
UNIVERSITEIT
STELLENBOSCH
UNIVERSITY
2012
FAKULTEIT **NATUURWETENSKAPPE** JAARVERSLAG
FACULTY OF **SCIENCE** ANNUAL REPORT

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'Quiver trees by night 2' deur Prof Florian Breuer

Hierdie panoramiese en surrealistiese foto van kokerbome en die Melkweg het in April 2013 die kortlys gehaal in die oop kategorie van die Wêreldfotografie-toekennings. Met meer as 122 000 inskrywings vanuit 170 lande, word die wedstryd gereken as een van die wêreld se voorste fotografie-toekenningsprogramme.

Cover photo
'Quiver trees by night 2', courtesy of Prof Florian Breuer

In April 2013, this panoramic and surrealistic picture of quiver trees and the Milky Way was shortlisted in the open category for the World Photography Awards. With over 122 000 entries from 170 countries, the competition is regarded as one of the world's leading global photographic awards programmes.

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Report from the **Dean's office**

There are many things to be proud of for 2012: we expanded our expertise and skills base with some excellent appointments; the number of subsidy earning publications reached a new record, as did the number of our NRF-rated scientists.

Several of our scientists have received national and international recognition for their work and our academic departments delivered the highest number of PhD graduates in our history.

Based on its scientific outputs, the faculty moved from position 331 in 2011 to 288 in 2012 in the Quacquarelli Symonds (QS) World University Rankings of faculties in the natural sciences. This is in line with the university's vision to be a research-led academic institution of excellence and a respected knowledge partner in South Africa, Africa and the world. The number of academics who have been rated by the National Research Foundation (NRF) increased from 84 in 2009 to 100 in 2012.

The faculty was awarded two additional SARChI chairs, as well as one shared with the University of Venda. Prof Jacky Snoep was awarded the research chair in Mechanistic Modelling of Health and Epidemiology which is linked to the South African Centre for Epidemiological Modelling and Analysis (SACEMA). The new SARChI chair in Mathematical and Theoretical Physical Biosciences, which the faculty shares with the African Institute for Mathematical Sciences (AIMS), is in the process of being filled.

Many of our scientists received national and international recognition. This includes Prof Leon Dicks, who received an award from the National Science and Technology Forum; Prof Dave Richardson, who was awarded the John FW Herschel Medal of the Royal Society of South Africa; and Prof Jannie Hofmeyr, who received a fellowship at the Berlin Institute for Advanced Study. Prof Liz Bressan was appointed as a member of a commission of the United Nations Educational, Scientific and Cultural Organisation (UNESCO) and Prof Kathy Myburgh was invited to partake in the expert panel of the Gatorade Sport Science Institute in America.

During 2012 several of our staff members were accepted as members of the Academy of Science of South Africa: they are Prof Michael Cherry from the Department of Botany and Zoology, Prof Alf Botha from the Department of Microbiology and Prof Klaus Koch, executive head of the Department of Chemistry and Polymer Science. Prof Eric Strauss, from the Department of Biochemistry, became a member of the South African Young Academy of Science.

Our former dean, Prof Eugene Cloete, was made a Fellow of the Royal Society of South Africa, and appointed as Stellenbosch University's new Vice-rector: Research and Innovation, from September 2012. We would like to make use of this opportunity to thank Prof Cloete, who was dean from 2009 until August 2012, for the exceptional energy, creativity and passion with which he managed this faculty.

At the end of 2012 the faculty established a Science Teaching and Learning Discussion Forum under the guidance of Prof Ingrid Rewitzky, Vice-Dean: Teaching, together with Dr Hanelie Adendorff from the Centre for Teaching and Learning and Dr Margaret Blackie from the Department of Chemistry and Polymer Science. The aim of the forum is to support the teaching and learning function in the faculty, as well as promoting research on this topic.

Several of our scientists have received national and international recognition for their work and our academic departments delivered the highest number of PhD graduates in our history.

Interactive teaching approaches in lectures and tutorials for some modules have contributed towards a more active and engaging learning experience for students. Although the impact of this approach is not fully measurable yet, it is creating an opportunity for deeper and enduring understanding. As a step towards encouraging more such initiatives, the faculty successfully secured Teaching Development Grants from the Department of Higher Education with the aim of improving the pass rate of undergraduate students, while also developing the interactive teaching skills of lecturers.

After a critical review of the undergraduate final year curricula of all programmes, a double major was reinstituted in most of the programmes. This programme renewal enables the faculty to equip students with more in-depth knowledge for postgraduate studies and allows them two possible options for honours studies.

Like the university as a whole, the Faculty of Science recorded a decrease in new student enrolment in 2012. Fortunately, the latter concern appears to be temporary. However, we are concerned about the small decrease in the diversity of our undergraduate student intake. An investigation into the reasons suggested that a lack of finance was the single most important contributor to low registration. The number of recruitment bursary offers from the faculty was therefore increased from 46 in 2012 to 149 in 2013.

Approximately 35% of our postgraduate students are from designated groups. The recovery of student diversity on all levels, and an increase in staff diversity, remains a major focus for the future.

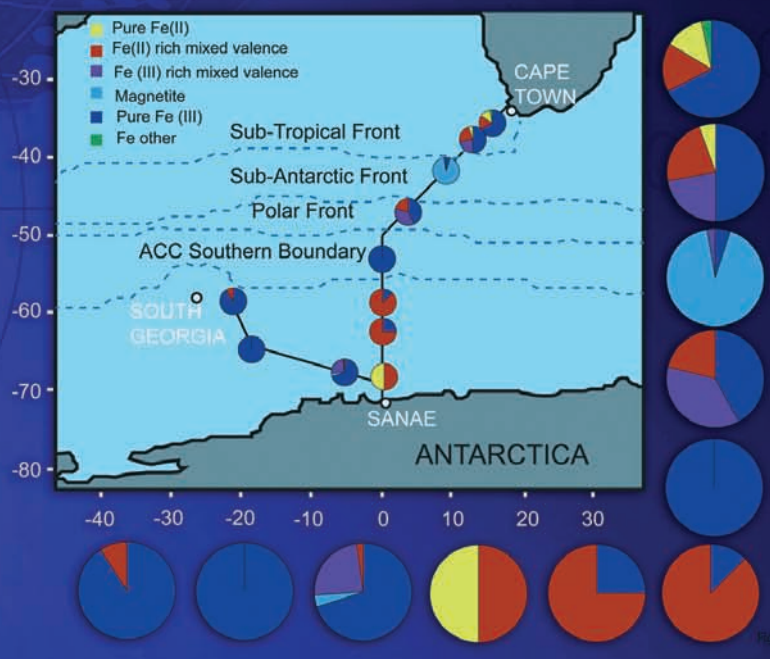
The Faculty of Science values its people as its most important asset. We are proud of the excellent reports of our eight academic departments, and it is evident that the faculty continues to be a major contributor to the wellbeing and sustainability of this university and South African society in general.

Prof Doug Rawlings
Dean (acting):
Faculty of Science,
Stellenbosch University

Prof Terry Robinson
Vice-Dean: Research,
Faculty of Science,
Stellenbosch University

Prof Ingrid Rewitzky
Vice-Dean: Teaching,
Faculty of Science,
Stellenbosch University

Department of **Earth Sciences**



Researchers study the chemical and mineralogical composition of iron particulates in the ocean between Cape Town and Antarctica. This adds to our understanding of how trace nutrients impact on the productivity of oceans, thereby affecting the global carbon cycle, ocean acidification and climate change. The map and pie charts above show the relative distribution of iron species as defined by their spectral features. The results of this study were published in the leading scientific journal, *Science*.

Map: Bjorn von der Heyden & Prof Alakendra Roychoudhury

Department of **Earth Sciences**

Research Interests

Tectonics and orogenic processes; sedimentology of the Karoo Basin; petroleum geology; petrogenesis of granitic rocks; metamorphic petrology; trace-element and isotope geochemistry; experimental petrology; shear-zone hosted gold deposits; massive sulphide deposits; heavy mineral placer deposits; metallogenesis of mobile belts; environmental water and soil geochemistry.

Research outputs	
Articles in accredited journals	19
Books	1
Conference proceedings	1
Editorial activities (books and journals)	4
MSc students graduated in 2012	8
PhD students graduated in 2012	5

Research highlights

Prof Gary Stevens's SARChI Chair was renewed and upgraded to a Tier 1 Chair, with increased funding. His NRF research rating was upgraded. He delivered a keynote address entitled "From Anatexis to Granite: an Examination of How Melt Chemistry and Peritectic Assemblage Entrainment Shape Granite Compositions" at the 34th International Geological Congress (Australia).

Prof Abraham Rozendaal chaired and presented a lecture in the Council for Geoscience Namaqualand Initiative Workshop, held in November.

Prof Alex Kisters' NRF rating was upgraded to B and he has secured significant funding for a major, three-year research project in Tanzania with AngloGold Ashanti.

Prof Ian Buick has secured three years of funding as a Special Visiting Researcher as part of the Brazilian Science Without Borders programme.

PhD student Bjorn von der Heyden, his supervisor Prof Alakendra Roychoudhury and a number of other contributors jointly published a high-profile paper in the journal *Science*. The title of the paper is: "Chemically and Geographically Distinct Solid-Phase Iron Pools in the Southern Ocean".

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Academic affairs

The honours cohort for 2012 is a record 34 students and is indicative of the year-on-year increases that we have been able to sustain since 2007 when we had halve that number. Given the nature of our project-driven honours programme the large numbers are proving difficult to handle. This has no impact on the department's ability to supervise MSc and PhD students, as these are recruited from external sources as well as the best of our own honours graduates.

The department also hosts 18 MSc and seven PhD students, a substantial cohort considering the size of our staff complement.

Service to the scientific community

Prof John Clemens chaired the Earth Sciences Ratings Panel of the National Research Foundation (NRF). He is the founding president of the Igneous and Metamorphic Studies Group (affiliated with the Geological Society of SA) and a member of the Post-NOMAD drilling programme steering committee.

Prof Alakendra Roychoudhury is an associate editor of the international journal *Applied Geochemistry*, a member of the Council for the International Association of GeoChemistry (IAGC), a member of the Awards Committee of the IAGC and the Geochemical Society and a founder member of Africa Earth Observatory Network (AEON). In addition he is also a board member of the Marine Research Institute (MA-RE) at the University of Cape Town, a steering committee member of the Applied Centre for Climate and Earth Systems Science (ACCESS), of the International Geotraces Programme, and of the National Oceanographic Equipment and Planning Committee.

Prof Gary Stevens is a committee member of the Western Cape Regional Expensive Equipment Programme (REEP). He also contributes in his position as Director of the Central Analytical Facility (CAF) at Stellenbosch University and, perhaps most importantly, as the SARChI Chair of Experimental Petrology, hosted within the Department of Earth Sciences, as part of the South African Research Chair Initiative (SARChI) Programme. He is a member of the editorial boards of *Lithos*, *Terra Nova* and the *Journal of Metamorphic Geology*.

Prof Alex Kisters serves on the editorial board of the *South African Journal of Geology* and as a panel member of the NRF South African National Antarctic Programme (SANAP).

Prof Ian Buick is a member of the editorial boards of *Lithos* and *Gondwana Research*.

Dr Jodie Miller chairs the Western Cape Branch of the Geological Society of South Africa (GSSA).

Prof Dirk Frei is a permanent member of the European Science Foundation's pool of reviewers for research proposals.

The academic staff in the department regularly serve as reviewers of scientific papers, research proposals and rating applications (nationally and internationally). They also acted as external examiners of MSc and PhD candidates.

Awards to staff and students

Ms Tarryn-Kim Rudnick was presented with the Geological Society of South Africa's Haughton Award for the best BSc Honours thesis in earth sciences at a South African university. Her thesis concerns aspects of the origin of the Swartberg Cu-Pb-Zn-Ag deposit in the northwest of South Africa.

Staff matters

Dr Catherine Clarke (environmental and soil geochemistry) left the Department of Earth Sciences and transferred to Soil Science as a lecturer. Her replacement, Dr Susanne Fietz, takes up her duties on 1 January 2013.

During 2012, Prof Axel Gerdes from Goethe University (Germany) was appointed as Extraordinary Professor. Prof Gerdes is a renowned researcher in geochemistry and isotope geoscience.

Collaboration

SOUTH AFRICA
Agricultural Research Council, Nietvoorbij
Council for Geosciences
Council for Scientific and Industrial Research
iThemba Labs
Rhodes University
South African Nuclear Energy Corporation
University of Cape Town
University of Pretoria
University of the Western Cape
University of the Witwatersrand

AFRICA
Geological Survey of Namibia
University of Namibia

INTERNATIONAL
General
Geotraces International (Australia, UK, USA)

Australia
Australian National University
Curtin University of Technology
James Cook University
Monash University
Museum Victoria
University of Adelaide

Brazil
Federal University of Ouro Preto

Canada
McGill University
University of Ottawa

China
China University of Geosciences, Wuhan Campus

Denmark
Geological Survey of Denmark and Greenland

Finland
University of Helsinki

France
University Blaise-Pascal, Clermont-Ferrand
University of Brest
University of Paris VII
University of Rennes
University of St Etienne

Germany
Aachen University of Technology
Freiburg University
Memorial University
University of Hamburg

India
University of Rajasthan
Indian Institute of Technology Kharagpur

Ireland
University College Dublin

Italy
University of Padova

Japan
Shizuoka University

The Netherlands
Delft University of Technology
Rijks University of Groningen
University of Utrecht

Spain
University of Grenada

Sweden
Linköping University

Switzerland
University of Lausanne

Photo: Engela Duvenage

Mr Bjorn von der Heyden and his study leader Prof Alakendra Roychoudhury.

Doctoral student publishes in Science

In a first for the Faculty of Science, one of our doctoral students made history when he published in Science, *one of the world's leading academic journals.*

The article, by ***Bjorn von der Heyden*** *and his supervisor,* ***Prof Alakendra Roychoudhury*** *of the Department of Earth Sciences, was published in the November 2012 issue of* Science, *in collaboration with Princeton University and the Council for Scientific and Industrial Research (CSIR).*

The study – of iron particulates in the ocean between Cape Town and Antarctica – is the first of its kind and the samples were collected during three research trips across the Southern Ocean. The chemical and mineralogical composition of particles in the surface seawater samples was analysed and researchers then identified five different types of iron particles. The finding adds to the understanding of how trace nutrients impact on the productivity of oceans, thereby affecting the global carbon cycle, ocean acidification and climate change.

Mr von der Heyden developed a novel technique to understand iron particle chemistry and used an X-ray-based method to locate, analyse and map nanosized particles in the seawater. For this, he had to use synchrotron apparatus at Lawrence Berkeley National Laboratory, because similar particle accelerators are not yet available anywhere in Africa.

United Kingdom
Durham University
Leeds University
Liverpool University
University of Edinburgh
Newcastle University

United States of America
Colorado School of Mines
Lehigh University
Princeton University
Woods Hole Oceanographic Institute

Funding

Anglo Base Metals
AngloGold
AngloGold Ashanti
AngloPlatinum
Australian Research Council
BHP Billiton
Chevron Texaco
ConocoPhilips
Council for Scientific and Industrial Research
European Union
ExxonMobil
Geological Society of South Africa
Government of Gabon
Inkaba ye Africa
Kumba Resources
Namaqua Sands
National Research Foundation
Schlumberger
StatoilHydro
TransHex
Water Research Commission

Staff

Academic

Prof JD Clemens
Prof IS Buick
Dr R Heyn
Prof A Kisters
Dr M Klausen
Dr D Mikes
Dr J Miller
Prof A Roychoudhury *(departmental head from October 2012)*
Prof A Rozendaal
Prof G Stevens

Extraordinary professors

Prof A Gerdes
Prof N Phillips
Prof W Verwoerd

Extraordinary associate professors

Prof D Frei

Extraordinary senior lecturer

Dr I Basson

Support staff

L Conradie
G Olivier
F Timmey

NRF-rated researchers

Internationally acclaimed researcher

Prof John Clemens
(igneous and experimental petrology)

Prof Ian Buick
(metamorphic petrology, geochemistry and isotope geochemistry)

Prof Gary Stevens
(SARChi Chair of Experimental Petrology)

Prof Alex Kisters
(structural geology and tectonics)

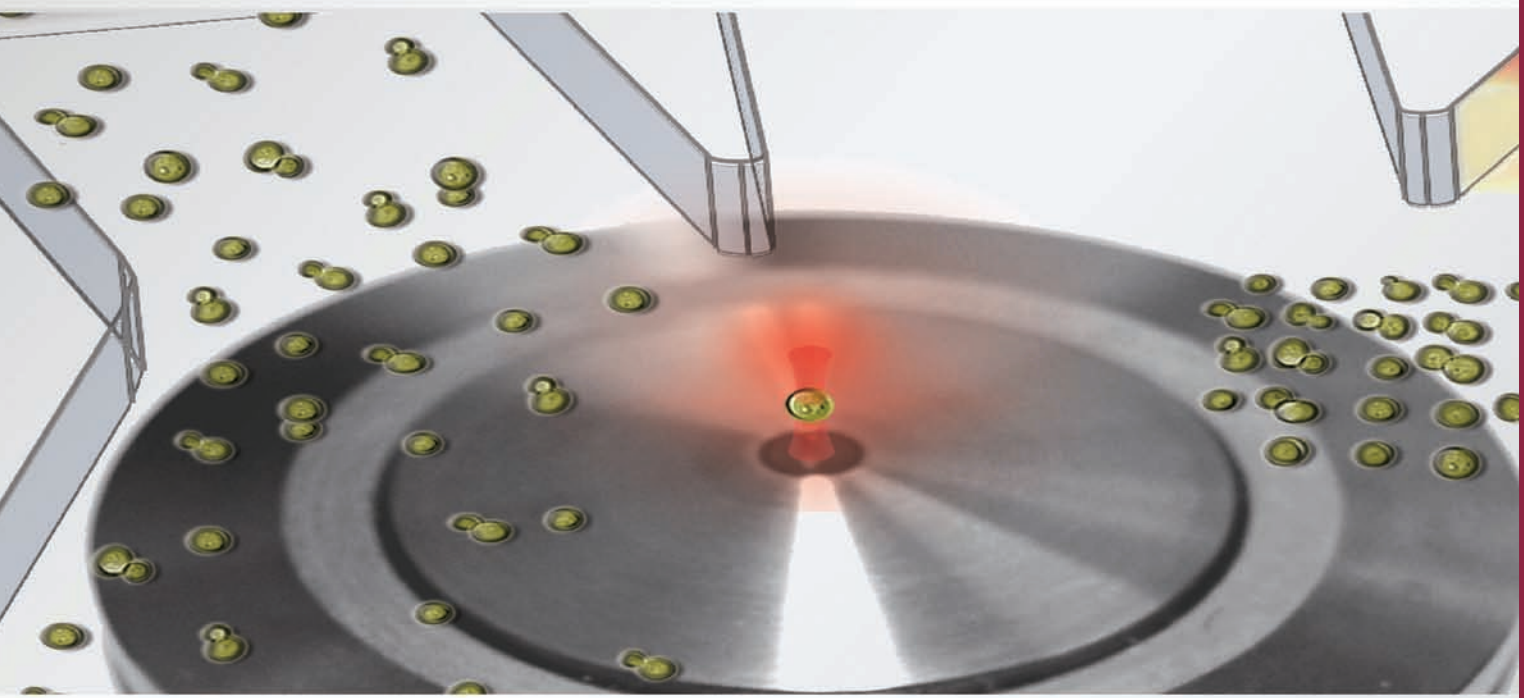
Established researcher

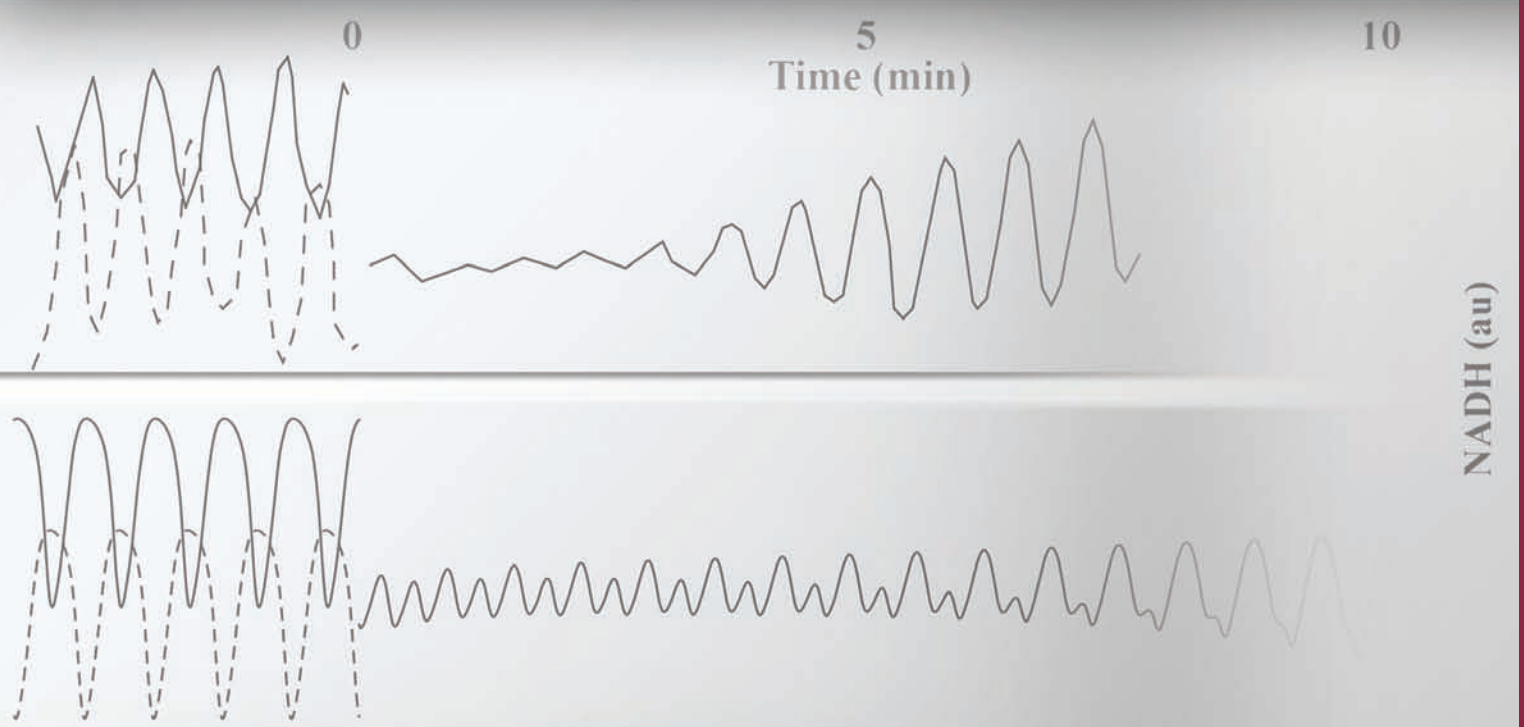
Prof Alakendra Roychoudhury
(environmental geochemistry and hydrology)

Scientists are studying the control and regulation of cellular processes using theory, computer modelling and experimental approaches. In this instance, they constructed a detailed mathematical model for yeast glycolytic oscillations to study the synchronisation of out of phase yeast populations in mixing experiments. They then used the same model to find experimental conditions for metabolic oscillations in isolated yeast cells. Together with researchers from the University of Gothenburg they were the first to observe sustained glycolytic oscillations in isolated yeast cells. Optical tweezers were used to position the cells, and a microfluidic chamber to control the environment.

