/NRF South African Research Chair in Migration, Language and Social Change.

The emphasis on humanities and social sciences has already seen UCT demonstrating measurable growth in the area of research and publication despite relative stagnation in these areas nationally.

UCT's active linguistics unit collaborates closely with colleagues in the School of Education and the Centre for Higher Education Development, along with the linguistics department at the University of the Western Cape. Sociolinguistics – described as one of the fastest-growing strands of linguistics – focuses on language and communication in society and social interaction. It carefully analyses everyday encounters in order to understand larger structures and processes like globalisation, inequality, social creativity, and the formation and contestation of identities. Its aim is to bring together empirical analysis and social and linguistic theory, as well as socio-political engagement.

The university recognises the importance of the humanities to both intellectual endeavour and the shaping of society, and remains committed to this sometimes undervalued area of academics.

Preserving the treasures of national heritage:

The Archive and Public Culture

The Archive and Public Culture Research Initiative works closely with other humanities-based research at the university to provide valuable intellectual support to a vibrant, thriving university research culture.

South Africa has a vast archival inheritance from the colonial and apartheid eras, which includes documents, images found in archival repositories and other collections, bones, natural specimens, art works, and maps. This inheritance, shaped in complex ways by the dominant concerns of the time, presents significant epistemological, conceptual, methodological, and ethical challenges for anyone delving into the treasure trove. And further complexity is added by post-apartheid policies and activities that now augment the collection and challenge the very perimeters and definition of archive itself.

Further complexity is added by post-apartheid policies and activities that now augment the collection and challenge the very perimeters and definition of archive itself.

Two aspects of archive have operated in especially stark ways in South Africa. The absence of a documentary archive was used to designate black South Africans as timelessly traditional and tribal, while the Truth and Reconciliation Commission bears the weight of managing the political history of the apartheid era. Critical interrogation of the notion of archive, and specific archives, is therefore a South African research priority.

At UCT, research in this area has been given renewed vigour under the Chair in Archive and Public Culture, which offers privileged insights into the normative understandings of the workings of archive, and an opportunity to interrogate afresh the definition of archive and develop new theoretical tools and conceptual vocabularies to be used in

approaching questions that challenge and extend older metropolitan ideas. Taking the initiative still further, it considers what the notion of archive enables and what it forecloses, and explores new methods for approaching archival and similar materials.

The initiative investigates to the fullest the circumstances of the making of the archival inheritance, its refashioning over time, and processes of inclusion and exclusion. This is accomplished by focusing on how archives shape public, political and academic discourses and practices, and were, themselves, shaped by public, political and academic discourses and practices.

This draws attention to the relationship between academic disciplines and their archives. Former UCT Vice-Chancellor Professor Njabulo Ndebele's observation that "[t]here can be no transformation of the curriculum, or indeed of knowledge itself, without an interrogation of archive" informs the initiative's exploration of these relationships in a variety of disciplines.

There can be no transformation of the curriculum, or indeed of knowledge itself, without an interrogation of archive.

Along with Professor Pippa Skotnes from UCT's Michaelis School of Art, the DST/NRF Chair in Archive and Public Culture anchors a UCT-wide initiative, Archive and Curation (ARC): The Visual University and Its Columbarium. ARC engages with projects that investigate the university's extended columbarium (the many research collections, both in formal university repositories and in informal bottom drawers of professors' desks or hidden in departmental cupboards), encouraging self-reflection of the relationships between disciplines and their archives within the university.

The initiative is committed to inter- and transdisciplinary modes of work and social learning formats. Close attention is given to postgraduate pedagogy and the production of future academics, with postgraduate research structured around regular research development workshops and active support for sole-authored student publications.

The platform has achieved high recognition, nationally and internationally, as a trusted voice with the will and power to speak out in support of archival institutions and the public interest, as well as for its trailblazing work as a novel form of popular media-based activist intervention.

District Six Museum

Institute for Humanities in Africa

Food for thought and room for lively, intellectual debate

A full and lively events programme in the Institute for Humanities in Africa (HUMA) – some 60 events in 2012 – was critical to realising the mission to create and champion a space for inter-disciplinary research and debate for graduate students and their peers. Events included two regular weekly seminars: a series structured by the dual research themes *On Being Human* and *Circuits of Consumption,* and a series of 'book lunches' intended to open discussion with authors of books published in the humanities.

Perhaps the liveliest 'book lunch' – in a room filled with people and strong views – was that of *The Second Sexism* by David Benatar, in which he maintains that men are the victims of new and pernicious modes of gender discrimination.

The year saw the launch of Continental Connections – seminars, lectures and workshops presented by invited visitors from Mali, Ghana, Uganda, and Nigeria. The first event dealt with discourse analysis: a combination of two lectures grappling with the genealogy of the concept of discourse, and a workshop focused on conducting discourse analysis.

A one-day symposium to mark the 50th anniversary of the publication of Rachel Carson's *Silent Spring* proved an especially successful event, convened around the visit to HUMA of keynote speaker Professor Rob Nixon (University of Wisconsin, Madison). The symposium planted the seed for an inter-disciplinary master's in Environmental Humanities – a first in South Africa.

Certain events are conventionally academic; others are intended for the wider public. Cape Town Commons is a HUMA public platform for debate on matters of citizenship in this city. The focus event for 2012 was the scandalous waste of public funds by the National Lotteries Board directly affecting the lifelines of a surprising number of Cape Town NGOs. The event was attended by hundreds from Cape Town and its wider environs.

Other notable events held in 2012 included a series of seminars held under Shamil Jeppie's research programme on African Arabic writing cultures in which local western-style calligraphers and scholars of Arabic writing spoke about the theory that informs their practice. Renowned Moroccan calligrapher Hamidi Belaid also ran a calligraphy course at the Michaelis School of Fine Art.

Research highlights included Deborah Posel's work on the politics of consumption in South Africa, which produced an analysis of the ANC Youth League under Julius Malema, and Ilana van Wyk's twin research emphases on prosperity gospel churches and the South African lottery, which resulted in a series of publications and lectures.

Zethu Matebeni's research, delving into questions of sexuality, and sexual and identity politics, culminated in a well-attended public debate in Langa township. A short film about the politics of gay and lesbian pride in South Africa was produced from this event. Matebeni concluded a four-year research project concerning HIV risk and the vulnerability of women in Southern Africa. A journal article published in *Agenda* addressed issues around pornography and feminism in South Africa, and Matebeni also published the book *Black Lesbian Sexualities and Identity in South Africa*, based on her PhD thesis.

The Tombo*uctou* Manuscripts Project

Associate Professor Shamil Jeppie, who leads the Tombo*uctou* Manuscripts Project, has made regular trips to the UNESCO world-heritage site of Timbuktu to work with an archive of handwritten texts in Arabic and African languages in the Arabic script, produced between the 13th and the 20th centuries.

A United Nations expert mission estimates that around 4 000 ancient manuscripts were destroyed by Islamic fundamentalists during their occupation of Timbuktu in early 2013. This is approximately one-tenth of the manuscripts that were stored in the city. Most documents were saved by the devotion of the library's Malian custodians, who spirited them out of the occupied city in rice sacks, on donkey carts, and by motorcycle, boat and 4-wheel drive.

Lamu Endangered Archives

During 2012 Associate Professor Jeppie took his interests in Islamic culture eastward to Lamu in Kenya, one of the original Swahili settlements in East Africa.

Funded by the British Library Endangered Archives Programme, Associate Professor Jeppie, together with Norwegian colleague Anne Bang and Ethiopian student Hasan Kawo, ran a project to catalogue the manuscripts of a small library at the Riyadha madrasa in Lamu. The 19th century Riyadha Mosque is one of the oldest and most influential Islamic teaching institutions in the Swahili world. During this visit, digitisation of the entire manuscript collection of unique copies on Islamic education in East Africa for the past 120 years was completed, generating a total of 35 000 digital images of the full collection.

Giving Vibrant Voice to Great Literature

The Coetzee Collective is the leading international research group on the writings of J.M. Coetzee, the South African 2003 Nobel laureate in literature. Coetzee's work has sparked an extraordinarily vibrant culture of research, teaching and conversation among postgraduate students in literature at UCT.

Coetzee Collective, Rebecca Saunders (Illinois State)
The Concept of Foreignness in Waiting for the Barbarians

The research hub, originally founded in 2006 as an informal discussion group, is hosted by Associate Professor Carrol Clarkson of the Department of English Language and Literature. A series of seminars at the university is sponsored by the hub, often featuring overseas visitors, while links are fostered with acclaimed researchers and postgraduate students throughout the world.

UCT postgraduate students in the English Department are at the core of the burgeoning international and inter-disciplinary field of "Coetzee Studies" which, in addition to the study of South African and world literatures, includes scholarship in fields like animal ethics, translation, linguistics, film studies and jurisprudence.

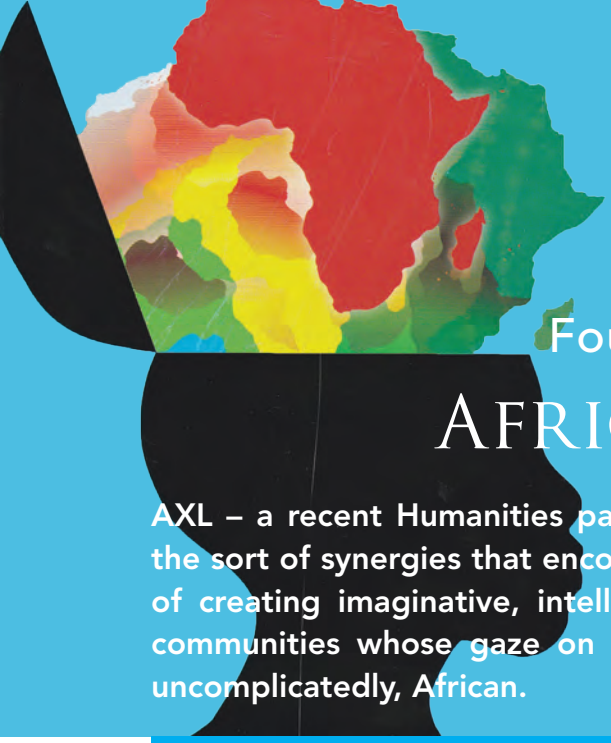
Two postgraduate students – Joshua Maserow and Eckard Smuts – presented papers at an October 2012 conference on Coetzee at Justus-Liebig University in Giessen, Germany. The event presented an opportunity for the Coetzee Collective to broaden the scope of its network and strengthen ties with its international members. A positive outcome of the conference has been an ongoing correspondence between researchers from the two universities.

Maserow has since graduated with distinction while Smuts is about to submit his doctoral thesis. They are joined by Daniella Cadiz Bedini, who wrote her MA on Coetzee, and will graduate with distinction in June 2013.

Still more good news: Dr Hedley Twidle's essay on Coetzee won the Bodley-Head Financial Times Essay Award – a major international honour in the field.

The 2012 highlight for the collective, which took place in December, was undoubtedly a visit to UCT by J.M. Coetzee himself. He read from his new novel, *The Childhood of Jesus*, not yet published at the time.

Coetzee's latest work, in a departure from previous novels, is the story of a young child's co-operative relationship with a man who is not his father and explores the myriad assumptions about the world normally invisible in ordinary adult life, and the limits and provisionality of any single explanation of a phenomenon.



Four times the focus on
African Studies

AXL – a recent Humanities partnership – has begun to forge the sort of synergies that encourage debate on the challenges of creating imaginative, intellectual, and politically engaged communities whose gaze on the world is, unqualifiedly and uncomplicatedly, African.

The merging in 2012 of four previously distinct academic departments in the Faculty of Humanities has created the School of African and Gender Studies, Anthropology and Linguistics (AXL) and it's an exciting place to be. Instead of working in silos, staff and students are encouraged to locate synergies, explore innovative ways of working and share knowledge and resources. The partnership consolidates years of research by African academics and is already bearing fruit in the form of cross-functional collaboration.

It is clear that AXL is uniquely positioned to provide exploration and insight into issues of what it means to be 'African', the meaning of culture, feminist discourse in Africa, the construction of identity and race, and the role of language alongside the continent's political and social development. The value of the school, according to its director, Associate Professor Jane Bennett, is its ability to examine familiar themes more critically, in new ways and from a quintessentially Afrocentric perspective.

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The journey towards AXL has not been without controversy. In 2011, the merits of the proposed amalgamation were hotly debated, leading to months of discussions by students, staff members and faculty executive, under intense media scrutiny. At the heart of the debate was the perceived devaluation of African Studies at the institution and concern about the loss of departmental independence for the Centre for African Studies (CAS).

These anxieties have been set aside following significant gains achieved since the launch, key among them the appointment of Professor Lungisile Ntsebeza (SARChI Chair in Land Reform and Democracy) to the AC Jordan Chair in African Studies. This has brought Professor Ntsebeza's renowned intellectual achievements and vision into the heart of the school.

Another gain in 2012 was the National Excellence for Teaching and Learning Award from the Higher Education Learning and Teaching Association of Southern Africa to

Associate Professor Jane Bennett, Director of AXL.

Dr Susan Levine (Social Anthropology), a recipient of UCT's Distinguished Teacher Award in 2011.

Through the AGI and Gender Studies, AXL students and staff benefited from the visit of internationally acclaimed documentary film-maker and writer Yaba Badoe (Ghana) in August. Badoe spent a week at UCT giving seminars and screening her award-winning documentary *The Witches of Gambaga*, which explores the negative impact of cultural beliefs and superstition in parts of Africa. The visit was co-ordinated in collaboration with the faculty's African Cinema Unit.

The Linguistics section hosted a successful residential seminar, titled *Language and Desire, which was attended by* AXL postgraduates, affiliates and faculty members.

The three SARChI Chairs held within AXL have, through a first-class array of seminars, digital production and research publications, continued to stimulate the school and wide range of affiliated researchers and writers.

The value of the school, according to its director, Associate Professor Jane Bennett, is its ability to examine familiar themes more critically, in new ways and from a quintessentially Afrocentric perspective.

AXL also published three issues of *Feminist Africa* and two editions of *Social Dynamics* in 2012. The *African Feminists: Talking the Walk* is another project that connects UCT academics and students with their counterparts in different African contexts. Initiated in 2011 by the African Gender Institute, the programme presents the work and ideas of African feminists in order to answer the question: What do African feminists look and sound like? Key events included seminar presentations, book launches, documentary screenings and panel discussions, including a visit from feminist activist Sara Longwe, who gave a talk on "Legal Voice: feminist activism from the body up" – an account of her legal struggles for equality in Zambia.

An important milestone for AXL has been the establishment of the Centre for African Languages Diversity, a research unit headed by Dr Matthias Brenzinger, created to stimulate the study and documentation of African languages to promote linguistic diversity on the continent. Through its scholarship programme and collaborations with international institutions, the unit will soon attract MA and PhD students from around Africa.

A Champion for Integrated African Studies

Professor Lungisile Ntsebeza has been appointed as the new AC Jordan Chair in the School of African and Gender Studies, Anthropology and Linguistics (AXL). This professorial chair in the field of African Studies was established at UCT in 1993 and is named after Archibald Campbell Mzolisa Jordan, who was a pioneer in the field of African Studies under apartheid.

According to Professor Ntsebeza, Africans, in particular South Africans, do not know enough about their own continent and have yet to prioritise a meaningful study of African issues. The AC Jordan Chair aims to address this challenge by championing the integration of African Studies into research, teaching and learning at undergraduate and postgraduate level across the institution.

Examples of this commitment to an African agenda can already be found in UCT's Afropolitanism drive, and in the work of the School of African and Gender Studies, Anthropology and Linguistics and the recently established Centre for African Language Diversity, as well as in the teaching of isiXhosa in the Health Sciences.

African Studies is in a sense inherently cross- and multidisciplinary, providing an opportunity for individuals from different disciplines and professions to address selected topics, problems or themes related to Africa.

South Africa's Chinese Diaspora and the Multilingual Transformation of Rural Towns

China's economic ties with Africa have strengthened in the last decade as more Chinese migrants settle here – recent estimates are as high as 400 000 compared to 20 000 in 1990.

Most recent migrants are from mainland China and are engaged in the retail sector. Iconic of this development are the so-called "China shops" found in almost every South African town, shops that do not cater to a niche ethnic market, as is common in the global North, but to a local African clientele.

The project looks at the multilingual transformation of rural towns, with ethnographic fieldwork focusing on the Eastern Cape towns of Tsolo, Cala and McClear – off the beaten track and rarely discussed in migration literature, which focuses instead on urban, metropolitan contexts. These three towns are vibrant market towns servicing a population engaged in subsistence agriculture, small-scale farming and some professional and government employment.

Since the late 1990s, trading in these towns has been transformed by international migration, with traders coming from China, from India and Pakistan, and from other African countries like Ghana and Senegal.

The project endeavours to understand how global migrants, especially the "new" Chinese diaspora, negotiate the linguistic, social and economic challenges of trade and everyday life in these rural African towns. Local residents are primarily isiXhosa-speaking with varying levels of English, yet Chinese traders have developed strategies to facilitate economic transactions: signage drawing on local meanings and languages, basic isiXhosa-Afrikaans-English jargon, and employment of language mediators to interact with customers. Further fieldwork will take place in November 2013 and throughout 2014, focusing on issues of ownership and consumption, and changing communication practices.

The project is funded by the National Research Foundation and conducted jointly by Associate Professor Ana Deumert (AXL, Linguistics) and Mr Nkululeko Mabandla (AXL, CAS) who are also involved in the recently established European Consortium on Globalization at the Margins, initiated jointly by Professors Jan Blommaert (University of Tilburg) and Leonie Cornips (University of Maastricht).

Texting Africa – Multilingual Digital Writing

Digital communication technologies, in particular popular and affordable texting, have opened new spaces for the informal use of written African languages.

Research has to date focused largely on the global North – Manuel Castells and his colleagues note in *Mobile Communication and Society:* "'We know a good deal about Norway because of the quality of the Norwegian research in the field, while we know little about Nigeria because of the scant reliable evidence on this important country."

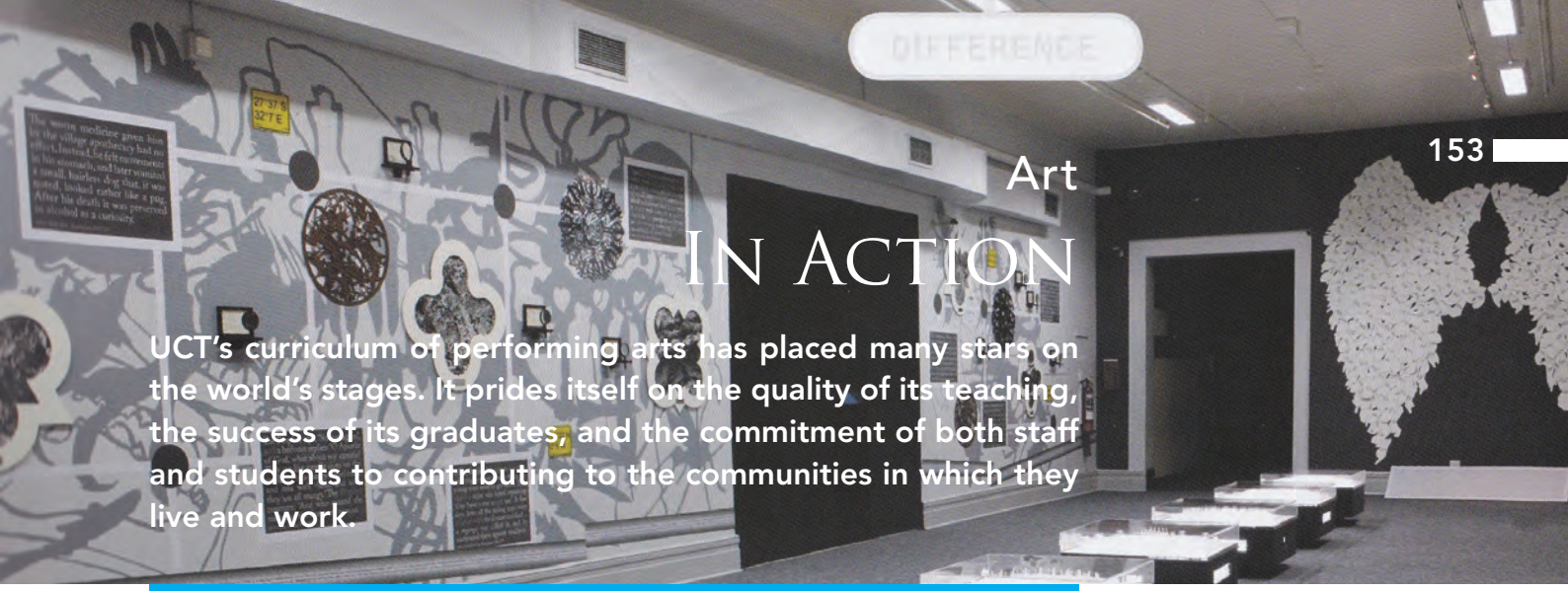
The Texting Africa project contributes to closing the research gap by focusing on digital literacy practices in Côte d'Ivoire, Ghana, Nigeria and South Africa. Data include text message corpora and screen data for other digital applications like Facebook and Twitter, as well as survey, interview, observation and focus-group data.

