# 2013

## Natural and Agricultural Sciences

# Annual Report

*Celebrating 100 years of Crystallography*

UNIVERSITY OF THE
**FREE STATE**
UNIVERSITEIT VAN DIE
**VRYSTAAT**
YUNIVESITHI YA
**FREISTATA**

UFS·UV
NATURAL AND
AGRICULTURAL SCIENCES
NATUUR- EN
LANDBOUWETENSKAPPE

# 2013

## Natural and Agricultural Sciences

# Annual Report

## 2014, the International Year of Crystallography

*The International Year of Crystallography 2014 (IYCr2014) commemorates not only the centennial of X-ray diffraction, which allowed the detailed study of crystalline material, but also the 400th anniversary of Kepler's observation in 1611 of the symmetrical form of ice crystals, which began the wider study of the role of symmetry in matter.*

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# Preface:
# Message from the Dean

My sincere thanks and appreciation to all staff and students for their dedicated efforts which brought both national and international scholarly accolades to the faculty and university in 2013.

Some of the numerous highlights were the following:

## Established scholars

- Prof André Roodt, Department of Chemistry, was again appointed Dean for the SA-YSSP2 (South African Young Scientist Summer Programme II), supported by the SA NRF/DST and the International Institute for Applied Systems Analysis in Vienna, Austria.
- Prof Hendrik Swart, Department of Physics, landed the faculty's first Research Chair under the DST/NRF SARChI initiative which will focus on Solid State Luminescent and Advanced Materials.
- Prof Marian Tredoux, Department of Geology, was part of an international research team that published an article in *Nature Communications* on the occurrence of platinum deposits in sulphite melts.
- Prof Rob Bragg and his group, Department of Microbial, Biochemical and Food Biotechnology, made an important breakthrough with regard to the beak and feather disease virus.
- The International Association of Advanced Materials (IAAM) awarded a medal to Prof Lodewyk Kock for "outstanding and notable contributions in the field of Materials Science and Technology".
- Prof Pieter Blignaut, Department of Computer Science and Informatics, and his group developed an eye tracker which has wide application and which has been produced at a much lower cost than the imported technology.
- During the general annual meeting of the International Federation for Home Economics, Prof Hester Steyn, Department of Consumer Science, was elected vice-president responsible for Africa.
- Prof Paul Grobler, Department of Genetics, was elected to the editorial committee of the Journal Mammalian Biology as sub-editor for Conservation and Genetics.

## Emerging scholars

- Dr Marieka Gryzenhout, Department of Plant Sciences, received the TW Kambule NRF-NSTF award as an emerging researcher for an outstanding contribution to SETI through research over a period of up to six years after obtaining her PhD.
- Dr Charles Haddad, Department Zoology and Entomology, co-authored a book, *Spiders of the Savanna Biome*, which provides details of the biology and morphological characteristics of each spider family and is richly illustrated with photographs, illustrations and microscope photographs.
- Dr Abdon Atangana, an applied mathematician who obtained his PhD in the Institute of Groundwater Studies in 2013, displayed levels of scholarly outputs which were not only exceptional but will also not easily be matched. He produced 19 accredited articles in that year and was appointed reviewer by nine scientific journals.

## Postgraduate students

- Lubabalo Sabo, an MSc student in Botany, received the award for the best presentation by a young scientist at the Indigenous Plant Users Forum held in Nelspruit in July 2013.
- Lisa Coetzee, an MSc student in Plant Pathology, was one of only two South Africans selected to attend the Global

4-H Youth Ag-Summit in August 2013, in Calgary, Alberta, Canada. The summit brought together young adults between the ages of 19 to 25 years from around the world to collaborate and share possible outcomes to alleviate hunger on our planet. Globally, only 120 young adults were selected (40 of which were Canadian citizens).