Graphics: Prof Jacky Snoep

Department of **Biochemistry**





Department of **Biochemistry**

Research Interests

Antibiotics and membrane active peptides; application of bio-active peptides in agriculture; bioactivity of rooibos, honeybush and *Sutherlandia frutescens;* biocatalysis; computational and experimental systems biology; enzyme inhibitor development; malaria metabolism and antimalarial drugs; mechanistic enzymology; membrane affinity separation; natural products; ostrich pathology and vaccine development; plant molecular systematics; potato virus systematics and detection; adrenal and prostate steroid hormone biosynthesis and metabolism; steroid receptors and binding proteins.

Research outputs	
Articles in accredited journals	31
Editorial activities (books and journals)	6
Books, conference proceedings, chapters in books	3
MSc students graduated in 2012	9
PhD students graduated in 2012	5

Research highlights

The Biochemistry Department was strongly represented at the 23rd Congress of the South African Society of Biochemistry and Molecular Biology which was held in January 2012 in conjunction with the Federation of African Societies of Biochemistry and Molecular Biology in the Drakensberg. Prof Erick Strauss presented the Beckman Coulter/SASBMB silver medal lecture as the winner of this award for 2010. Prof Ann Louw and five of her students presented two oral presentations and three poster presentations. Prof Marina Rautenbach and six of her students presented two oral and five poster presentations.

Dr Donita Africander attended the Cold Spring Harbor Laboratory Meeting on Nuclear Receptors and Disease in New York (USA) and presented a poster on her research. Prof Dirk Bellstedt and one of his students presented two lectures at the 5th PVYWide Organization Meeting in Edinburgh (Scotland) and subsequently visited the Royal Botanic Gardens Edinburgh.

Prof Ann Louw presented an invited lecture at the Symposium on Bioactive Principles of Medicinal Plants and Diet at the Technische Universität Dresden (Germany) in October 2012. She presented a poster at the combined congress of the Federation of European Biochemistry Societies (FEBS) and the International Union of Biochemistry and Molecular Biology (IUBMB) in Seville (Spain) in September 2012.

Prof Marina Rautenbach was a visiting scientist at the Leipzig Institute for Molecular Pharmacology in Berlin (Germany) in July 2012. She gave three poster presentations at the 3rd International Conference on Antimicrobial Peptides in Villeneuve d'AscQ (France). Prof Johann Rohwer presented a lecture at the 5th Annual Conference on Python in Science (EuroScipy 2012) held in Brussels (Belgium).

Prof Jacky Snoep's research group, together with Swedish collaborators, published three back-to-back papers in the *Federation of European Biochemical Societies Journal* (FEBSJ) on glycolytic oscillations. These papers were also selected for the virtual issue of the journal to showcase excellent examples of systems biology work. Dr Anna-Karin Gustavsson (a Swedish participant) received the award for the best young scientist's contribution.

Prof Erick Strauss gave an invited lecture at the Zing Natural Products Conference in Lanzarote (Spain) in February 2012. Prof Pieter Swart presented a plenary lecture at the Molecular Medicine Conference 2012 (MMC2012) held in Bangkok (Thailand) in December 2012.

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Academic affairs

One of the strengths of the Biochemistry Department is its large number of postgraduate students: in 2012 the department enrolled 20 Honours students, 34 MSc students and 23 PhD students.

Service to the scientific community

Dr Donita Africander served as treasurer of the South African Society of Biochemistry and Molecular Biology.

Prof Johann Rohwer was a member of the international Standards for Reporting Enzymology Data (STRENDA) commission and served as an associate editor of *BMC Systems Biology*. He was also elected to the editorial board of *Frontiers in Plant Systems Biology*.

Prof Jacky Snoep served as editor for the following journals: *Federation of European Biochemical Society Journal* (FEBSJ), *Microbiology, IET Systems Biology*, and *Metabolomics*.

Awards to staff and students

Two academic staff members were successful in their applications to the NRF for re-evaluation. Prof Jacky Snoep improved his rating from B3 to B2 and Prof Ann Louw improved her rating from C3 to C2.

Dr Karl Storbeck and Ms Lindie Schloms both received an Award of Excellence for young researchers at the 15th Conference of the Adrenal Cortex in Texas (USA) in June 2012.

Prof Jacky Snoep was awarded a SARChI research chair in mechanistic modelling of health and epidemiology, to work on a mechanistic understanding and mathematical modelling of whole body disease state during malaria and HIV infections, and diabetes type II development. He will work closely with the South African Centre for Epidemiological Modelling and Analysis (SACEMA) on modelling HIV epidemiology.

Staff matters

Dr Karl Storbeck was appointed as a lecturer with effect from 1 June 2012. Mr Charlton Jansen was appointed as an assistant with effect from 1 July 2012.

Community interaction

Prof Marina Rautenbach gave two talks on proteins and amino acids in natural fertilisers to wine farmers in the Boland. The aim of these talks was to showcase the role of biochemistry in agriculture. She also acted as consultant for several companies such as SABMiller, Rhodes Food Group, Diasorin and EcoFert.

Collaboration

SOUTH AFRICA

BBI Enzymes
Council for Scientific and Industrial Research, Biosciences
Department of Biochemistry, University of Pretoria
Departments of Chemistry and Molecular and Cell Biology, University of Cape Town
Department of Medical Bioscience, University of the Western Cape
Diasorin
EcoFert
Elsenburg Agricultural College
Grootfontein Agricultural Development Institute
Institute of Pharmacology, University of Cape Town Medical School
Klein Karoo Group
Mohair South Africa
Post-Harvest & Wine Technology Division, Agricultural Research Council, Infruitec-Nietvoorbij
Potatoes South Africa
Research Solutions
Rhodes Food Group
SABMiller
South African Rooibos Council
SurePure
School of Biochemistry, Genetics and Microbiology, University of KwaZulu-Natal
School of Chemical and Metallurgical Engineering, University of the Witwatersrand
Unit for Drug Research and Development, North West University

INTERNATIONAL

Australia
Australian National University
La Trobe University

Germany
Leibniz Institute of Molecular Pharmacology
Max Planck Institute of Chemical Ecology
Max Planck Institute of Molecular Plant Physiology

Hungary
Department of Inorganic and Analytical Chemistry, University of Debrecen

Italy
Italian National Research Council (CNR), Institute of Protein Biochemistry

Netherlands
Vrije Universiteit Amsterdam

Spain
Universitat Autònoma de Barcelona

Sweden
University of Gothenburg

Switzerland
University of Zürich

United Kingdom
Royal Botanic Garden Edinburgh
University of Aberdeen
University of Edinburgh
University of Manchester

United States of America
Department of Physiology, Medical College of Georgia,
Department of Chemistry, University of Wisconsin
Department of Dermatology and Urology, Feinberg School of Medicine, Northwestern University, Chicago
Department of Molecular and Integrative Physiology and Internal Medicine, University of Michigan

Funding

BBI Enzymes
Biopep Research Fund
Cancer Association of South Africa
Ernst Oppenheimer Fellowship Trust Fund
German/South African Bilateral Fund
Hungarian/South African Bilateral Fund
Klein Karoo Group
Medical Research Council
Mohair South Africa
National Research Foundation
Potatoes South Africa
Research Solutions
SABMiller
South African HIV/AIDS Research and Innovation Platform
South African Malaria Initiative
South African Rooibos Council
SurePure
Stellenbosch University
Technology and Human Resources for Industry Programme (THRIP)
Water Research Commission

Biochemist receives further funding for rooibos research

Prof Amanda Swart *is one of a handful of South African scientists whose research endeavours are to benefit from a R2 million research grant from the South African Rooibos Council (SARC).*

Prof Swart is a biochemist and an associate professor in the SU Department of Biochemistry. For the past four years she has received SARC-funding for her work on the unique ability of red bush tea to lower stress levels.

Prof Swart published scientific evidence that rooibos tea lowers the production of cortisol, the so-called "stress hormone". Cortisol is produced by the adrenal glands in the human body. Although cortisol is part of the normal human metabolism, stressful lifestyles can result in high levels of this steroid hormone. The overproduction of cortisol as a result of stress can lead to a number of lifestyle diseases such as hypertension, metabolic syndrome, cardiovascular disease, insulin resistance and Type 2 diabetes.

Her research team was able to pinpoint two rare components in rooibos – the two flavonoids called aspalathin and nothofagin – that have an influence on the biosynthesis of cortisol. Aspalathin has not been found in any other plant material, while nothofagin has a very limited distribution in nature.

Staff

Academic

Prof P Swart *(head of department)*
Dr DJ Africander
Prof DU Bellstedt
Dr A Botes
Prof J-HS Hofmeyr
Prof A Louw
Prof M Rautenbach
Prof JM Rohwer
Prof JL Snoep
Dr K Storbeck
Prof E Strauss
Prof AC Swart

Extraordinary professor

Prof WCA Gelderblom

Support Staff

W Maart *(secretary)*
AP Arends
KD Botha
R Brandt
CA de Villiers
L du Toit
A Februarie
LL Foster
GD Gerstner
CR Jansen
C Langeveldt
RP Louw
Dr MA Stander

NRF-rated researchers

Leading international researcher

Prof Jannie Hofmeyr
(systems biology and complexity studies)

Internationally acclaimed researcher

Prof Johann Rohwer
(systems biology)

Prof Jacky Snoep
(systems biology)

Prof Pieter Swart
(adrenal steroidogenesis, affinity separation and protein immobilisation)

Established researcher

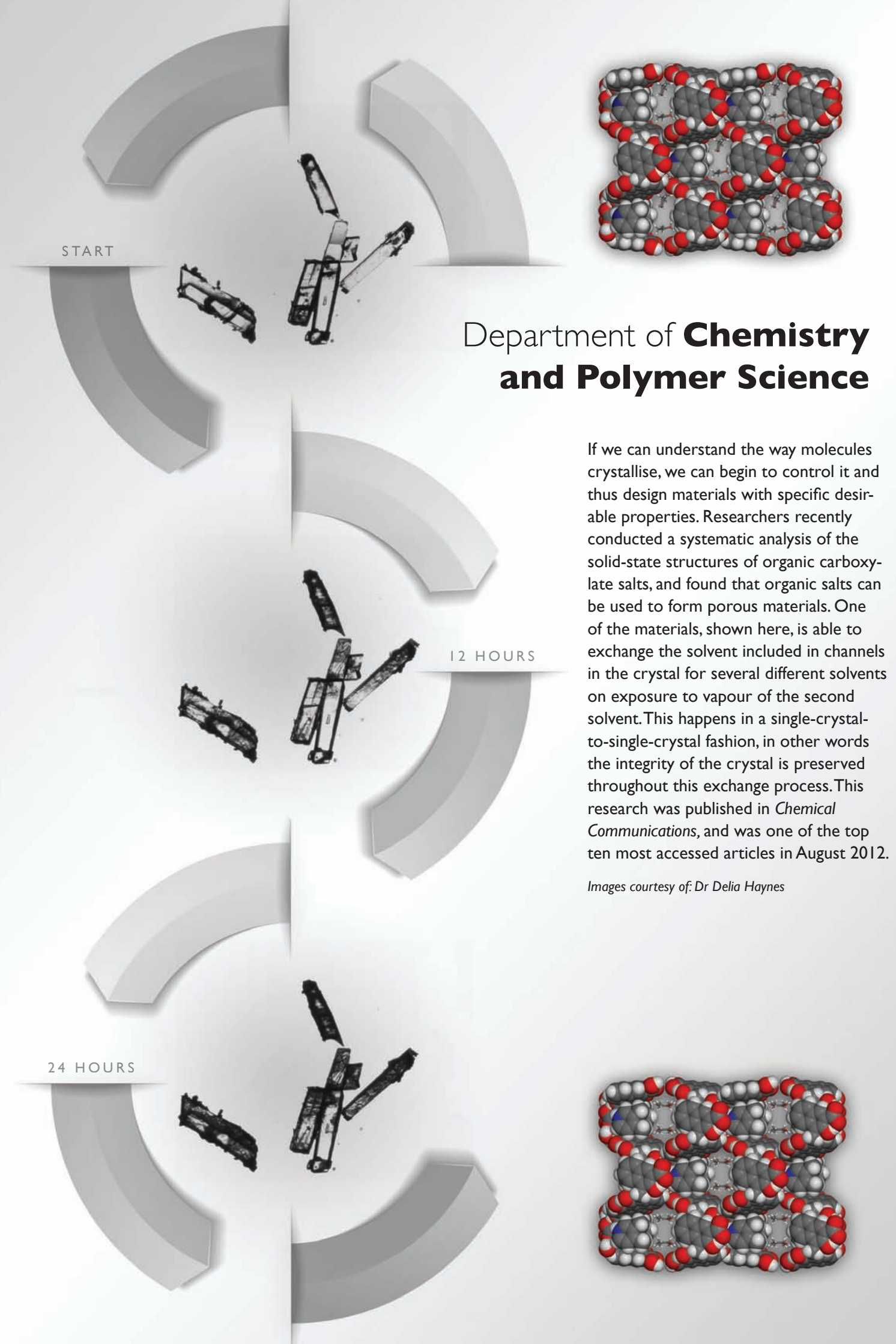
Prof Dirk Bellstedt
(molecular systematics and immunology)

Prof Ann Louw
(steroid receptors, bioactivity of honeybush)

Prof Amanda Swart
(bioactivity of honeybush and Sutherlandia frutescens)

NRF Prestigious Awardee

Prof Erick Strauss
(mechanistic enzymology and inhibitor development)



Department of **Chemistry and Polymer Science**

If we can understand the way molecules crystallise, we can begin to control it and thus design materials with specific desirable properties. Researchers recently conducted a systematic analysis of the solid-state structures of organic carboxylate salts, and found that organic salts can be used to form porous materials. One of the materials, shown here, is able to exchange the solvent included in channels in the crystal for several different solvents on exposure to vapour of the second solvent. This happens in a single-crystal-to-single-crystal fashion, in other words the integrity of the crystal is preserved throughout this exchange process. This research was published in *Chemical Communications*, and was one of the top ten most accessed articles in August 2012.

Images courtesy of: Dr Delia Haynes

Department of **Chemistry and Polymer Science**

Research Interests

Synthetic methodology directed towards useful new compounds and materials (catalysts, polymers, other supramolecular frameworks with application potential, membranes and biologically active compounds); separation technology and advanced analysis (GC-MS, HPLC-MS, GPC, electroanalysis, NMR, polymer separation, AFM, ICP-MS , CRYSTAF and X-ray diffraction); modelling of molecular structure; platinum metals chemistry research in the context of refining and purification; medicinal chemistry.

Contact details

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Web www.sun.ac.za/chemistry

Research outputs	
Articles in accredited journals	90
Articles in non-accredited journals	8
Conference proceedings	2
Chapters in books	4
MSc students graduated in 2012	18
PhD students graduated in 2012	13
DSc students graduated in 2012	1

Research highlights

The department's research productivity continued to grow and reached a record in 2012, with 82 peer-reviewed papers, 10 published symposium and conference proceedings and four chapters in books appearing. Moreover, in December 2012 one DSc, eight PhD and three MSc degrees (one *cum laude*) were awarded, while in the March 2013 graduation ceremony, an additional 5 PhD and 10 MSc (one *cum laude*) degrees were conferred. Prof Bert Klumperman graduated DSc, the only one in more than a decade, while also having guided four students to their PhD graduation.

The high-impact journal of the Royal Society of Chemistry (RSC), *Chemical Communications*, featured an article by Dr Delia Haynes and co-workers on its cover. The title of the article is "Interconversion between different stoichiometric forms of a three-component crystal via liquid-assisted grinding".

Dr Katharine de Villiers-Chen, Dr Tanya Le Roux and PhD student Kalifi Gildenhuyss published a full paper, titled "The Single Crystal X-ray Structure of ß-Hematin DMSO Solvate Grown in the Presence of Chloroquine, a ß-Hematin Growth-Rate Inhibitor" in the *Journal of the American Chemical Society*, the flagship journal of the American Chemical Society and the preeminent journal in the field.

The National Research Foundation (NRF) awarded higher research ratings to staff members Prof Bert Klumperman (A2) and (Emeritus) Prof Helgard Raubenheimer (B1), Associate professors Catharine Esterhuysen and Albert van Reenen (C2), with Dr Stephen Pelly being rated Y2.

Several academic researchers visited the department to collaborate with staff members and present seminars. They are: Prof Ebbe Nordlander, University of Lund (Sweden); Dr Alan Kenwright, Durham University (UK); Prof Alan Rowan, Radboud University (Netherlands); Prof Tom Simpson, University of Bristol (UK); Prof David Wright, Vanderbilt University (USA); Prof Jonathan Steed, Durham University (UK); Dr Graeme Day, University of Southampton (UK); Prof Kevin Naidoo, University of Cape Town (SA); and Prof Tadeusz Gorecki, University of Waterloo (Canada).

Academic staff members and students represented the department at several national and international conferences. Prof Klaus Koch gave a plenary lecture at the 21st Slovenian-Croatian Crystallographic Meeting, an invited lecture at the 40th International Conference on Coordination Chemistry (Spain) and a keynote lecture at the Platinum Conference: A Catalyst for Change, organised by the

Southern African Institute of Mining and Metallurgy (South Africa).

Prof Harald Pasch was invited to present keynote lectures at the International Symposium on High Performance Liquid Phase Separations (HPLC 2012) (USA) and the first National Institute for Standards and Technology (NIST) Workshop on Macromolecular Separations-by-Design (USA). He also presented invited lectures at the Applied Polymer Chemistry (APC) Talks (Germany), ANALYTIX-2012 (China), the International Union of Pure and Applied Chemistry (IUPAC) Macro 2012 World Polymer Congress (USA), the 4th International Conference on Polyolefin Characterization (USA), and the Polymer Science Lecture Series (China).

Prof Bert Klumperman gave invited lectures at the 33rd Australasian Polymer Symposium (Australia), the Macro Group UK International Conference on Polymer Synthesis (UK), and the American Chemical Society National Meeting (USA).

The department was represented by Prof Selwyn Mapolie at the XXVth International Conference on Organometallic Chemistry (Portugal) and the 40th International Conference on Coordination Chemistry (Spain), while Prof Peter Mallon attended the POLYCHAR 20 (World Forum on Polymers and Advanced Materials) (Croatia). Dr Delia Haynes served on the organising committee of Indaba 7 (South Africa) and participated in the Gordon Research Conference on Crystal Engineering (USA). Dr Katherine de Villiers-Chen participated in the Gordon Research Conference on the Chemistry and Biology of Tetrapyrroles (USA) and Dr Robbie Luckay attended the 40th International Coordination Chemistry Conference (ICCC) (Spain).

Prof André de Villiers gave invited keynote addresses at the 12th International Symposium on Hyphenated Techniques in Chromatography (HTC-12) (Belgium), Separation Science Asia 2012 (Malaysia) and ChromSAAMS 2012 (South Africa).

Service to the scientific community

Staff members were involved as members with several national councils and organisations, particularly the South African Chemical Institute (SACI), the Society of Biological Inorganic Chemistry, the South African Crystallographic Society (SACryst), the Academy of Science of South Africa and the Royal Society of South Africa.

Membership of international organisations included the Royal Society of Chemistry (UK), the American Chemical Society, the American Crystallographic Association, the Royal Dutch Chemical Society and the International Society for Biomedical Polymers and Polymeric Biomaterials.

Prof Catharine Esterhuysen serves as a member of the South African committee of the International Union of Crystallography (IUCr), as well as president of the South African Crystallographic Society (SACrS).

Prof Peter Mallon is the chairperson of the Western Cape Section of SACI and a member of the SACI Council. Dr Gareth Arnott is a member of the board of SACI Western Cape, while Dr Margaret Blackie serves as its treasurer. Dr Arnott is also a member of the 2014 Frank Warren organising committee, responsible for putting together the next biennial South African Conference on Organic Chemistry.

Prof Klaus Koch and Prof Harald Pasch are members of the executive committee of the International Coordination Chemistry Conferences (ICCC).

Prof Mallon serves on the scientific committee of the World Forum on Advanced Materials (POLYCHAR) and is the chairman of the organising committee of POLYCHAR 22 which will take place in Stellenbosch in April 2014.