The Texting Africa project contributes to closing the research gap by focusing on digital literacy practices

The project began in 2010, but recent publications have focused on the role of creativity and linguistic play in digital writing. Good texters have an ability to manipulate language and create new words and expressions and, while much of this formal creativity happens in English or French, writers make skilful use of African language resources.

The data shows such practices to be widespread, and multilingual linguistic creativity to be a hallmark of the genre. For many African writers – educated in a school system which privileges former colonial languages – digital writing is a place where they write African languages on a regular basis, unsupervised, a space where African languages are cool and alive.

The project, led by Professor Ana Deumert (AXL, Linguistics), is funded by the National Research Foundation and South Africa Netherlands Research Programme on Alternatives in Development. The work benefited from research collaboration with Dr Kristin Vold Lexander, University of Oslo, and a specialist in texting in Senegal. Future collaboration is anticipated with the recently launched Centre for Multilingualism in Society Across the Lifespan (MultiLing, University of Oslo).



Art

In Action

UCT's curriculum of performing arts has placed many stars on the world's stages. It prides itself on the quality of its teaching, the success of its graduates, and the commitment of both staff and students to contributing to the communities in which they live and work.

UCT is renowned for its performing arts curriculum spanning music, dance, film, drama and art. In the past year the work of students and faculty in the performing arts shone both locally and internationally.

Special mention must go to pianist Jane Yu, an alumna of the South African College of Music, who is delighting audiences around the world with her extraordinary musical abilities. After completing her honours degree at UCT, and following a highly successful performance at Carnegie Hall earlier this year, she has been chosen to pursue her master's degree at the Manhattan School of Music.

UCT's School of Dance students also returned triumphant from the International Theatre School (ITS) Festival in Amsterdam, having won the coveted ITS Guest Award for best international performance. *A Journey from Past to Present* interpreted four themed pieces that formed part of the South African story. The students did not try to emulate European dance styles but delivered an authentic and technically skilled performance. Judges were impressed with the novel way in which the performance merged traditional and international dance styles in a manner both unique and exciting.

To ensure that more South Africans have the opportunity to pursue careers on the stage, key advances have been made in finding funding for the arts at UCT. UCT's Opera School has a proud legacy of discovering talent in disadvantaged communities rich in musical culture, yet its programmes remain some of UCT's most expensive. To further the university's broader transformation agenda of developing inclusive curricula and engaging African voices, the Opera School Endowment Fund was launched in 2012 to make pledging donations more accessible to both individuals and organisations.

A key role of arts at UCT is to explore, express and interpret what it is to be South African and African. Several important exhibitions took place in 2012, including the annual Michaelis School of Fine Art's Graduation Exhibition, which showcased the extraordinary work of 52 students. Key among these was the exhibition by Associate Professor Johann van der Schijff at the Iziko South African National Gallery titled *Community Punching Bags*. In a collaboration with several Cape Town high schools, the punching bags, adorned with faces, demonstrated that issues often not spoken of, such as violence, discrimination, racism and xenophobia, can be addressed in a collaborative and creative way through interactive art.

The African Cinema Unit, under the directorship of Associate Professor Lesley Marx, hosted the first Alternative Africa Film Festival, *Right-wing Vampires, Ritual and Rapture*. Other activities from the unit included the launch of Professor Jyoti Mistry's book *We remember differently: Race, Memory, Imagination,* and the presentation by South African film-maker Ross Devenish of his film and television work. Award-winning director Oliver Hermanus was also showcased, while students benefited from a screenwriting and screen production master class.

DST/NRF SARChI Chairs
associated with this theme

Professor Carolyn Hamilton

Archive and Public Culture

Professor Carolyn Hamilton holds the DST/NRF Chair in Archive and Public Culture, and leads the inter-disciplinary research initiative in Archive and Public Culture based at the School of African and Gender Studies, Anthropology and Linguistics. Professor Hamilton was previously head of the Constitution of Public Intellectual Life Project and director of the Graduate School for the Humanities at the University of the Witwatersrand. She was also a member of the Board of the South African History Archive and founder member of the Gay and Lesbian Archive. Her archive work is rooted in an ongoing interest in the history of South Africa in the eras immediately before colonialism for which there are limited written archives. Other illuminating materials will need to be explored. Professor Hamilton was responsible, in partnership with the Nelson Mandela Foundation, for the establishment of the Archival Platform – an electronic civil-society-based intervention in the politics of archive.

Professor Rajend Mesthrie

Migration, Language and Social Change

Rajend Mesthrie is Professor of Linguistics in the School of African and Gender Studies, Anthropology and Linguistics, and holds the DST/NRF Chair in Migration, Language and Social Change. He is a past president of the Linguistics Society of Southern Africa

Professor Rajend Mesthrie with students at the annual linguistics workshop.

(2001 to 2009) and head of the Linguistics Section at UCT (1998 to 2009). He was elected honorary life executive member of the Linguistics Society of Southern Africa in 2012. He is currently an executive member of the International Society for English Linguistics and an elected member of the SA Academy of Science. Professor Mesthrie has published widely in the field of sociolinguistics, with special reference to language contact and variation in South Africa. He is co-editor of the Cambridge University Press journal *English Today*, which produces scholarship dealing mostly with English in global and migratory contexts. He is a board member of another 12 journals in the fields of sociolinguistics, globalisation and English, South African sociolinguistics, sociology, and African studies, and holds an A rating from the NRF.

Islam, African Publics and Religious Values

Abdulkader Tayob is Professor of Islamic Studies, Head of the Department of Religious Studies and holds the DST/NRF Chair in Islam, African Publics and Religious Values. He obtained his doctoral degree in 1989 from Temple University in the United States. Professor Tayob is a recognised scholar in the study of modern Islam in general, and Islam in South Africa and Africa in particular. His current research spans religion education in South Africa, modern Islam, and biographies of religious engagement. By pursuing these interests, he examines the way religion is taught in public life. Building on the work of Islam in public life, he will examine the role of religion studies as part of life orientation and religious studies as a free-standing subject in South African schools. He will continue his cutting-edge research into how to approach the study of Islam in the modern world, with the main area of

Professor Abdulkader Tayob

focus being the link between present and past, along with the categories used to best interpret the present. His third area of research is a focus on the personal dimension of religious revival. Taking a biographical approach, he questions what motivates people to join religious revival groups. These questions are posed to Muslim activists in South Africa, Egypt and Nigeria, and Muslims and Christians in East Africa.

Professor Lungisilie Ntsebeza

Land Reform and Democracy in South Africa

Professor Lungisile Ntsebeza holds the DST/NRF Research Chair in Land Reform and Democracy in South Africa. He has conducted extensive research on the land question in South Africa, specifically on land rights, democratisation, rural local government, traditional authorities, and land and agrarian movements. Professor Ntsebeza has published *Democracy Compromised: Chiefs and the Politics of Land in South Africa* (Brill Academic Publishers, Leiden, in 2005 and the HSRC Press in 2006). He has also co-edited *The Land Question in South Africa: the Challenge of Transformation and Redistribution* (HSRC Press, 2007, with Ruth Hall), and *Rural Resistance in South Africa: The Mpondo Revolts after Fifty Years* (Brill Academic Publishers, Leiden, 2011, and UCT Press, 2012, with Thembela Kepe). His current research interests, apart from land and agrarian questions, include an investigation of African Studies at UCT and a related project on the political and intellectual history of the late Archie Mafeje.

African Cinema Unit

The African Cinema Unit is an initiative within the Centre for Film and Media Studies that is committed to promoting the study of African cinemas, taking account of the richness and diversity of the film cultures that have emerged from the countries that make up this vast and complex continent. Associate Professor Martin Botha's book *South African Cinema 1896–2010* (Intellect) was published in 2012, and represents the first broadly based text that encompasses the history of South African cinema in its entirety. Under the directorship of Associate Professor Lesley Marx, several events also showcased alternative African cinema (e.g. the first Alternative Africa film Festival) and brought film-makers to the university.

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Centre for Contemporary Islam

The Centre for Contemporary Islam (CCI) was established in 1996 to co-ordinate research conducted at UCT on Islam and Muslim societies, and the dissemination of findings to a broader public. The main projects of the CCI include Islam and Public Life in Africa; Sufism, Gender and Islam; and the Timbuktu Manuscripts Project. The CCI publishes the annual *Journal for Islamic Studies*. The centre is based in the Department of Religious Studies, and has the active participation of scholars from outside the department.

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Centre for Popular Memory

The Centre for Popular Memory (CPM) is an Africa-focused oral-history research, advocacy and archival centre linked to the Department of Historical Studies. Research prioritises multilingual approaches to the impact of post-traumatic legacies in Africa and specialises in multileveled technology outputs through academic journals, exhibitions and film, including scholarly content for portable media platforms.

Research Groupings
associated with this theme

Through the African Oral History Archive project, the CPM has more than 3 000 oral history recordings in 12 languages, many with full transcripts and translations, preserved, migrated and gathered over 25 years.

The African Memory Project (AMP) aims to increase access to, and use of, oral and visual collections in Africa. To this end, it collaborates with international leaders in fields of oral history and memory studies to analyse Africa-centred research materials. Memories of Apartheid is a key project of AMP that seeks to engage civil society on various levels and includes a number of transnational and international research and educational partners. The project will develop a large-scale oral-history programme and conduct filmed oral-history interviews with people who lived through apartheid, across South Africa. It will also develop a centralised digital archival model for the gathering and dissemination of audiovisual archival material for educational use on an international scale.

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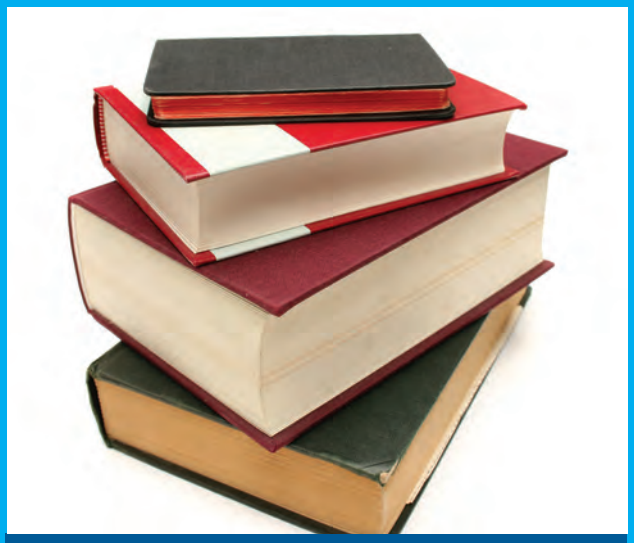

Centre for Rhetoric Studies

The centre was founded in 1995 and remains unique on the continent, where it has pioneered the emergence of rhetoric studies (as mentioned in Blackwell's *International Encyclopedia of Communication*). It concerns itself with multidisciplinary research in public rhetoric, deliberative democracy and argumentative culture. The centre engages in three main activities: hosting research fellows, organising academic conferences and registering postgraduate students (master's and PhD). It publishes its findings through the *African Yearbook of Rhetoric* (AfricaRhetoric Publishing). The Centre has a success rate of nearly 100 per cent in numerous competitively funded international research projects.

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Institute for Comparative Religion in Southern Africa

The Institute for Comparative Religion in Southern Africa (ICRSA) is dedicated to the postcolonial study of religion and religions in South Africa and the Southern African region. In addition to developing resources for the study of religions and reconfiguring the study of religion from a Southern African perspective, ICRSA has participated in international research projects on religious education and cultural heritage. ICRSA houses the peer-reviewed, accredited *Journal for the Study of Religion*.

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Isaac and Jessie Kaplan Centre for Jewish Studies and Research

The Isaac and Jessie Kaplan Centre for Jewish Studies and Research was established in 1980 under the terms of a gift to the University of Cape Town by the Kaplan Kushlick Foundation and is named in honour of the parents of Mendel and Robert Kaplan. The centre, the only one of its kind in South Africa, is autonomous and has its own governing body. It seeks to stimulate and promote the entire field of Jewish studies and research at the university with a special focus on the South African Jewish community. The centre is multidisciplinary in scope and encourages the participation of scholars in a range of fields including history, political science,

education, sociology, comparative literature, and the spectrum of Hebrew and Judaic studies.

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Lucy Lloyd Archive, Resource and Exhibition Centre

The Lucy Lloyd Archive, Resource and Exhibition Centre (LLAREC) is a research centre to promote the visual as a site of meaning and knowledge. Its focus is on collections and curatorship in which objects are allowed to become both sites of knowledge and mnemonics in which reference can be made to a wider meaning.

At the heart of the centre's curatorial practice is the issue of representation; many of its projects interrogate the ways in which the historical, social and medical construction of identity are revealed through representation. Major projects have included the publication of the Bleek and Lloyd archive, the production of portfolios and artists' books, and the installation of exhibitions at various venues. LLAREC incorporates the Katrine Harries Print Cabinet, and is now part of the Centre for Curating the Archive, which includes major photographic collections and a visual history archive, as well as the projects that curate them.

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Research Institute on Christianity and Society in Africa

The Research Institute on Christianity and Society in Africa (RICSA) is engaged in research into religion in public health, globalisation, and public theology. Its primary activity has been the International Religious Health Assets Programme (IRHAP) – a multi-institutional, multisite, inter-religious, transdisciplinary collaborative research project co-ordinated at UCT.

Initiated in 2003 together with colleagues from Emory University, it includes academics and practitioners from other South African centres, and has a strong partnership with Methodist Le Bonheur Healthcare (a seven-hospital system in Memphis, USA), while working with other partners in Africa, Europe and the USA.

IRHAP maps and assesses religious health assets, policy processes, and capacity-building at the interface of religion and public health. Its more recent work is with the Hospice Palliative Care Association of South Africa, building community partnerships for the strengthening of health systems. It is conducting research on male peace and safety in the context of interpersonal violence (three sites in South Africa and the USA, in conjunction with the Medical Research Council and the UNISA-based Peace and Safety Lead Programme), and is taking more of an interest in health systems and primary health care. RICSA is also known for its published multiyear, multivolume project on the social history of Christianity in South Africa (UNISA Press, CD-ROM).

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The Green Economy

Greening the economy is a crucial process if countries want to improve human wellbeing and social equity while reducing environmental dangers and ecological shortages. UCT research across many disciplines is breaking new ground and helping to speed up the transition.

At UCT, a number of researchers across the university are engaged in various inter- and multidisciplinary research projects, with the aim of contributing substantially to a greener economy, and thereby improving the well-being of all South Africans. A number of these projects extend into Africa, broadening the reach and increasing the impact. The research being undertaken in the Faculties of Science and Engineering & the Built Environment has been particularly ground-breaking, and promises to make fundamental contributions to this area, and to inspire and train the next generation of scholars.

Clean technology and cleaner production have been research themes in UCT's Department of Chemical Engineering since the time of the 1992 Earth Summit in Rio de Janeiro. Initially viewed as newcomers to academic research, such themes have steadily gained in importance as the magnitude of local and global environmental degradation became clearer. The 2011 'Green Economy' report of the United Nations Environment Programme (UNEP) signalled a new globally concerted effort to address the Millennium Development Goal 7 (ensuring environmental sustainability). This concept of a green economy was readily taken up in South Africa, to realise its economic development potential. Green economy desks or programmes have since been established in national, provincial and many local governments.

But is more research needed? Is it not enough to simply deploy tried and tested wind turbines and photovoltaics so as to start greening South Africa's electricity supply?

The large-scale use of renewable energy for electricity generation undoubtedly is a necessary condition for sustainable development. In this regard, the recent global green economy push is making significant gains on earlier programmes. But, according to UCT researchers, a programme only focused on green energy is unlikely to be sufficient, as it does not link strongly enough to development concerns, or address environmental problems related to the material rather than the energetic dimension of our consumption-based economy.

Globally, this material dimension of sustainable development has been receiving concerted new attention through the work of the International Resource Panel established by UNEP in 2011. UCT scholars have made contributions to its work on urban material flows and on metals.

National research capacity in these fields remains thin. The "resource efficiency" concern has been formally branded into the work of the National Cleaner Production Centre hosted by the Council for Scientific and Industrial Research, but scholarly work has remained isolated to no more than a handful of studies, an important one in 2012 having been a DST-commissioned study on the higher-education dimension of modernised waste management.

Most importantly, outside the realm of natural resource management, very little scholarly work in South Africa appears to be tackling the difficult linkages between environmental sustainability and social development: conditions such as extreme inequality, poor basic education and extreme violence are likely to hinder green-economy efforts as much as they obstruct the struggle of our generation for a better quality of life for all. It is in this difficult crossover area that UCT researchers have located some of their research projects.

But is more research needed? Is it not enough to simply deploy tried and tested wind turbines and photo-voltaics so as to start greening South Africa's electricity supply?

A major critique emerging in the sustainability sciences is that traditional academic work entrenches the division of knowledge into discipline silos and thus hinders complete solutions to development challenges in the real world. Piecemeal solutions leave behind legacies for future generations. As a response, inter- and transdisciplinary approaches to knowledge generation are increasingly being considered an essential component of sustainability research.

UCT has started to recognise this imperative formally with the formation of the African Climate and Development Initiative. In the work of the Department of Chemical Engineering, this process has been more organic, and internal collaboration spans a diverse network of university-accredited research groupings, Signature Themes, and DST/NRF SARChI Research Chairs.

Research Project

Towards a Technology-specific Innovation System for Harnessing Waste-based Bioenergy

This project aims to unlock the energy and greenhouse-gas mitigation potential of waste biomass in South Africa, drawing on UCT's 20-year experience of researching clean technologies, waste minimisation and industrial ecology, and on supporting existing expertise of the University of Venda to realise key objectives.

The energy potential of waste biomass in Africa and South Africa has repeatedly been estimated to be sizeable. Theoretically, the project aims to better understand, and then help activate, the potential of a technology-specific innovation system to convert the identified potentials into sustainability gains, through processes of societal learning.

Much of the required technology exists in Asia and in Europe, but innovation is still required to make these technologies work in the South African context. Researchers at UCT are inspired by the recent spontaneous, bottom-up emergence of a technology-specific innovation system for biogas in Germany and are beginning to investigate the similar emergence of such an innovation system in South Africa.

The project is based at the University of Cape Town, in the Faculty of Engineering & the Built Environment, contributing to its "social innovation" ambitions, but tying into UCT's African Climate and Development Initiative. Since a key feature of biogas technology is its cross-cutting nature covering matters of sanitation, solid-waste management, energy supply and nutrient cycling, there are collaborations and interactions with colleagues in the Department of Civil Engineering, the Energy Research Centre and the African Centre for Cities. However, as the potential waste biomass is occurring in both urban and rural areas, as are South Africa's sustainable development challenges, the project is run in partnership with colleagues at the University of Venda who already have developed some expertise in biogas technology in rural settings.

Key features of the project work plan include describing the present state of the biogas innovation system and in so doing to identify mechanisms that induce or block adoption of the technology. The project also aims to stimulate the direction of the biogas innovation system by the planning, construction and operation of four demonstration facilities, designed to give effect to key functions of the university in a technology-specific innovation system. These demonstration facilities are harnessed in a targeted work plan to initiate learning of technologies and to track the uses to which this learning is put.

The project is funded by the National Research Foundation's Global Change, Society and Sustainability Research Programme, 2012–2014.

Technology Deployment for Sustainable Urban Development – "Township Caterers"

(In collaboration with UCT's student initiative "Engineers without Borders", 2010–2012, supported by the Vice-Chancellor's Strategic Fund)

'The number of people relying on the traditional use of biomass is projected to rise from 2.7 billion today to 2.8 billion by 2030. Using World Health Organization estimates, linked to our projections on biomass use, it is estimated that the household air pollution from the use of biomass in inefficient stoves would lead to over 1.5 million premature deaths per year, over 4000 per day in 2030, greater than estimates for premature deaths from malaria, tuberculosis or HIV/AIDS.' (World Energy Outlook, 2010).

Roadside catering is widespread in African towns and cities – and it mostly makes use of open fires. Fuel wood is either harvested or obtained from commercial or construction and demolition activities. With a significant amount of construction timber treated with insecticides, notably with chromated copper arsenate (CCA), it may well be that food preparation and consumption is undertaken in the presence of toxic heavy metals. This concern was investigated in several informal dwellings or townships in Cape Town and surrounding areas. The primary objectives of this project were:

- to determine whether or not CCA-treated wood was being used, particularly for food preparation, and what food it was being used to prepare;
- regardless of whether this concern could be confirmed, to do the investigation in such a way as to harness student social-engagement enthusiasm to impact on the well-established health burden of wood and smoke exposure.

If the result was found to be positive, the further objectives were:

- to determine the specific exposure to CCA from handling the wood, handling the ash, and breathing in the air from the combusted wood;
- to determine whether caterers exposed to CCA displayed elevated levels of these substances.

Since this was quite a diverse project, the consortium of involved parties was extensive. While it was driven by the Environmental and Process Systems Engineering Research Group, a strong partnership was formed with Engineers without Borders, with collaboration from UCT's Centre for Occupational and Environmental Health, the Centre for Transport Studies and the Environmental Policy Research Unit and, later, indispensable ties with the Energy Research Centre.

Professor Harro Von Blottnitz (back, right), who leads the "Township Caterers" project, together with students and caterers.

The following milestones have since been achieved: the collection and analysis of wood samples which confirmed some use of treated timber (CCA); the collection and testing from human subjects has also been undertaken. These findings are the subject of three journal papers to appear in 2013. They have been communicated to both the City of Cape Town's Air Quality Management Department and the South African Wood Preservation Association, with both bodies having initiated responses to address the problem. Lastly, Nyanga in Cape Town was selected as pilot site for testing the alternative technology (efficient wood stoves) that reduces exposure.

Environmental and Social Dimensions of
The Bio-economy

The past two decades have witnessed a surge of interest in the use of biodiversity, biological products, and biological processes in the mainstream economy, on a scale unprecedented in history, linking markets in virtually every corner of the globe.

Located at the interface of leading genetic and information technologies, and the juncture of a wide range of developing social, political and ethical concerns, the so-called bio-economy has fundamentally changed the way in which biodiversity is used and commercialised. New applications for genetic resources in the biotechnology industry have led to novel and varied demands for biodiversity, in forms previously unimagined. Intended products include new drugs, climate-resilient crops, industrial processing, novel ingredients for the food, herbal and personal-care industries, and other advances that generate significant benefits for society, financial returns for the companies that market products, and a range of benefits for countries that provide the biological material. At the same time, livelihood opportunities have opened up for rural communities engaged in commercially harvesting and producing supplies with high value in global and local markets.

The Chair's strong focus on engagement with communities, indigenous knowledge holders, and policy-makers, embeds within it a practice of engaged scholarship and social responsiveness.

There is a growing focus on the opportunities of the bio-economy throughout the industrialised and developing world. Yet, despite the profound societal implications of these developments, our understanding of the environmental and social dimensions remains poorly developed. This has been made all the more challenging by the immense changes in global economic systems, the rate of scientific change, and the information revolution. Environmental degradation and global climate change overlay these transformations and their multifaceted consequences on the bio-economy are only just beginning to be recognised.

In 2012, UCT was awarded a DST/NRF South African Research Chair in the Environmental and Social Dimensions of the Bio-economy. The Chair is located in the Department of Environmental and Geographical Science, and provides an exciting opportunity to advance knowledge in this newly emerging arena by catalysing the advancement of research and understanding across and within disciplines, building a critical mass of intellectual capacity, enabling human capital development and in particular a new cohort of skilled postgraduate students, and informing policy and public debate in this rapidly evolving but underdeveloped field. Its strong focus on engagement with communities, indigenous knowledge holders, and policy-makers, embeds within it a practice of engaged scholarship and social responsiveness, with the objective of developing a pioneering, highly collaborative and globally relevant knowledge hub with international stature.

South Africa's mix of developed and developing economies, well-developed scientific and industrial infrastructure, unique biodiversity and rich indigenous knowledge systems provides an exceptional foundation for the research, which focuses on four central themes.

The first theme centres on access and benefit sharing, bio-discovery and the bio-economy, aiming to strengthen the conceptual underpinnings of access and benefit-sharing through enhanced understanding of implications for commercial sectors involved in the global and national bio-economy, and their responses to environmental and equity considerations. The research incorporates global reviews of the key sectors (e.g. pharmaceuticals, herbal medicine, nutraceuticals, industrial biotechnology, agriculture, personal care and cosmetics, food and beverage) involved in the commercial use of biodiversity, providing analyses of the scientific and technological developments that underpin bio-discovery, and the market, industry and societal trends that drive demand for access to genetic resources and shape benefit-sharing, economic development and environmental sustainability.

The second theme links closely to the first, but with a stronger focus on the broader use of biodiversity by rural communities, and links to livelihoods and poverty alleviation. The objective of this component of the research is to deepen knowledge and understanding of approaches to biodiversity use and trade that alleviate poverty, reduce inequality and improve environmental sustainability. Building on existing research, this objective also has a strong creative component, revealing the stories of indigenous plants, the communities that use them, and the paths they travel as indigenous knowledge, identities and resources are transformed into drugs, cosmetics, food and flowers for the global consumer market. This integrates a variety of disciplines in a holistic way – anthropology, environmental science, botany, photography and the assemblage of an important archive.

The third theme focuses on the elucidation of governance approaches in Southern Africa that strengthen the rights of custodians of biodiversity and traditional knowledge holders, facilitate implementation of the Convention on Biological Diversity and the Nagoya Protocol, and stimulate environmentally sustainable and socially just approaches in the bio-economy. A second stream of research within this objective investigates the so-called innovation chasm between research results, commercialisation and socio-economic outcomes, well recognised as a constraint towards achieving significant outcomes of the bio-economy.

The research agenda of the Chair is strongly interdisciplinary by nature, aiming to build UCT-wide collaborations in addition to those at national and international levels.

The fourth theme is an evolving one: to deepen understanding of the environmental and social impacts of emerging technologies within the bio-economy such as genetic engineering, industrial biotechnology and biofuel production.

The research agenda of the Chair, which has been filled by Associate Professor Rachel Wynberg of the Environmental Evaluation Unit (also see page 43) is strongly interdisciplinary by nature, aiming to build UCT-wide collaborations in addition to those at national and international levels.

Indeed, UCT is ideally placed to host the Chair since a wide range of departments are engaged in aspects of the bio-economy, located in almost every faculty across campus. Activities include scientific research and development to generate particular applications; ecological studies to assess sustainable use; legal scholarship to investigate intellectual property rights, traditional knowledge and biosafety regimes; social science analysis to address the myriad of questions raised by this field of enquiry; and initiatives in the fine arts, reflecting the increasing confluence of arts and sciences to find innovative solutions to societal problems. Obvious synergies exist with existing Research Chairs in Drug Discovery (Chemistry), Bioprocessing (Chemical Engineering), Customary Law, and Intellectual Property Rights and Biotechnology (Private Law), as well as the African Climate and Development Initiative. It is intended that activities between these spheres will have a synergistic effect, catalysing new areas of research inquiry and stimulating transdisciplinary analyses that are often difficult to undertake discretely.

DST/NRF SARChI Chair
associated with this theme

Environmental and Social Dimensions of the Bio-economy

Profiled on page 43

Research Groupings
associated with this theme

Environmental Economics Policy Research Unit

The Environmental Economics Policy Research Unit (EPRU) is the South African branch of the Environment for Development initiative. This is a capacity-building programme in environmental economics, which focuses on research, policy advice, and teaching in China, Central America, Ethiopia, Kenya, South Africa, and Tanzania. EPRU is a collaborative association of researchers specialising in environmental and natural resource issues.

The unit was established in 2007 to promote sustainable development and poverty reduction in Southern Africa. To achieve this, EPRU aims to enhance the effectiveness of environmental policy-making by adopting a threefold strategy of research, teaching and policy consultation.

Research has been concerned with farm workers' wages, land use and rural poverty, and inequality among subsistence fishermen.

During the last five years, EPRU's policy-relevant experience in research pertaining to ecosystems management, biodiversity conservation, air quality and water quality has grown extensively. The centre also has previous research capacity and experience relevant to the socio-economics of agriculture, fisheries and conservation. Specifically, this strain of research has been concerned with farm workers' wages, land use and rural poverty, and inequality among subsistence fishermen, as well as the role of community-based wildlife conservation in poverty mitigation. EPRU has successfully worked with a number of local and national stakeholders on medium-sized projects, such as the South African National Parks (wildlife sector), the Department of Water Affairs and Forestry (water sector), the Department of Environmental Affairs and Tourism (marine and coastal management), and the City of Cape Town (air-quality management and energy savings). In the next few years, EPRU plans to bid for larger research projects that will enhance collaboration among EPRU research fellows, with other researchers and, importantly, with key stakeholders.

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Energy Research Centre

The Energy Research Centre (ERC) conducts high-quality, targeted and relevant research, as well as offering postgraduate opportunities at master's and doctoral levels. The main research areas are energy efficiency; energy, environment and climate change; energy poverty and development; and energy systems analysis and planning. The staff of the ERC have qualifications in engineering, natural and environmental sciences, urban and regional planning, economics, law, politics, sociology, and anthropology.

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Centre for Occupational and Environmental Health Research

The Centre for Occupational and Environmental Health Research aims to be a principal centre of occupational and environmental health research, teaching and training, occupational medical clinical services, policy advice, technical consultancy services and advocacy, and a source of supportive outreach activities in South Africa, parts of Africa, and internationally. It conducts multidisciplinary research, teaching and service provision that integrate laboratory, clinical, epidemiological, and policy skills in relation to occupational health problems that have high priority in Southern Africa. This is in order to facilitate identification and improved characterisation of these and other problems, and to better understand the determinants of these problems and their solutions.

The centre explores and develops means of maintaining the health of individuals and the environment, especially the work environment, and of preventing the development of health problems in those exposed to injurious environments at work or more generally. Public policy research is conducted into issues ranging from toxic or injurious exposures through to health surveillance, and the functioning of relevant health services. Inter-institutional research, teaching and service (including outreach) collaboration and capacity development are priorities of the centre, along with fostering local and global networks for occupational and environmental health promotion through collaboration with the United Nations and other agencies, notably the World Health Organisation (WHO). The centre is currently a WHO Collaborating Centre for Occupational Health.

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Environment Evaluation Unit

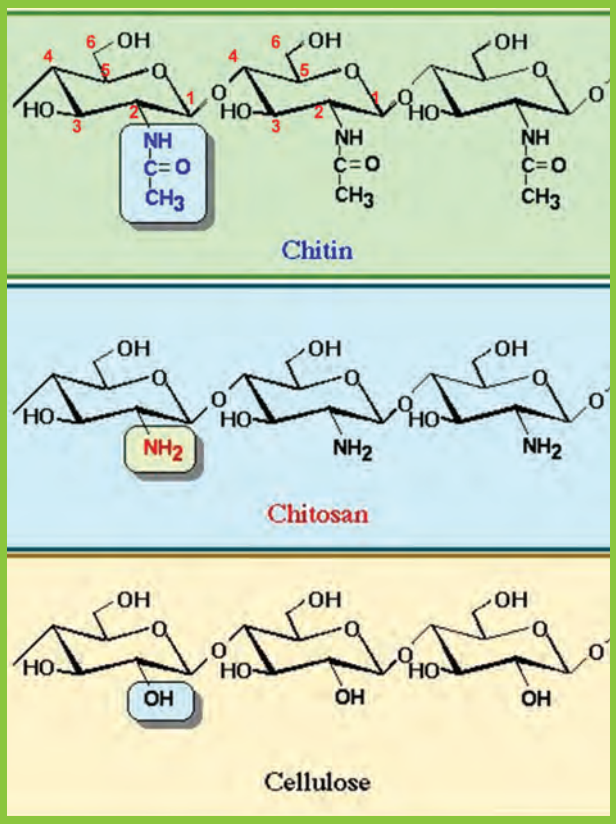
Please refer to page 110

The Chemical 'Chameleon', Versatile Chitosan makes for an Array of Potential Applications

Dr Anwar Jardine's research group in UCT's Department of Chemistry has been investigating chitosan, derived from chitin, a natural polysaccharide that is the second most abundant organic source on earth. Chitin is partly responsible for the robust hard shell or exoskeleton of insects and crustaceans, with a structure that is similar to cellulose.

Chitin and chitosan have an array of potential applications, and numerous products have already reached the market for the treatment of a variety of diseases, including arthritis, inflammatory bowel disease, and general inflammatory damage.

The growth of the chitin and the chitosan market worldwide is propelled by the new manufacturing technologies and expansion in the application domain – these new, high-end products are worth considerably more than the low-cost polymers that previously dominated the industry, spurring on innovation.



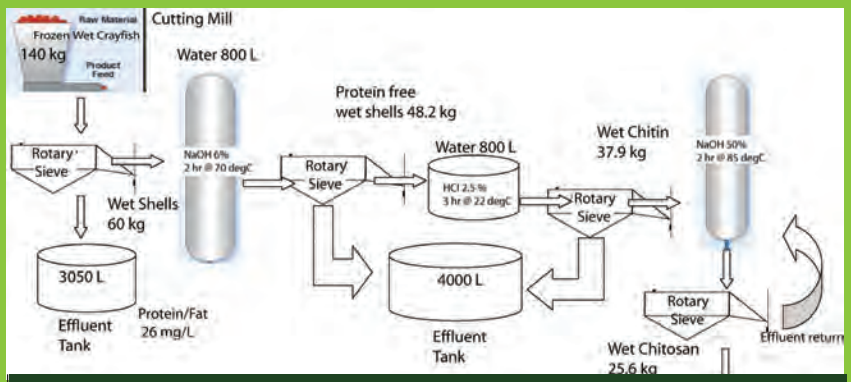
Dr Jardine and his team have modified chitosan by converting the 6-hydroxy group in the polymer to a 6-amino group, turning a sparingly soluble polymer into one that is now completely soluble in aqueous media. This forms the basis of a patent that has recently been granted in the USA, with other patent applications pending. Solubility in aqueous solutions has broadened the scope of application, particularly in "green" technologies that seek to replace or minimise the use of organic solvents in chemical processes.

The main source of the raw material is the shell of the Southern Spiny Lobster, *Palinarus gilchristi*, after removal of the tail for sale. It is estimated that in South Africa about 440 tons of this waste are available. This shell exoskeleton can be transformed into a backbone of another sort – a soluble, modified chitosan "backbone" molecule that can be used as a chemical catalyst support. The team added a platinum group metal catalyst to this novel chemical backbone, enabling efficient, heterogeneously catalysed synthesis of fine chemicals in "green" solvent systems, the subject of a further patent.

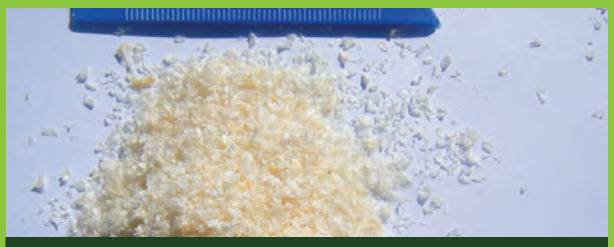
Currently, waste shells are either discarded while at sea, or landed and sold locally as flavouring agents at between R5 and R10 per kilogram. Although the yield of high-quality chitosan is only 3 to 5% based on wet-shell weight, the potential market value of up to R3000/kg chitosan is attractive and higher-value-added derivatives are even more enticing.

The modified backbone is currently being explored in a water purification application for the reduction of high

Dr Anwar Jardine (centre) and the chitosan research group in the Department of Chemistry.



Local chitosan manufacturing pilot process



Milled crayfish shells (above right) and chitosan (above)

salt load. A British Council Africa Knowledge Transfer Partnership sponsored project is seeking to improve the poor groundwater quality on the arid West Coast, at Garies in the Kamiesberg municipality (Northern Province). If successful, this will have a significant impact on the local community, whose development is severely hampered by the scarcity of local potable water, with water needing to be trucked in at certain times. The first 'laboratory phase' of the project is complete and the pilot in Garies will strive to translate the laboratory process into the field, ultimately improving the municipality's "green" and "blue drop" water quality and management rating.

Another successful application has seen the use of this modified chitosan as a solid support for the chromatographic separation of fish oil. The fish oil is a by-product of the pelagic fishing and has a low commercial value owing to competing vegetable oils. This silver-based "argentation chromatography" allows saturated fatty acids to be separated from unsaturated fatty acids. Unsaturated fatty acids have great nutritional value (e.g. omega-3 and -6 fatty acids). Saturated fatty acids, on the other hand, have cosmetic value or serve better as feedstock for biodiesel.

Engineering The Future

There is an urgent need for innovation in science and technology – globally, but especially in South Africa, as the economic powerhouse in Africa. But this will only be sustainable if the country can also bridge the "innovation chasm" and transform innovation and research into commercially viable products and services and create new industries to drive economic growth.

Research at UCT contributes to cutting-edge developments in various technologies and scientific discoveries, from information and communications technology and biotechnology to mining beneficiation, that are crucial to the advancement of the South African economy.

With a fast-developing economy pursuing sustainable growth, the South African national research and development strategy has come to emphasise innovation – in particular, commercially viable innovation of relevance to economic growth and wealth creation. This requires a substantial investment in the development of new technologies and capacity that will enable the country to convert its undisputed research expertise into social and economic advantages.

Bridging the innovation chasm is a national imperative and it demands a collaborative response from government, industry and universities.

As one of the country's leading universities, UCT is deeply committed to this national research and development strategy and to pursuing sustainable development.

The Faculty of Engineering & the Built Environment at UCT is very active in this regard and is rated as one of the finest on the continent. It has the highest number of NRF-rated engineering academics in South Africa and has strong links with industry and government agencies, which provide significant funding for a variety of research projects.

The faculty is recognised as a world leader in key engineering technologies such as synthesis gas technology, fuel cell technology and hydrogen.

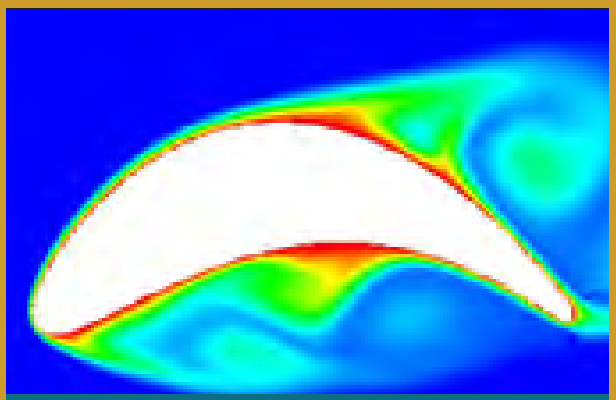
To strengthen this already strong research focus, UCT was awarded two new South African Research Chairs in Engineering in 2012, one in Reaction Engineering and the other in Industrial Computational Fluid Dynamics. These new Chairs, together with existing research programmes spanning UCT's strategic initiatives and research groupings, will actively support the broad South African process industries: the bioprocess, chemical, energy, food, petrochemical and mineral-processing industries, which represent a substantial component of the nation's gross domestic product. Whereas manufacturing is the largest contributor to national GDP, chemical manufacturing is the largest sub-sector and UCT is at the forefront of driving innovation in this area.

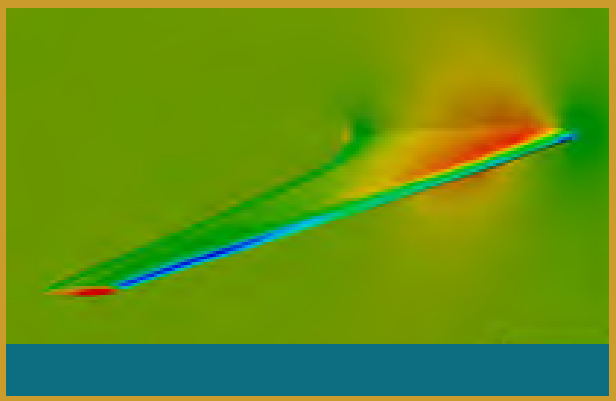
There is also a strong emphasis on sustainability research as well as on developing green technology, such as wind-turbine technology and solar energy, amongst others. Another interesting focus with a global component is on impacts and explosions. Two current major worldwide concerns are unexploded landmines and protection against terrorist activity. Highly publicised acts of terrorism such as 9/11 and, most recently, the Boston marathon bombing, have raised awareness of the increased need for protection, and UCT's Blast Impact and Survivability Research Unit is leading a number of projects which seek to study the effect of explosive devices.

Bridging the innovation chasm is a national imperative and it demands a collaborative response from government, industry and universities. Advances in engineering at UCT are made possible by significant investment from government via the DST/NRF SARChI Chairs, a Centre of Excellence as well as a national Centre of Competence, and the Department of Trade and Industry's Technology and Human Resources for Industry Programme (THRIP), which provides critical industry partnerships.

Working with such partners, UCT plans to continue to rise to the challenge of transforming innovation and research into commercially viable products and services and creating new industries to drive economic growth on the continent.

Pushing the Boundaries of Manufacturing and Design: It's Elemental, Dr Watson ...





Graphical representations of output from computational fluid dynamics analyses conducted using the Elemental software to investigate flows over wing profiles and stresses on an aircraft wing and fuselage.

Computational Fluid Dynamics (CFD) is an exciting new computer-based technology that provides insight into the dynamics of fluid flow, enabling the building of a model to represent a system or device, with accurate prediction of the detailed fluid dynamics offering unprecedented insight and allowing opportunities for virtual prototyping that would be otherwise too costly in the "real" world.