Prof Bert Klumperman is involved in a number of international committees, including the International Union of Pure and Applied Chemistry (IUPAC) Working Party on Polymerization Processes and Kinetics; the IUPAC task group on the kinetics of RAFT-polymerization; and the International Advisory Board for IUPAC's 2012 conference in Warwick (UK). He also served on the International Advisory Committee for IUPAC MACRO 2012 World Polymer Congress in Virginia (USA), the International Advisory Committee for the 2013 conference of the European Polymer Federation in Pisa (Italy), as well as on the Scientific Advisory Board for the international conference on Industrial Biotechnologies to take place in Nanjing (China) in 2013.

Prof Mallon served on the NRF review panel of the Chemistry Thutuka programme for post-doc and early-career researchers. Dr Katherine de Villiers-Chen acted as judge at the regionals of the Eskom Expo for Young Scientists.

Staff members served on the editorial boards of a number of national and international journals. Prof Catharine Esterhuysen is a member of the editorial board of the *International Science & Technology Journal* of Namibia and Prof Willem van Otterlo is the scientific editor (Organic Chemistry) for the *South African Journal of Chemistry*. Prof Len Barbour serves on the editorial board of the *New Journal of Chemistry* and the editorial advisory board of *Crystal Engineering Communications* (both Royal Society of Chemistry journals). He was guest editor of a special themed issue of *Chemical Communications* (on CO_2 capture) and guest editor of a special themed issue of *Crystal Engineering Communications* (on macrocyclic chemistry). Prof Bert Klumperman is a member of the editorial board of *ChemZA* and of the editorial advisory board of *Transactions of the Royal Society of South Africa*. He is also the editor of the *European Polymer Journal*.

Awards to staff and students

Dr André de Villiers was named Chromatographer of the Year by the Chromatographic Society of South Africa (ChromSA) at the ChromSAAMS Conference (South Africa).

In 2012, our top female students walked away with all the student prizes. Ms Leandi van der Westhuizen received the SMM-award for the best BSc (Hons) student in Chemistry. Ms Alet van der Westhuizen, Ms Leanne Brits and Ms Nicola Steyn received Element Six DST/NRF Centre of Excellence awards for achievements in Polymer Science, and Ms Carla Egen was awarded the Jooste Postgraduate Award for Textile Science.

Staff matters

In 2012 the university's glassblower, Mr Eric Ward, reached retirement age. We were fortunate to find a replacement for this important post with the appointment of Mr Malcolm McLean. Mr Ward, a 'master' glassblower, will assist in guiding the new incumbent to achieve master glassblowing status in the next two years.

SU chemists create new separation technique

Chemists from Stellenbosch University were inspired by research dating back to the 1950s to develop a new process to make the separation of xylene (a chemical derived from crude oil) faster and more energy efficient.

This new process could benefit the production of pigments for the paint industry, fungicides, polymers and various types of plastics used today.

***Dr Matteo Lusi,** who until recently was a postdoctoral fellow in the Department of Chemistry and Polymer Science, carried out the research, along with Prof Len Barbour, who holds the South African Research Chair (SARChI) in Nanostructured Functional Materials at SU.*

The work was published in the top chemical journal Angewandte Chemie, *and also highlighted in news articles in* Chemistry World, *the news magazine of the Royal Society of Chemistry as well as* Chemical and Engineering News, *published by the American Chemical Society.*

Dr Rehana Malgas-Enus joined the Department after the resignation of Dr Alpheus Mautjana.

Community interaction

Together with Prof Harald Pasch from Polymer Science, the department made a financial contribution to assist two learners from Kayamandi High School to participate in a science fair in China.

Collaboration

SOUTH AFRICA

Cape Peninsula University of Technology
Department of Science and Technology, South African Research Chair Initiative Programme (SARChI)
Durban University of Technology
Nelson Mandela Metropolitan University
University of Cape Town
University of Fort Hare
University of Johannesburg
University of KwaZulu-Natal
University of Pretoria
University of the Western Cape
University of the Witwatersrand
University of South Africa
Walter Sisulu University

INTERNATIONAL

Australia

Monash University
University of Western Australia

Austria

Borealis
Mondi

Belgium

Katholieke Universiteit Leuven
University of Ghent
Vrije Universiteit Brussels

Canada

University of Waterloo

Czech Republic

Technical University of Liberec

Germany

Bergische Universität GH Wuppertal
Deutches Kunststoff Institut
Heraeus GmbH, Hanau
Leipzig University
Max Planck Institute for Colloids and Interfaces
Technical University of Munich
University of Duisburg
University of Erlangen, Nuremberg
University of Münster
University of Ulm

India

Indian Institute of Technology, Kanpur

Mauritius

University of Mauritius

The Netherlands

Delft University of Technology
Eindhoven University of Technology
University of Leiden, Gorleus Laboratory
Utrecht University

Poland

Polish Academy of Sciences

Sweden

Chalmers Institute of Technology
Lund University
Swedish Royal Institute of Technology

United Kingdom

St Andrews University, Scotland
University of Cambridge
University of Cardiff
University of Durham
University of Leeds

United States of America

Cornell University
University of California, Berkeley
University of Missouri-Kansas City
University of North Carolina
University of Southern Mississippi
University of Wisconsin, Madison

Funding

Anglo Platinum
BASF
BioPAD
Borealis
Dutch Polymer Institute
ESKOM
Harmony Gold
Heraeus GmbH, Germany
Ikusasa Chemicals
KWV
Mintek
Mondi
National Equipment Programme
National Research Foundation
Netherlands Polymer Institute
NRF Thuthuka
Plascon
SARCHI
Sasol
Sastech
THRIP
Water Research Commission

Staff

Academic

Prof KR Koch *(departmental head)*
Dr GE Arnott
Prof LJ Barbour
Dr MAL Blackie
Dr L Cronje
Prof AJ de Villiers
Dr K De Villiers-Chen
Prof JLM Dillen
Prof C Esterhuysen
Dr WJ Gerber
A Gericke
Dr DA Haynes
Prof EP Jacobs
Prof L Klumperman
Dr T le Roex
Dr M le Roux
Dr RC Luckay
Dr M Lutz
Prof PE Mallon
Prof SF Mapolie
Dr N Mautjana
Prof H Pasch
Dr SC Pelly
Prof WAL van Otterlo
Prof AJ van Reenen
Dr PFM Verhoeven

Extraordinary professors

Prof W Hiller
Prof WM Mackenroth
Prof PJF Sandra

Extraordinary researcher

Dr JB McLeary

Emeritus professors

Prof BV Burger
Prof PS Steyn
Prof HG Raubenheimer
Prof R Sanderson

Support staff

JG Goldie *(departmental manager)*
JE Joubert
SG May
D Davids
Dr MJ Hurndall
MMG Cooper
AE Fourie
WJ Adonis
LD Bailey
M Bickerstaff
MC de Jongh
JD Groenewald
Dr GW Harding
D Isaacs
MC Johnson
DJ Koen
R Lawrence
CW Maart
MG Marupula
S Mohamed
JS Motshweni
J Smit
PJ Steyn
M Taylor
A van Zaal
U Wanza
E Ward
D Wenn
GR Willemse

NRF-rated researchers

Leading international researcher

Prof Len Barbour
(functional nanostructured materials)

Prof Bert Klumperman
(living radical polymerization and advanced macromolecular architectures)

Internationally acclaimed researcher

Prof Ben Burger
(chemical communication in living organisms)

Prof Harald Pasch
(analytical polymer science, multidimensional chromatography)

Prof Helgard Raubenheimer
(ligand design aimed at applications in homogeneous catalysis; gold chemistry)

Prof David McLachlan
(electrical and magnetic properties of composites)

Prof Klaus Koch
(platinum group metals)

Prof Willem van Otterlo
(organic synthesis and medicinal chemistry)

Established researcher

Prof Ron Sanderson
(polymeric materials)

Prof Catharine Esterhuysen
(intermolecular interactions)

Prof Ed Jacobs
(membrane and process development)

Dr Njabu Gule, Dr Rueben Pfukwa, Dr Nathalie Bailly and Dr Osama Bshena with their supervisor, Prof Bert Klumperman, holder of a South African Research Chair (SARChI) on Advanced Macromolecular Architectures in the Department of Chemistry and Polymer Science.

Four PhD graduates make supervisor proud

Four polymer science graduates – all sharing the same supervisor – were among the doctorate students in the Faculty of Science who received their degrees in 2012.

***Dr Njabu Gule, Dr Rueben Pfukwa, Dr Nathalie Bailly** and **Dr Osama Bshena** were all supervised by **Prof Bert Klumperman**, holder of a South African Research Chair (SARChI) on Advanced Macromolecular Architectures in the Department of Chemistry and Polymer Science.*

Dr Bailly worked in the field of anti-tumour drug delivery. She developed a delivery vehicle consisting of an amphiphilic block copolymer. In vitro tests show very promising results in the uptake of the drug-loaded copolymer assemblies by tumour cells.

Dr Gule helped to develop the nanofibres used to develop the Stellenbosch University Water Institute teabag water filter. Antimicrobial polymer nanofibre technology developed by Dr Bshena and Prof Klumperman can be used in the air filters of hospitals to curb the spread of bacteria.

Dr Pfukwa worked on the hierarchical self-assembly of novel para-aryltriazole helical foldamers.

Photo: Engela Duvenage

Khumbulani Ntshidi and Abongile Hlaleleni presented their poster at the Department of Chemistry and Polymer Sciences.

Kayamandi learners tell SU chemists about their Expo project

Two learners from Kayamandi High School, who participated in a science fair in China because of their involvement in the Eskom Expo for Young Scientists, were guests of the Department of Chemistry and Polymer Science at Stellenbosch University.

***Abongile Hlaleleni** and **Khumbulani Ntshidi** gave a short presentation about their research project, and gave an overview of their experiences in China.*

This follows the support that the two Grade 11 learners received from the Department of Chemistry and Polymer Science, which, together with other local organisations, helped to sponsor the trip.

Prof Peter Mallon
(complex polymer materials and polymer nano-composites)

Prof Selwyn Mapolie
(homogeneous catalysis via dendrimeric complexes)

Prof Albert van Reenen
(polyolefins)

Dr Robbie Luckay
(ligand design for metal ion coordination in industrial and medical applications)

NRF Prestigious Awardee

Dr James McLeary
(environmentally friendly polymers for coatings applications)

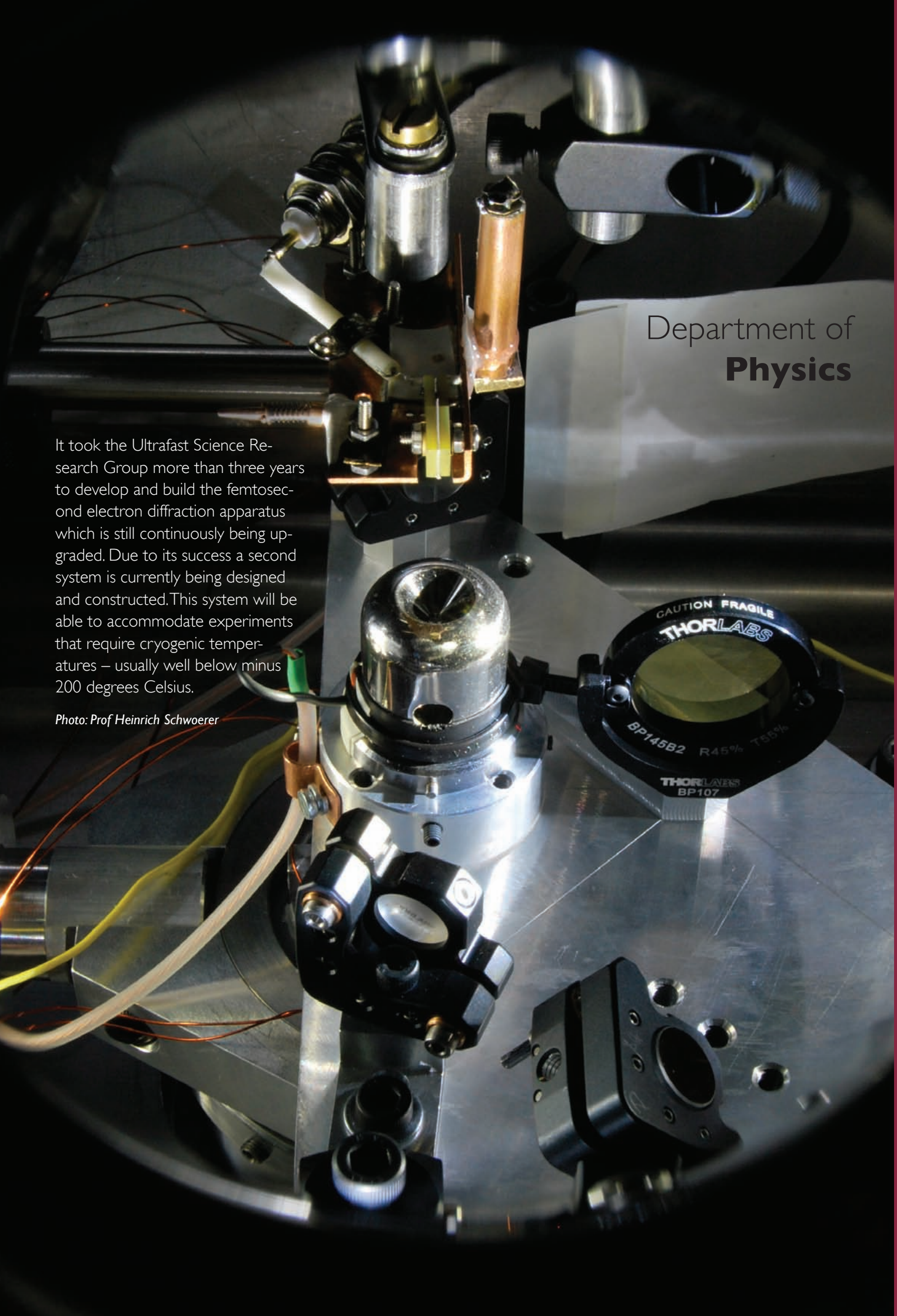
Promising young researcher

Dr André de Villiers
(separation science fundamentals and applications)

Dr Delia Haynes
(crystal engineering of non-metal containing materials)

Dr Gareth Arnott
(inherently chiral calixarenes; asymmetric methodology)

Dr Stephen Pelly
(medicinal chemistry – drug design and synthesis)



Department of **Physics**

It took the Ultrafast Science Research Group more than three years to develop and build the femtosecond electron diffraction apparatus which is still continuously being upgraded. Due to its success a second system is currently being designed and constructed. This system will be able to accommodate experiments that require cryogenic temperatures – usually well below minus 200 degrees Celsius.

Photo: Prof Heinrich Schwoerer

Department of **Physics**

Research Interests

Laser physics (spectroscopy and ultrafast science); nuclear physics (interaction cross-section of protons with nuclei); theoretical physics (condensed matter and complexity)

Research outputs	
Articles in accredited journals	48
Books, conference proceedings, chapters in books	11
Book reviews, articles in specialist journals	1
MSc students graduated in 2012	11
PhD students graduated in 2012	5

Research highlights

The new energy research project at the Laser Research Institute unravelled fundamental light-induced charge dynamics in dye-sensitized solar cells. Working within an international collaboration – Prof Heinrich Schwoerer (SARChI chair), Prof Derck Schlettwein from the Institute for Applied Physics at the University of Giessen (Germany), Dr Christian Litwinski from PicoQuant in Berlin (Germany) and Prof Tebello Nyokong from the chemistry department at Rhodes University (South Africa) – this activity aims for improving efficiency and applicability of novel sunlight harvesting devices.

The Ultrafast Science Research Group, led by Prof Heinrich Schwoerer, has established a world-class femtosecond electron diffraction apparatus for the investigation of structural dynamics with temporal and spatial atomic resolution. One of the highlights in 2012 in the context of molecular electronics was the observation of a structural and electronic phase transition in a strongly correlated crystal.

PhD student Ms Zikona Ndlovu took part in an experiment performed at the Joint Institute for Nuclear Research (JINR) (Russia) using neutron activation to measure trace elements of pollutants which were absorbed by mosses and lichens sampled around Stellenbosch. Ms Ndlovu received the award for the best oral presentation in nuclear physics from the South African Institute for Physics for her work on the use of mosses and lichens to monitor air pollution in the Western Cape.

Dr Paul Papka partook in co-organising the Nuclear Spectroscopy Frontiers Workshop which was held at the iThemba LABS. Prof Shaun Wyngaardt and Prof Richard Newman organised the 3rd South Africa – JINR symposium held in Stellenbosch, as well as the 2nd South Africa – China symposium held in Somerset West. The symposium presented an opportunity for some of the foremost nuclear physicists from both countries to interact on common topics in nuclear physics and to explore opportunities for nuclear physics research in the two countries.

PhD student Mr Cobus Swartz visited Birmingham University to collaborate with Prof Martin Freer on theoretical calculations for his research on searching for the Hoyle-like state via the reaction ^{22}Ne(p,t)^{20}Ne. Mr JJ van Zyl presented a paper entitled "Angular distributions of the analysing power in the excitation of low lying states of ^{56}Co" at the 13th International Conference on Nuclear Reaction Mechanisms at Varenna (Italy). He presented another paper entitled "Incident-energy dependence of the analyzing power in the ^{58}Ni(p,^{3}He)^{56}Co reaction between 80 and 120 MeV" at the International Conference on Nuclear Structure and Related Topics in Dubna (Russia).

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Honours students in Nuclear Physics, Ms Elsje Opperman, Mr Erasmus du Toit and Mr Wiggert Brummer took part in the SA – JINR summer practice. The group hosted several international researchers such as Prof Fedor Simkovic of the Comenius University (Slovakia), Prof Ivan Stekl of the Czech Technical University (Prague), Prof Phil Woods of the University of Edinburgh (Scotland), Prof Marina Frontasyeva of the Joint Institute for Nuclear Research (Russia), Prof Peiwen Ji and Prof Men Pu of the National Science Foundation of China.

The Laser Research Institute (LRI) was host to a number of international laser scientists who participated in research activities. One of them was Prof Herbert Stafast from the Jena Institute of Photonic Technology (IPHT) (Germany) who has been involved with vacuum ultraviolet spectroscopy and nonlinear optics for over ten years.

Other research visits were from Prof Regina de Vivie-Riedle and Prof Eberhard Riedle from Ludwig-Maximilians-Universität München (Germany), Prof Tony Parker from Rutherford Appleton Laboratories (UK), Prof Thomas Feurer of the University of Bern (Switzerland), and Dr Alexander Heidt from the Optoelectronics Research Centre at the University of Southampton (UK) and Prof Markus Schwoerer as collaborator in a project on phase transitions in organic solids funded by the Deutsche Forschungsgemeinschaft (DFG).

Prof Heinrich Schwoerer (SARChI Photonics) chaired a workshop on Ultrafast Structural Dynamics held at the Stellenbosch Institute for Advanced Studies (STIAS). Tutorial lecture series were given by Prof Konrad Samwer (Göttingen), Prof Dwayne Miller (Hamburg/Toronto), Prof Dieter Vollhardt (Augsburg), Prof Steve Johnson (Zürich), Prof Markus Schwoerer (Bayreuth), Dr Marcus Kollar (Augsburg) and Dr Günther Kassier (Hamburg).

The Optical Society of America (OSA) Student Chapter at SU hosted Prof Tom Birks from Bath University for a workshop. The students of OSA's SU chapter, together with post graduate students in Theoretical Physics, visited ten high schools in the Western Cape during a week-long outreach programme.

PhD student Mr Nicolas Erasmus was invited to present a lecture on "Charge Density Dynamics in Tantalumdiselenite" at the 2nd Banff Meeting on Structural Dynamics in Matter (Canada). Dr Günther Kassier presented a contributed talk and a poster.

PhD student Mr Egmont Rohwer presented a poster on his solar cell project entitled "Photoinduced charge transfer between Indoline D149 and porous ZnO" at the 18th International Conference on Ultrafast Phenomena (Switzerland) and Prof Heinrich Schwoerer gave an oral presentation on the Structural Dynamics Project at the same conference.

All senior members of the Laser Research Institute (LRI) actively participated in the 5th African Laser Centre student workshop, held in Namibia. Prof Piet Walters again served as the administration organiser of the event. PhD student Mr Wilfrid Ndebeka and MSc students Mr Raphael Okoye and Mr Farooq Kyeyune gave oral presentations about their research projects. Mr Ndebeka, PhD student Mr Dirk Spangenberg and honours student Ms Thandeka Mhlanga attended the IONS-Africa 1, the first conference of the International OSA Network of Students held in Africa.

Various members of the Institute of Theoretical Physics (ITP) presented their work at international conferences and workshops, as well as at the annual conference of the South African Institute of Physics, held in Pretoria. Most members of the ITP have been actively involved with some or other research activities at NITheP and in co-supervision of students. ITP students have continued contributing in Department of Physics outreach projects, including a tour in September 2012 to schools in the Overberg region as part of an outreach activity by students from the Laser Research Institute.

Another research highlight is that of Prof Herbert Weigel and Prof Hugo Reinhardt of Tübingen University (Germany), when they revisited the nature of strong interaction condensates and refuted recent claims that they were hadron rather than vacuum properties. The resulting article was published in the April 2012 edition of *Physical Review D*.

Prof Hans Eggers attended the 8th Workshop on Particle Correlations and Femtoscopy (WPCF12) at the Frankfurt Institute for Advanced Studies, followed by research visits to the Institute for High Energy Physics in Vienna (Austria) and the Max-Planck-Institut für Physik in Munich (Germany).

With colleagues from the Department of Chemistry and Polymer Science, Prof Kristian Müller-Nedebock was a co-author of a publication on sorption in porous materials published in *Angewandte Chemie*.

Other research activities included covering various aspects of condensed matter systems, and work in noncommutative formalism in quantum mechanics by Dr Hannes Kriel and Prof Frederik Scholtz.