The global commercial CFD software market currently generates over R5.6 billion annually

UCT's Department of Mechanical Engineering is home to an "all South African" CFD code dubbed "*Elemental*". Pioneered by Professor Arnaud Malan in 1999, *Elemental* is already supporting next-generation aircraft design, and Airbus, one of the leading aircraft manufacturers, "found the *Elemental* code to be scientifically innovative while outperforming competing codes by a significant margin, particularly in terms of accuracy". *Elemental* also plays a pivotal role in the European Union FP7 project "Future Fast Aeroelastic Simulation Technologies".

The global commercial CFD software market currently generates over R5.6 billion annually and is one of the fastest-growing fields in engineering. It is becoming the de facto standard strategic design tool in sectors ranging from biomedical devices and power generation to aircraft design and the space industry.

The technology will spawn two UCT spin-out companies – Numerus Technologies (Pty) Ltd and Elemental IP Holdings (Pty) Ltd – during 2013, which will allow South Africa to enter lucrative software and modern technology markets, and which will be well positioned to ride Cape Town's International Design Capital 2014 wave.

Elemental software forms the basis for the DST/NRF SARChI Research Chair in Industrial CFD, which was awarded to UCT in 2012. This will not only contribute to the commercialisation drive, but will support the UCT initiative to further world-class CFD research and technology development.

The Pressing Matter of Mine-water Clean-up

The treatment and disposal of water in the mining sector is a ticking time bomb increasingly threatening South African cities and surrounding communities while garnering the focus of both media and legislative bodies. The success of the research project Refining the BIOX and ASTER processes for Gold, led by Professor Susan Harrison and Dr Rob van Hille of UCT's Centre for Bioprocess Engineering Research in the Department of Chemical Engineering, is therefore no small feat.

South African scientists and engineers – leading the development of bioprocesses for gold recovery from sulphidic ores – have in the past achieved the worldwide commercialisation of BIOX™, a hydrometallurgical process in which micro-organisms oxidise iron and sulphur within the gold mineral concentrate. The outcome is soluble ferric iron and acid that leach sulphidic minerals from the concentrate, leaving gold accessible for extraction with a cyanide solution.

This latest research at UCT focuses on refining this technology to improve performance and robustness, with a particular focus on process intensification through the use of modern molecular tools for tracking the microbial consortium present in the process.

Associated with this process is the more recently launched ASTER™ process for microbial remediation of residual cyanide and thiocyanate formed in the gold-recovery process.

Another key issue surrounding the mining industry is that of responsible mine closures following cessation of mining activities. The ASTER™ process is linked to both the BIOX™ process for remediation of its effluents and the maximisation of water recycle towards zero emissions, as well as associated precious metal extractions using other upstream technologies followed by extraction with cyanide

The research, funded through Goldfields, has been presented in China, Germany and the USA, with a range of journal papers in preparation, in addition to industrial application of its findings.

Getting the Mining – Cost – Environment Balance Right

South Africa's mineral resources are being depleted, making it necessary to find ways to extract metals from increasingly lower-grade resources. This requires technologies with low energy and processing inputs that provide a balance between resource beneficiation, cost efficiency and environmental impact.

Heap bioleaching technologies can do this, in addition to having the potential to process waste rock displaced in the mining operation. The technology uses available iron and sulphide as an energy source, and provides leaching agents for metal extraction from low-grade ore that is crushed and stacked in large heaps, which are irrigated and aerated so that micro-organisms grow on the rock surface.

South Africa has played an important role in the development of technology for "hot heaps" operating under thermophilic conditions – relatively high temperatures that cause certain bacteria to grow. This UCT project focuses on understanding the micro-environments established within the heap that can be manipulated to intensify the leaching process. Through use of custom-designed equipment, this project has presented the first rigorous characterisation of microbial growth rates on whole ore under temperatures ranging from ambient to 65˚.

The project, now completed, was funded by BHP-Billiton and led by Professor Susan Harrison, who holds the NRF/DST SARChI Research Chair in Bioprocess Engineering Research. A team of researchers from the Centre for Bioprocess Engineering Research in the Department of Chemical Engineering have contributed to this cross-disciplinary study, along with Dr Rob van Hille, Associate Professor Jochen Petersen, Emmanuel Ngoma, Nathan van Wyk, Lucinda Bromfield, Frances Pocock and Lukhanya Mekuto, Cambridge University's Dr Andy Sederman, UCT PhD graduate Marijke Fagan, and Imperial College London's Professors Jan Cilliers and Peter Lee.

Five journal papers were published and a further six were prepared for publication in 2013.

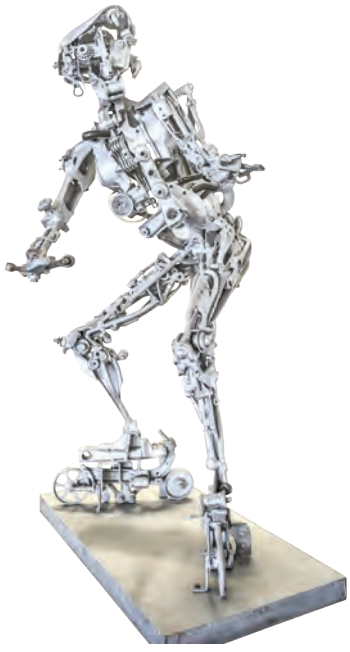
Cooking up a storm:

Adding Value To South Africa's Process Industries

The Department of Chemical Engineering is recognised locally and internationally as the leading academic department of its kind in Africa. It has cemented a reputation for unique research programmes and projects that meet the challenges posed by a highly developed industrialised era.

UCT's Department of Chemical Engineering helps to keep South Africa at the forefront of emerging technologies in various important economic sectors such as mining, water management, bioenergy and renewable energy, greenhouse gas emission reductions and pharmaceutical developments regarding insulin and antiretroviral medication.

Research in the department has grown significantly over the last ten years, with postgraduate numbers doubling from 92 in 2002 to 185 in 2012. The department hosts four university-accredited research groupings: the Crystallization and Precipitation Research Unit and the Centres for Bioprocess Engineering Research, Catalysis Research and Minerals Processing Research. There are also two DST/NRF SARChI Chairs (Bioprocess Engineering and Minerals Beneficiation), the DST/NRF Centre of Excellence in Catalysis, and the DST Competence Centre in Hydrogen and Fuel Cells, as well as one of the university's Signature Research Themes in Minerals to Metals.



The goal is for South Africa to supply 25% of the future global fuel-cell market with novel, locally developed and fabricated platinum-group metal catalysts by 2020.

The DST/NRF Centre of Excellence in Catalysis (c*change) is a virtual research programme of national scope and significance, with multidisciplinary participants from ten higher-education institutions. Its core focus is the field of catalysis science – a critical industrial technology underpinning the South African economy. This includes the Fischer-Tropsch process, that converts coal and natural gas to liquid fuels, which currently provides 40% of South Africa's liquid-fuels requirements. In

April 2012, c*change hosted the country's first syngas convention, marking another important step in the path to cementing the country's pre-eminence in this area.

The work of c*change also feeds into the National Hydrogen and Fuel Cells Technologies Flagship project, branded as Hydrogen South Africa (HySA), that is seeking to establish South Africa as one of the few nations that export high-value products into the growing international hydrogen and fuel-cells markets. Recognising the importance of the potential role of hydrogen in the economy, the South African government has established three competency centres nationwide under the HySA banner. HySA/Catalysis, based at UCT and co-hosted by Mintek, has been mandated to develop the competency, skilled workforce, and ultimately the manufacturing industry to support a hydrogen economy in South Africa. Current research focuses on alternative energy sources that are locally produced.

Platinum-group metals are key catalytic materials in hydrogen fuel cells and South Africa is strategically situated, possessing 75% of the world's platinum reserves. The goal is for South Africa to supply 25% of the future global fuel-cell market with novel, locally developed and fabricated platinum-group metal catalysts by 2020, thereby diversifying the applications of the nation's platinum-group metal resources and promoting socio-economic benefits through value addition to its key natural resources.

Another major research focus in the department that is attracting international attention is in bioprocess engineering. UCT has a long track record of research in bioprocess engineering dating from the late 1960s. The bioprocess engineering research grouping was formalised as an accredited unit, BERU, in 2001 and its accreditation was upgraded to the Centre for Bioprocess Engineering Research (CeBER) in 2008. CeBER's vision is to be a cross-disciplinary research enterprise, developing the nation's bioprocess engineers, providing new insights into bioprocesses and bioproducts and becoming global leaders in selected relevant research niches.

One of the main research areas in CeBER is bioleaching, a process where microbes are used as biocatalysts to convert metal compounds into their soluble forms. This leaching process is an alternative economical method for the recovery of metals such as copper, zinc and gold from low-grade mineral ores, with low investment and operation costs.

CeBER also strives to address environmental issues primarily related to water. Current projects consider acid rock drainage prevention through enhanced management of waste materials and remediation as well as emerging

technologies for renewable energy generation and greenhouse gas emission reductions.

Also concerned with the elimination of waste is the Centre for Minerals Research, a multidisciplinary, inter-departmental research centre located within Chemical Engineering focusing on the processes of froth flotation, comminution and classification. Inefficiencies in these processes translate into both an enormous loss of revenue and an unnecessary waste of the world's valuable and steadily declining mineral reserves.

All these activities play a crucial role in ensuring that UCT contributes towards keeping South African science healthy and competitive. More importantly, the emphasis on sustainability and capacity development throughout is also playing to the national imperative to bridge the innovation chasm in the country. It is this that will be the real engine for innovation at UCT in the years to come.

Research Project

Keeping the Lights On

Rolling blackouts will continue to plague South Africa unless the country's brightest sparks establish research solutions to stabilise and control the nation's power systems.

UCT's Department of Electrical Engineering is investigating ways to transmit more power in a reliable and efficient way with the use of High Voltage Direct Current (HVDC) transmission lines, parallel to High Voltage Alternating Current (HVAC) transmission lines. Using HVDC offers economic and technological advantages compared to using HVAC alone. The hybrid system brings new challenges of its own and focus has been on the interactions between HVAC and HVDC, and the effect of line length on the stability of the system.

A research team led by UCT's Professor Komla Folly are now involved with the second phase of the project. Their research investigates a broader application of this concept to a new Smart Grid and deals with the potential outcomes of introducing more renewable energy sources and technologies to the grid, which would result in a more complex power system that would become increasingly difficult to control. Maintaining the security and stability of the system is critical to achieving a reliable power supply, along with sustainable development of the electric power industry and the nation's economic growth.

In addition, researchers are mindful that HVDC transmission systems and renewable energy technologies that are available in Africa, but underutilised at present, have the potential to be developed for commercialisation and to create the type of "green jobs" crucial for moving towards a green economy.

Project collaboration included researchers at UCT, the University of KwaZulu-Natal and Cape Peninsula University of Technology, as well as at universities elsewhere in Africa, and in Asia, the USA and Canada. Eskom and Zeta Power Consulting provided industry collaboration. The project was funded by the Department of Trade and Industry's Technology and Human Resources for Industry Programme. Over the course of the project, 15 MSc and two PhD students have graduated, of whom 98% are black and three are female. Several conference papers and journal articles have been published between 2010 and 2012.

Associate Professor Genevieve Langdon

Impacts are a part of daily life, ranging from minor bumps to devastating explosions. Associate Professor Genevieve Langdon, who leads the Blast Performance of Novel Lightweight Materials project in the Department of Mechanical Engineering, seeks to study the effect of explosive devices.

Her primary focus is on the response of lightweight materials and structures to blast loading. This includes materials such as fibre-reinforced polymeric composites, textile concrete, hybrid metal-composite structures, sandwich panels, and cellular materials such as honeycombs and foams.

Her primary focus is on the response of lightweight materials and structures to blast loading.

Unlike traditional steel structures, lightweight materials absorb energy through a wide range of different failure mechanisms and often recover much of their original shape once the pressure is removed. This makes understanding the changing behaviour of lightweight materials particularly important and challenging.

She was also involved in the setting up of an apprenticeship programme that seeks to boost skills in the engineering sector.

Associate Professor Langdon completed a fellowship, funded by the 1851 Royal Commission, at the Blast Impact and Survivability Research Unit at UCT and worked at the University of Liverpool Impact Research Centre from 1999 to 2004. As part of her role at UCT, she was also involved in the setting up of an apprenticeship programme – UCT's first – in the Department of Mechanical Engineering that seeks to boost skills in the engineering sector by offering internships to newly qualified interns in the industry. She is also a founding member of the new South African Young Academy of Science – a group that is designed to bridge the gap between the more senior and well-established Academy of Science of South Africa and the up-and-coming young scientists who may well be future leaders in their fields.

Researcher Profile

Associate Professor Hans Beushausen

Associate Professor Hans Beushausen of the Department of Civil Engineering received the UCT College of Fellows Young Researcher Award in 2012 for his research on concrete durability, performance assessment of concrete structures, and repair systems for concrete structures.

He is the founding member and unit leader of the Concrete Materials and Structural Integrity Research Unit at UCT, which focuses on concrete infrastructure performance and renewal. He has supervised or co-supervised more than 35 postgraduate students in the last five years, 21 of whom have graduated to date.

Within South Africa and other African countries, Associate Professor Beushausen is recognised as a leading researcher in his field. In addition, he has supervised or conducted about 200 consulting projects between 2010 and 2012. Among his clients were the South African National Roads Agency, Eskom, the Namibian Ports Authority, and the Namibian Water Authority.

In March 2012, he was awarded the Wason Medal for Materials Research, together with Professor Mark Alexander and Mike Otieno.

Research Groupings
associated with this theme

Sasol Advanced Fuels Laboratory

The Sasol Advanced Fuels Laboratory (SAFL) was established in 2002 to actualise Sasol's future-oriented fuels research relating to combustion and emissions from automotive and aviation engines. A parallel goal was the development of human-resource capacity to meet Sasol's and South Africa's future technology needs. SAFL activities for the past year are reflected in five master's degree graduations and seven conference/journal publications. In addition, the appointment of a senior chemistry research leader has expanded the discipline base at the SAFL from being predominantly mechanical engineering to include a chemistry/chemical engineering capability as well. Capital investment at the SAFL has been substantially augmented with the recent acquisition of a sophisticated single-cylinder test engine that is representative of next-generation automotive technology.

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Centre for Catalysis Research

The Centre for Catalysis Research concerns itself with both fundamental and applied research and development in the general field of heterogeneous catalysis – encompassing all of catalyst synthesis, physico-chemical characterisation and performance evaluation for industrially interesting chemical conversions. The principal fields of investigation include Fischer-Tropsch synthesis, zeolite/acid catalysis (especially as applied to hydrocracking and the transformation of phenols and derivatives) and catalysis by platinum-group metals and gold. In addition, the Centre for Catalysis Research is the host laboratory for the DST/NRF Centre of Excellence in Catalysis (c*change) and the DST Competence Centre in Hydrogen and Fuel Cell Catalysis.

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Blast Impact and Survivability Research Unit

The Department of Mechanical Engineering has been involved in impact dynamics for over 25 years. The Blast Impact and Survivability Research Unit (BISRU) has developed experimental facilities which include a blast chamber, a selection of drop testers, material characterisation systems, and a sled tester for impact biomechanics. This collection of equipment is unique in that no other university laboratory worldwide has this full suite of facilities in one area. The research activities are aimed at promoting the study and understanding of impact dynamics through projects at senior undergraduate level and master's, doctoral and postdoctoral levels. The research objectives are to reduce the risk of injuries and to save lives through fundamental principles of science and engineering. BISRU currently has several international interactions through collaborative projects with universities in Australia, Argentina, Europe and the USA.

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Concrete Materials and Structural Integrity Research Unit

The Concrete Materials and Structural Integrity Research Unit at the University of Cape Town has been developing technologies and procedures for the design and assessment of concrete structures for more than 20 years. The unit has had a marked focus on infrastructure performance and renewal, largely in response to industry needs.

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Centre for Materials Engineering

The Centre for Materials Engineering strives to educate and train students in techniques and fundamentals in the broad field of Materials Engineering. It also seeks to serve a wide range of engineering activities, giving advice concerning material processing, properties and performance, while maintaining an international profile for its research. The research activities of the centre are aimed at addressing national needs in terms of both the provision of technological solutions and the development of skilled graduates.

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Centre for Minerals Research

The Centre for Minerals Research is a multidisciplinary, inter-departmental research centre based in the Department of Chemical Engineering. The focus of research is on the processes of comminution, classification, and froth flotation, arguably the most important unit operations in mineral beneficiation. The primary objective of the centre is to investigate the above research areas at both an industrial (applied) level and a laboratory (fundamental) level, so as to develop predictive models for describing the performance of industrial units and circuits. The centre enjoys excellent international collaborations with all the world's leading mining companies.

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DST/NRF Centres of Excellence

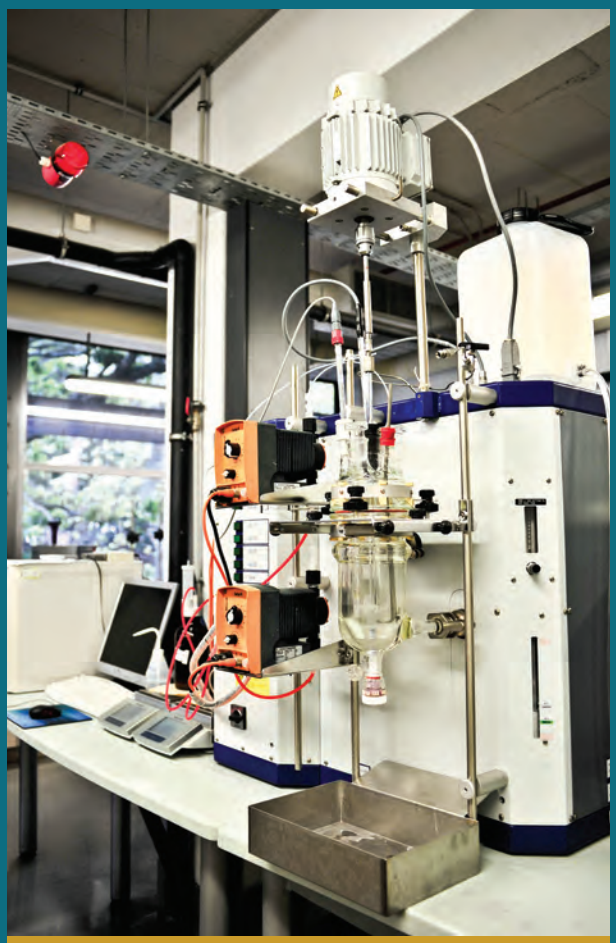
DST/NRF SARChI Chairs

associated with this theme

DST/NRF Centre of Excellence in Catalysis, c*change

The DST/NRF Centre of Excellence in Catalysis, c*change, is hosted by the Centre for Catalysis Research at the Department of Chemical Engineering. During 2012, the c*change team comprised 51 postgraduate students (82% of them South African students, of whom 45% and 76% were female and black, respectively), 12 postdoctoral researchers, and 25 academics from 16 research groupings in 10 participating South African higher-education institutions. A total of 21 projects were funded during the course of 2012, of which 13 were multi-institutional and/or inter-disciplinary ones. The centre was also awarded a DST/NRF SARChI Chair in catalysis

Subsequent to its 2011 participation as a co-organiser of the European Federation of Catalysis Societies Summer School in the Netherlands, c*change has organised a similar three-day Autumn School during 2012. The Autumn School was followed by the c*change Syngas Convention.



Professor Jean-Paul Franzidis

Minerals Beneficiation

Professor Jean-Paul Franzidis obtained his PhD from the Open University in the United Kingdom. He joined the Department of Chemical Engineering at UCT in 1983. His research career has been in various aspects of mineral (including coal) beneficiation, especially flotation. In 1996 he moved to the University of Queensland, Australia, to lead the world's largest collaborative mineral-processing research project, the AMIRA P9 project, which received numerous awards for both research and research methodology. His flotation research led to the development of a steady-state flotation circuit simulator, JKSimFloat, which has been applied to over 150 flotation operations worldwide. From 2003 to 2007 he was Chief Investigator of two large Australian Research Council Linkage grants. In 2007 he returned to UCT to direct the newly formed Minerals to Metals Signature Theme. He was awarded the SARChI Chair in Minerals Beneficiation in 2008.

Bioprocess Engineering

Professor Sue Harrison of the Department of Chemical Engineering holds the DST/NRF Research Chair in Bioprocess Engineering and is the director of the Centre for Bioprocess Engineering Research (CeBER). Her research interests include bioprocess engineering spanning bacterial, fungal, archael and algal bioprocesses with application in biohydrometallurgy, acid mine drainage prevention, maximising resource productivity, wastewater biorefineries, bioenergy products, biocommodities from wastes, fine chemicals, neutraceuticals and expression of niche peptides and proteins. Professor Harrison has a strong interest in minimising the environmental burden associated with processes. Components of research involving clean products and processes and bioremediation processes are currently being focused explicitly around sustainable process engineering to complement a teaching interest in sustainable development in process industries.

DST/NRF SARChI Chairs

associated with this theme

Professor Sue Harrison's presentation at TEDxCapeTown 2012 focused on the potential of integrated bioprocesses to be used to enhance resource productivity. By using resources efficiently, overall demand is reduced, as are wastes requiring assimilation.

Catalysis

The DST/NRF Centre of Excellence in Catalysis, c*change, has been awarded a SARChI Chair in Catalysis, which is expected to boost the scientific output of the centre. The Chair, which has not yet been filled, will focus on the field of preparation and characterisation of nano-materials and assist various activities throughout the centre, with the expectation that this will provide a mechanism of bringing the research of c*change to the level of world-class excellence.

Reaction Engineering

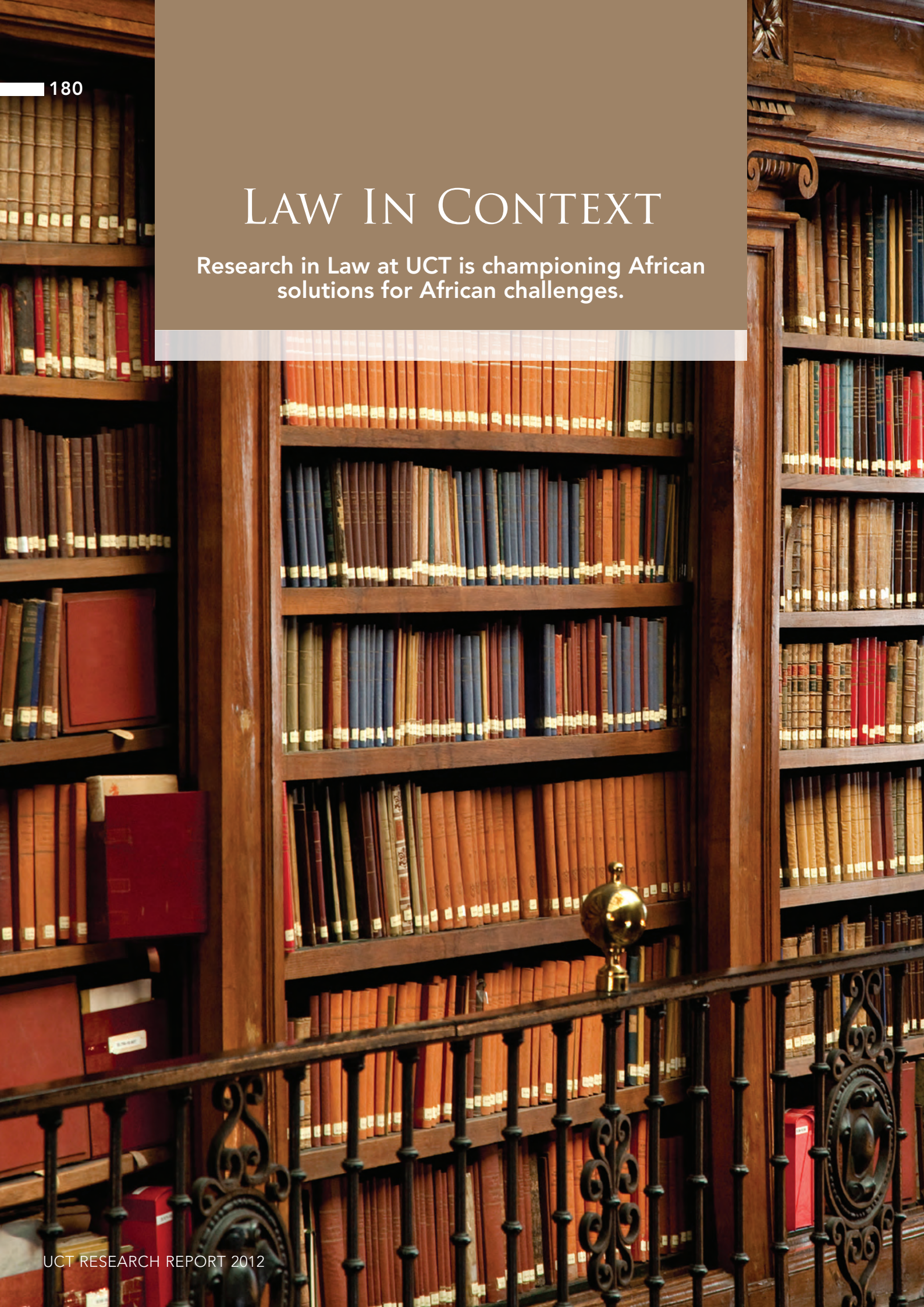
UCT was awarded a SARChI Chair in Reaction Engineering in 2012 and a recruitment process to fill this Chair is currently under way. Reaction engineering comprises all physico-chemical transformations, the design of equipment for their mediation and the integration of such units into complete industrial processes. This Chair is expected to establish competencies and human capacity development; and undertake novel research in South Africa.

Industrial Computational Fluid Dynamics

UCT was awarded a SARChI Chair in Industrial Computational Fluid Dynamics (CFD) in 2012. The recruitment of a candidate is under way and it is envisaged that the Chair will grow the CFD field to develop a CFD technology niche that will empower and serve engineers in industry to develop improved products. CFD is today a widely used strategic tool, with the current market size estimated at R5.6 billion annually. It is also one of the most scientifically rigorous and fastest-developing fields in engineering.

Law In Context

Research in Law at UCT is championing African solutions for African challenges.



Two of the most exciting loci of research in the Faculty of Law at the University of Cape Town are the Centre for Comparative Law in Africa and the Centre for Criminology. Each of them demonstrates that law, both substantively and in its application, is heavily influenced by the context in which it operates – and that the law and its application can be improved by closely investigating this context from different vantage points.

Comparative law at its best takes account of the cultural, sociological and political background of the systems that are being compared. When done in this way, comparative law has the power to provide new solutions to old problems. Too often comparative-law scholarship neglects these dimensions, and for too long has our specifically African setting been ignored in research aimed at the improvement of our law. The Centre for Comparative Law in Africa, led by Professor Salvatore Mancuso, states that its aim is to address "the need to devise contextually sound law and policy responses to pervasive developmental challenges facing our continent" and "to develop a discipline that lends itself to optimal application in the pluralistic legal frameworks within which life is lived in Africa". This ambitious programme has already been put into action in several important ways as outlined below. (To learn more about the activities of the Centre for Comparative Law in Africa, visit its website at http://www.comparativelaw.uct.ac.za/).

All law inevitably shapes the community in which it operates and all research in law is therefore, in one way or another, societally relevant

As in all spheres of law, the efficacy of the criminal justice system is inextricably bound to the conditions, and attitudes to crime and criminal law, in the society for which it was created. In the context of the high levels of crime and violence in our society, the research of the Centre of Criminology is vital. Led by Professor Clifford Shearing, holder of the DST/NRF SARChI Chair in Security and Justice, the centre records that "it has a long history of engaging contemporary issues within the twin domains of justice and security" and that "this engagement has enabled it, since its inception in 1977, to remain Africa-focused and globally engaged".

The centre's research covers a wide range of topics in policing and in penal systems, as well as in the exciting and novel area pertaining to the risks associated with lowered levels of environmental security. Some of this engaged research, which gives effect to the centre's slogan, "imagine, innovate, integrate", is outlined below (and to learn more about the work of the centre, visit its website, http://www.criminology.uct.ac.za/, and its two blogs [one on physical security and the other on environmental security]).

Highlighting the African focus and social relevance of these particular two endeavours in the Faculty of Law does not mean, of course, that the other research in the faculty is of a different kind. All law inevitably shapes the community in which it operates and all research in law is therefore, in one way or another, societally relevant. To give a flavour of the wide range of the important research in the faculty, this report profiles four of the faculty's top researchers and highlights the doctoral theses and books produced by members of the staff of the faculty in the course of 2012.

Centre for Comparative Law In Africa

The Centre for Comparative Law in Africa (CCLA) was established in 2011 to promote the study of comparative law and draw on the strengths of comparative methodology to research into the multifaceted field of law in Africa.

The centre presents an opportunity to develop a discipline that lends itself to optimal application in the pluralistic legal frameworks within which life is lived in Africa. In its mission to contribute to the development of comparative law in Africa, the strategy of the CCLA is to establish the field at UCT, build capacity in it across the continent through academic programmes, apply comparative law expertise in consultancies and disseminate new knowledge in comparative law in Africa through conferences, publications and professional networks.

Its location within the Department of Commercial Law recognises the centrality of comparative law to ongoing efforts at economic integration on the African continent. The CCLA offers an LLM in Comparative Law and conducts research on a variety of themes that apply the comparative methodology. Its innovative LLM course, Chinese Law and Investments in Africa, launching as a bloc course in September 2013, has attracted many students. Currently the centre is involved in a collaborative research project on mineral law and policy in three southern African countries (Namibia, Botswana and Zambia) under the UCT PERC Africa Knowledge Project and is also hosting a project on Eritrean land law.

Mineral Law in Africa

The aim of the mineral law for Africa project is to create a systematic, academic commentary on mining and mineral laws in Africa, starting with a selection of Southern African countries which present comparative case studies in relation to South Africa. The choice of the research subject is located within the key goals of PERC, namely, to develop a collaborative research-based team, establish research collaboration with academic colleagues in other African universities and generate research findings that are relevant to Africa and which reflect its situational realities.

The project is also aligned to the broader mandate of the Centre for Comparative Law in Africa in the sense that by creating a multi-jurisdictional research team, it expands the Law Faculty's research networks. Further, it seeks to be socially responsive by addressing a subject that affects the lives and livelihoods of much of the African working population. In addition, it builds academic capacity through its involvement of academic staff and postgraduate students in the collaborating institutions, namely UCT and the universities of Botswana, Namibia and Zambia.

Outputs from this research project will include articles presenting an overview of the research findings and a book on each jurisdiction studied, which will constitute Juta's Library of Mining Law in Africa. This project is led by Professor Hanri Mostert of the Department of Private Law with the Chair in Comparative Law in Africa providing expertise on comparative methodology. Another projected outcome is the launch of a website for the uploading of the data from the research project. It is expected that this project will be followed by studies of other African regions.

Eritrean Land Law

The aim of the Eritrean land-law project is to enrich the scarce bibliographic resources on Eritrean law with a comprehensive analysis of its legal framework on land law. Previous research done on this subject will be expanded to create a comprehensive and updated legal material which will represent the reference in a sector – that of land – which is extremely important for the Eritrean livelihood. The project aims to produce a book which will give comparative insights into land tenure in Eritrea (including customary), among other systems of land administration. The book will be published in Italian (Trieste University Press, 2013), and thereafter translated into English and published in South Africa under the "Comparative Law in Africa" book series (Juta Press).

The project is also aligned to the broader mandate of the CCLA in the sense that it is framed in the Afropolitan vision of UCT, and it will position the CCLA as a leading institution in the research on key themes of African law. Further, it seeks to be socially responsive by addressing a subject that affects the lives and livelihoods of almost all Eritrean citizens and giving them full information on the legal regime applicable to their land.

Future activities

The CCLA is in the process of peer-reviewing papers for the first edition of its journal, the *Journal of Comparative Law in Africa*. Furthermore, papers presented at its workshop on comparative law methodology in Africa held in October 2012 are being peer-reviewed for publication as the inaugural volume in the above-mentioned CCLA book series.

Professor Salvatore Mancuso

The CCLA has recently secured an endowment to support its academic visitors programme and has been nominated to host a fellow under the All Africa House fellowships from September to December 2013. The CCLA is home to the emerging African Association of Comparative Law and is connected to a number of other networks, including the African Legal Support Facility, the Organisation for the Harmonisation of Business Law in Africa, the Global Forum on Law Justice and Development, and the International Association of Legal Sciences.

In its effort to be one of the main actors of legal development in Africa and beyond, the CCLA has been already involved in some relevant activities in this respect: the Chair has been the facilitator of the last meeting held by the African Legal Support Facility (emanating from the African Development Bank) on capacity-building for lawyers in Africa. He has also been a member of the teams of experts advising the Egyptian government on the Draft Mediation Law and the Ghanaian government on the Legal Aid Bill. He is presently a member of the team of experts advising the government of Fiji on the Draft Mineral Law.

The CCLA is also currently working on the organisation of a group involving Somali scholars and jurists resident in South Africa and lawyers interested in Somali law to create a working group to advise the Somali government in the rebuilding of their legal system and to do systematic research on Somali law.

Centre of Criminology

The Centre of Criminology's research programme builds on established areas within criminology and established strengths within the Centre of Criminology, and is stretching the boundaries of criminology in ways that will enable it to recognise and respond to the changing international and local risk landscapes.

Research on policing at the Centre of Criminology is concerned both with public police and private policing developments in South Africa and in transitional contexts, particularly in Africa.

During the course of 2012, research under the direction of Professor Elrena van der Spuy explored policing in the context of peacekeeping. This entailed an exploration of the way in which the transnational space of peace missions places new demands on the national police as well as the role of policy transfer. It also involved an investigation into the politics and logistics of policing conflict through the examination of national and regional case studies. Professor van der Spuy also undertook research on the Social History of Criminal Justice Reform in South Africa post-1990, in relation to the police, the former Independent Complaints Directorate, the Judicial Inspectorate of Prisons and the National Prosecuting Authority.

AAThe Polycentric Governance Programme, directed by Julie Berg, explored changes in the character of policing by focusing attention on the authorities who direct, and the providers who undertake, policing. Research foci within this area include:

- City Improvement Districts and their security governance
- accountability of the private security industry
- developing a "whole of society" approach to security governance within the Western Cape
- developing innovative policy with The Safety Lab, a project of the Cape Town Partnership and the Provincial Government of the Western Cape and the Western Cape Department of Community Safety
- developing a networked, international research programme on transnational private security

Initial discussions were held with the Safety and Violence Initiative at UCT about establishing a multidisciplinary programme on manifestations and dynamics of non-state violence in Africa.

In the light of the sharp deterioration of the global environment, the Centre of Criminology has introduced environmental security governance within its research ambit.

The Centre's Penal Policy programme, led by Dr Gail Super, an NRF postdoctoral research fellow, explored the relationship between punishment and society and the role of punishment in state-making. Dr Super's book *Governing through Crime in South Africa: the Politics of Race and Class in Neoliberalizing Regimes* will be published by Ashgate Publishing in 2013.

In the light of the sharp deterioration of the global environment, and the local impact this is having on ecosystems and communities across Africa, the Centre of Criminology has introduced environmental security governance within its research ambit.

This research stream, led by Professor Clifford Shearing, explored how influential "fulcrum" institutions, with the capacity to lever societal change, are responding to the risks presented by an increasingly insecure environment. Partners within this programme include the World Wide Fund for Nature (WWF), several municipalities and private sector institutions.

Inspiring the Next Generation Of Scholars

Scholarship at the Centre for Law and Society is always orientated outward to what it sees as the key challenges facing South Africa today, while from within its teaching and supervision programme develops a new generation of engaged scholars and activists.

The Centre for Law and Society (CLS) has consolidated and expanded its flagship programmes – the Law, Race and Gender Research Unit (LRG), and the Rural Women's Action Research Project (RWAR) – led by Dr Aninka Claassens, director of RWAR; and Associate Professor Dee Smythe, director of the CLS.

For two decades LRG has carried out in-depth research, and has trained and mentored more than a thousand judicial decision-makers on a range of social issues, even as it has actively sought to support the transformation of the justice system.

Dr Aninka Claassens

The CLS has been closely involved with law reform, constitutional litigation and community organising, which has led to the establishment in 2012 of the Alliance for Rural Democracy.

RWAR, too, has adopted a distinctive methodology: combining regular rural, community-based consultations with empirical research, to establish the content of living customary law which is in contradistinction to the rule-bound versions of customary law entrenched by new, conservative laws.

The work of the Centre for Law and Society has resulted in high quality research outputs such as the Acta Juridica on Marriage, Land and Custom (forthcoming, 2013), edited by Claassens and Smythe. The CLS has also been closely involved with law reform, constitutional litigation and community organising, which has led to the establishment in 2012 of the Alliance for Rural Democracy.

Acting for Rural Women

Women make up 59 percent of the poorest areas in South Africa, and while research shows significant numbers of single women have managed to acquire independent land rights since 1994, these positive developments have been put at risk by recent traditional leadership laws that bolster the power of chiefs to unilaterally define the content of custom. These new laws have also exacerbated the tendency of chiefs to enter into unilateral mining and investment deals on communal land without consulting its occupants.

The apartheid tribal boundaries effectively re-imposed by these laws serve two purposes: they lock 16 million people into ascribed tribal identities, while simultaneously locking alternative institutions out. This pre-empts rural people's ability to organise themselves in any way other than as tribal subjects.

The Rural Women's Action Research Project highlights the danger of reactionary versions of customary law used to bolster autocratic chiefs and shut down processes of local transformative change. At the same time, there is enormous potential in recent Constitutional Court judgments that interpret customary law as 'living law' that develops as society changes.

So it becomes crucial to provide evidence of current practice and underlying values in challenging the distorted version of customary law entrenched by the new laws. This is necessary for litigation purposes in striking down the new laws, and to develop feasible alternatives to government's current approach.

RWAR's research shows that rural people are engaged in finding positive ways to reconcile citizenship rights and indigenous precedents. Rigorous empirical research is crucial, as is the involvement of rural people in the design and development of the research, and for the articulation of policy implications.

Documenting Traditional Courts

Researchers have documented on a daily basis for nine months – under the leadership of Dr Sindiso Mnisi Weeks – the vernacular dispute management practices of six headmen in the Msinga area.

Drawing on this data, and further interviews with members of the Mchunu and Mthembu traditional councils, traditional leaders and disputants, Dr Mnisi Weeks will complete a monograph on the subject. The research provides a foundation for opposing the autocratic Traditional Courts Bill in its current form and is the basis for developing a position on the future regulation of these courts.

Pathways to Justice: Msinga and Surrounding Areas

This project, led by Associate Professor Dee Smythe with Diane Jefthas, complements research concerning Traditional Courts in the same area of Msinga.

It documents intersections between traditional justice mechanisms and the formal criminal justice system. Analysis of 1066 police dockets have begun to reveal patterns of vigilantism, compensation payments, and the relationship between police and traditional leaders. Qualitative research with traditional leaders, police, prosecutors and magistrates is under way.

Changing Marital Status and Access to Land for Rural Women

Massive processes of change are under way in rural areas in relation to single women's access to land since 1994, according to survey data.

Using in-depth qualitative research, Dr Aninka Claassens and Nolundi Luwaya, have set out to better understand the dynamics of change processes and the factors that both support and inhibit positive change. Research findings will be used in policy briefs and articles that critique current

Professor Jaco Barnard-Naudé

Jaco Barnard-Naudé completed his law studies at the University of Pretoria and also holds a master's degree in creative writing from UCT. He is an NRF-rated researcher, an honorary Fellow at the Birkbeck Institute of Humanities, and a recipient of the UCT Fellows' Award, the Grotius Medal, the Santam Prize for Economics and the Gauteng Law Council Prize. He completed a doctorate in critical legal theory with specific focus on adjudication in the South African law of contract in transformation.

Professor Barnard-Naudé's research is primarily situated at the inter-disciplinary junctures of critical legal theory, political philosophy, literature and psychoanalysis. He has a particular interest in sexual minority freedom and, primarily in collaboration with Professor Pierre de Vos, has authored a number of influential journal articles and book chapters on this topic in the context of both post-apartheid South Africa and foreign jurisdictions.

In 2012, his published research reflected his interest in poststructuralist influences on literature, with two articles on the relationship between philosophy and literature in the context of the Afrikaans literary tradition. He also published an article in the *Stellenbosch Law Review* on the relationship between law and poetry against the background of protest poetry in the Afrikaans canon. Professor Barnard-Naudé brought his interest in a post-apartheid critical jurisprudence for South Africa specifically to bear on the four chapters he contributed in 2012 to a new textbook, *Introduction to law and legal skills*, published by Oxford University Press Southern Africa. In these contributions he stresses the importance of understanding the inextricable relationship between law and politics in the study of the South African transition to democracy.

2012 also saw Professors Barnard-Naudé and De Vos shifting their ongoing collaboration to contemporary politics in South Africa with the publication of an article on the politics of aesthetics in the context of the Jacob Zuma *Spear* debacle. In this contribution they draw on insights from postcolonial and aesthetic theory to plead for a nuanced understanding of Brett Murray's painting as a complex and problematic work, whilst at the same time arguing the importance of the constitutional right of freedom of expression for democracy. Professor Barnard-Naudé concluded his research outputs for 2012 with the publication in the *South African Law Journal* of a critical appreciation of Professor Jacques de Ville's *Jacques Derrida: Law as absolute hospitality* (2011). In this book review, he argues that current work on poststructuralist ethics all too often loses sight of the political raison d'être of the postcolonial context, namely that it is a context that calls for the building and maintenance of an ontologically post-apartheid, radically horizontal, public sphere, in which the (constitutional) ideal of equality plays a fundamental role.

Professor Hugh Corder

Hugh Corder, a graduate of the universities of Cape Town, Cambridge and Oxford, has been Professor of Public Law at UCT since 1987. His main teaching and research interests fall within the field of Constitutional and Administrative Law, particularly judicial appointment and accountability, and mechanisms to further administrative accountability. Professor Corder has been widely involved in community work since his student days, concentrating on popular legal education, race relations, human rights and the abolition of the death penalty. He served as a technical adviser in the drafting of the transitional Bill of Rights for South Africa. He has written three books, edited a further seven, and contributed many articles and chapters in books.