Academic affairs

The Department of Physics had the pleasure of co-hosting with the Centre for Teaching and Learning (CTL) acclaimed physicist Prof Eric Mazur from Harvard University, and Ms Angelica Natera, Associate Director for Academic Innovation at LASPAU, a non-profit organisation affiliated with Harvard University. Prof Mazur's presentation "Confessions of a converted lecturer" was attended by staff from all faculties and followed by a work session facilitated by Ms Natera on "Promoting and sustaining teaching innovation".

MSc student Ms Andrea von Flotow and PhD student Mr Egmont Rohwer travelled to the USA to represent the Stellenbosch Laser Student Chapter at the annual meetings of the International Society for Optics and Photonics (SPIE) and of the Optical Society of America (OSA) respectively.

Prof Eric Mazur

Acclaimed Harvard physicist at SU

Stellenbosch University's Physics Department hosted the acclaimed Harvard University physicist, ***Prof Eric Mazur,*** *for a workshop on teaching innovation on 28 May 2012.*

Besides winning various awards for his work in Physics, Prof Mazur has a keen interest in teaching and is a world leader in the area of teaching innovation.

During his presentation Prof Mazur explained how he came to the astonishing conclusion that his teaching was causing students to fail, as they were just memorising information rather than learning to understand the material. He demonstrated, with supporting data, how he adjusted his teaching and how it has improved the students' performance significantly.

Service to the scientific community

Staff members were closely involved with several national councils, organisations and schools, as well as with the organising of international conferences.

Prof Frederik Scholtz is the director of the National Institute for Theoretical Physics (NITheP), while Prof Hendrik Geyer is the director of the Stellenbosch Institute for Advanced Studies (STIAS).

Prof Frederik Scholtz served on the board of the South African Institute of Physics (SAIP). He is also chair of the SAIP Theoretical Physics Division and Prof Erich Rohwer is chair of the SAIP Photonics Division.

Prof Erich Rohwer serves on the steering committee of the Photonics Initiative of South Africa (PISA). Prof Hubertus von Bergmann is a director of the African Laser Centre (ALC).

The LRI was host to the 5th African Laser Centre (ALC) Student Workshop which was organised by Prof Piet Walters. The workshop was attended by 60 students and researchers representing 17 institutions from 19 countries. The guest speakers were Prof Thomas Feurer of Bern University (Switzerland), Dr Alexander Heidt from Southampton University (UK) and Prof Mourad Zghal of the Université of Carthage (Tunisia).

Dr Paul Papka is chair of the Physics Advisory Committee for the Separated Sector Cyclotron Facility at iThemba LABS, and a member of the Physics Advisory Committee of their Materials Research Department.

The Department of Physics once again presented its annual, week-long introductory course on inductively coupled plasmas (ICP).

Awards to staff and students

Prof Heinrich Schwoerer was successful in securing the SARChI-chair in Photonics funding for another five year period.

Prof Richard Newman was nominated by a top performing first year student as the lecturer who contributed most to his success during his first academic year.

Honours student Mr Erasmus du Toit won the Meiring Naudé medal from the Faculty of Science for the best candidate in a BSc Honours programme in Physics. At the 3rd IONS Asia conference in China, Mr Nagla Numan-Ali received the award for the best poster.

At the annual South African Institute of Physics (SAIP) conference at the University of Pretoria postgraduate students of the Department of Physics received several awards. The prize winners were Ms Melanie Mclaren (best oral presentation by a PhD student in the field of Photonics), Ms Zikhona Ndlovu (best oral presentation by a PhD student in the field of Nuclear Physics), Mr Wayne Koen (best work in Applied Photonics), Mr Darryl Naidoo (best PhD presentation based on a publication), Ms Andrea von Flotow (best poster by a MSc student in the field of Photonics), Mr Riaan Coetzee (best oral presentation by a MSc student in the field of Photonics), Ms Thandeka Mhlanga (best poster presentation by an Honours student in Photonics). At a conference for postgraduate bursary students of the Square Kilometre Array (SKA) Africa, Ms Marissa Geyer was awarded the prize for the best presentation by an MSc student. Ms Chrischelle Hanekom received the Rector's Award for excellent achievement in leadership.

The efforts of our staff were recognised by the University. Ms Heleen Randall, Mr Stanley February, Prof Erich Rohwer, Dr Paul Papka, Mr JJ van Zyl and Mr Gerhard Louwrens received SU Rector's Performance Awards.

Staff matters

Prof Richard Newman moved from iThemba LABS to join the Nuclear Physics group as associate professor.

Dr Pieter Neethling was appointed as lecturer in the Laser group.

Prof Brandon van der Ventel and Prof Shaun Wyngaardt were promoted to associate professors and Dr Lee Boonzaaier to senior lecturer.

Prof Hubertus von Bergmann was appointed as extraordinary professor in Laser Physics.

Dr Pieter van der Westhuizen retired in March after 33 years at the department.

Community interaction

The outreach committee of the department was very active with contributions made by staff and postgraduate students to the Maties Science Winter Week, the

Stellenbosch University Open Day and the Eskom Expo for Young Scientists. Postgraduate students of the Stellenbosch Student Chapter of the Optical Society of America (OSA), which is part of the Laser Research Institute and the Institute for Theoretical Physics, visited ten schools in the Overberg region during an outreach tour of one week. They received financial support from OSA, the International Society for Optics and Photonics (SPIE), NITheP and Stellenbosch University.

The department obtained funding from the South African Agency for Science and Technology Advancement (SAASTA) to organise events to motivate students to participate in science. Undergraduate students undertook visits to iThemba LABS, the South African National Space Agency (SANSA) in Hermanus and the Institute for Marine Technology (IMT) in Simon's Town. The department also hosted learners from Oscar Mpetha High School and exposed the learners to basic techniques of data acquisition and analysis by means of a simple ticker-tape experiment. This event was co-sponsored by iThemba LABS.

Prof Richard Newman and Prof Shaun Wyngaardt, in collaboration with staff members of iThemba LABS, undertook an outreach project to Cloetesville High School, Kayamandi High School, Kylemore High School, Lückhoff High School and Paul Roos Gymnasium to introduce learners to nuclear and environmental science by measuring radon levels in their homes.

Collaboration

SOUTH AFRICA

CSIR National Laser Centre
Free State University
iThemba LABS
National Institute for Theoretical Physics (NITheP)
Rhodes University
Square Kilometre Array
University of Cape Town
University of Pretoria
University of the Western Cape

AFRICA

African Institute for Mathematical Sciences (AIMS)
African Laser Centre
Africa Theoretical Physics Programme at the Stellenbosch Institute for Advanced Study (STIAS)

INTERNATIONAL

China

School of Physics, Beijing University

Germany

Institute for Applied Physics, Giessen University
Institut für Photonische Technologien Jena e.V.
PicoQuant
University of Tübingen

India

S.N. Bose National Centre for Basic Sciences
Physical Research Laboratory (PRL), Ahmedabad

Russia

Joint Institute for Nuclear Research (JINR)

United Kingdom

Rutherford Appleton Laboratory
University of Bristol

United States of America

Syracuse University

Funding

CSIR Defence, Peace, Safety and Security (DPSS)
CSIR National Laser Centre (NLC)
Deutsche Forschungsgemeinschaft
Deutscher Akademischer Austauschdienst (DAAD)
Earth Anti-NeutRino TomograpH (EARTH) Foundation
Innovation Fund of the Department of Science and Technology
iThemba LABS
National Institute for Theoretical Physics (NITheP)
National Research Foundation
Optical Society of America
Pebble Bed Modular Reactor
Scientific Development and Integration
South African Research Chair Initiative Programme (SARChI)
Square Kilometre Array

Staff

Academic

Prof EG Rohwer *(executive head)*
Dr L Boonzaaier
C Dreyer
Dr A du Plessis
Prof HC Eggers
Prof HB Geyer
Dr H Kriel
Prof KK Müller-Nedebock
Dr PH Neethling
Prof RT Newman
Dr P Papka
Prof FG Scholtz
Prof HPH Schwoerer
Dr JA Stander
Dr CM Steenkamp
Prof BIS van der Ventel
Dr P van der Westhuizen
JJ van Zyl
Prof H Weigel
Prof SM Wyngaardt

Extraordinary professors

Dr A Avdeenkov
Dr LR Botha
Prof AA Cowley
Prof T Dlamini
Prof CA Dominguez
Prof A Forbes
Prof WD Heiss
Prof M Kastner
Prof J Meng
Prof T Parker
Dr I Snyman
Prof H Stafast
Prof HM von Bergmann

Emeritus professors

Prof PR de Kock
Prof PE Walters

Support staff

C April
DC Beukman
AS Botha
MC Botha
J Burns
SH February
JM Germishuizen
GJ Louwrens
CD Pool
DP Pool
H Randall
CJ Ruperti
EJ Shields

Theoretical physicists confirm vacuum characteristics of strong interaction condensates

*SU physicist **Prof Herbert Weigel** and **Prof Hugo Reinhardt** of Tübingen University (Germany) revisited the nature of strong interaction condensates and refuted recent claims that they were hadron rather than vacuum properties. The resulting article was published in the April 2012 edition of Physical Review D.*

Prof Weigel provided the following popular note on their work:

In Physics we distinguish between four fundamental interactions: gravitation, electromagnetism and the weak and strong nuclear forces. While gravitation and electromagnetism are experienced in everyday life, weak and strong nuclear forces are much less apparent, yet they are responsible for the formation of atomic nuclei. Even more, the components of nuclei (nucleons = protons and neutrons) are not elementary but composites of more elementary particles: the quarks and gluons. They represent the degrees of freedom for quantum chromo dynamics (QCD), the fundamental theory for the strong nuclear force. Particles that are subject to this force are called hadrons and nucleons are a particular type of hadrons.

However, QCD is a very complicated theory that evades direct solution and simpler models must be utilised to understand the formation of nucleons (and thus nuclei).

These models are to resemble as many properties of QCD as possible. A central feature of QCD is chiral symmetry. It concerns the intrinsic angular momentum (a property of rotational motion) of particles that are subject to the strong nuclear force and states that particles whose angular momenta align with, or are aligned in the opposite direction with the direction of propagation, do not interact with each other.

On the other hand, this feature does not manifest in the observed particle masses. The only way this contradiction can be resolved is by the lowest energy configuration (called vacuum) not possessing chiral symmetry. Such a vacuum property is quantified by so-called condensates, non-zero quark and gluon 'observables' which, however, do not have a particle interpretation.

In this explanation of particle masses the condensates are universal, i.e. their values are not dependent on whether or not nucleons are around. This picture has come under some dispute recently. If condensates were indeed different, they would strongly affect the description of the energy in the universe (which is far from being understood anyhow).

Recently a conception that condensates would be nucleon rather than having vacuum properties has attracted quite some attention. As a response, Reinhardt and Weigel revisited a model that unambiguously answers the question of whether a nucleon or a vacuum type configuration is present at a given point in space. In this model calculation, the condensates undoubtedly occur as vacuum properties in the sense that they indeed exist outside nucleons. However, they do undergo modification in the realm of the nucleons.

NRF-rated researchers

Internationally acclaimed researcher

Dr Alexander Avdeenkov
(theoretical physics)

Prof Anthony Cowley
(nuclear physics)

Prof Hendrik Geyer
(theoretical physics)

Prof Dieter Heiss
(theoretical physics)

Prof Michael Kastner
(theoretical physics)

Prof Frederick Scholtz
(theoretical physics)

Prof Heinrich Schwoerer
(laser physics)

Prof Herbert Weigel
(theoretical physics)

Established researcher

Prof Hans Eggers
(theoretical physics)

Prof Kristian Müller-Nedebock
(theoretical physics)

Prof Erich Rohwer
(laser physics)

Dr Christene Steenkamp
(laser physics)

Prof Brandon van der Ventel
(nuclear physics)

Prof Hubertus von Bergmann
(laser physics)

Prof Shaun Wyngaardt
(nuclear physics)

Promising young researcher

Dr Paul Papka
(nuclear physics)

Department of **Physiological Sciences**

This image – taken by the state-of-the-art confocal LSM 780 microscope coupled to a super resolution ELYRA S1 platform – shows a mammalian cell with detailed mitochondrial structure (red) and tubulin network morphology (green). The image is acquired through a specialised method termed super-resolution structured illumination. Both mitochondria as well as the tubulin network are implicated in many disorders. This R8 million microscope was imported from Germany, and is one of the few that has for the first time broken the limit of resolution in light microscopy.

Image courtesy of Dr Ben Loos

Department of **Physiological Sciences**

Research Interests

Metabolic syndrome, diabetes and heart diseases (myocardial ischemia, diabetic cardiomyopathy); metabolic syndrome and HIV/AIDS; muscle physiology and biology; skeletal muscle atrophy and hypertrophy; satellite cells and myoblasts; cardiac metabolism, hypoxia and ischemia; multidisciplinary stress biology; cancer and modes of cell death; neurological disorders, exercise science

Research outputs	
Articles in accredited journals	16
Books, conference proceedings, chapters in books	4
MSc students graduated in 2012	8
PhD students graduated in 2012	4

Research highlights

Several staff members attended and participated in international and national conferences. Locally, Prof Faadiel Essop delivered plenary lectures at the Pre-Rural Research Day Summit as part of the AIDS Priorities Symposia series, and at the Research Symposium of the Diabetes Discovery Platform at the Medical Research Council. He also presented lectures at the 3rd Cape Winelands ANOVA Conference and at the 2nd UK – SA Cardiovascular Research Workshop held at the University of Cape Town. Prof Essop was a keynote speaker at the 40th Annual Congress of the Physiological Society of Southern Africa which was hosted by the SU Department of Physiological Sciences. Prof Essop went to Egypt to participate as a keynote speaker at the 6th International Congress of the African Association of Physiological Sciences.

Prof Kathy Myburgh presented a session at the 2012 Experimental Biology Annual Meeting held in San Diego (USA) and attended a symposium held at the American College of Sports Medicine in San Francisco (USA). She was also a symposium speaker at the 41st European Muscle Conference (Greece).

Dr Ben Loos presented a paper entitled "The membrane fusion process of autophagosomes and lysosomes" at the 50th Annual Conference of the Microscopy Society of Southern Africa.

At the 40th Annual Congress of the Physiological Society of Southern Africa, he presented a paper entitled "Cutting the edge – superresolution structured illumination microscopy in cellular physiology".

The department produced a substantial number of peer-reviewed publications. We had 12 postgraduate students who graduated in 2012 – eight MSc and four PhD degrees – a record for the department.

Prof Anne Jonassen from the University of Bergen (Norway) spent a one-year sabbatical in the department on invitation from Prof Anna-Mart Engelbrecht which further strengthened collaborative research work between our departments. She collaborated on a project that evaluated (*in vitro* and *in vivo*) a newly identified protein with significant cardioprotective properties. Dr Bali Sishi and Dr Ben Loos were also involved in this collaboration.

Dr Ben Loos started the establishment of a new research focus on cell death susceptibility in neurodegenerative diseases. This includes: a classical cell physiology approach assessing neuronal cell death and neuronal migration; a (nano)-biophysics approach utilising superresolution structured illumination microscopy in collaboration with Prof Kristian Müller-Nedebock and Dr Leandro Boonzaaier, Department of Physics; and a systems biology approach in collaboration with Prof Jannie Hofmeyr, Department of Biochemistry.

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Dr Loos undertook a research visit to Queens College (US) to work in the laboratoy of Prof Zarah Zakeri on cell death mechanisms. Dr Loos and Prof Bert Klumperman successfully applied to the National Nanotechnology Equipment Programme (NNEP) for the acquisition of an Elyra Superresolution microscope. The microscope was installed and launched in Sept 2012. It is housed in the Cell Imaging Unit in the Central Analytical Facility (CAF) and is extremely unique in its capabilities, bringing superresolution and confocal microscopy to the university

Academic affairs

Our postgraduate student population grew tremendously, with 15 Honours, 17 MSc and 12 PhD students registered to follow our programmes in 2012. This is firmly in line with our strategic objective to increase the number of students who graduate with doctoral degrees in our discipline.

Ms Gina Leisching, Ms Rudo Mapanga, Mr Jamie Imbriolo and Ms Marie van der Vyver graduated with PhD degrees. Of the eight MSc graduates, Ms Heloise le Roux, Mr Justin Mills, Ms Clare Springhorn and Ms Lize Engelbrecht received their MSc degrees cum laude.

Dr Ben Loos received funding from SU's Fund for Innovation and Research into Learning and Teaching for the compilation of a microscopy/histology book to be used in teaching.

Service to the scientific community

Prof Faadiel Essop was elected as council member of the African Association of Physiological Sciences. He also serves on the editorial boards of the *American Journal of Physiology* and the *Open Obesity Journal,* and is a member of the International Committee of the American Physiological Society.

Prof Kathy Myburgh is an international member of the organising committee of the European Muscle Conference. She was the principle organiser of the South African 2nd Stem Cell Indaba, held in Stellenbosch, and chaired a session at the NRF/SAASTA Critical Thinker's Forum on Stem Cells (Johannesburg). Prof Myburgh is Section Editor for the international journal *Bio Med Central Physiology* and serves on the editorial board of *Medicine and Science in Sports and Exercise.*

Prof Anna-Mart Engelbrecht was elected as a member of the executive committee of the South African Society for Cardiovascular Research (SASCAR) and continued to serve on the editorial board of the *International Journal of Biomedical Sciences.* She was also the chairperson of the organising committee of the Annual Physiology Congress of the Physiology Society of Southern Africa (PSSA).

The SU Department of Physiological Sciences organised and hosted the annual Physiology Congress of the Physiology Society of Southern Africa (PSSA). The organising committee consisted of Prof Anna-Mart Engelbrecht, Mrs Grazelda Simon, Dr Theo Nel, Dr Ben Loos, Prof Kathy Myburgh and Prof Carine Smith.

Dr Nell and Prof Engelbrecht also acted as members of the NRF Evaluation Panel 2012 for the allocation of NRF bursaries and postdoctoral fellowships.

Dr Ben Loos stepped down as manager of the Cell Imaging Unit at SU's Central Analytical Facilities, but will remain involved in an advisory role with regard to microscopy experimental challenges. This This includes promoting ongoing interaction between the Electron Microbeam Unit and the Cell Imaging Unit. Dr Loos is also involved with CAF training courses in fluorescence microscopy.

The annual research day for third year science students was organized by, amongst others, Dr Ben Loos. During this event postgraduate students present short talks on their research in order to share knowledge and encourage undergraduates to consider postgraduate studies in Physiological sciences.

Awards to staff and students

The excellent efforts of our staff were recognised by the university and Prof Faadiel Essop, Prof Anna-Mart Engelbrecht, Prof Kathy Myburgh and Dr De Wet Strauss received SU Rector's Performance Awards.

Prof Kathy Myburgh received an award of the American College of Sports Medicine for 25 years of membership. Dr Lydia Lacerda received the prize for the best presentation by an established researcher at the 40th Annual Meeting of the Physiology Society of Southern Africa (PSSA).

Ms Gina Leisching was the winner of the prestigious Wyndham Student Presentation Competition at the 40th Annual Congress of the Physiology Society of Southern Africa where she competed against PhD students from all universities in South Africa. At the same congress, Ms Clare Springhorn received the first prize in the Johnny van der Walt poster competition, Ms Yogeshni Govender was awarded a merit certificate for the best MSc presentation and Ms Megan Mitchell received the award for the best presentation by an Honours student. Ms Leisching was also invited to present her work at the "New Voices in Science" day hosted by Stellenbosch University for PhD students.

PhD student Ms Kathleen Reyskens received the first prize for her presentation at the 2nd UK – SA Cardiovascular Workshop hosted by the University of Cape Town.

Several staff members of the department received new grants for research, they are: Dr Ben Loos (from the Medical Research Council; the NRF field development grant; Subcom B funding); Dr Balindiwe Sishi from the Medical Research Council); Dr Theo Nell, Dr Annadie Krygsman and Prof Anna-Mart Engelbrecht received funding from the Cancer Association of South Africa.

Staff matters

Dr Theo Nell successfully completed his MSc Medical Science (Clinical Epidemiology) degree.

Community interaction

Dr Ben Loos and Dr Balindiwe Sishi served as adjudicators at the regional Eskom Expo for Young Scientists in Stellenbosch. Most of the staff members were involved with the annual Stellenbosch University Open Day as well as the Maties Science Winter Week.

The department again arranged the very successful hands-on winter week with the theme "Physiology is Cool" for high school learners from previously disadvantaged schools. Dr De Wet Strauss still annually presents refresher courses in Biology for teachers.

Collaboration

SOUTH AFRICA

Cape Peninsula University of Technology

Nelson Mandela Metropolitan University

University of Cape Town

Kathleen Reyskens

Student commended for study on link between ART and heart disease

*Phd student **Ms Kathleen Reyskens** was commended for her research on the link between antiretroviral treatment (ART) and heart disease in HIV positive people when she was awarded first place for her presentation at the 2nd UK-SA Cardiovascular Research workshop in Cape Town, 2012.*

Organised by the European Society of Cardiology (ESC), the University of Cape Town and the South African Society for Cardiovascular Research (SASCAR), the aim of the workshop was to highlight the work of young researchers in the United Kingdom and South Africa, and to promote fruitful cardiovascular research collaborations.

*Under the supervision of **Prof Faadiel Essop**, leader of the Cardio-Metabolic research group in the Department of Physiological Sciences, she studied the side-effect that one specific antiretroviral therapeutic (ART) drug might have, specifically in enhancing heart disease in specific HIV positive patients.*

"We need to find out what mechanisms are behind the side-effects and how the drug might be increasing a patient's risk of contracting specific heart diseases," said Ms Reyskens, who is a holder of a Harry Crossley Foundation bursary. "Ultimately, if we can find out how it works, we might be able to adapt the drug to eliminate the side-effects."