Professor Corder had a busy and productive 2012, of which two research projects representing different aspects of his areas of interest are highlighted here. For him, research in law tends to be a solitary activity. Although he has occasionally written with others, and although he has also been part of a research team, usually for short periods of intense activity (such as drafting a bill for Parliament), his preferred position is to read, reflect and write on his own. The works highlighted below represent the outcome of both sorts of research.

His work in the area of constitutional law, and his particular focus for the past 35 years, has been the judicial branch of government, as well as a specialised area of constitutional law called administrative law, which is any legal system's response to the rapid growth and intrusiveness of executive authority over the last century. It typically centres on the courts' attempts to regulate the exercise of that power to ensure a measure of procedural fairness.

The first piece is a substantial chapter for a book on the judiciary in South Africa. The editors asked Professor Corder to write on judicial accountability, a particularly vexed topic, for the following reasons. Judicial impartiality and independence are critical to any constitutional democracy, but judges exercise authority on behalf of the state in interpreting and enforcing laws, so there must be methods to ensure their accountability to the electorate. One of the ways in which this occurs is through the doctrine of the "separation of powers" in government, and through the role of the executive and Parliament in appointing judges. This chapter focuses on accountability mechanisms for serving judges, such as that they sit in open court, that their judgments are criticised by other lawyers, academics and in the media, that judgments may be appealed to higher courts, and that judges who are guilty of gross misconduct may be impeached. Most of the chapter examines the structures and procedures introduced recently into our law by Parliament, such as a binding Code of Conduct as well as tribunals established under the auspices of the Judicial Service Commission. One such notorious incident involves a judge who was found guilty of drunken driving, and whose case will soon be heard by a tribunal.

The second piece is a chapter in a book (edited by leading constitutional scholars from Australia, Switzerland and the USA) which seeks at an international level to explore themes common to constitutional law in a comparative manner. Professor Corder was twinned with a Swedish academic, and they were asked to write about access to information, a vital part of administrative justice in any modern system of constitutional governance. Sweden was the pioneer in this area, South Africa very much a latecomer, and the authors approach the issue from very different legal and cultural vantage points, so there was much of interest in the writing process. It is hoped that the outcome will be equally stimulating!

Professor Hanri Mostert

Professor Hanri Mostert's undergraduate studies in Humanities and Law at Stellenbosch University piqued her interest in the resource potential of land. Throughout her doctoral studies she pursued the question of how land as a scarce resource of great public importance could be appropriately regulated, whilst simultaneously private claims to it could be acknowledged. Having honed her research skills at the Max Planck Institute for Public and International Law in Germany, she completed her doctorate in 2000.

Since then, through her appointments at Stellenbosch University (2001 and 2008), and the University of Cape Town (since 2008), she has endeavoured to share her insights with new generations of property-law students. Her work has had impact both locally and internationally, through her appointment as a visiting Professor at the Rijksuniversiteit Groningen in the Netherlands, her involvement in the International Alliance for Land Tenure and Administration, and her work supporting the South African Law Commission, World Bank and international and national litigation.

Professor Mostert's original interests in property law have matured into specialisations in land law and mineral law. In these fields, she has contributed to the most authoritative sources on South African law, addressing issues of constitutional property protection, landlessness, tenure security, restitution, nationalisation, land governance and mineral-resource regulation. Her latest monograph, *Mineral Law – Principles and Policies in Perspective* (Juta, 2012), has already assisted the courts' understanding of mineral law.

Throughout her doctoral studies she pursued the question of how land as a scarce resource of great public importance could be appropriately regulated

Her work emphasises the state's duties to achieve better living standards and ensure responsible individual autonomy. She defends the notion of engaged citizenship in the enhancement of freedom and quality of life for individuals and the community and comments on the role of the judiciary in building a society subscribing to principles of accountability and trust in property law.

Professor Mostert has now embarked on a project to create a book series dealing with the mineral laws of Africa, and building a network of African mineral law specialists. With Juta Law Publishers she is also working on a series of opinion pieces on law, the first of its kind in South African legal publishing.

Professor Mostert holds a B rating from the National Research Foundation. She also held fellowships of the Commonwealth Programme, the Max Planck Foundation, the German Academic Exchange Service and the Alexander Von Humboldt Foundation.

Professor Chuma Himonga

Professor Chuma Himonga completed an LLB at the University of Zambia, an LLM at King's College London, and a PhD at the London School of Economics and Political Science. She is Professor of Law at the University of Cape Town and an NRF-rated researcher. She has served as a former deputy dean of undergraduate and postgraduate studies at UCT, an Akademische Rätin auf Zeit at the University of Bayreuth, Germany (1988–1994), and as a lecturer at the University of Zambia (1978–1988). She has collaborated in three major international and regional academic research projects in Europe and Africa, and is a former member of the South African Law Reform Commission Project Committee on Customary Law.

Professor Himonga convenes public and postgraduate seminars in All Africa House (where she serves as the warden), and manages a fellowship programme for academics from other African universities, funded by UCT. She has served on a number of boards of trustees, including the International Association of Law Schools Board from 2005 to 2010.

Professor Himonga's current preoccupation as holder of the South African Research Chair in Customary Law is refocusing research in customary law from theoretical studies to "grounded" empirically based investigations of the actual workings of customary law. This approach reflects the changed conceptualisation of customary law as living customary law in legal theoretical discourses. It is furthermore consistent with the normative frame of living customary law confirmed as the legitimate sources of law by the South African Constitution and Constitutional Court, and increasingly by other African legal systems.

A true and more realistic determination of the relationship between customary law and other components of Africa's legal pluralistic landscape depends on how well the former is researched and understood as a system of living law.

The ground-breaking nature of the direction of the South African Research Chair in Customary Law's research is to be viewed against the dearth of research on the African continent that takes the empirical investigation of customary law as a normative system seriously. While volumes of important literature have been published on customary law, little is based on the actual practices of the people who are subject to customary law, and therefore of little relevance to the lives of this legal system's adherents and its implementation by the state.

A true and more realistic determination of the relationship between customary law and other components of Africa's legal pluralistic landscape, including human rights and democratic governance, also depends on how well the former is researched and understood as a system of living law. These underscore the significance of Professor Himonga's scholarly undertakings and the direction of the research at her Chair.

Books Published in 2012

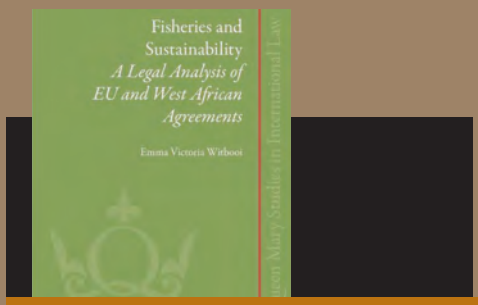
Reinventing Labour Law

Rochelle Le Roux and Alan Rycroft

The employment relationship has throughout the centuries been one of the most regulated of contracts. This regulation has extended to basic conditions, health and safety, unemployment insurance, dismissals, strike law, and much more. Most regulation reflects the priorities and policies of the government of the day. The Labour Relations Act 66 of 1995 (1995 LRA) was historically a fresh start in a democratic South Africa, an act harnessed to the Bill of Rights which, for the first time, guaranteed a range of labour-related rights.

This volume of *Acta Juridica* is partly devoted to a critical review of the first 15 years of the 1995 LRA. However, the intention was that the contributing authors should focus on more than the successes and failures of the act and that at least some of the contributions should have a strong prospective emphasis, exploring the possible future challenges to and solutions for regulating the labour market post-2011. In other words, the editors intended this volume to assist in tracking the future of labour-market regulation in South Africa.

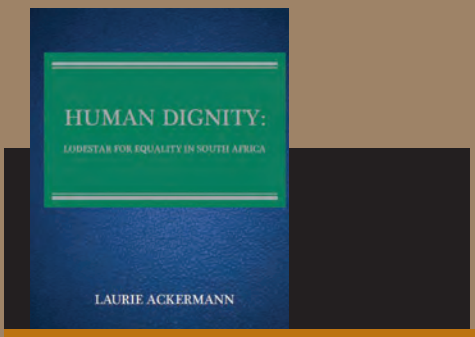
Fisheries and Sustainability. A Legal Analysis of EU and West African Agreements



Emma Witbooi

Marine-living resources are currently under severe threat from unsustainable use. International law urges a precautionary approach in the use of remaining fish stocks, necessitating rational domestic management of coastal fisheries and requiring foreign nations accessing these stocks to co-operate to this end. The manner in which bilateral fishing relations between the EU and various West African states have historically played out, however, has not followed this route. This book is a legal study of these relations from an inter-disciplinary and contextual perspective with particular reference to sustainability questions, using three broad conceptual lenses – common resource management, integration towards sustainable development, and the colonial legacy – to interrogate the extent to which these interactions operated as legal instruments of sustainability.

Human Dignity: Lodestar for Equality in South Africa



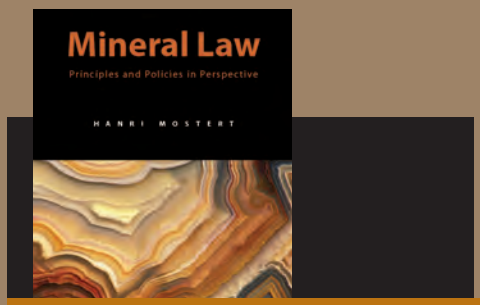
Laurie Ackermann

Human Dignity: Lodestar for Equality in South Africa provides an in-depth analysis of human dignity and its relationship to equality in South African law. The author argues that human dignity is the attributive key that unlocks the constitutional meaning of equality and unfair discrimination. Equality cannot be usefully debated without first asking the vital question "'Equality of what?" The answer, it is contended, must be "human dignity". The philosophical and Abrahamic religious roots of these constitutional concepts of dignity and equality are investigated, then further explored and illustrated in the comparative context of South African, German and Canadian constitutional jurisprudence.

Clashes and tensions between rights inevitably occur when the equality and non-discrimination rights of a Bill of Rights are applied horizontally, that is between subjects of the state themselves. The human dignity

of the contestants plays a vital role in resolving such tensions and conflicts. Human dignity moreover has a determining function when applying constitutionally mandated restitutionary (compensatory) equality and when determining what the legitimate extent and duration of such restitution is. These issues are also considered in a comparative constitutional context

Mineral Law: Principles and Policies in Perspective



Hanri Mostert

Mineral Law: Principles and Policies in Perspective provides a unique look at the context of current mineral law. It examines the system introduced by the Mineral and Petroleum Resources Act 28 of 2002 by juxtaposing it with preceding generations of mineral law. It deals with the regulatory and proprietary aspects of mineral law, the constitutionality of the transitional provisions introducing the new mineral law order, and its continuity with former generations of mineral law.

The New Environmental Governance

The New Environmental Governance (NEG) explores a bold and profoundly new way of governing global environmental problems. It seeks to help overcome the limitations associated with relying on an interventionist state, and its market-based approach to governance, and to offer more effective and legitimate solutions to today's most pressing environmental problems. As such, NEG emphasises a host of alternative characteristics of governance that integrate participation, collaboration, deliberation, learning and adaptation, and "new" forms of accountability.

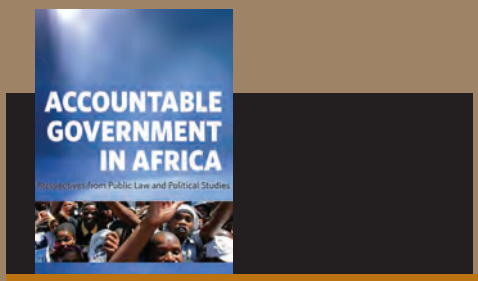
Cameron Holley, Neil Gunningham and Clifford Shearing

Yet, while these unique features have generated significant praise from legal and governance scholars, there have been few systematic evaluations of NEG in practice. Indeed it is still unclear whether NEG will in fact "work" and, if so, when and how. This book offers one of the most rigorous research investigations into cutting-edge trends in environmental governance to date. Focusing its inquiry on some of the most central, controversial and/or under-researched characteristics of NEG, the book offers fresh insights into the conditions under which we can best achieve successful NEG.

The book synthesises its findings to identify seven key pillars of "good" NEG, central to its success, that will provide useful guidance for policymakers and scholars seeking to apply new governance to a wide range of environmental and non-environmental policy contexts. The book also advances our understanding of state governance and is a valuable reference for scholars, researchers and students working in law and regulation studies, especially those in the field of environmental law.

Books Published in 2012

Accountable Government in Africa: Perspectives from Public Law and Political Studies



Danwood Chirwa and Lia Nijzink

The book brings together a number of leading experts in the fields of public law, political science and democratisation studies to discuss problems of accountability, identify ways of making African governments accountable and describe the extent to which these mechanisms work in practice. Thus it presents new knowledge about legal and political developments in a number of African countries that is relevant to the policy goal of developing and deepening democratic governance and accountable government on the continent. *Accountable Government in Africa* will be of interest to academics, students and practitioners in the fields of public law, public administration, political studies and African studies, as well as anyone who has an interest in developing and deepening democratic governance and accountable government on the African continent.

Tom Bennett, Eva Brems, Giselle Corradi, Lia Nijzink and Martien Schotsmans

African Perspectives on Tradition and Justice

This volume aims to produce a better understanding of the relationship between tradition and justice in Africa. It presents six contributions of African scholars related to current international discourses on access to justice and human rights and on the localisation of transitional justice.

The contributions suggest that access to justice and appropriate, context-specific transitional justice strategies need to consider diversity and legal pluralism. In this sense, they all stress that dialogical approaches are the way forward. Whether it is in the context of legal reforms, transitional processes in post-war societies or the promotion of human rights in general, all contributors accentuate that it is by means of co-operation, conversation and cross-fertilisation between different legal realities that positive achievements can be realised.

The contributions in this book illustrate the perspectives on this dialectical process from those operating on the ground, and more specifically from Sierra Leone, Mozambique, Malawi, South Africa, Uganda and Rwanda. Obviously, the contributions in this volume do not provide the final outcome of the debate. Rather, they are part of it.

Research Groupings
associated with this theme

Centre of Criminology

The Centre of Criminology (previously the Institute of Criminology), founded in 1977, aims to initiate, co-ordinate and develop research in the broad field of criminology, and to promote public interest in all aspects of criminology. The centre's research programme focuses primarily on state policing, plural policing, crime prevention, and environmental security. Teaching support to the criminology focus falls within the Department of Public Law and research support is provided by the centre's Multi-Media Electronic Resource Library.

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Intellectual Property and Policy Research Unit

The Intellectual Property (IP) and Policy Research Unit assists in developing IP law and policy in Southern Africa and aims to contribute to the manner in which this topic is treated in the emerging and developing countries throughout the world. The unit is in a position to become an influential leader within Southern Africa for research and scholarship in intellectual property law and policy. It seeks to explore many issues facing the changing world of IP and relate these to the needs of society, IP holders and consumers. The unit is leading research projects in areas such as IP rights and innovation, development, copyright and creative commons, nanotechnology and new technologies.

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Institute of Development and Labour Law

The Institute of Development and Labour Law was established in 1996 through the merger of the Labour Law Unit and the Institute of Development Law. The institute plays a leading role in development and labour law teaching and research. It is involved with training courses in South Africa and other countries in Southern Africa. It also regularly contributes to the training programmes of other organisations, and collaborates closely with other leading university centres and NGOs.

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DST/NRF SARChI Chair
associated with this theme

Professor Clifford Shearing

Security and Justice

Professor Clifford Shearing holds the South African Research Chair in Security and Justice at UCT and is also Chair of Criminology and director of the Centre of Criminology. Previously he held positions at the Australian National University (2001–2006) and the University of Toronto (1975–2001).

He obtained a PhD in sociology at the University of Toronto in 1977. He is an A1-rated NRF scholar. Professor Shearing's research and writing has focused on the governance of security and he has sought, through his policy work and practical engagements, to enhance the quality of security and justice. A particular focus of his work has been contributing to the development of institutions and processes that enhance the ability of poor communities to both direct and contribute to their safety. His current research focuses on developments in international private security and the emerging issue of environmental security.

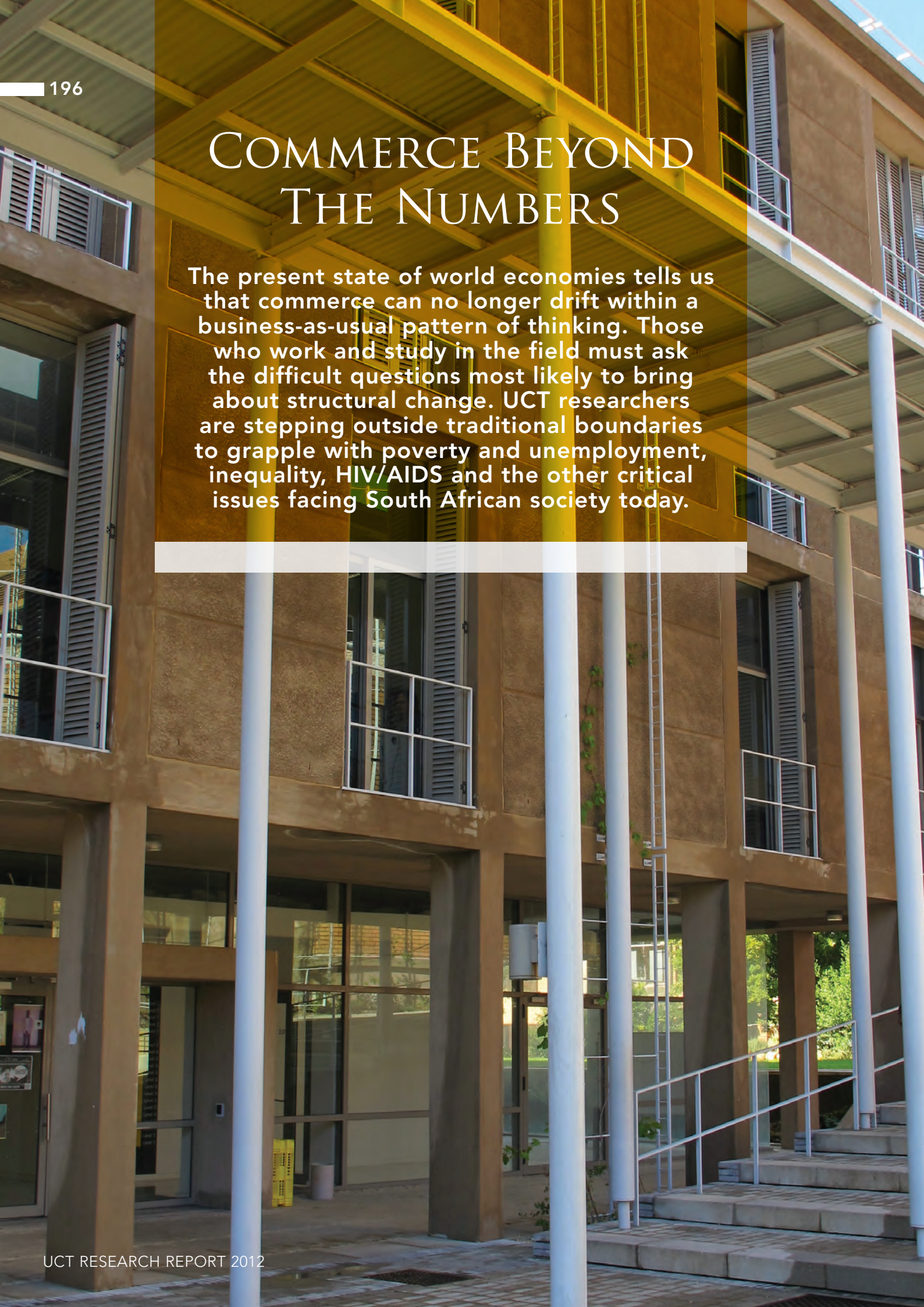
UCT's Dr Waheeda Amien (left), Professor Nazeem Goolam (Rhodes University) and Professor Chuma Himonga (UCT), pictured at the CCLA Methodology Workshop held in 2012.

Customary Law

Profiled on page 191

Commerce Beyond The Numbers

The present state of world economies tells us that commerce can no longer drift within a business-as-usual pattern of thinking. Those who work and study in the field must ask the difficult questions most likely to bring about structural change. UCT researchers are stepping outside traditional boundaries to grapple with poverty and unemployment, inequality, HIV/AIDS and the other critical issues facing South African society today.



The two greatest influences on the way UCT's Commerce Faculty has gone about its work in the past year are a quest for relevance, at both policy and grassroots level, and an increasing spirit of collaboration within the sciences. In addition, the faculty has continued to place emphasis on social innovation and entrepreneurship, along with leadership and a values-driven ethic that has seen it grow in both excellence and relevance, increase its research outputs, and seize the unique opportunities of the day.