According to Prof Essop, this research is important because ARTs may further fuel the growing burden of cardio-metabolic syndrome, a combination of risk factors that predispose individuals to the future onset of type 2 diabetes and cardiovascular diseases: "It is crucial to understand better the underlying mechanisms driving these processes. Since the roll-out of ARTs has markedly improved over the last decade, associated metabolic perturbations will increasingly manifest in such individuals," he explains.

AFRICA

Kenyatta University (Kenya)

University of Botswana (Gaborone)

INTERNATIONAL

Australia

Griffith University

University of Sydney

Canada

Carleton University

France

University of La Réunion

Greece

University of Thessaly (Trikala)

Hungary

Biological Research Centre, Hungarian Academy of Science

Norway

University of Bergen

United States of America

University of North Carolina

Pepperdine University

Funding

Cancer Association of South Africa

European Union Higher Education HIV/Aids Programme (HEAIDS)

Medical Research Council

National Institutes of Health

National Research Foundation

Nestlé Nutrition Institute Africa

Norwegian Programme for Development, Research and Education (NUFU)

PepsiCo International

Stellenbosch University

Staff

Academic

Prof MF Essop *(departmental chair)*
Prof KH Myburgh
Prof A-M Engelbrecht
Prof C Smith
Dr JA deW Strauss
Dr T Nell
Dr B Loos
Dr B Sishi

Support staff

Dr A Krygsman
Dr L Lacerda
Mr A Isaacs
Mrs G Simon

NRF-rated researchers

Internationally acclaimed researcher

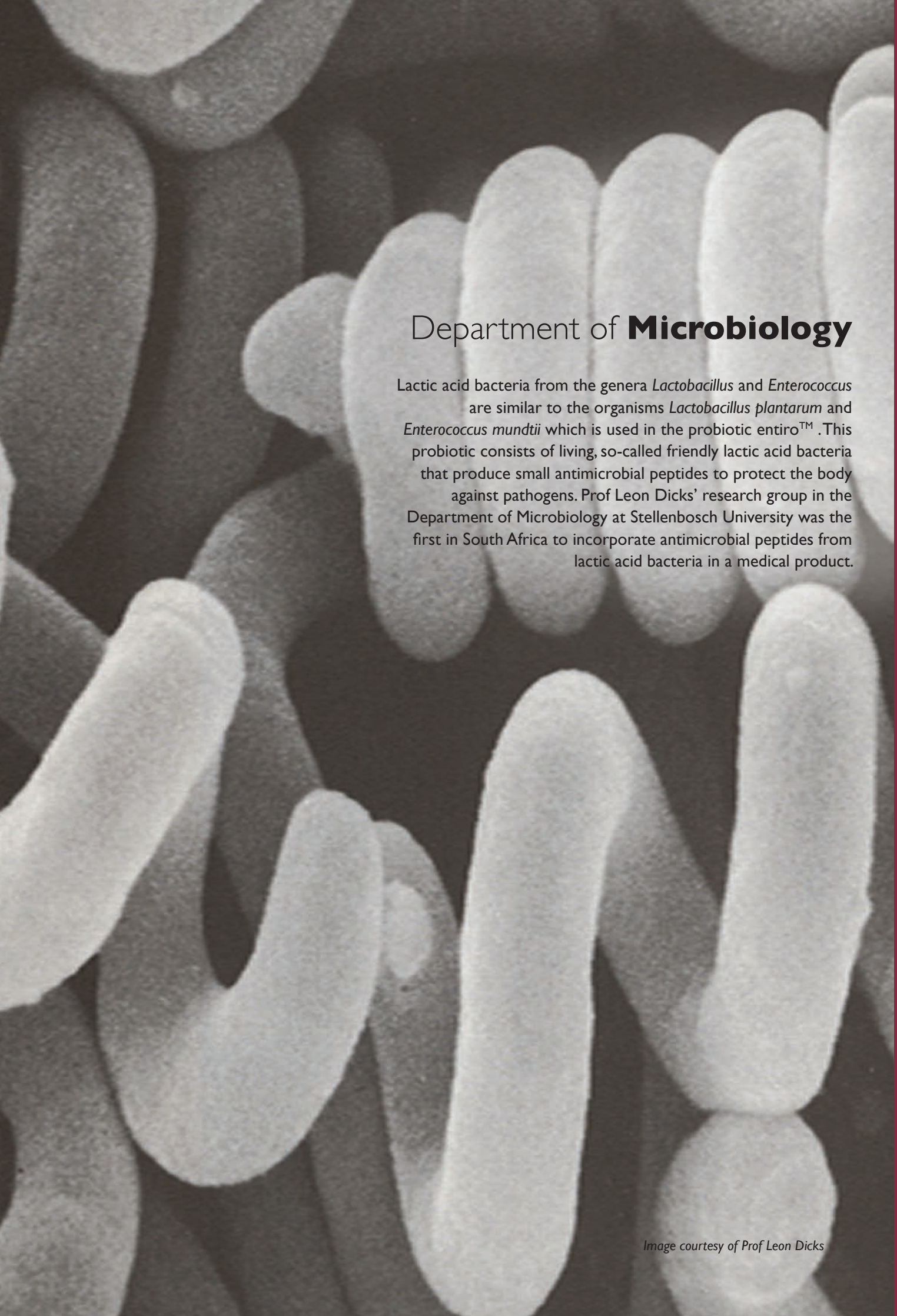
Prof Kathy Myburgh
(skeletal muscle biology)

Established researcher

Prof Faadiel Essop
(cardiac metabolism)

Promising young researcher

Prof Anna-Mart Engelbrecht
(cell-death and signalling)



Department of **Microbiology**

Lactic acid bacteria from the genera *Lactobacillus* and *Enterococcus* are similar to the organisms *Lactobacillus plantarum* and *Enterococcus mundtii* which is used in the probiotic entiro™ . This probiotic consists of living, so-called friendly lactic acid bacteria that produce small antimicrobial peptides to protect the body against pathogens. Prof Leon Dicks' research group in the Department of Microbiology at Stellenbosch University was the first in South Africa to incorporate antimicrobial peptides from lactic acid bacteria in a medical product.

Image courtesy of Prof Leon Dicks

Department of **Microbiology**

Research Interests

Bioprocessing of agricultural products; bioprospecting for enzymes that hydrolyse plant polysaccharides; genetic manipulation of yeasts for the conversion of plant material to bioethanol and production of enzymes/pharmaceutical proteins in yeast and fungi for use in vaccine production; microbiology of biomining of ores, arsenic resistance and generation of defined mutants and plasmids of biomining bacteria; taxonomy of lactic acid bacteria; characterisation of antimicrobial peptides (including bacteriocins) produced by lactic acid bacteria and their industrial application; fungal communities from fynbos soil; biology of soil fungi, particularly *Penicillium* and *Mucor;* the interactions between yeast and their biological, chemical and physical environment; taxonomy of ascomycetes (fungi); development of probiotic lactic acid bacteria for humans and animals; antibiotic resistance of waterborne pathogens; monitoring and optimisation of domestic rainwater tanks

Research outputs	
Articles in accredited journals	31
Books, conference proceedings, chapters in books	2
MSc students graduated in 2012	5
PhD students graduated in 2012	4

Research highlights

Prof Leon Dicks did breakthrough research on lactic acid bacteria for which he received the prestigious TW Kambule Award at the NSTF-BHP Billiton Awards. He discovered two bacterial strains with antimicrobial peptides that are highly effective in fighting some of the major pathogens involved in topical infections and gastro-intestinal disorders. His research also led to a product marketed by Cipla Medpro as entiro™. The product is backed by 25 research papers, has been registered in 65 countries and is available from major South African pharmacies from 2013.

Prof Dicks also presented a paper at the Third International Symposium on Antimicrobial Peptides in Lille (France). Mr Tiaan Heunis and Mr Du Preez van Staden presented posters at the same symposium.

Prof Emile Van Zyl presented a paper on the development of cellulolytic yeast at the 13th International Congress on Yeasts in Madison, Wisconsin (USA) and on advanced biotechnologies for the production of aviation biofuels at the 7th Workshop on Sustainable Aviation Biofuels Brazil (SABB) in São José dos Campos (Brazil).

Dr Riaan den Haan delivered a paper on cellulolytic yeast at the 34th Symposium on Biotechnology for Fuels and Chemicals in New Orleans, Louisiana (USA).

Ms Kim Trollope in Dr Heinrich Volschenk's laboratory, presented a poster at the 6th International Congress on Biocatalysis (Biocat2012) in Hamburg (Germany). Mr Ferdinand Postma in Prof Alf Botha's laboratory, presented a poster at the 7th Congress of the International Symbiosis Society, Krakow (Poland).

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Academic affairs

After turning 50 in 2011, the Department of Microbiology shook its feathers and undertook a five-year self-evaluation process which provided an opportunity for introspection and plans for the future. With the help of external moderators, the final report highlighted the department's good research profile and high undergraduate success rates built on a strong staff component characterised by a spirit of collegiality and mutual support. Major challenges facing the department include increasing undergraduate student numbers, a decline in PhD students and sustainability issues with regard to fluctuating external funding to support research and to maintain and replace dated equipment.

Lecturers have maintained a high standard of teaching for all undergraduate courses, with an average lecturer impression mark of 77%. Teaching content is updated continuously to keep abreast of the latest developments in the field of microbiology and to relate course content to real-life examples, with many students testifying that this is what makes teaching relevant. However, coping with increasing undergraduate student numbers and underprepared students, remain daunting impediments to the quality of teaching.

In 2012, the department took part in a programme-wide recurriculation exercise to reintroduce the two major-model at third year level. To be phased in during 2014, the changes to the curriculum will increase the depth of microbiology teaching at the final year level with four full modules spread over two semesters and will better prepare students for a postgraduate qualification.

The department maintains a high number of postgraduate students (11 Honours, 23 Masters and 10 PhD students) relative to the number of academic staff. Our lecturers were actively publishing their research results resulting in about three articles per lecturer.

Service to the scientific community

Prof Leon Dicks serves on the editorial boards of the *International Journal of Food Microbiology* (since 1999), the *Journal of Applied Microbiology* (2005-2012), *Letters in Applied Microbiology* (2005-2012), *Probiotics and Antimicrobial Proteins* (since 2008), *Beneficial Microbes* (since 2008) and the *Bioscience of Microbiota, Food and Health* journal (since 2011). He is editor in chief of the *South African Journal of Enology and Viticulture*.

Prof Karin Jacobs serves as the vice-president of the African Mycological Association and is a member of the editorial board of *Mycology*.

Prof Alf Botha was elected as member of the Academy of Science of South Africa (ASSAf), joining Profs Doug Rawlings, Bernard Prior, Emile van Zyl, and Leon Dicks as members of the Academy. Prof Botha is also a member of the editorial board of the *Canadian Journal of Microbiology* and *FEMS Yeast Research* and a member of the Materials Research Group (MRG) Users Advisory Committee at iThemba Laboratories.

Prof Emile van Zyl continued as member of the Advisory Board of the Bioimprove programme in Sweden. Dr Heinrich Volschenk is a council member of the South African Society for Microbiology (SASM).

Awards to staff and students

Prof Leon Dicks was awarded the prestigious TW Kambule Award at the NSTF-BHP Billiton Awards for his breakthrough research on lactic acid bacteria.

Prof Emile van Zyl was runner-up for the 2012 Energy Award from the South African National Energy Association (SANAE). Prof Alf Botha and co-authors received the Douw Greeff prize for the best paper published during 2011 in the journal *Suid-Afrikaanse Tydskrif vir Natuurwetenskap en Tegnologie*. This prize is awarded annually by the South African Academy for Science and Arts for a research or review article of outstanding scientific quality.

Staff matters

Prof Emile van Zyl started as the fifth chair of the Department of Microbiology whilst Prof Doug Rawlings acted as Vice-Rector: Research for six months. When Prof Eugene Cloete, dean of the Faculty of Science and also a member of the department was elected as the new Vice-Rector: Research & Innovation, Prof Rawlings took up the position of acting dean of the Faculty of Science.

Community interaction

Prof Emile van Zyl, Senior Chair Biofuels, presented scientific and informal seminars, including a presentation to the U3A Helderberg, titled "Sustainable biofuel production in Southern Africa: Opportunities and Challenges." U3A stands for University of the Third Age, a worldwide network of learning communities for older people.

The department participated in a project at the Kleinmond Housing Project to broaden knowledge about the quality of harvested rainwater in South Africa. Funded by the Water Research Commission, Ms Penelope Dobrowsky, Dr Michele de Kwaadsteniet and Dr Wesaal Khan, under the leadership of Prof Eugene Cloete, found that while the chemical quality of the rainwater was generally lower than the stipulated drinking water guidelines, the microbial analysis indicated that the water in the domestic rainwater harvesting tanks should not be used for potable and certain domestic purposes.

Ms Dominique Mannel from the Department of Sociology and a research assistant at the SU Water Institute, investigated the acceptance and perception on the use of the domestic rainwater harvesting tanks by interviewing 68 households. The Kleinmond Housing Project is an initiative of the Council for Scientific and Industrial Research (CSIR) and the Department of Science and Technology (DST). Research is continuing to improve the microbial quality of harvested rainwater to within potable standards through the implementation of point-of-use treatment technologies, such as filter or solar disinfection systems.

MSc student Ms Veronique Meyer assisted learners at her former high school, Lückhoff High School in Stellenbosch, with gaining practical experience in water testing.

Dr Michele de Kwaadsteniet and Mrs Louisa van der Westhuizen served as regional judges at the 2012 Eskom Expo for Young Scientists and Ms Jenade Lynch and Dr Wesaal Khan provided technical assistance to pupils preparing for this event.

Dr Khan and Dr Heinrich Volschenk coordinated the department's involvement with regard to University Open Days, the Maties Science Winter Week and other ad hoc visits by high school learners. These well-coordinated interactions raised learners' interest in microbiology and are partly responsible for increased enrolment in recent years.

SU scientists develop a high-tech 'tea bag' filter for cleaner water

*When microbiologist **Prof Eugene Cloete** became Dean of the Faculty of Science at Stellenbosch University (SU) in January 2009, he did not allow his expanded administrative duties to overwhelm his passion for his subject. To the contrary, he picked up on relevant research outside his own field of expertise, which sparked the invention of a high-tech disposable filter that looks like a tea bag and cleans polluted water.*

Together with researchers from the Department of Microbiology and SU polymer scientists, he patented the innovative invention in 2012 – a portable, easy-to-use and environmentally-friendly water filter bag that fits into the neck of a bottle.

"The water is cleaned right then and there when you drink from the bottle," Cloete explains.

The sachet combines years of fundamental research on water purification, nanotechnology and food microbiology in a practical way. It promises to provide easy access to clean drinking water for vulnerable communities, for instance those living near polluted water streams.

Prof Cloete, who is also Chairperson of the SU Water Institute, says he got the idea for the filter on an introductory visit to InnovUS, the University's technology transfer company. "I was shown the electro-spinning technique of spinning ultra-thin fibres on a nanoscale developed by Dr Eugene Smit of the Department of Chemistry and Polymer Science," he remembers.

A research team was put together and after various trials and experiments, a filter sachet was developed that not only resembles a tea bag in shape and size, but is made of the same biodegradable material as off-the-shelf rooibos tea bags.

The Stellenbosch University Water Institute and its "tea bag" water filter form part of SU's HOPE Project, a set of development goals aimed at improving lives in South Africa and the rest of the continent.

Collaboration

SOUTH AFRICA

Agricultural Research Council, Nietvoorbij
Cape Peninsula University of Technology
Council for Scientific and Industrial Research
Medical Research Council
Polytechnic of Namibia
Rhodes University
University of the Western Cape
Water Research Commission

INTERNATIONAL

Chile
Andrés Bello University

Germany
Karlsruhe Institute of Technology

Finland
University of Turku

France
Muséum national d'Histoire naturelle

Italy
University of Padova
University of Verona

Japan
Kyushu University
Tokyo University of Agriculture
The University of Tokyo

Netherland
Centraal Bureau voor Schimmelcultures

Sweden
Umeå University

United States of America
Dartmouth College
Rutgers, State University of New Jersey

Wales
Bangor University

Funding

Cipla Medpro
Department of Science and Technology
Mascoma Corporation
National Research Foundation
Polytechnik of Namibia
RAPS GmbH & Co
Sloan Trust
South African National Energy Research Institute
Technology and Human Resources for Industry Programme
Technology Innovation Agency
Water Research Commission

Staff

Academic

Prof WH van Zyl *(departmental chair)*
Prof M Bloom
Prof A Botha
Prof TE Cloete *(vice-rector: research and innovation)*
Prof LMT Dicks
Prof K Jacobs
T Jansen
Dr W Kahn
Prof DE Rawlings *(acting dean)*
Dr H Volschenk

Extraordinary professors

Prof B Axcell
Prof L Lynd
Prof BA Prior
Prof J Thevelein
Prof D Toerien

Support staff

L J Daniels
M Gey van Pittius
MH Koopman
J Lynch
LA Malherbe
R Robyn
M Stuurman
T van der Merwe
L van der Westhuizen
W Wentzel

NRF-rated researchers

Leading international researcher
Prof Doug Rawlings
(molecular biology of biomining bacteria and their plasmids)

Internationally acclaimed researcher
Prof Alf Botha
(yeast and fungal ecology)

Prof Eugene Cloete
(water biotechnology)

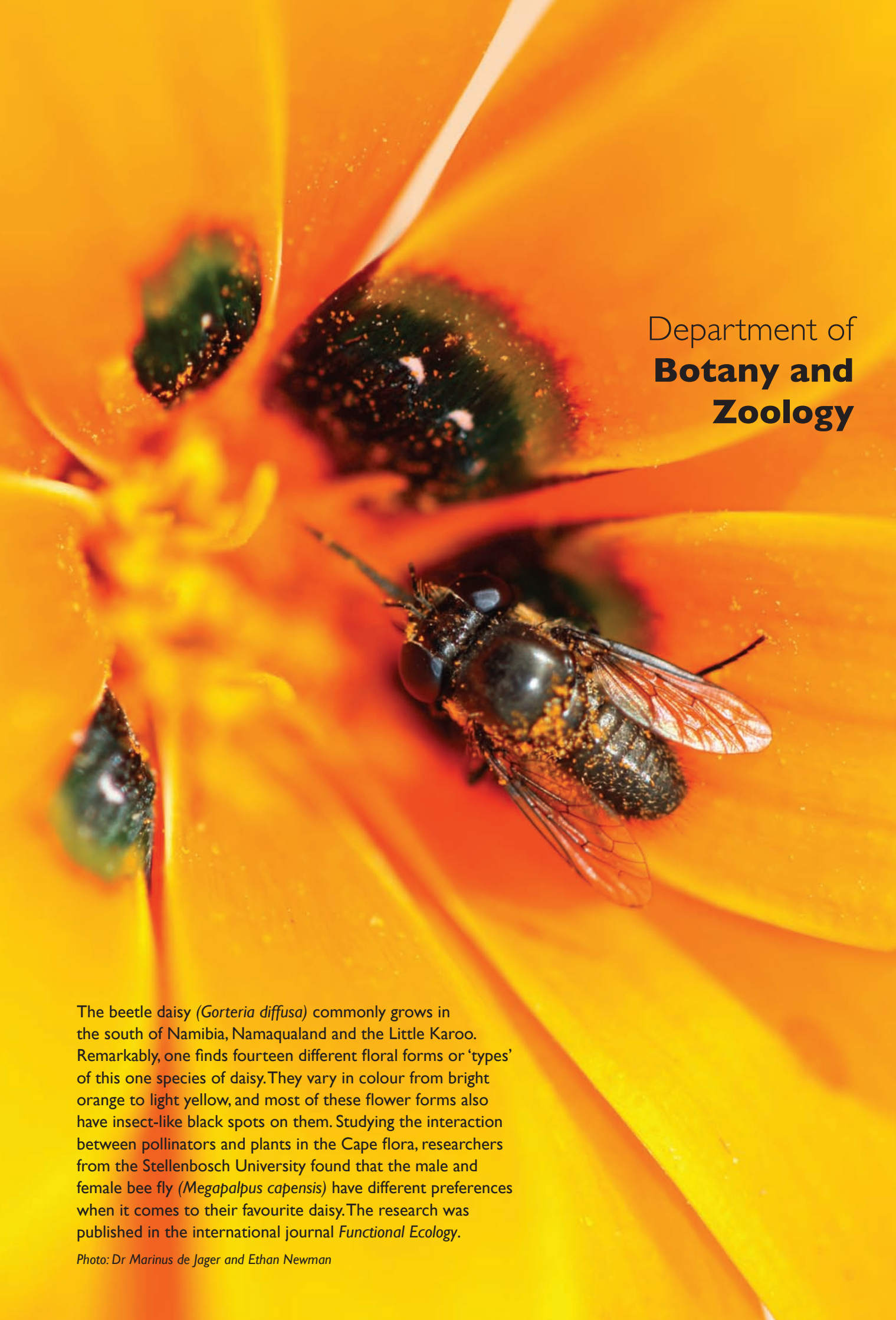
Prof Leon Dicks
(lactic acid bacteria, probiotics and bacteriocins)

Prof Emile van Zyl
(bioethanol from plant material and production of proteins in yeast and fungi)

Established researcher
Prof Marinda Bloom
(fungal bioprocessing)

Prof Karin Jacobs
(microbial ecology)

Dr Heinrich Volschenk
(bioprospecting for enzymes and production of proteins in yeast)



Department of **Botany and Zoology**

The beetle daisy *(Gorteria diffusa)* commonly grows in the south of Namibia, Namaqualand and the Little Karoo. Remarkably, one finds fourteen different floral forms or 'types' of this one species of daisy. They vary in colour from bright orange to light yellow, and most of these flower forms also have insect-like black spots on them. Studying the interaction between pollinators and plants in the Cape flora, researchers from the Stellenbosch University found that the male and female bee fly *(Megapalpus capensis)* have different preferences when it comes to their favourite daisy. The research was published in the international journal *Functional Ecology*.