The Commerce Faculty has enjoyed the highest rate of improvement in annual peer-reviewed, accredited journal outputs at UCT over the past three years.

During a period of significant budgetary pressure that forced steady increases in the faculty's ratio of undergraduate students to staff, and postgraduate students in need of supervision, two professors received the first A ratings ever awarded by the National Research Foundation to researchers in any commerce faculty in South Africa. The number of staff with an NRF B rating, which indicates considerable international recognition, doubled. These are objective signals of improvement not easily achieved.

The basic essential condition for this success under pressure is straightforward: the faculty's academic corps has an unusually low median age, so a high number of the staff are still growing in their research capacities, confidence and efficiency. Crucially, when confronted with shrinking resources, especially in that most precious asset, time, most staff have responded by working even harder and longer than they had already been. The faculty has supported and leveraged this superior collective work ethic through organisational change.

Across the sciences, research has for many decades become increasingly collaborative; this is due mainly to greater specialisation which requires projects to involve multiple authors. A second driver is the global tendency to extend larger grants to fewer but more ambitious projects, rather than making small grants to individuals. This is leading international research universities to organise around strong thematic research units guided by the best principles of entrepreneurship and enterprise management.

Organisation into research units is particularly important to the Commerce Faculty for an idiosyncratic set of reasons. As noted above, the faculty is comparatively young, and young researchers thrive best given close mentorship and leadership by established scholars who are better positioned to attract funding. Relatedly, a key to improving postgraduate recruitment and completion rates is providing incoming doctoral and research master's students with

strong support structures. Research students who work not merely with a single supervisor, but as members of a collaborative group engaged in multiple related projects at any given time, are much more likely to graduate more quickly, experience less stress and risk of alienation during their thesis work, be exposed to a wider view of research in their discipline, and be richly networked when they seek employment after completing their studies.

The Commerce Faculty has long contained within itself a model for this kind of organisation. Historically, the strongest part of the faculty concerned with research is the School of Economics (SoE) which has, for almost a decade, been structured around four research units: the AIDS and Society Research Unit (ASRU), DataFirst, the Development Policy Research Unit (DPRU), and the Southern Africa Labour and Development Research Unit (SALDRU).

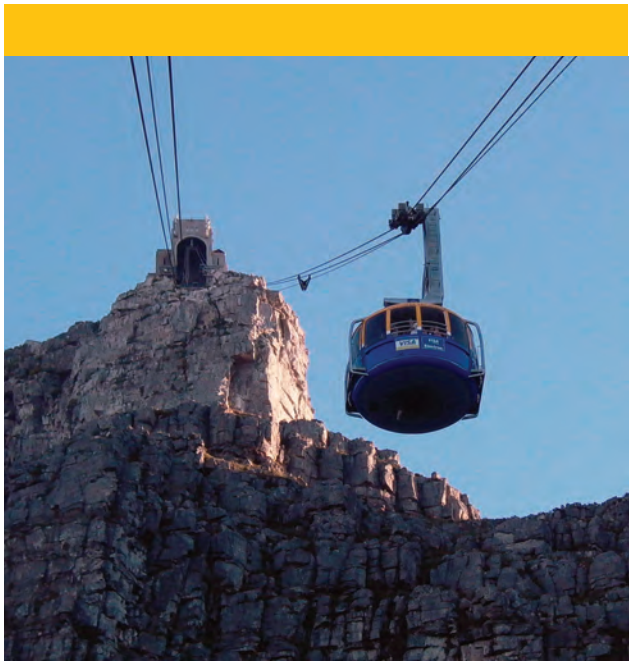
SALDRU – the longest established and mightiest of the units – has for 30 years highlighted poverty and inequality as its focal issues and produced a substantial body of groundbreaking work that has helped policymakers to systematically address poverty alleviation in South Africa.

The unit is entrusted with the design and administration of the National Income and Development Survey, funded by the Office of the President. Since 2010, it has housed the

Abdul Latif Jameel Poverty Action Lab for Africa (J-PAL Africa), with its Head Laboratory at MIT, and it works with African governments, NGOs and businesses to generate evidence needed for effective policies that improve the lives of poor people. SALDRU has provided the recruitment and project context for multiple doctoral and research master's students.

Outside the SoE, four Commerce research units already existed before 2010: the Centre for Actuarial Research (CARe), which focuses on technical demography and on modelling the demographic and epidemiological dynamics of HIV/AIDS; the Centre for Information Technology and National Development in Africa (CITANDA), which studies the management, development, use and impact of information and communication technology in areas related to business, economic and social development in Africa, with a special focus on new mobile communication technologies and applications customised to the needs of African enterprise; the Institute for Monitoring and Evaluation (IME), which promotes capacity-building in programme evaluation in Africa; and the University of Cape Town Unilever Institute of Strategic Marketing (UISM), which has built a national reputation as South Africa's foremost source of intelligence on South African consumer behaviour.

Since 2010, a strategic plan to extend existing research platforms into "wall-to-wall" research units across the faculty has been adopted. No academic is required to join a unit but, if coverage of units is sufficiently deep, all academics can find a natural home in at least one.



The first two new units to be accredited by the University Research Committee (URC) were the Research Unit in Behavioural Economics and Neuroeconomics (RUBEN), which uses experiments to study ways in which people and households in developing and least-developed economies assess risk and make decisions, and the unit for Policy Research in International Services and Manufacturing (PRISM), which seeks to improve South Africa's competitiveness through undertaking evidence-based research on firm and sector-level competitiveness, as well as contributing to policy frameworks that impact on African industrialisation paths. Both RUBEN and PRISM have collaboration agreements with strong international partner institutions, which the faculty views as a preferred feature of all research units. RUBEN is currently in negotiation with the Risk Management Institute at Georgia State University to design a joint doctoral programme.

This was followed by the African Collaboration for Quantitative Finance and Risk Research (ACQuFRR), which will be part of a larger, forthcoming structure – the research wing of the planned African Institute for Financial Markets and Risk Management (AIFMRM), funded by a coalition of banks and insurance firms.

The UCT Tourism Research Unit (TRU) studies South Africa's tourism industry with the aim of identifying unrealised opportunities and formulating innovative and sustainable methods of filling these gaps.

Two units operating within the faculty, not yet URC-accredited, are the Development Unit for New Enterprise (DUNE), which focuses on building entrepreneurial capability in South Africa by researching the dynamics of leadership and innovation in the fields of general entrepreneurship, technopreneurship and social entrepreneurship; and the unit for Practice and Research on Occupational Health Psychology in Africa (PROHPA), which is dedicated to applied research on issues relating to the well-being, safety and health of people at work, through focus on the work environment, the individual, and the work–family interface.

Most of these new units are in their founding stage of development and considerable growth is expected in their range and quantity of output in the years ahead. Crucially, all are tasked with diversifying their sources of research funding to enable more growth and scope in the faculty as a whole.

The optimistic expectation is that the recent acceleration of research in the faculty will continue through coming decades with dynamic outcomes, not only for the academic community, but for South Africa at large.

The business of GLOBAL CHANGE

UCT's Graduate School of Business (GSB) is different from others; it stands out from the crowd and speaks to a relevance badly needed in the world today. As a business school it is prepared to ask the uncomfortable questions and make the difficult choices to stand things on their heads, if necessary, to bring about practical change, from the shaping of national policy to innovation in local business models for improved service delivery.

The GSB sees one of its key roles as enabling new ways of thinking, behaving and striving to be proactive in response to Africa's challenges. In the wake of the financial crisis, and with social and environmental challenges multiplying across the planet, innovation from business schools is a necessity, not a luxury. And at the heart of all GSB initiatives is a commitment to research.

The GSB has identified five systemic research themes around which mainstream research is clustered: values-based leadership, social innovation and entrepreneurship, governance and sustainability, development finance, and infrastructure, reform and regulation.

But the organising principle of all research at the school is understanding emerging markets. Given that the school is situated, geographically, in a society and economy which is undergoing a rapid socio-political and economic transition from agrarian and feudal lifestyles to modern consumer lifestyles and careers, it is ideally situated to study such contexts. It provides researchers with a special opportunity to conduct emerging market research that is of interest to the leading international scholarly journals in all management disciplines, and contributes to the well-being of diverse stakeholders.

Research excellence is encouraged and incentivised at the school and 20% of GSB staff now have National Research Foundation ratings. Emphasis is on supporting and incentivising an increase in the quality, quantity and relevance of research that is transforming

Professor Walter Baets

SARChI Chairs
associated with this theme

Social Science Chair in Economic Growth, Poverty and Inequality
Profiled on page 91

Poverty and Inequality Research
Profiled on page 91

and transformative, selectively comprehensive, locally responsive and engaged, and globally competitive.

In a boost to research at the school, the first Old Mutual Research Fellows in Emerging Economies were recruited during 2012 with funding from Old Mutual. The research fellowship is aimed at understanding the complexity and uncertainty inherent in emerging markets, while simultaneously developing young, previously disadvantaged academics.

As a business school it is prepared to ask the uncomfortable questions and make the difficult choices to stand things on their heads.

The establishment of two new research centres is also furthering research output: the Bertha Centre for Social Innovation and Entrepreneurship and the Allan Gray Centre for Values-Based Leadership.

Partly as a result of these activities, the GSB remains one of the most recognised and celebrated business schools in Africa. In 2012 it was endorsed by the international community, receiving accreditation from both the Association of MBAs and the European Foundation for Management Development. The school's full-time MBA programme is also the only one in Africa to be ranked in the *Financial Times* Top 100 MBAs ranking and its Executive Education programmes were rated one of the best in Africa.

Such recognition helps to ensure that the school is putting UCT on the world map when it comes to business – specifically to changing the way business is thought about and practised in emerging markets.

Research Groupings
associated with this theme

Advancement of Business CompetitivenessUnit

The Advancement of Business Competitiveness Unit aims to be the primary source of knowledge and support for the advancement of competitiveness of organisations in South Africa and the rest of Africa in both the private and public sectors. Research focuses on undertaking surveys to map current business practices in the various sectors of the South African economy with the aim of benchmarking them against best practices. Using case studies, the unit also undertakes in-depth investigations of the business practices peculiar to the value chains of the various sectors. Both the surveys and the case studies will generate insights into the potential weaknesses of the value chains which hinder competitiveness in both the private and public sectors.

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Centre for Actuarial Research

The Centre for Actuarial Research is the only unit of its kind at an African university. It brings together multidisciplinary teams to build capacity, improve techniques and produce independent research in demography, healthcare financing, social security and HIV/AIDS modelling. The main focus of the centre is on training and research in demography and modelling the demographic impact of HIV/AIDS in Southern Africa.

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Research Unit In Behavioural And Neuroeconomics (RUBEN)

RUBEN is an inter-disciplinary group of researchers who use economic experiments, often together with functional Magnetic Resonance Imaging techniques, to examine the role that social, cognitive and emotional factors play in economic decision-making. In particular, the methodological approach in which the members of the team are experts allows the estimation of risk

attitudes and time preferences of individuals, households, and communities in the field. RUBEN is currently the only centre for experimental research in economics on the African continent, providing training, research leadership and technical resources for the benefit of researchers across the continent. A key aspect of RUBEN activity is training. RUBEN hosts annual training workshops for scholars from the rest of the continent, and raises funds to cover all workshop costs for these participants. In addition, the unit aims to provide scholarships for four to six postgraduate students annually.

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Policy Research in International Services and Manufacturing

Policy Research in International Services and Manufacturing (PRISM) is a research and policy unit within UCT's School of Economics. PRISM provides a lens to focus research and policy work broadly on issues of globalisation, trade and industrialisation. It is home to a number of related research activities, projects and programmes concerned with issues of globalisation, global value chains, industrialisation paths, foreign direct investment and multinational corporations, international trade, foreign investment, the defence industry, policy governance, infrastructure development, the role of knowledge-intensive services, innovation, and international competitiveness. PRISM has an applied focus, responding to economic policy questions issues in South Africa, the rest of Africa and beyond.

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UCT Tourism and Events Research Unit (UCT-TRU)

The UCT Tourism and Events Research Unit is an interdisciplinary specialist research and teaching unit within the School of Management Studies. The mission of the unit is to undertake high quality research and engage in research-led teaching in order to contribute to policy formation by business, governments and international organisations. Current research interests include the analysis and measurement of tourism's economic impact, consumer behaviour and the demand for tourism and travel, and the impact of social media on tourist decision-making.

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The African Collaboration for Quantitative Finance and Risk Research (ACQuFRR)

ACQuFRR is a research unit that spans the activities of the quantitative finance group in Actuarial Science and researchers in the Department of Finance and Tax who share an interest in risk research. It provides structure and support for the pursuit of quantitative financial (risk) research that is distinctive to Africa and emerging market economies. Many of its teams are multidisciplinary, in keeping with its mandate, and may include market practitioners. ACQuFRR's focus is on postgraduate training, research and professional workshops.

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Environmental-Economics Policy Research Unit

Profiled on page 164

Southern Africa Labour and Development Research Unit

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Centre for Information Technology and National Development in Africa

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Development Policy Research Unit

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Global Partnerships, Local ICT Solutions

Over the last decade, UCT's researchers have contributed to the rapid evolution of processors, high performance computing and information systems, which is pushing the boundaries of research paradigms.

High Performance Computing at UCT

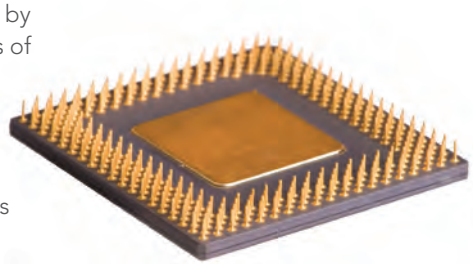
From supercomputers to mobile technology, the field of High Performace Computing has opened up a host of new possibilities for researchers, with some having played a key role in the development of industry-standard computing languages and software, and others contributing to emerging technologies in taking healthcare to the next level.

High Performance Computing (HPC) is an enabling technology that seeks to improve the performance of computing applications. The interdisciplinary nature of HPC research impacts on a wide range of applications; for example, a carbohydrate simulation might be reduced from years to months, or digital 3D content produced in real time rather than requiring minutes to generate. At UCT there are number of researchers working on HPC, and a major theme of their research is improving the speed of discipline-specific computational solutions.

The Centre for Research in Computational and Applied Mechanics (CERECAM) has been in existence in various forms since 1981. During this period, it has grown into a flagship research centre comprising 13 full-time academic staff members from six departments spanning three faculties, and with networks across the world. Consequently, inter-disciplinary thinking and activity have become firmly embedded in the objectives of the centre.

The principal objective of CERECAM is to provide a coherent focus and point of interaction at UCT for research and applications in the general area of non-linear mechanics by promoting and supporting fundamental research, applied research, and industrial interaction in the mechanics of structures, solids, and fluids. The application of research that is facilitated through CERECAM is both broad and varied: this ranges from the development and utilisation of HPC tools to study the biomechanics of myocardial infarction (heart attacks) and the production of biodegradable stents, to the computational aspects of flotation, leaching, precipitation and crystallisation, which are important to the chemical process industry, the mining industry and the environmental field.

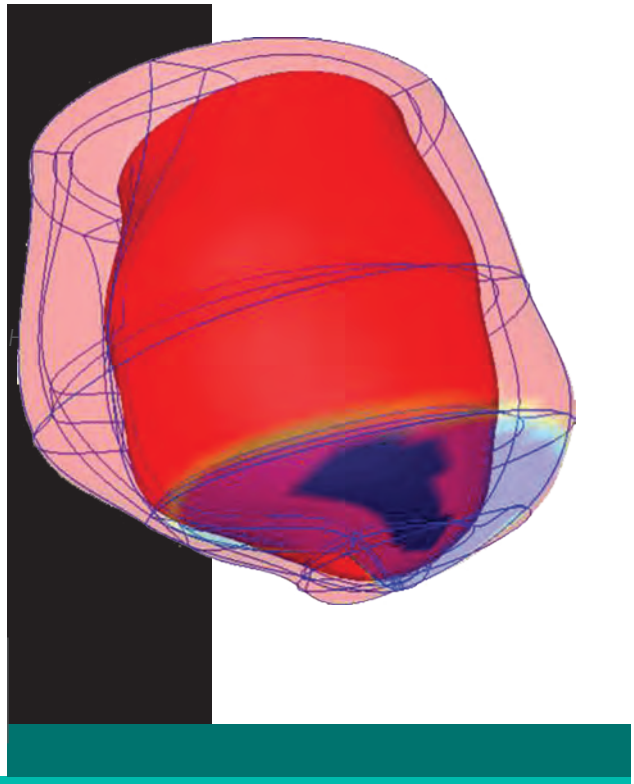
Research areas of interest thus span a wide range that includes theoretical, computational and experimental investigations in solid and fluid mechanics, with corresponding research activities organised into a number of research programmes which range from those of a fundamental nature to projects having a direct link to industry and other applications. Areas of activity in solid mechanics include plasticity, structural mechanics and fracture mechanics. In the domain of fluid mechanics, much activity is motivated by problems in aerodynamics and in the mining industries. Beyond these traditional areas of interest, biomechanics is a major area of activity, and particulate flow characterisation has become established as a major focus in its own right.



During 2012, twelve postgraduate CERECAM students graduated, two of whom were registered at the doctoral level. Thirty-three students continue their studies through the centre, approximately two-thirds of whom are PhD candidates.

Biomechanics of the Upper Airway

Sleep apnoea is a type of sleeping disorder characterised by pauses in breathing or instances of shallow or infrequent breathing during sleep. Each pause in breathing is called an apnoea, and can vary in duration from at least ten seconds to minutes. There are three types of sleep apnoea and, according to the World Health Organisation, more than 120 million people worldwide suffer from this chronic respiratory disease.



In another CERECAM project, Professor Daya Reddy and PhD student Jean-Paul Pelteret are concerned with the use of modelling and computational techniques to develop a better understanding of the mechanisms of obstructive sleep apnoea. The initial phase of this work involved the development of a model for the non-linear anisotropic behaviour of the tongue, which comprises a number of muscle groups, as well as of other relevant soft tissues. Further work has entailed the simulation of fluid-structure interaction involving the tongue and soft palate, and upper airway flow.

Myocardial Infarction and Heart Failure

Cardiovascular diseases (CVD) will become the leading cause of death by 2020, superseding infectious diseases such as HIV, TB, and malaria. The risk of CVD has been reported to increase with the improvement of economic wealth and social environment, in particular in Africa.

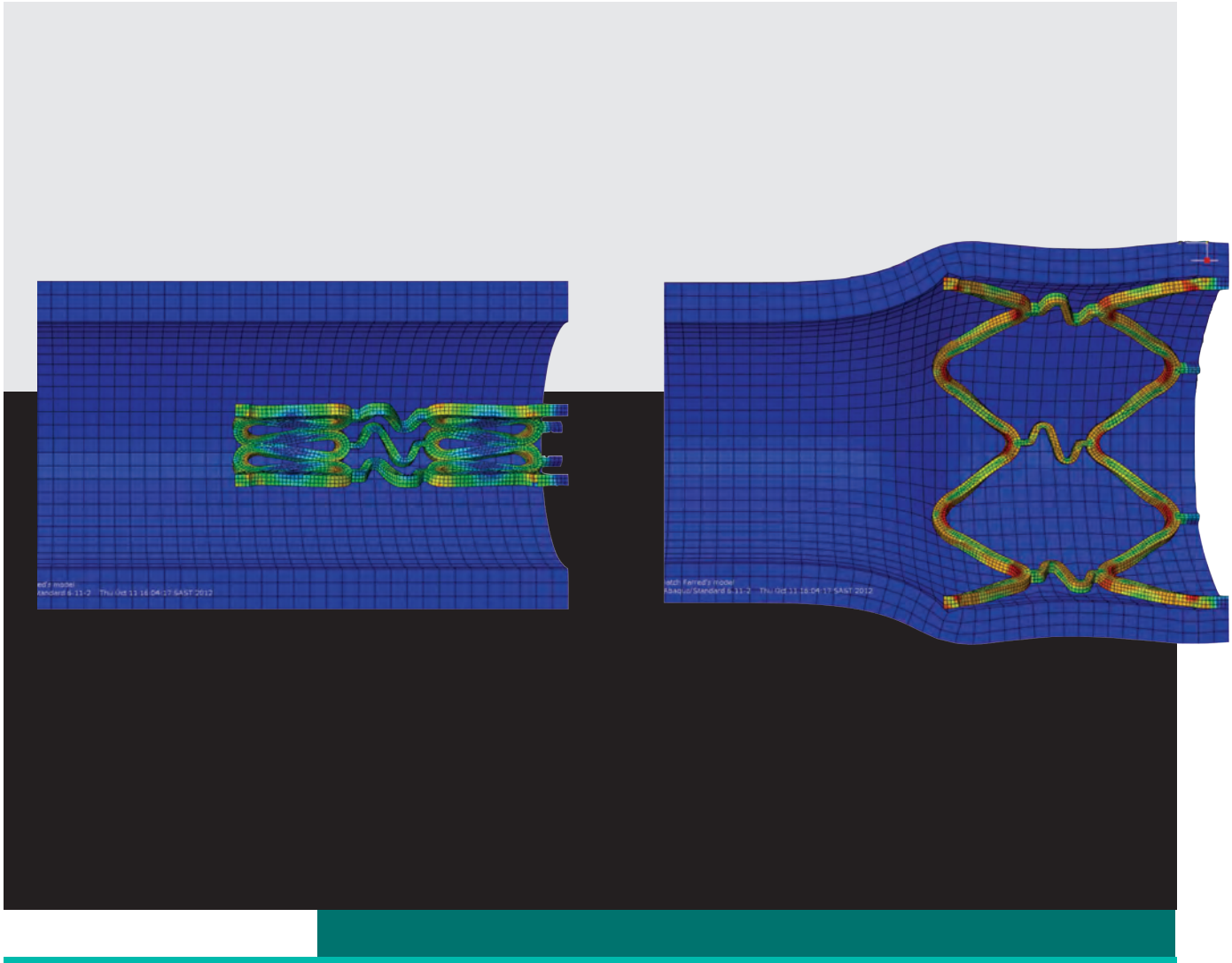
A higher risk for acute myocardial infarction, the leading causes of congestive heart failure, has been reported in the black African group in sub-Saharan Africa due to an increased level of hypertension. Similarly, the American Heart Association expects in the near future a dramatic increase in CVD incidences in Africa, in particular in the younger population, in conjunction with the emergence of a new epidemic of obesity, diabetes and uncontrolled hypertension. Up to one-third of infarct patients develop heart failure, making myocardial infarction the most common cause of heart failure. The fact that 30 to 40% of patients die from heart failure within the first year after diagnosis, even with optimal modern treatment, indicates the urgent need for alternative therapies.

The aim of this collaborative research project, which is sponsored by the national Centre for High Performance Computing, is the development and utilisation of HPC tools to study the biomechanics of myocardial infarction (MI) and emerging MI therapies based on biomaterial injection into the infarct. The presented problem is highly complex, including the representation of the architecture of cardiac soft tissue with dispersed biomaterial at micro- if not nano-scale, the highly non-linear elastic myocardial mechanics, and the electro-sensitivity of the myocardial muscle. Comprehensive treatment exceeds conventional computing resources in terms of problem size and complexity of the developed codes to capture the physical phenomena with sufficient accuracy. HPC will form an imperative platform for this research towards the advancement of MI therapies and prevention of heart failure.

The project is led by Associate Professor Thomas Franz and Professor Daya Reddy, in close collaboration with UCT's Dr Sebastian Skatulla, Dr Dieter Legner, Associate Professor Neil Davies, Dr Jeroen Kortsmit and Laura Dubuis, and Dr Carlo Sansour of the University of Nottingham, and provides an excellent framework within which seven postgraduate students are being trained and mentored.

Designing Biodegradable Stents

In modern society, advances in biotechnology have made it possible for the quality and length of human life to be vastly improved. One such advancement has been the development of the stent, a tiny mesh 'tube' which, when inserted into a natural passage in the body, serves to prevent or counteract a disease-induced constriction in the flow of blood or other bodily fluids.

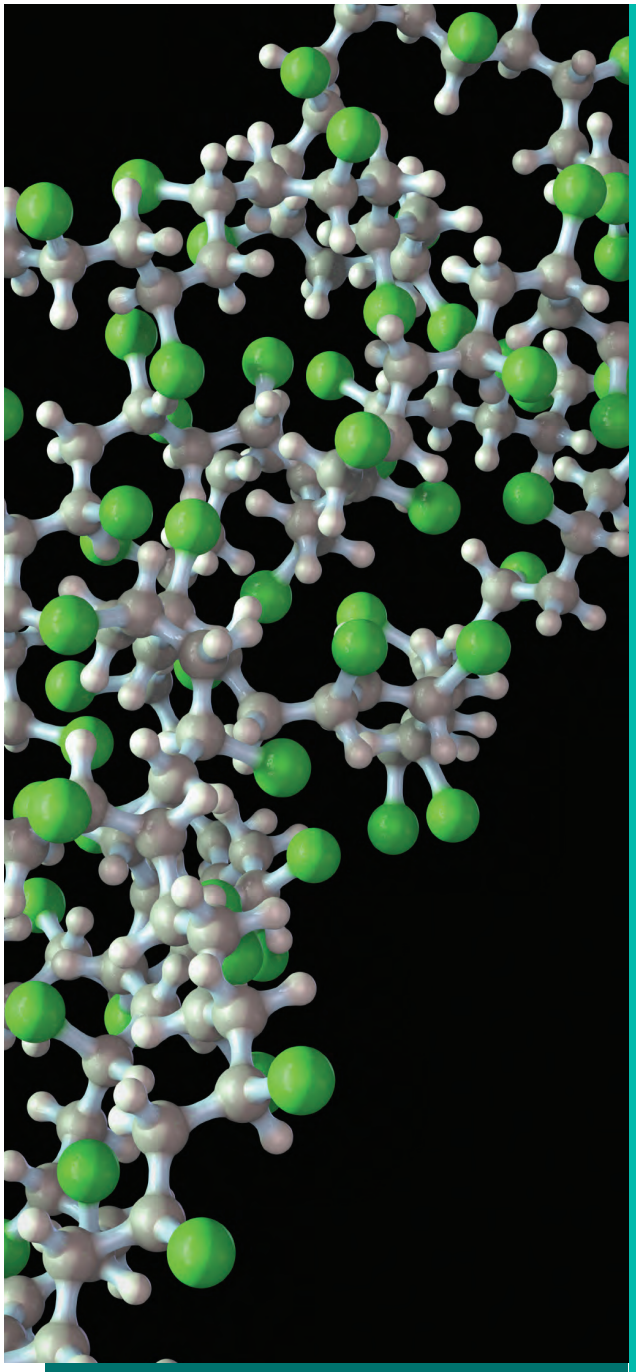


Permanent metal drug-eluting stents, i.e. stents which slowly release a drug, are the best-performing stents in clinical use today. There are, however, drawbacks to using permanent stents: they induce a chronic foreign-body stimulus in the host artery, obstruct future cardiac interventions and also prevent normal artery mechanical behaviour, to name but a few. If the stent can maintain its strength long enough to assist in the healing of the artery, and gradually transfer load onto the native vessel as it degrades, a fully healed artery may be restored. Thus there is much interest in the design of biodegradable stents.

Current research is concerned with a preliminary investigation into the properties of materials suitable for use in stent manufacture, the design of associated stent geometries, and computational simulations. This project is supported by Disa Vascular, and led by Professor Daya Reddy, with one master's student Richard Pauck.

Computational Electromagnetics: Electro-Mechanical Coupling of Electro-active Polymers

Functional or active materials are those materials whose physical and chemical properties are sensitive to change in the environment, such as temperature, pressure, or the presence of an electric field. These materials are used to develop smart structures which are capable of sensing and adapting to changes in their environment, and smart systems, which comprise smart material, a smart structure, and intelligent processing. As such, they have a broad range of applicability and play an essential and important role in everyday life.



In recent years, functional or active materials have played an increasingly important role in the design of advanced and smart structures as well as intelligent and micro-electromechanical systems. Amongst these kinds of smart materials are the smart hydrogels used in the development of therapeutic devices and drug delivery, piezoelectric polymers which produce an electric current upon being subjected to mechanical strain (and have industry and manufacturing as their largest application market, followed by the automotive industry), and conducting polymers which are collectively known as electroactive polymers (EAP). EAP have a wide range of applications, with one of the most common being in the development of artificial muscles.

These materials are used to develop smart structures which are capable of sensing and adapting to changes in their environment.

A research project being led by Dr Sebastian Skatulla of the Department of Civil Engineering intensively studies the properties of EAP in experiments, and has developed a number of mathematical models. In contrast to existing theories, Dr Skatulla's work seeks to address nonlinear electro-mechanical coupling in a very fundamental manner, that is, to formulate a continuum mechanical approach which directly links electric stimulus and resulting deformation of the polymer material. As the theory is kept very general, it is applicable to a high diversity of electro-mechanical coupling problems.

Dr Skatulla's collaborators include Dr Carlo Sansour (University of Nottingham) and Associate Professor Arunachalakasi Arockiarajan (Indian Institute of Technology Madras).

Strain Gradient Plasticity

In physics and materials science, plasticity describes the change in the shape or size of a material undergoing non-reversible changes in response to an applied force or change in temperature. Perfect plasticity is a property of materials to undergo irreversible deformation without any increase in stresses or loads. Plastic materials with hardening require increasingly higher stresses in order for further plastic deformation to occur. Generally plastic deformation is also dependent on the speed of the deformation; such materials are said to deform visco-plastically.

Because the constitutive relations of classical plasticity do not possess a natural length scale, they are therefore unable to account for size effects. Gradient theories represent a popular and well-established extension which allows for physically relevant length scales to be introduced.

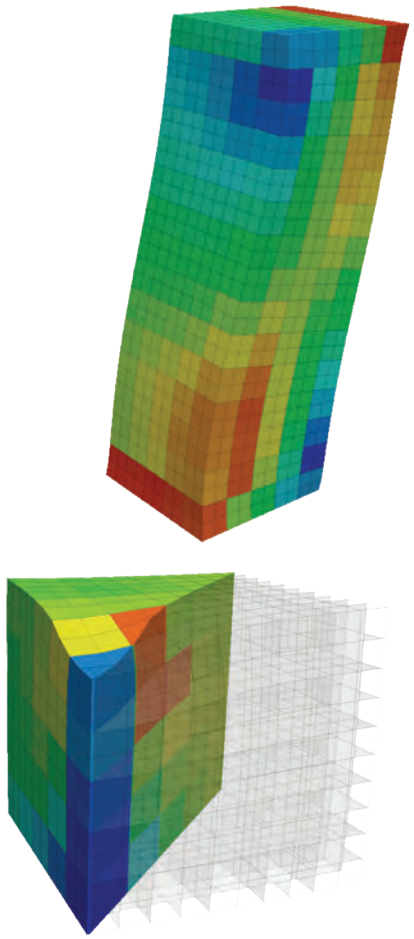
Current research in this area is devoted to problems of single- and polycrystal plasticity. A crystal has atoms in a near-perfect arrangement where a 'pattern' is repeated in regular intervals, whereas a polycrystal is composed of many microscopic crystals. However, the arrangement of atoms or molecules in most crystalline materials is not perfect. The regular patterns are interrupted by crystallographic defects. One focus has been on the development of variational formulations, where the role of particular choices of defect energy and of dissipation functions has been investigated. Also of interest are new hardening relations.

Perfect plasticity is a property of materials to undergo irreversible deformation without any increase in stresses or loads.

Another area of research is on modelling the influence of the grain boundary on the overall response of the continuum. A grain boundary is the interface between two crystallites in a polycrystalline material. Grain boundaries are defects in the crystal structure, and tend to decrease the electrical and thermal conductivity of the material.

Computational work has been concerned with the development and implementation of finite element approximations for visco-plastic crystal problems involving large deformations, and in which both energetic and dissipative microstresses are present. Both single crystals and ensembles of crystal grains are considered.

This large, multi-institution project, led by Professor Daya Reddy, spans a network of five institutions across the globe, and has already produced one master's student. Two doctoral students and a second master's student are currently engaged in research in this area, while Professor Reddy's collaborators include Dr Francois Ebobisse and Dr Andrew McBride from UCT, Professor Swantje Bargmann (Technische Universität Hamburg-Harburg), Emeritus Professor Morton Gurtin (Carnegie-Mellon University), Dr Britta Hirschberger (Leibniz Universität Hannover), Professor Paul Steinmann (Friedrich-Alexander-Universität Erlangen-Nürnberg) and Professor Ali Javili (Friedrich-Alexander-Universität Erlangen-Nürnberg).



Information technology solutions for

The Developing World

ICT4D is a multidisciplinary field which investigates the design and creation of computer systems for the developing world. These systems could cover any sub-discipline in ICT, for example, virtual environments, computer security, interaction design, artificial intelligence, and information retrieval. However, such systems need to be designed and configured according to the needs of the developing world within which power is limited, networks are scarce, and users can be illiterate. ICT4D thus focuses on the creation of ICT solutions that address defined developmental and social challenges such as education, medical care, identity and human dignity.

The work of the UCT Centre in ICT for Development (ICT4D) is about bringing digital technology to bear on the challenges facing society. The centre creates new forms of technology to directly address the developmental problems within society, problems that do not exist in developed economies where most of the world's technology is created.

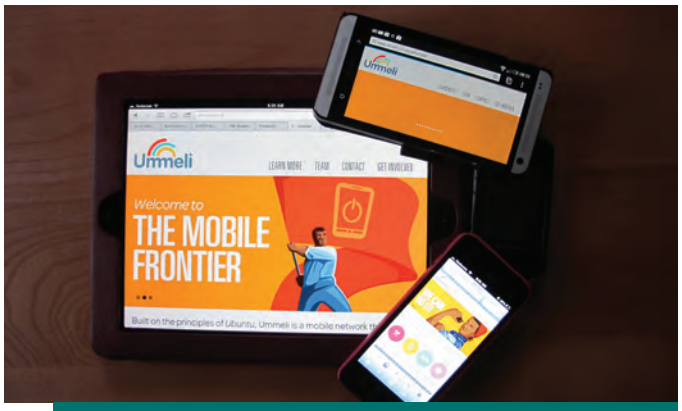
In order to ensure the efficacy, relevance and sustainability of the centre's work, it has partnered with a variety of departments throughout the university – the spectrum ranges from recent projects with the Department of Civil Engineering to others with the Centre for Film and Media Studies in the Faculty of Humanities. The centre also engages with NGOs and civil society through developing digital technology to enhance and improve the work that they are doing.

As educators and researchers, staff affiliated with the centre also take a long-term approach to the problem of creating technology relevant to Africa. The best and most sustainable way to reach that goal is to impart those skills to students and educators throughout Africa. To this end, the Hasso Plattner Institute in Germany sponsors nine PhD bursaries in the centre, specifically for African postgraduate students to visit UCT and conduct research in ICT4D.

The centre is also helping define this field of research internationally by co-hosting the ICTD conference in 2013. This is the first time it will be held in Africa, and it is expected to attract some 500 delegates from across the world, drawn from commercial organisations, government, NGOs and a wide variety of academic disciplines. The work of the centre is further supported by technology companies, the most recent of which is Nokia, which will open a research lab within the centre in 2013.

Ummeli

Ummeli is a system aimed at finding jobs and training opportunities for the unemployed. The idea for this project came from an NGO based in Khayelitsha called Learn to Earn, which trains people in a variety of skills.



When trainees leave, however, they often battle to find jobs. One of ICT4D's HPI bursary students, Shikoh Gitau, spent several months visiting the Learn to Earn site, observing and interacting with the trainees to see if she could discover how better to find them jobs. Over time, she realised that employers were posting jobs on websites; however, the trainees did not look at these websites – their Internet access was mediated through basic-feature mobile phones. In instances where they did find a relevant job advert, they did not have access to computing facilities to create a CV, and were therefore unable to e-mail these to the potential employers.

Thus, obtaining design input from the Learn to Earn community, Gitau set about building a mobile service for mobile handsets which took job advertisements from popular websites and modified them so that they could be accessed on smart phones. Furthermore, the system would ask users a series of questions, the answers to which it used to generate a CV from a template, which could be sent to potential employers. Although the system started with twenty users, it soon went viral. When the number of users reached into the thousands, another technology-based NGO, the Praekelt Foundation, offered to invest in the system and launch it as a free service on the Vodacom network. This became the Ummeli system, which currently has more than 100 000 users. Gitau has gone on to work for Google in Kenya, designing systems that should improve the lives of people throughout Africa.

The Transformation of Information Systems at UCT

A decade ago, the information-systems research agenda at UCT seemed clear: statistically driven empirical research in how information systems functioned (or, sometimes, not) inside corporate organisations. Since then, three key trends have emerged in the way in which research is conducted and students are trained.

Firstly, the democratisation of Information and Communication Technologies (ICTs) has ensured that computerised information systems are no longer the domain of large corporates, but rather extending to small and medium-sized organisations. Even more dramatically, information systems are changing the way governments work and many students now investigate e-government systems. These environments have proved to be different from those of a large corporate, with much of the current information-systems research being undertaken in these settings.

Secondly, Web 2.0 tools such as wikis, blogging and social networking have wrested the control of Internet content generation from big business and yielded it much more democratically to ordinary individuals. At UCT, researchers were thrust into the social sciences by having to investigate how individuals and communities were reacting to information technologies. With this came a change in mindset about the nature of data to collect, the underlying paradigms, and the theories to use to frame an analysis.

Finally, mobile phones hold the promise to give every African his or her own computing device, and with it, access to previously unimaginable amounts of information and computer power.

The transformation of the discipline does not stop there. New information technologies such as cloud computing, 3-D printing and biometrics, virtualisation, augmented reality, and big data emerge at an ever-faster rate, forcing us to relook the way we work and train students. Applying a transdisciplinary approach puts researchers in the prime position to explore topics such as technology innovation and entrepreneurship, security, and governance approaches.

DST/NRF SARChI Chairs
associated with this theme

Professor Kevin J. Naidoo

Scientific Computing

Professor Kevin J. Naidoo has held the Scientific Computing SARChI Chair since 2007 and is director of the Scientific Computing Research Unit at UCT. His research has two interlinked objectives. Firstly, he develops state-of-the-art high performance computing software to provide a modelling and informatics platform creating a life-science virtual laboratory. This includes the development of accelerated software for high-speed chemical and chemical biology computations. A second research objective is to use the life-science virtual laboratory to identify enzyme targets and investigate their detailed molecular action. Professor Naidoo's current focus is the implementation of his gene-to-molecule rational approach to answering key questions that will lead to solutions in microbial and neoplastic (cancer) diseases.

Computational Mechanics

Professor Daya Reddy, who holds the SARChI Chair in Computational Mechanics, is a member of the Department of Mathematics and Applied Mathematics, and Director of the Centre for Research in Computational and Applied Mechanics (CERECAM). He is a graduate of UCT and Cambridge University, and served as dean of the Science Faculty between 1999 and 2005. There are three major, inter-related foci of the research chair: the mathematical modelling of complex material behaviour; analysis of the resulting models to determine their well-posedness; and the development and implementation of algorithms for computational solution. Examples of recent and current work include the behaviour of metals at the micro structural level, non-Newtonian fluids such as polymers, and a variety of applications in cardiovascular biomechanics. The research is highly multidisciplinary and includes collaborators in the mathematical sciences, biomedical sciences, and various branches of engineering.

A major project has been concerned with the development of models and associated simulations for the behaviour of single crystals, in the micron range. There is substantial practical interest in such problems, given their relevance to the manufacture of MEMS (micro-electromechanical systems). The mathematical models are considerably more complex at such scales as they need to take account of size-dependent behaviour. Work during 2012 built on the results of a research programme that has been in progress for the last seven years, with collaborators based in the USA and Germany. A further achievement during 2012 has been the completion and publication of work on modelling of the upper airway. The anatomically accurate mathematical model takes account of neural stimuli to muscles in the tongue and adjacent tissues, and the resulting simulations have allowed for new insights into the mechanisms that induce sleep apnea.

Professor Daya Reddy

Research Groupings
associated with this theme

Scientific Computing Research Unit

The Scientific Computing Research Unit (SCRU) was established in 2009 and has as its core mission the development and application of computer code for scientific problems, specifically in chemistry, biophysics, physics, and engineering.

The unit has made major technical advances in biophysical computational modelling, with the development of a generalised free energy code called FEARCF. In 2009, the unit was awarded a long-term development grant from the Nvidia Corporation to advance the SCRU program to port quantum code to graphical processing unit-based computer clusters. The research group has strong links with international groups, particularly via its Scientific Computing International Lecture Series programme.

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Information and Communications Technology Centre for Development

The Information and Communications Technology Centre for Development (ICT4D) was established in 2008 to capitalise on UCT's unique position in the ICT domain, namely, producing world-class ICT research, but being based in a developing economy. Incorporating researchers from across the university, the centre looks to create ICT solutions that can be applied in a developing-world context.

ICT4D was established to capitalise on UCT's unique position in the ICT domain.

Being the only such centre in a developing country, we have been able to attract researchers and students from across the globe. The Hasso Plattner Institute Research School in ICT4D, which provides bursaries for African students working in this field, was launched in 2009 and will be based within the wider structure of the centre.

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Centre for Information Technology and National Development in Africa (CITANDA)

CITANDA is located within the Department of Information Systems. It brings together researchers, projects, funders, and programmes focused on the use of information and communication technology (ICT) in the service of national development. CITANDA researchers study, using a diversity of research approaches, the management, development, adoption, and impact of ICT in areas related to business, economic, and social development in Africa.

The centre specifically explores and investigates information systems (IS) phenomena that arise at the nexus of interaction between information technology and Africa's business, cultural, social, and economic context, in order to advance knowledge concerning IS in organisations and society in Africa. Through CITANDA, the Department of Information Systems attracts a large cohort of PhD and master's degree students from across Africa and beyond.

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