Photo: Dr Marinus de Jager and Ethan Newman

Department of **Botany and Zoology**

Research Interests

Animal biodiversity; Antarctic and southern island research; behavioural ecology of vertebrates; Cape flora; climate change; community ecology; economic botany; conservation genetics and phylogeography; ecotoxicology; ecotoxicogenomics; endocrine disruption; evolutionary genomics of animals; evolutionary physiology of animals; fynbos ecology and genomics; herpetology; indigenous plant use and medicinal plants; insect behaviour and physiology; ecophysiology; invasion biology; macroecology; molecular systematics; palaeontology; plant animal interactions; plant biodiversity; plant biochemistry; plant biotechnology; plant ecology; plant ecophysiology; plant physiology and photosynthesis; plant functional genomics; plant mycorrhiza-fungi; plant systematics; stress ecology; vertebrate functional biology.

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Research outputs

Articles in accredited journals	133
Editorial activities (books and journals)	54
Books, conference proceedings, chapters in books	14
MSc students graduated in 2012	12
PhD students graduated in 2012	11

Research highlights

The department and associated staff take pride in the fact that the majority of the research papers were published in ISI accredited journals with high impact factors. Members of the Department of Botany and Zoology received more than R10 million in the form of research funding.

More than seventy percent of the academic staff now have NRF ratings (A = 3; B = 1; C = 6; Y = 9). As a result of the active research programmes of the department and the Centre for Invasion Biology, 37 new students registered for postgraduate degrees in Botany or Zoology (15 honours; 15 MSc and seven PhD). We also attracted many prominent national and international visitors and provided an academic home to 13 postdoctoral fellows from four nationalities.

Through these active collaborations we hosted visits from Dr Robert Barclay from the University of Calgary (Canada), Prof Jaimie Dick and Prof Mhairi Alexander of Queens University (Ireland), Prof Susan Mazer of the University of California (USA), Prof Eric Imbert from the *Institut des Science de l'Évolution de Montpellier* (France), Dr Heather Whitney of Bristol University (UK) and Dr Andrea Cosocov from the University of Cordoba (Argentina). Other visitors were Dr Sara Aguado de la Paz of the University of Oviedo (Spain), Dr Michelle Greve from Aarhus University (Denmark), Prof Steven Karl of the Hawai'i Institute of Marine Biology (USA), Dr Christine Meynard from the *Centre de Biologie pour la Gestion des Populations* (France) and Prof Michael Udvardi of the Noble Foundation in Oklahoma (USA).

Our seminar programme attracted several national research presenters such as Dr Woody Cotterill of the Africa Earth Observatory Network (AEON), Dr Lara Atkinson of the South African Environmental Observation Network (SAEON), Dr Lara van Niekerk of the CSIR Estuaries and National Biodiversity Assessment, Mr Saberi Marais of InnovUS and Dr Laura Blamey of the Marine Institute at the University of Cape Town.

Academic staff of the department and the C•I•B attended and presented research at several national and international conferences. International contributions include Dr Alex Valentine who visited the National University of Mexico and the Nobel Foundation in Oklahoma (USA), Dr Sophie von der Heyden who visited the National Evolutionary Synthesis Centre at Duke University (USA) and Dr Susana Clusella-Trullas who was an invited seminar speaker at the Department of Zoophysiology at Aarhus University (Denmark).

Dr Tammy Robinson presented at the 1st International Conference on the Regulation of Invasive Species of South Africa and Germany at the Justus Liebig University (Germany). Prof Dave

Richardson, Dr John Wilson and Dr Cang Hui attended the Tree Invasion Workshop at Bariloche (Argentina) and Prof Conrad Matthee and Prof Terry Robinson visited collaborators at the University of Montpellier (France) for on-going research. Dr Cang Hui visited collaborators at CSIRO and Monash University (Australia) and Prof Dave Richardson attended the NEOBIOTA conference in Pontevedra (Spain).

The Department of Botany and Zoology is the home of choice for several research associates who contribute towards research productivity. They include Prof Jan Nel, Prof Eddie van Dijk, Prof Jan Giliomee, Prof Dan Baird, Prof Sophie Reinecke, Prof Koot Reinecke, Dr Ted Oliver, Dr Edmund Pool, Dr Willie Sirgel, Dr Krystal Tolley, Dr John Wilson and Dr Colin Tillbury.

Academic affairs

At undergraduate level, the department is responsible for teaching six modules in Biology (first year) and 12 modules in Biodiversity and Ecology (second and third year). Some of the first year modules are taught as service courses to large numbers of students from other faculties. In this respect teaching assistance was provided by Dr Juri van den Heever, Dr Marnel Mouton, Dr W le Roux, Dr Sjirk Geerts, Dr Kenneth Oberlander, Mr Marinus de Jager, Mr Hannibal Musarurwa, Mr Christoff Truter, Mr Edward Archer, Mr Bernard Coetzee, Ms Janine Colling and Ms Natasha Mothapo.

The revised Biodiversity and Ecology programme was implemented during 2012. The new programme will increase the number of undergraduate modules on offer from 18 to 20 during 2013, and two new modules (Invasion Biology and Biome Ecology) will be introduced as third year modules during 2014. The changed programme will allow undergraduate students more exposure to the field of biodiversity and ecology. The content of the undergraduate programme is specifically designed to provide a solid platform for postgraduate studies in Botany and Zoology with emphasis on biodiversity, evolution and ecology. The new third year modules for 2013 include an Ecology Field Course, Angiosperm Diversity and Evolution, Global Change Biology, Evolutionary Ecology, Evolutionary Patterns and Processes, and Conservation Biology.

The department continued with the interactive tutorial system for small groups of first year students who have different levels of competency. The additional teaching is presented once a week by 11 dedicated senior postgraduate students in the form of formal tutorial classes. The same tutors are available for regular consultations with individual students. The programme, co-ordinated by Prof Theresa Wossler, proved to be very successful. Despite the larger class sizes the pass rate of first year students in most courses increased significantly since the introduction of this programme.

Thirty-seven postgraduate students successfully completed their degrees in the department (14 Honours, 12 MSc and 11 PhD). At present there are 39 Master's and 33 PhD students registered in the department. Fifteen MSc and six PhD students successfully presented project proposals during 2012. Three proposals to upgrade from MSc to PhD were evaluated and approved by the academic committees of the department.

Service to the scientific community

Several staff members acted as external examiners for courses or served on advisory panels to various conservation and government bodies.

The staff members of the Department of Botany and Zoology who acted as external examiners included Dr Carol Simon (Cape Peninsula University of Technology), Dr Nokwanda Makunga (University of the Free State and the University of Cape Town), Prof le Fras Mouton (University of the Free State and the University of the Western Cape), Prof Theresa Wossler (Rhodes University), Prof Hannes van Wyk (University of the Western Cape and the University of Cape Town), Dr Alex Flemming (University of the Western Cape and the University of Cape Town), Dr Tammy Robinson (University of Cape Town), Prof Valdon Smith (University of the Western Cape).

Prof Michael Cherry served as a panel member of the National Research Foundation (NRF) for the allocation of grants in Zoology and Ecology, as well as a trustee for the Kalahari Research Trust. Dr Allan Ellis served as board secretary of the South African Association of Botanists (SAAB) and supervised two NRF interns. Dr Carol Simon acted as a consultant for an abalone farm and served as representative on the International Polychaete Association.

Dr Nokwanda Makunga served as the president of the South African Association of Botanists (SAAB) and on the scientific committee of the Medical Research Council's Research Day. She was the invited speaker at SciFest 2012 as part of the National Science and Technology Forum roadshow in Grahamstown, and was invited as a member of the delegation that accompanied the Department of Science and Technology (Indigenous Knowledge Systems Platform) to India. She is the principal investigator for a THRIP-funded grant in partnership with Footprint Management Solutions.

Dr Alex Valentine was on the advisory board of JS Marais Park, while Prof le Fras Mouton was frequently interviewed as part of the RSG Afrikaans radio programme "Hoe verklaar jy dit?". Prof Terry Robinson served as an assessor at the National Research Foundation (NRF), was a board member of the International Cytogenetic and Genome Society and served as an executive and founding board member of the World Lagomorph Society. Prof Theresa Wossler was an active member of the Helderberg Advisory Committee which makes recommendations about issues such as fire management, animal translocations and public concerns to the management committee of the Helderberg Nature Reserve in Somerset West (South Africa).

Prof Hannes van Wyk served on the programme committee for the Berlin 10 International Conference, the organising committee of the International Symposium on Toxicity Assessment and on the steering committee of the Water Research Council. He was also a member of the evaluation panel for the Junior Captain Scott Medal. Prof Conrad Matthee was a member of the Riverine Rabbit Working Group Steering Committee of the Endangered Wildlife Trust. Dr Anton Pauw served as a trustee of the Wildflower Conservation Trust, was a member of the Red Hill Conservation Group, and was interviewed for the BBC Series "Wonders of Life". Dr Sophie von der Heyden's book, the *Southern African Sea Life – A Guide for Young Explorers*, was published by STRUIK.

Prof Leanne Dreyer acted as a scientific consultant to the *Woordeboek van die Afrikaanse Taal* (WAT) and was a core member of the DST-NRF Centre of Excellence in Tree Health Biotechnology.

Photo: Engela Duvenage

C•I•B technical officer Thembile Khoza showed Minister Naledi Pandor some of the ant samples that have been collected as part of the limbovane Outreach Project to Western Cape schools.

Science and Technology Minister Pandor visits C•I•B

*The Minister of Science and Technology, **Ms Naledi Pandor**, received an impressive snapshot of the globally significant activities and endeavours of the DST-NRF Centre of Excellence for Invasion Biology (C·I·B) when she recently visited the Stellenbosch University campus.*

*The Minister, along with **Dr Albert van Jaarsveld**, President and CEO of the National Research Foundation (NRF) and other key NRF officials, spent the morning in the company of SU Rector **Prof Russel Botman**, the acting SU Vice Rector: Research Prof Douglas Rawlings, Faculty of Science Dean **Prof Eugene Cloete** and staff members of the C·I·B.*

The C·I·B is one of seven Centres of Excellence established nationally by the Department of Science and Technology and the National Research Foundation since 2004. Its members undertake research on the impact that invasive species have on biodiversity and ecological services such as water provision.

Invasive species are organisms that have either accidentally or intentionally been transferred outside of their original area of occurrence, and now cause biodiversity damage and/ or economic harm. It is estimated that the economic cost of the impact of invasive species is 5% of the global gross domestic product (GDP).

During her visit, Minister Pandor also heard about how the C·I·B is using ants as the theme of its limbovane high school education project to inspire a new generation of young scientists.

Ms Pandor said she was pleased to have had the opportunity to visit the Centre along with her team. She encouraged staff involved to continue their dedicated work and to do even more to ensure that their work will have an impact on science and society.

Prof Savel Daniels served on the National Research Foundation (NRF) postdoctoral panel, while Dr Victor Rambau served on the committee for the Zoological Society of Southern Africa. Dr Tammy Robinson served on the board for the reviewing of funding applications for the NRF's Thuthuka fund.

Staff members were also actively involved in editorial activities for several prestigious journals. These include: Prof Michael Cherry (*Behavioral Processes; Folia Zoologica and Emu;* and editor-in-chief of *SA Journal of Science*), Dr Allan Ellis (associate editor of the *Botanical Journal of the Linnaen Society*), Dr Carol Simon (editor of the newsletter of the Zoological Society of Southern Africa), Dr Makwanda Makunga (associate editor of the *South African Journal of Botany*), Dr Alex Valentine (*African Journal of Herpetology* and associate editor of *African Zoology*), Prof Terry Robinson (*Chromosome Research*; *Cytogenetics and Genome Research*; and *Heredity* and co-edited with dr F Yang a special issue for *Heredity* entitled "Molecular Cytogenetics: Karotype evolution, phylogenomics and future prospects"), Prof Theresa Wossler (assistant editor of *African Entomology*), Prof Hannes van Wyk (editor of *African Zoology*), Prof Conrad Matthee (*Integrative and Comparative Biology; Koedoe* and *African Journal of Marine Science*), Dr Anton Pauw (subject editor for the *South African Journal of Botany*), Dr Susana Clusella-Trullas (*Journal of Thermal Biology; Frontiers in Invertebrate Physiology* and *Austral Ecology*), Dr Cang Hui (*Biological Invasions; Applied Mathematical and Computational Sciences*; *The Open Zoology Journal*, and *The Scientific World Journal*), Dr Jaco le Roux (review panel for *Czech Science*, and associate editor of *Biological Invasions*), and Prof Valdon Smith (*Polar Record*).

Several staff members are active in the oganisational or decision-making structures of various service organisations. These include the South African Association of Botanists (SAAB), the Agricultural Research Council (ARC), the Task Team for the Development and Regulation of Alien Species under the South African Biodiversity Act, the Scientific Committee on Antarctic Research (SCAR), the Zoological Society of Southern Africa (ZSSA), the South African Council for Natural Scientific Professions (SACNSP), the South African National Biodiversity Institute (SANBI), the National Research Foundation Biodiversity Focus Panel, the South African Society for Systematic Biology Council (SASSB), the Global Biodiversity Information Facility, the Lagomorph Specialist Group, the Onderstepoort Veterinary Research Institute, the Kalahari Research Trust, the Riverine Rabbit Working Group Steering Committee, the Water Research Commission steering committee, the Junior Captain Scott panel of the South African Academy for Science and Art, and the Southern African Reptile Conservation Assessment (SARCA).

Some of the international service organisations we are accosiated with include the Australian Antarctic Division, the Nederlandse Organisatie voor Wetenschappelijk Onderzoek (NWO) (Netherlands), the Committee for Research and Exploration of the National Geographic Society (USA), the International Union for the Conservation of Nature, the Amphibian Panel of the European Union's Organisation for Economic Cooperation and Development, the UK National Environmental Research Council, and the Institute for Ecological Research (Netherlands).

Awards to staff and students

Several of our staff members were honoured for their work. Dr Bruce Anderson received an Oppenheimer Scholarship and went on a research sabbatical to Japan. Prof Savel Daniels received Oppenheimer and Fulbright Scholarships for his research trip to Harvard University.

Prof Terry Robinson received acclaim for his role in the compilation of the most comprehensive family tree for mammals yet, published in January 2012 in the leading academic journal *Science*. Prof Michael Cherry was elected to the Academy of Science of South Africa and Prof Theresa Wossler was elected to the committee for Teaching and Learning at SU.

Our students, in collaboration with their supervisors, received various awards for their work. Mr Bernard Coetzee (supervised by Prof Steven Chown) won the prize for the best student presentation at the 3rd European Congress of Conservation Biology, while Ms Genevieve Thompson (supervised by Prof Dave Richardson, Dr Jaco Le Roux and Dr John Wilson) delivered the best PhD presentation at the meeting of the South African Association for Botanists (SAAB). Ms Nina du Toit (supervised by Prof Conrad Matthee, Prof Bettine Jansen van Vuuren and Dr Sonja Matthee) delivered the best presentation by a doctoral student at the 10th meeting of the Southern African Society for Systematic Biology. Mr

Adriaan Engelbrecht (supervised by Dr Sonja Matthee and Prof Conrad Matthee) walked away with the 3rd prize at the same conference. Ms Natasha Mothapo (supervised by Prof Theresa Wossler) and Mr Marinus de Jager (supervised by Dr Allan Ellis) were selected out of 60 students to present their work at the 2012 New Voices in Science conference at SU.

Staff matters

Dr Jaco le Roux, a molecular invasion biologist, was appointed as lecturer from 1 January 2012 and Dr Susana Clusella-Trullas as senior lecturer as from 1 October 2012. We had to bid farewell to Dr Sue Jackson who resigned as academic lecturer, but will continue her affiliation with the department as research associate. Ms Judy Smith resigned as from November 2012 after five years of service. Prof Steven Chown (professor in Botany and Zoology and director of the C•I•B) accepted an appointment at Monash University, Australia, but continues his involvement with the department as an extraordinary professor. Prof Dave Richardson was appointed as new director of the Centre for Invasion Biology.

Community interaction

A number of lecturers were involved in the Maties Science Winter Week. Under the leadership of Prof Leanne Dreyer learners were made aware of the sustainable use of biodiversity for commercial and cultural benefits.

The C•I•B limbovane project continued to be very successful in teaching biodiversity to teachers and high school leaners. This outstanding project received the attention of Minister Naledi Pador during a visit to the department on 21 February 2012

Collaboration

SOUTH AFRICA

Agricultural Research Council, Infruitec-Nietvoorbij

Agricultural Research Council, Pretoria

CapeNature

Cape Peninsula University of Technology

Council for Scientific and Industrial Research (CSIR)

CSIR Natural Resources and the Environment research unit

Department of Agriculture, Forestry and Fisheries

Department of Environmental Affairs DST-NRF Centre of Excellence in Tree Health Biotechnology

Endangered Wildlife Trust

Forestry and Agricultural Biotechnology Institute

Iziko South African Museum

Medical Research Council

Nelson Mandela Metropolitan University

Northwest University

Perishable Products Export Control Board

Plant Protection Research Institute

Rhodes University

Sasol Technology

South African Institute of Aquatic Biodiversity

South African National Biodiversity Institute

South African National Parks

University of Cape Town

University of KwaZulu-Natal

University of Pretoria

University of Pretoria, Faculty of Veterinary Science

University of the Free State

University of Venda

University of the Western Cape

Working for Water Programme

INTERNATIONAL

Argentina

University of Cordoba

University of Rio Cuarto

Australia

Australian Antarctic Division

Australian Centre for Evolutionary Biology and Biodiversity, University of Adelaide

Australian National University

Commonwealth Scientific and Industrial Research Organisation

Curtin University of Technology

Department of Environment and Conservation, Western Australia

James Cook University

Kings Park and Botanic Garden

Macquarie University

School of Earth and Environmental Sciences, University of Adelaide

University of Adelaide

University of Melbourne

University of New South Wales

University of Queensland

University of Sydney

Belgium

Flanders Institute for Biotechnology, University of Ghent

Brazil

Universidade Federal de Santa Catarina

Canada

Simon Frazer University

University of Toronto

China

Guangdong University of Technology

Prof Dave Richardson was also honoured with the FW Herschel Medal of the Royal Society of South Africa.

Invasion biologist to serve as Professor-at-Large

*The appointment of **Prof Dave Richardson,** director of the Centre for Invasion Biology (C•I•B), as a James March Professor-at-Large at the University of Vermont (UV), is another feather in his cap. His appointment at this premier small research university, one of the USA's best, comes just weeks after he received the John FW Herschel Medal from the Royal Society of South Africa.*

Prof Richardson studies the dynamics of plant invasions and is an international authority on trees and shrubs as invasive species. Much of his work aims to provide practical guidelines to improve the management of invasive species, but he also contributes to theoretical frameworks and general models to understand the dynamics of invasions.

According to the University of Vermont, Professors-at-Large are expected to "invigorate the intellectual and cultural life of the University." Incumbents of this position are not only selected for their high accomplishments, but "also for their broad-ranging interests and their personal and professional accessibility". Professors-at-Large, of which no more than 20 are appointed during one period at Vermont, typically offer public lectures and collaborate and consult with students.

His appointment at UV is for seven years, during which this A-rated scientist will visit Burlington for up to four residency periods of several weeks each.

Maties receive prizes for parasite studies

Two doctoral students from Stellenbosch University (SU) – both with a particular preference for the study of parasites – were awarded prizes at the 10th conference of the Southern African Society for Systematic Biology (SASSB), held in Arniston. ***Ms Nina du Toit*** *delivered the best presentation by a doctoral student, while* ***Mr Adrian Engelbrecht*** *took third place in this category.*

The SASSB is aimed at promoting systematics and taxonomy in South Africa and is multi-disciplinary in nature.

The two students share the same supervisors – ***Prof Conrad Matthee****, head of the Department of Botany and Zoology, whose research programme focuses on molecular systematics and population genetics, and* ***Dr Sonja Matthee*** *of the Department of Conservation Ecology and Entomology, who in turn studies the taxonomy and ecology of parasites.*

Ms Du Toit is busy with an extensive phylogeographical study of the striped mouse (Rhabdomys pumilio), focusing specifically on the parasitic louse (Polyplax arvicanthis) that only occurs on this rodent.

Mr Engelbrecht is focusing on a parasitic mite (Laelaps giganteus) that is believed to occur on various types of small rodents in Southern Africa.

As it is not currently clear how host specific Laelaps giganteus actually is, Mr Engelbrecht's study should provide, among other things, more concrete evidence in this regard.

According to Dr Matthee very little research has been done on the phylogeography or genetic distribution of certain African species of parasites.

Hefei University of Technology
Lanzhou University

Czech Republic
Academy of Sciences of the Czech Republic
Botanical Institute
Charles University
Veterinary Research Institute, Brno

Denmark
Aarhus University
University of Copenhagen

Finland
University of Jyvyskyla

France
Centre de Biologie pour la Gestion des Populations, Université Montpellier II
Centre d'Ecologie Fonctionnelle et Evolutive
Institut des Sciences de l'Evolution, Université Montpellier II
Institut National de l'Environnement Industriel et des Risques
Musée national d'Histoire naturelle
National Centre for Scientific Research (CNRS)
Université de Franche-Comte
Université Montpellier I
Université Paul Sabatier Toulouse III

Germany
Alfred Wegener Institute for Polar and Marine Research
University of Braunschweig
University of Freiburg
University of Hamburg
University of Leipzig
University of Würzburg

Greece
Agricultural University of Athens

Hungary
Hungarian Academy of Sciences

India
India Institute of Science

Iran
Tarbiat Modares University

Italy
University of Bologna
University of Siena

Japan
Kyoto University
National Institute for Basic Biology

Kenya
University of Nairobi

Mexico
National University of Mexico

The Netherlands
Data-Analyse Ecologie
Wageningen University

New Zealand
University of Auckland

Norway
University of Oslo

Poland
Jagiellonian University
Institute of Botany, Polish Academy of Sciences

Portugal
Instituto Superior de Psicologia Aplicada
Technical University of Lisbon
University of Evora

Spain
Centre Technológic Forestal de Catalunya
Doñana Biological Station
National Museum of Natural Sciences
Universidad de Oviedo
Universidad Pablo de Olavide
Universitat Autònoma de Barcelona
Universitat de Girona
Universitat de València

Sweden
Lund University
Stockholm University
Swedish University of Agricultural Sciences

Switzerland
University of Zurich

United Kingdom
British Antarctic Survey
British Trust for Ornithology
Plymouth Marine Laboratory
Queen Mary College, University of London
Royal Botanic Gardens, Kew
The Wellcome Trust Sanger Institute
University of Bristol
University of Cambridge
University of Exeter
University of Sheffield

United States of America
Cornell University
Field Museum Chicago
Nobel Foundation
University of California (Berkeley)
University of California (Santa Cruz)
University of South Georgia
University of Vermont
University of Villanova

University of Wisconsin
West Virginia University

Funding

British Ecological Society
Claude Leon Foundation
National Centre for Scientific Research (CNRS), France
Council for Scientific and Industrial Research (CSIR)
Department of Agriculture, Forestry and Fisheries
Ernst Oppenheimer Fellowship Trust Fund
German Academic Exchange Service (DAAD)
University of Montpellier, France
National Geographic Society of America
National Natural Science Foundation of China (NSFC)
National Research Foundation
Oppenheimer Memorial Trust
Royal Society, United Kingdom
Sasol Technology
South African Biodiversity Initiative
Stellenbosch University
Table Mountain Fund
Thuthuka
Water Research Commission
Working for Water Programme
World Wide Fund for Nature

Staff

Academic

Prof CA Matthee *(head of department)*
Dr BC Anderson
Prof MI Cherry
Prof SL Chown
Dr S Clusella-Trullas
Prof SR Daniels
Prof LL Dreyer
Dr AG Ellis
Dr AF Flemming
Dr S Jackson
Prof B Jansen van Vuuren
Dr JJ Le Roux
Dr NP Makunga
Prof PLN Mouton
Dr CA Pauw
Dr RV Rambau
Prof SA Reinecke
Prof DM Richardson
Dr TB Robinson
Prof TJ Robinson
Dr CA Simon
Prof VR Smith
Dr AJ Valentine
Prof JH van Wyk
Dr S von der Heyden
Prof TC Wossler

Centre of Excellence for Invasion Biology

Prof SL Chown *(director till May 2012)*
Prof DM Richardson *(director)*
Dr C Hui

Extraordinary professors

Prof S Barrett
Prof AM Bauer
Prof SL Chown
Prof MA McGeogh
Prof KJ Gaston
Prof MA McGeogh
Prof L Mumba

Support staff

L Willems *(principal secretary)*
JL Basson
A Fransman
F Gordon
RM Honing
S Johnson
DJD Julies
A Kleinert
R Robertson
MP Sauerman
M Siebritz
JN Smith

John Cooper was congratulated by Mark Anderson, CEO of Birdlife SA, and Vernon Head, chair of Birdlife South Africa.

Photo: Lesley Clemens

BirdLife SA honours seabird expert John Cooper

*Seasoned ornithologist **John Cooper**, a research associate at Stellenbosch University, has become the first local seabird expert ever to receive the prestigious Gill Memorial Medal of BirdLife South Africa.*

It is the second award made to Mr Cooper in 2012, and one which recognises his dedication over the past four decades to research and conserve seabirds such as albatrosses and petrels. Mr Cooper is a research associate of the DST-NRF Centre of Excellence for Invasion Biology at SU.

It is only the 18th time that the engraved bronze medal has been awarded since 1960, and the first time ever that it honours an ornithologist who has concentrated on studying seabirds over his career. The Gill Memorial Medal, BirdLife South Africa's most prestigious award, acknowledges an outstanding lifetime contribution of an amateur or professional person to the knowledge of southern African birds.

The mission of BirdLife South Africa is to promote the enjoyment, conservation, study and understanding of wild birds and their habitats

Photo: Engela Duvenage

Dr Sophie von der Heyden

Marine biologist writes book on sea life for children

Did you know that a sea-star feeds by pushing its stomach out through its mouth and placing it directly over its prey? That octopuses are quite clever? Or that Columbus' crabs are sky blue?

***Dr Sophie von der Heyden**, a marine biologist in the Department of Botany and Zoology at Stellenbosch University, wrote a marine guide with these and other interesting facts for children between the ages of eight and fourteen.* Southern African Sea Life: A Guide for Young Explorers *is published by Struik Nature and has been available in bookstores since November 2012.*

The guide provides an overview of Southern African ocean currents, the importance and conservation of oceans, and various marine habitats. Marine plants and animals, such as seaweeds, molluscs, fish, seashore birds and marine mammals and reptiles are all discussed with the help of easy to understand text and quality colour photography.

*Respected marine photographer **Guido Zsilavecz** from the Southern Underwater Research Group (SURG) contributed most of the photographs that were used to make the identification of species easier. Illustrations by **Sally McLarty**, an experienced illustrator of children's and nature books, are also included.*

The book includes a holiday guide section, which focuses on various popular sections of the Southern African coastline, including the West Coast, the Wild Coast, Namibia and Mozambique.

N Solomons
RC Thompson
JP Williams
H Witbooi

Centre of Excellence for Invasion Biology

K Coombe-Davis
S Davis
M de Morney
D du Plessis
M Gaertner
A Garthwaite
K Jumbam
T Khoza
S Kritzinger-Klopper
E Marais
C Momberg
E Nortje
C Scheepers
D Scott
M van der Vyver

NRF-rated researchers

Leading international researcher

Prof Steven Chown
(biological invasions and evolutionary physiology)

Prof Dave Richardson
(biological invasions and conservation biogeography)

Prof Terry Robinson
(evolutionary genetics and phylogenomics of mammals)

Internationally acclaimed researcher

Prof Valdon Smith
(Antarctic and Southern Island biology and ecology)

Established researcher

Prof Mike Cherry
(behaviour ecology)

Prof Leanne Dreyer
(evolution of the Cape Flora)

Prof Conrad Matthee
(molecular systematics and phylogeography)

Prof Pieter le Fras Mouton
(evolutionary ecology of lizards)

Dr Alexander Valentine
(molecular physiology of host-microbe interactions of legumes in phosphorus deficient soils)

Prof Theresa Wossler
(communication and social organisation in hymenopteran)

Promising young researcher

Dr Bruce Anderson
(plant-animal interaction)

Prof Savel Daniels
(molecular systematics, phylogeography and conservation of invertebrata)

Dr Susana Clusella-Trullas
(thermal adaptation of ectotherms and implications for climate change)

Dr Allan Ellis
(evolutionary ecology of plants and insects)

Dr Nokwanda Makunga
(medicinal plant biotechnology)

Dr Anton Pauw
(evolutionary ecology of plants and their pollinators)

Dr Victor Rambau
(cytogenetics, phylogeography)

Dr Carol Simon
(marine invertebrate reproduction and polychaete worm taxonomy)

Dr Sophie von der Heyden
(marine molecular ecology and conservation)

IMAGE 1

Department of **Mathematical Sciences**

(Mathematics, Applied Mathematics, Computer Sciences)

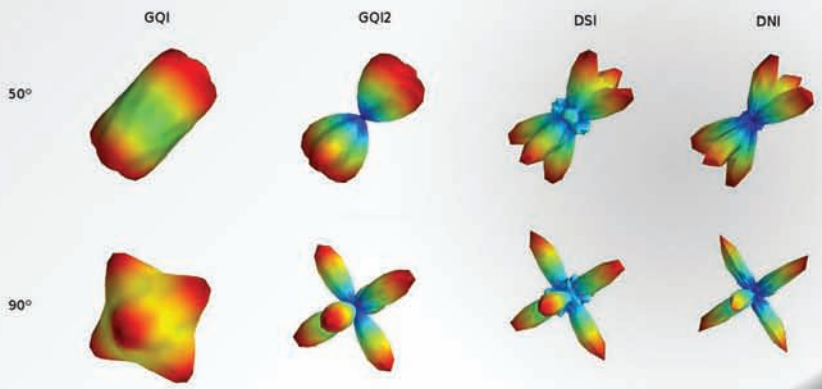
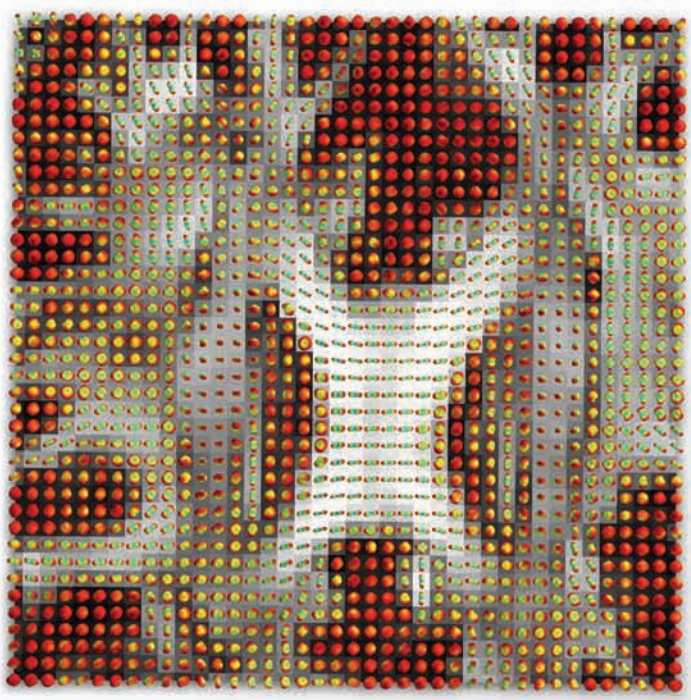


IMAGE 2

IMAGE 3



In an effort to understand the brain's structural connectivity, researchers in the field of Applied Mathematics are working towards improving techniques for modelling the diffusion of water molecules in the human brain. The images above show the probability of flow at single points in the brain (images 2, 3) while image 1 shows how the information can be integrated to represent fibre tracts.

Images: Dr Stéfan van der Walt and Dr Eleftherios Garyfallidis

Department of **Mathematical Sciences**

(Mathematics, Applied Mathematics, Computer Science)

Research Interests

Algebra and number theory; analysis, topology and category theory; approximation theory, computational mathematics, numerical analysis and scientific computing; discrete mathematics; financial mathematics; mathematical and computational biology; machine learning and computer vision; IP networks; automata theory and formal languages; program verification; flow modelling in porous media; software engineering.

Research outputs

Articles in accredited journals	52
Editorial activities (books and journals)	many
Books, conference proceedings, chapters in books	27
MSc students graduated in 2012	19
PhD students graduated in 2012	9

Research highlights

Researchers in Mathematics, Applied Mathematics and Computer Science have continued to achieve high standards in their respective fields of specialisation. This is reflected by the increased number of publications in journals of high standing and the strengthening of collaborations with other researchers and the industry.

The National Research Foundation (NRF) awarded six research chairs to Stellenbosch University under the South African Research Chair Initiative. One of these, a research chair in Mathematical and Theoretical Physical Biosciences, is a joint proposal of the Department of Mathematical Sciences and the African Institute for Mathematical Sciences (AIMS). This provides an exciting opportunity to build a special multidisciplinary research group.

The newly established IBM Software Centre of Excellence forms part of the IBM Academic Initiative, a global programme facilitating collaboration between IBM and educators. This centre will support the Computer Science Division in their training of highly skilled computer scientists to meet the shortage of such skilled professionals in industry and business. This centre includes a postgraduate computer laboratory and provides an environment for matching high-quality education with exposure to state-of-the-art and emerging technologies.

The Hungarian–South African Intergovernmental Science &Technology Cooperation Programme, coordinated by Prof Leon van Wyk, has stimulated collaboration between South African and Hungarian mathematicians working in the area of non-commutative ring theory. As part of this programme, Prof Van Wyk is collaborating with Prof Jenõ Szigeti of the University of Miskolc, Prof dr. Hab Edmund Puczłyowski of the University of Warsaw, and Dr Pham Ngoc Ánh and Dr László Márki of the Renyi Institute of Mathematics at the Hungarian Academy of Sciences. During 2012 all these researchers visited Stellenbosch University and Prof Van Wyk also visited each of them during his sabbatical in the second semester. This research collaboration of the past three years has led to the publication of six research articles and the acceptance of another three articles. One of these articles was published in the *Journal of Algebra*, a leading international journal on general Algebra and the rest were published in *Linear Algebra and its Applications* and *Linear and Multilinear Algebra*, both being leaders in their field of Linear Algebra .

It is commendable that 52 research articles were published in accredited journals, with 44 of these written by researchers in Mathematics. Prof Florian Breuer's paper "Special subvarieties of Drinfeld modular varieties" was published in the *Journal Für Die Reine und Angewandte Mathematik*. This journal is ranked as being in the top

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10% of Mathematics journals, based on article impact score, using the Science Citation Index. Prof Helmut Prodinger, the only A-rated researcher in the department, maintained his high annual publication rate of over ten publications, five of which were single-author papers. Prof Stephan Wagner published five papers, three of which were single-authored papers and Dr Zurab Janelidze published five papers, one of which was a single-authored paper. There is also a growing trend that supervisors are encouraging their graduate students to publish their results – five single-author papers were published by doctoral students in Mathematics.

We were very well presented at two national discipline conferences. The Computer Science Division presented seven papers at the 2012 Annual Congress of the South African Institute for Computer Scientists and Information Technologists (SAICSIT2012). This was a great achievement and an opportunity to showcase this division of our department. At the 55th Annual Congress of the South African Mathematical Society, the Mathematics Division presented 24 papers – ten by academic staff members and 14 by postgraduate students!

Our staff members were also actively involved as keynote speakers in both national and international workshops and conferences.

"Relaxation systems and high-order accurate flow computations" was the title of Prof Mapundi Banda's invited lecture at the German Academic Exchange Service (DAAD) International Workshop on Modeling, Computing and Optimization (India). Prof Banda then delivered a plenary lecture entitled "Networking flow and transport processes" at the 55th Annual Congress of the South African Mathematical Society.

Prof André Weideman presented a plenary talk at the 36th South African Symposium on Numerical and Applied Mathematics (SANUM 2012): "Efficient Contour Integrals for the Numerical Inversion of the Laplace Transform", held at the University of the Witwatersrand. He also presented this as a colloquium talk at the University of Fribourg (Switzerland).

At a specialist Number Theory conference in Germany, Prof Florian Breuer gave an invited talk "On Drinfeld modular polynomials".

Dr Bruce Bartlett gave an invited lecture entitled "Invariants of 3-manifolds via generators and relations of the 1-2-3 bordism 2-category" at the UCT/AIMS workshop on Geometric Analysis. During an invited research visit to Dr David Gay at the University of Georgia, Dr Bartlett presented the talk "Generators and relations for 1-2-3 topological quantum field theories" at the Georgia Topology Seminar.

Prof Willem Visser presented two invited lectures in the USA: "Green: Reduce, Reuse and Recycle Constraints" was presented at the NASA Ames Research Center and the title of the lecture he presented at the Fujitsu Laboratories of America, was "Probabilistic Symbolic Execution". He presented the same paper as an invited talk at the Korea Advanced Institute of Science and Technology (KAIST) in South Korea.

Prof Willem Visser was elected to the executive committee of ACM SIGSOFT, the leading academic organisation for software engineering. His election is proof of his standing as an internationally recognised leading researcher in Software Engineering. Over the past four years he has maintained his collaboration with the NASA Ames Research Group on two projects: Java PathFinder and Symbolic PathFinder. He also presented papers at the International Symposium on Software Testing and Analysis (ISSTA) and the 20th International Symposium on the Foundations of Software Engineering (FSE 20) (USA). Prof Visser's paper, based on his research visit to NASA in 2012, has been accepted for the 35th International Conference on Software Engineering (ICSE 2013).

Several researchers were granted sabbaticals. Prof Mapundi Banda was granted research leave for six months as part of the conditions of his NRF Career Award for Y-rated researchers (2011 – 2012). During this time he spent a month at the University of British Columbia as a visiting professor, where he collaborated with Prof Douw Steyn.

Dr McElory Hoffmann visited the Department of Computer Science at the Université catholique de Louvain (Belgium) for ten months where he conducted research as a postdoctoral fellow and supervised Master's students in the Machine Learning Group.

During her sabbatical for part of the second semester, Dr Karin Howell initiated a new research collaboration with an academic from Russia, Dr Dennis Chistyakov, as part of her "Maxmal Algebras in Function Algebra" research project.

During his research leave in the first semester, Prof Helmut Prodinger headed to Shanghai and Taipei, to meet his scientific partners Dr Rosena Du, Dr Michael Fuchs and Dr Hsien-Kuei Hwang. Later in the year Dr Fuchs visited Prof Prodinger in Stellenbosch. On invitation from Dr Hwang, Prof Prodinger was bestowed the honour of writing an introductory chapter for the collected papers of Prof Philippe Flajolet. Part of his research leave was devoted to this special task, and the collection should appear in 2013.

Dr Stéfan van der Walt took up a postdoctoral research position in the Henry H Wheeler Jr Brain Imaging Center within the Helen Wills Neuroscience Institute, University of California at Berkeley. His research focused on the analysis of the fiber structure of the human brain, based on diffusion-weighted magnetic resonance imaging (MRI) data. In support of the project, and as part of a growing global movement towards open and reproducible research, contributions were made to several open source software packages, including DiPy (diffusion imaging in Python) and the IPython web notebook, a new platform for online publication and sharing of scientific computation and writing.

Photo: Engela Duvenage

Computer Science student Heila van der Merwe with Prof Willem Visser, head of the Division of Computer Science in the Department of Mathematical Sciences (Mathematics, Applied Mathematics, Computer Science) and Mr Clayton Booysen of the IBM Software Group.

SU home to IBM's first Software Centre of Excellence in South Africa

***Stellenbosch University** and **IBM** are collaborating to help meet the shortage of Computer Science skills in South Africa with the establishment of the Software Centre of Excellence on 12 June 2012.*

The joint academic initiative will provide equipment and training resources to postgraduate Computer Science students, helping them develop much needed technical skills.

The first-of-its-kind centre of excellence in South Africa includes a postgraduate computer laboratory in the SU Computer Science Division, with advanced software including the Rational® development environment which will provide a fully-fledged software production environment for students to hone their skills.

The IBM Academic Initiative is a global programme that facilitates the collaboration between IBM and educators to teach students the information technology skills they need to be competitive and keep pace with changes in the workplace.

"It is important for us to energise the classroom and that calls for integrating the latest technology into our curriculum in order to prepare students for high-value job opportunities," says Prof Ingrid Rewitzky, Vice-Dean: Teaching of the SU Faculty of Science and chair of the SU Department of Mathematical Sciences (Mathematics, Applied Mathematics, Computer Science).

The CoE opening is part of a long term relationship between the University and IBM.

Prof Leon van Wyk devoted his sabbatical to his collaborative projects with researchers in Hungary, as part of the Hungarian–South African Intergovernmental Science & Technology Cooperation Programme. He also visited Prof Kirby Smith at Texas A&M University for research collaboration.

During his six month sabbatical, Prof André Weideman visited Prof Bengt Fornberg at the University of Colorado Boulder (USA) for collaboration on a research article, "A computation exploration of the Second Painleve Equation" and Prof Nick Treffethan at the Mathematics Institute at the University of Oxford for further work on their survey article on the use of the trapezium rule in numerical mathematics. He also participated in conferences in Italy, the United Kingdom and Switzerland.

Two researchers of the Bureau of Industrial Mathematics at the University of Stellenbosch (BIMUS), Dr Milton Maritz, the director, and Prof Francois Smit, are currently involved in research and development projects in the field of Applied Mathematics in the private sector. Dr Maritz is working with Rheinmetall Denel Munition (Pty) Ltd on the following projects: Adaptation to STREAK: Software for analysing streak images in detonation events; Adaptation to JETP: Software for analysing (on X-ray film) particulation in shape charge jets; FRAPP: (New) Software for simulating trajectories of fragments and the subsequent penetration of plates; and 3-Dimensional reconstruction of trajectories of fragments from two or only one flash X-ray, with or without a horisontal witness plate (a geometrical and matching problem).

Prof Francois Smit is involved in consultative capacity for various projects with Rheinmetall Denel Munition (RDM), Denel Dynamics, Reutech Radar Systems (RRS), the Council for Scientific and Industrial Research (CSIR) and Formo Fibreglass. His current focus is the inter-institutional project "FLUXION: Research in the Computational Mechanics of Fluids" for the South African Department of Defence. FLUXION is intended to develop skills in the field of computational mechanics and applications including computational fluid dynamics, finite element analysis and fluid structure interaction. This portion of the LEDGER programme is managed by the Aeronautics Systems competency area at the CSIR. The LEDGER programme is funded by the South African Department of Defence. Three postgraduate projects – a PhD (in Engineering) and two MSc projects in Applied Mathematics are included in this funding. Prof Francois Smit is the supervisor for both MSc students.

As part of the Memorandum of Understanding between Stellenbosch University and the CSIR, four researchers in Applied Mathematics are involved with collaborative projects with research units at the CSIR and with supervision of master's and doctoral students, enrolled at Stellenbosch University and based at the CSIR.

Prof Francois Smit and Dr Hardus Diedericks are supervisor and co-supervisor, respectively, of doctoral student, Mr Luther Terblanche, who is working on "Analysis of extreme events in the coastal zone" with the Coastal Engineering and Port Infrastructure group within the Built Environment Unit at the CSIR. In the same capacities they also supervise Mr Patrick Shabangu, a master's student working on "Investigating boundary conditions for near-shore area hydrodynamic models" with the Coastal Systems Group within the Natural Resources and the Environment Unit at the CSIR. They are also working on the improvement of boundary conditions for near-shore models in CFD applications.

Dr Willie Brink is collaborating with the Mobile Intelligent Autonomous Systems (MIAS) group within the Modelling and Digital Science unit at the CSIR.

Prof Mapundi Banda is supervising doctoral student Ms Belinda Matebese working on "Sampling-based algorithms for motion planning". She is based in Mobile Intelligent Autonomous Systems (MIAS) within the Modelling and Digital Science Unit at the CSIR. Prof Banda is also supervising doctoral student Mr

Tumelo Uoane working on "Modelling generation and transport of Acid Mine Drainage (AMD) using computational fluid dynamics (CFD) techniques" with the Advanced Mathematical Modelling and simulation Group within the Modelling and Digital Science Unit at the CSIR.

Academic affairs

We introduced new information and communication technologies to improve on the more traditional approaches to undergraduate teaching and learning in the department.

Addressing the need of first-year Computer Science students to have lectures in the language of their choice, Dr McElory Hoffmann made use of video recordings. For a week he presented the lectures in Afrikaans with English videos on the web and then the process was alternated in the subsequent week. Student feedback was extremely positive.

Dr Milton Maritz made use of self-developed demos in MATLAB in his Vector Calculus module he presented for second-year Engineering students, because the visualisation of concepts in vector calculus is fundamental for their understanding. The appreciation of the students made the effort worthwhile.

Dr Bruce Bartlett addressed the challenge of large tutorial classes (classes bigger than the desired one tutor for 20 students) in a creative way. He has been using the Multivariable Calculus course from MIT Open Courseware in his W244 class since 2011. The most useful aspect about this course is the recitation videos, where a student instructor demonstrates or "recites" the solutions to certain problems to a small group on the blackboard. Students love to see a solution "demonstrated" to them and at their own pace (not possible in large tutorial classes). Students draw inspiration and energy from the notion that they are potentially "on par" with MIT students.

Hands-on computer labs for the third-year Numerical Analysis module were developed by Prof André Weideman for students to effectively implement the methods developed in the lectures, meaningfully interpret the results, improve the algorithm and/or implementation as needed, and to make informed decisions about the most suitable algorithm for a particular problem.

With the ever decreasing availability of chalk boards and the requests from students for on-line notes, the tablets are proving popular for presenting lectures. Students benefit from this as lectures can be made available on the web immediately after the face-to-face class and the lectures are enhanced by the use of colour, pictures, demos and/or extracts from the textbook or other resources.

Mathematics students from nine South African universities attended the first Summer School in Number Theory organised by Prof Florian Breuer. The event aimed to attract talented undergraduate students in order to expose them to an exciting area of Mathematics not offered at all universities in South Africa and also to encourage them to pursue postgraduate studies in Mathematics. A focus was placed on elementary number theory, as well as analytic and combinatorial number theory. Advanced topics such as cryptography, Diophantine equations, cardinal arithmetic, elliptic curves, the Riemann Zeta-function and Riemann Hypothesis, Ducci sequences, and the analogy between number fields and function fields were also covered.

The Financial Mathematics Honours programme was launched as a joint initiative of Stellenbosch University, the University of Cape Town and the African Institute for Mathematical Sciences (AIMS). Dr Peter Ouwehand is the local coordinator of the programme and is involved with lecturing three of the modules offered as part of the programme, as well as with project supervision.

A total of 28 students (15 South African students and 13 students from Africa) in the department were awarded PhD and Master's degrees. These included two PhDs in Applied Mathematics, one PhD in Computer Science, six PhDs in Mathematics, two MSc degrees (cum laude) in Applied Mathematics, two MSc degrees (cum laude) in Computer Science, ten MSc degrees (cum laude) in Mathematics, one MSc degree in Computer Science and four MSc degrees in Mathematics. Among those graduating with a PhD in Applied Mathematics, was Ms Sonia Woudberg, a lecturer in Applied Mathematics.

About 20 honours students graduate each year. Most of these students choose to take up attractive employment offers in South Africa at financial institutions, IT companies and research and development institutes, such as the CSIR. A challenge for all three divisions is to attract more South African students to pursue master's and doctoral

Doing maths for planet Earth

Well-known American mathematical physicist and blogger ***Prof John Baez*** *delivered a public lecture at the 55th annual conference of the South African Mathematical Association via Skype, thereby saving one tonne of carbon emissions by not flying.*

This was the first time that the conference, hosted by Stellenbosch University's Department of Mathematical Sciences (Mathematics, Applied Mathematics, Computer Science), included a public lecture. The aim of the lecture was to raise awareness of 2013 being the year of Mathematics of Planet Earth, a global effort by mathematical societies and institutes to encourage scientists to study the math that underpins geologic and biological processes on Earth.

Prof Baez is also closely involved with the blog Azimuth, described as an international collaboration to create a focal point for scientists and engineers to work together on common problems such as climate change, mass extinction and peak oil.

According to Prof Baez the global warming crisis is part of a bigger transformation in which humanity has to realise that Earth is a finite system: "Our population, energy usage and the like cannot continue to grow exponentially. If civilization survives this transformation, it will affect mathematics – and be affected by it – just as dramatically as the agricultural revolution or industrial revolution," he writes on his blog about the lecture.

The rest of the conference focused on the role these annual events play in enhancing collaborative mathematics research endeavours between South African and African universities.

First summer school in number theory held

Mathematics students from nine South African universities attended the first Summer School in Number Theory from 23 to 27 January 2012 at SU.

The summer school was presented by the Mathematics division of the SU Department of Mathematical Sciences (Mathematics, Applied Mathematics, Computer Science) under leadership of ***Prof Florian Breuer*** *and* ***Lesley Wessels.***

According to Prof Breuer, the event aimed to attract especially talented undergraduate students in order to expose them to this exciting area of Mathematics and motivate them to continue with graduate studies in Mathematics.

A focus was placed on elementary number theory, as well as analytic and combinatorial number theory. Advanced topics such as cryptography, diophantine equations, cardinal arithmetic, elliptic curves, the Riemann Zeta-function and Riemann Hypothesis, Ducci sequences, and the analogy between number fields and function fields were also covered.

Lectures were presented by PhD student ***Dirk Basson*** *and SU mathematicians* ***Prof Stephan Wagner***, ***Dr Arnold Keet, Prof Florian Breuer***, ***Dr Zurab Janelidze*** *and* ***Ms Lesley Wessels***, *as well as* ***Dr Christine Swart*** *and* ***Dr Kenneth Hughes*** *from the University of Cape Town.*

studies, even for part-time study while working in industry.

Service to the scientific community

The 55th Annual Congress of the SA Mathematical Society with the theme "Maths uniting Africa" was hosted by the department from 31 October to 2 November. The theme was chosen to emphasise the important role these annual congresses play in enhancing collaborative mathematics research endeavours between universities in South Africa and Africa. The organising committee – Dr Bruce Bartlett, Prof Florian Breuer, Dr Cornelia Naude, Dr Paul Grobler, Dr Karin-Therese Howell, Prof Stephan Wagner and chaired by Prof Ingrid Rewitzky – incorporated several fresh ideas into the normal congress programme. These included a public lecture on the eve of the congress, a new and fairer system for evaluating postgraduate presentations for the best talk awards, a more organised programme for the contributed talks, congress material respecting the Go Green Campaign of the university, personalised wine gifts, and a conference photo.

It is an honour for academics to be involved in discipline-focussed organisations, associations or research groups and several academic staff members are involved in research journal editorial activities and/or programme committees of research conferences in Computer Science.

Dr Sonia Woudberg will serve as the treasurer of the Southern African Society of Rheology (SASOR) from 2012 to 2014.

Dr Bruce Bartlett is a research associate of the National Institute for Theoretical Physics (NITHEP) and he served on the advisory committee for the Berlin 10 Open Access conference held at STIAS in November 2012.

Dr Farai Nyabadza serves as a board member of the Canon Collins Trust in Southern Africa, as the secretary general of the Africa Society for Biomathematics (ASB), and as the secretary general of the Southern Africa Mathematical Sciences Association (SAMSA).

Dr Zurab Janelidze was appointed as a consultant for a Portuguese grant project "Métodos Categoriais em Álgebra Não Abeliana" funded by Fundação para a Ciência e a Tecnologia (FCT, Portugal).

In recognition of their significant contributions to the African Institute for Mathematical Science (AIMS), Prof Stephan Wagner has been appointed as an AIMS associate faculty member, Prof Florian Breuer as an AIMS associate research fellow, and Prof Ingrid Rewitzky as a member of the AIMS executive team.

Awards to staff and students

Dr Hendrik Boshoff, Mr Piet Crous, Prof Florian Breuer, Prof David Holgate, Dr Zurab Janelidze and Dr Farai Nyabadza were honoured at the First-Year Academy's Prestige Evening, in recognition of their contribution to the success of the University's top 32 first-year students.

Lecturers as well as postgraduate students made us proud with their award-winning papers presented at conferences.

Mr Jacques Swanepoel, a junior lecturer in Computer Skills and a doctoral student in Applied Mathematics, received the International Graphonomics Society Best Student Paper Award at the 13th International Conference on Frontiers in Handwriting Recognition. The title of his winning talk was "Writer-specific dissimilarity normalisation for improved writer-independent off-line signature verification".

Mr Willem Bester, Dr Cornelia Inggs and Prof Willem Visser won the award for the best Computer Science paper, entitled "Test-case generation and bug-finding through symbolic executions", at the 2012 Annual Congress of the South African Institute for Computer Scientists and Information Technologists (SAICSIT 2012). This paper is based on Mr Willem Bester's research work for his Master's thesis.

At the annual congress of the South African Mathematics Society, Mr Dirk Basson received the award for the best doctoral research talk, while Mr Tovo Randrianarisoa and Mr Anton de Villiers were awarded honorable mention for their master's research talks.

Ms Maryke van der Walt received the Faculty of Science Medal for 2012 for being the best master's student in the Faculty. Her master's thesis entitled "Ternary Interpolation Subdivision" was prepared under the supervision of Prof Johan de Villiers. She is now pursuing her doctoral studies at the University of Missouri - St Louis under the supervision of Professor Qingtang Jiang.

Mnr Jan Buys, whose honours project was supervised by Prof Brink van der Merwe in 2011, received the IBM prize in 2012 for the

best honours student in Computer Science.

DAAD (the German Academic Exchange Service) in association with the African Institute for Mathematical Sciences (AIMS), awards annually seven, three-year scholarships for exceptional students (who are African nationals from Sub-Saharan countries, excluding South African nationals) to pursue a PhD programme in Mathematical Sciences at a South African university. In 2012, Mr Eric Andriantiana, Mr Eyaya Eneyew, Mr Tahina Rakotoniaina, Ms Ony Minoarivelo received such scholarships for their doctoral studies in the department. In December 2012, an additional three Stellenbosch University students – Mr Alex Bamunoba, Ms Savannah Nuwagaba, and Mr Fortunat Solofomampionoa Rajaona - were awarded such scholarships.

Staff matters

During the year the Ad Hominem promotion of several staff members were approved with effect from 1 January 2013. Prof Florian Breuer, Dr Farai Nyabadza and Dr Karin-Therese Howell were promoted to full professor, associate professor and senior lecturer respectively (Mathematics). Dr Stéfan van der Walt and Dr Sonia Woudberg were promoted to senior lecturer (Applied Mathematics).

In January 2012 we welcomed Prof Mapundi Banda as a professor of Applied Mathematics. His research interests lie in numerical methods for flow and transport processes. After leaving academia for five years to pursue research as a numerical modeller in the National Resources and the Environment Unit at the CSIR, Dr Gerhardus Diedericks was attracted back to Stellenbosch University as a senior lecturer in Applied Mathematics.

Prof David Holgate resigned in September after 15 years of service to the university to take up the position of professor and Chair of the Department of Mathematics and Applied Mathematics at the University of the Western Cape.

In November, Applied Mathematics hosted a special retirement lunch for Mr Piet Crous who retired after 43 years of service to Stellenbosch University. He was the epitome of professionalism who always focused on the bigger picture. His enormous contributions over the years cannot be measured by numbers or awards – he significantly and positively influenced generations of students with his special ability to connect with his students.

Three vacancies in the department were filled with appointments of upcoming young academics. In Computer Science, Prof Bernd Fischer will take up the position of associate professor in February 2013 and will strengthen the System Software Verification research group. In Mathematics, Dr Gareth Boxall and Dr Dimbinaina Ralaivaosaona will take up lectureships in April 2013 and July 2013, respectively. Dr Boxall's research expertise lies in Model Theory and Logic, and Dr Ralaivaosaona's in Probabilistic Combinatorics.

Community interaction

The International Mathematical Union declared "The Mathematics of Planet Earth" as the theme for 2013, and with the involvement of the South African Mathematical Society (SAMS) and the African Institute for Mathematical Sciences (AIMS) in activities celebrating this theme, it was decided that a public lecture be organised to precede the 55th Annual Congress of the South African Mathematical Society at Stellenbosch University. This event, organised by Dr Bruce Bartlett, was quite unique since it featured Prof Mark Swilling (Director of the Sustainability Institute) as well as Prof John Baez (University of California Riverside), who presented via Skype and pre-recorded video. The event was attended by about 190 people, including a number of learners from the Cape Academy of Mathematics Science and Technology in Cape Town, SAMS delegates, students and staff members of Stellenbosch University, members of the public, and AIMS students. The event was extensively advertised to schools in the Stellenbosch district. Prof John Baez's talk is available on YouTube (http://www.youtube.com/watch?v=L4RpU1iLg34 http://www.youtube.com/watch?v=L4RpU1iLg34) and has been discussed in online forums.

The Maties Computing Club, currently co-ordinated by Mr Willem Bester and Dr Steve Kroon, was launched by the Computer Science Division. At the weekly Friday meetings, there is an interactive informal lecture to encourage learners and people from industry, regardless of their level of technical background, to do some programming.

As part of her role as Community Interaction and Marketing representative, Dr Karin-Therese Howell initiated school visits to talk to learners about studying Mathematics and career possibilities. A programme for tracking the progress of students majoring in Mathematics over their three-year degree programme was initiated in order to ensure the Mathematics modules are inspiring and relevant, and will continue next year.

Prof Lynette van Zijl is passionate about support for students with unique challenges in the learning environment – in particular, students who have visual barriers, limited hearing, are on the autism spectrum, or have reading and/or learning challenges (dyslexia, dysgraphia). Through her development of computer-assisted therapies, learners and university students with such disorders have a better chance of success in their studies. It is noteworthy that these technology systems are applications of her research work in automata theory, and that she is being approached for assistive technology consultation by schools.

The Department of Mathematical Sciences, under the coordination of Prof Pieter Maritz, is one of the training centres of the Siyanqoba Regional Olympiad Training Programme (sponsored by the Department of Science and Technology and run by the South African Mathematics Foundation.) The aim is to assist high school learners, in particular non-white learners, entering in Olympiad competitions to improve their performance and competence. Prof Stephan Wagner and Dr Steve Kroon have been involved in the training sessions. In addition, under the leadership of Prof Stephan Wagner, the department has continued its active involvement in the South African Mathematics Olympiad Training Programme (sponsored by Harmony Gold Mining) with a training camp each December as well as on South African Mathematics Olympiad Committees responsible for setting and moderating the annual South African Mathematics Olympiad question papers.

Collaboration

SOUTH AFRICA

African Institute for Mathematical Sciences (AIMS)
Council for Scientific and Industrial Research
Denel
Gensec Asset Management
iThemba Labs
Nelson Mandela Metropolitan University
Reutech Radar Systems
Rheinmetall Denel Munition
SASOL
University of Pretoria
University of the Witwatersrand

AFRICA

National University of Science and Technology (Zimbabwe)
Université d'Antananarivo (Madagascar)
University of Botswana (Botswana)

MSc student Mr Willem Bester

Computer Science student wins best paper award

Students from Stellenbosch University's Computer Science Division in the Department of Mathematical Sciences presented a record number of papers at the 2012 Annual Research Conference of the South African Institute for Computer Scientists and Information Technologists (SAICSIT 2012), that ran from 1 to 3 October 2012 in Centurion, Gauteng.

Furthermore, ***Mr Willem Bester*** *won the Best Computer Science paper award for his contribution titled 'Bug-finding and automatic test-case generation through symbolic execution'. The paper is based on his MSc study under the guidance of* ***Prof Willem Visser*** *and* ***Dr Cornelia Inggs****.*

INTERNATIONAL

Argentina
Instituto Tecnológico de Buenos Aires (ITBA)

Australia
University of Melbourne

Austria
Alpen Adria Universität Klagenfurt
Graz University of Technology
Vienna University of Technology

Belgium
Université catholique de Louvain

Germany
University of Kassel
University of Tübingen

Hungary
Hungarian Academy of Sciences
University of Miskolc

Ireland
Trinity College Dublin

Mexico
Universidad Nacional Autónomo de México

Poland
National Institute of Telecommunications
University of Warsaw

Portugal
Centre for Mathematics University of Coimbra

Romania
University of Bucharest

Russia
Joint Institute for Nuclear Research
Moscow State Pedagogical University

Serbia
University of Kragujevac
University of Novi Sad

Switzerland
ETH Zürich

United States of America
Georgia Southern University
NASA Ames Research Centre
Texas A&M International University
University of Colorado Boulder
University of Nebraska-Lincoln

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Mellon Early Researcher Career Programme (Mentorship Programme)
Nokia Siemens Networks
National Research Foundation Bilateral Cooperation: Hungary
National Research Foundation Incentive Funding
Stellenbosch University
Telkom

Staff

Academic

Prof IM Rewitzky *(executive head)*
Prof MK Banda
Dr B Bartlett
Prof F Breuer
Dr WH Brink
EJ Burger
Dr J Coetzer
PH Crous
Dr GH Diedericks
Prof A Fransman
Dr J Geldenhuys
I Govender
Prof BW Green
Dr PJP Grobler
Prof J Hargrove
HA Haroldt
Prof BM Herbst
Dr M Hoffman
Prof D Holgate
Dr K-T Howell
Dr CP Inggs
Dr Z Janelidze
Dr AP Keet
Dr RS Kroon
Dr MF Maritz
Prof S Mouton
Dr MA Muller
Dr NL Muller
Dr CG Naude
Dr F Nyabadza
Dr P Ouwehand
Prof H Prodinger
Prof GJF Smit
JP Swanepoel
Prof AB van der Merwe
Dr S van der Walt
Prof L van Wyk
Prof L van Zijl
Prof W Visser
Prof S Wagner
Prof JAC Weideman
LK Wessels
Prof M Wild
S Woudberg

Extraordinary professors

Prof JM de Villiers
Prof MB Dwyer
Prof T Krzesinski
Prof JW Sanders
Prof B Schölkopf

Extraordinary associate professors

Prof K Scheffler

Extraordinary senior lecturers

Dr R Ghomrasni

Dr A Welte

Extraordinary lecturer

Dr R Ouifki

Extraordinary researcher

Prof D Laurie
Prof P Maritz
Dr C Rohwer

Support staff

M Abrahams
A Adams
L Adams
W Bester
W Isaacs
B Jacobs
OM Marais
MM Rhoda
AL Roman
D Stephanus
M van Niekerk

NRF-rated researchers

Leading international researcher

Prof Helmut Prodinger
(analysis of algorithms, number theory and combinatorics)

internationally acclaimed researcher

Prof Ben Herbst
(computer vision and machine learning)

Prof David Holgate
(category theory)

Prof Leon van Wyk
(ring theory and matrix algebras)

Prof Willem Visser
(software failure, software engineering and software development)

Prof André Weideman
(numerical analysis and scientific computation)

Estabelished researcher

Prof MK Banda
(numerical methods for flow and transport processes)

Dr Jaco Geldenhuys
(software engineering, specifically model checking and process algebra)

Dr Sonja Mouton
(banach algebras and spectral theory)

Dr F Nyabadza
(mathematical biology)

Prof Ingrid Rewitzky
(mathematics of computer science)

Prof Brink van der Merwe
(automata theory)

Prof Lynette van Zijl
(theoretical computer science and assistive technologies)

Promising young researcher

Prof Florian Breuer
(number theory)

Dr Zurab Janelidze
(category theory and universal algebra)

Prof Stephan Wagner
(combinatorics and graph theory)

Jacques Swanepoel (right) at the award ceremony with awardee George Eskander, Angelo Marcelli of the International Graphonomics Society (IGS), conference chair Sebastiano Impedovo, and Rejean Plamondon (IGV).

Signature expert wins award in Italy

***Jacques Swanepoel**, a doctoral student in Applied Mathematics, received international recognition for the development of specific algorithms that can be used to make it easier to identify static signatures.*

He received a prize from the International Graphonomics Society for the best presentation by a student during the International Conference on Frontiers in Handwriting Recognition in Italy. Graphonomics entails the analysis, recognition and production of handwriting.

The title of his winning talk was "Writer-specific Dissimilarity Normalisation for Improved Writer-independent Off-line Signature Verification". The term 'off-line' in handwriting analysis refers to traditional pen-on-paper signatures, which are digitalised with a scanner, whereas 'on-line' signatures are made on a tablet with a digital pen.

His research was not conferred an award for nothing. Mr Swanepoel has already tested it on Dolfing's data set, a database of 1 530 authentic signatures and 3 000 forged versions and found that his system was, time and again, more successful in indicating the real signature than any other existing system.

This would be extremely valuable in, among others, banking, where it is necessary first to determine whether or not a signature on a cheque or credit-card slip is authentic before payment is made.

*Mr Swanepoel is doing his doctoral research under the supervision of **Dr Hanno Coetzer** of the Applied Mathematics Division in the Department of Mathematical Sciences (Mathematics, Applied Mathematics and Computer Science). It forms part of research on computer vision, pattern recognition and machine learning.*

Publikasielys | **Publication list**

Aardwetenskappe | Earth Sciences

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