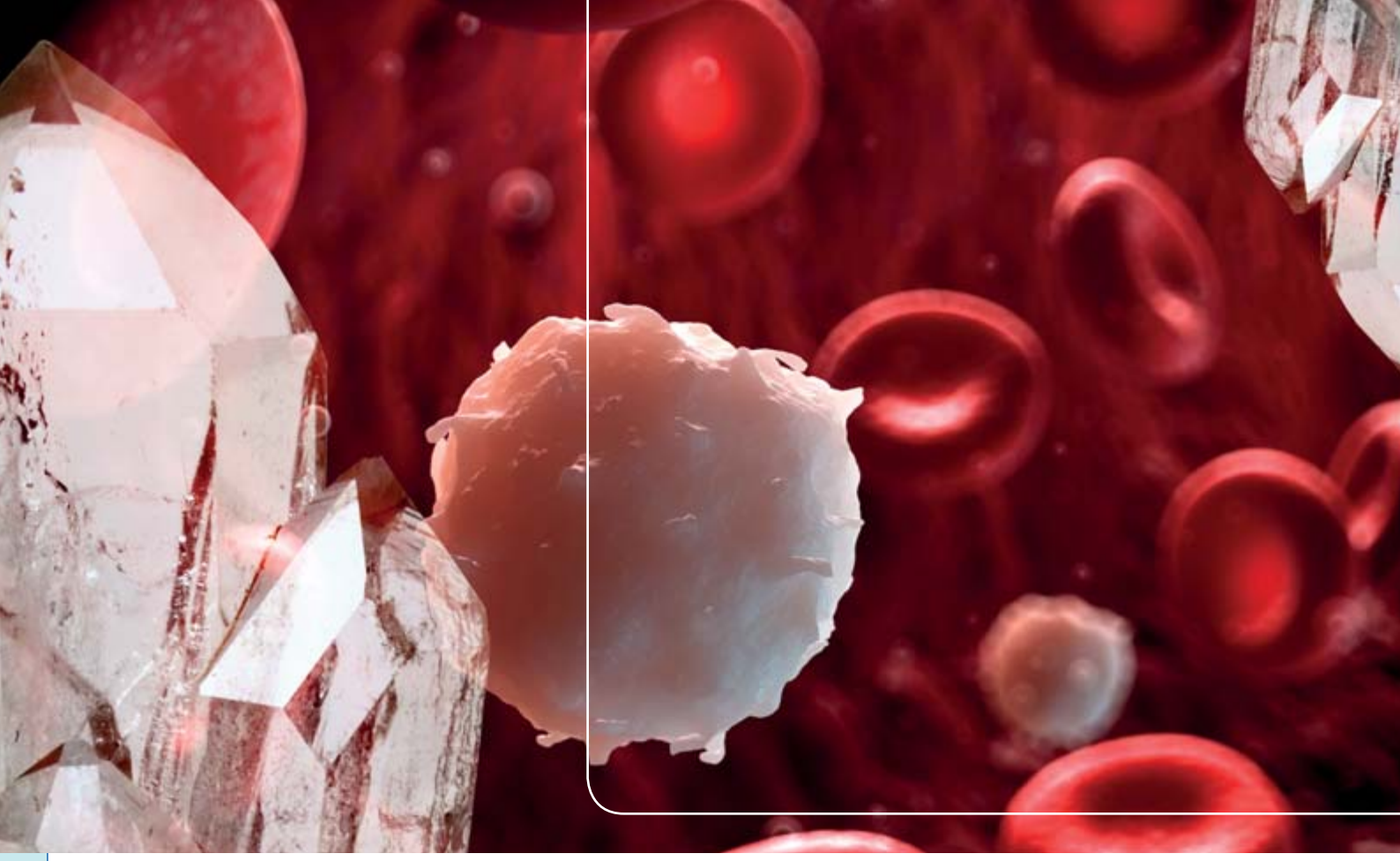
- During the 12th Annual UNESCO/IUPAC Workshop and Conference on Macromolecules and Materials at the University of Stellenbosch, Tladi Mofokeng, MSc student in Chemistry at the Qwaqwa Campus, won the prize for the best poster.
- Justin Harvey, PhD candidate, and Ruaan van Zyl, MSc candidate, were among the winners of the 2013 International Competition for Young African Statisticians, sponsored by Statistics South Africa. The prizes included comprehensive sponsorships to attend the 2013 World Statistics Congress in Hong Kong

Finally, to cap yet another great year, the faculty graduated 229 master's and 42 doctoral candidates and its accredited publication grew with 27%, representing 39% of the university's output for the year.

*Professor Neil Heideman, Dean.*


Strategic Academic

# Clusters



Strategic Academic Cluster:

# Advanced Biomolecular Research

## Overview

The Cluster for Advanced Biomolecular Research awarded R50 000 to each of the following eight projects:

- Genetic prediction for diseases of lifestyle in black South Africans (Dr Gerda Marx).
- Sequence variation within the glycine N-acyltransferase (GLYAT) gene of South Africans of African descent (Dr Frans O'Neill).
- Determination of the whole-genome sequence of South African Norovirus strains with next generation sequencing (Dr Trudi O'Neill).
- Milk proteomics (Prof Garry Osthoff).
- The identification and characterisation of biomarkers in human saliva in response to cytomegalovirus infection: A pilot study (Dr Gabre Kemp).
- Genome-wide nucleosome positions in blood and insect form *Trypanosomabrucei* (Prof Hugh Patterton).
- A comprehensive analysis of the involvement of the *Saccharomyces cerevisiae* epigenome in lifespan extension (Dr Elize Patterton).
- An integrated high-throughput and systems biology approach for the metabolic engineering and elucidation of the physiology of ethanolic fermentation by *Kluyveromycesmarxianus* and *Saccharomyces cerevisiae* as model organisms (Prof James du Preez).

The projects were chosen by peer review on scientific merit, and to support genomics, proteomics and bioinformatics activities which have developed into vital foundations of research in modern life sciences.

The following are the major achievements of the funded projects:

**Dr Gerda Marx:** One BMedSc student completed her degree at the end of 2013 for a project entitled "Molecular method development to detect the PPAR gamma gene mutation associated with Type 2 Diabetes Mellitus". A cohort of patients suffering from Type 2 Diabetes is currently being assembled for continuation of this project.

**Prof James du Preez:** Prof Du Preez presented an invited lecture at Lund University entitled "*Kluyveromycesmarxianus*: prospects and problems related to the production of second generation bioethanol". The PhD student/junior lecturer funded by this grant, Mr Du Toit Schabort, is still busy with his research on metabolic modelling and should finish before the end of 2015.

**Dr Frans O'Neill:** Ms Sana Mokhosi completed her BSc (Hons) on the project, and is currently undertaking her MSc degree.

**Dr Trudi O'Neill:** One MSc student received funding from the project and presented a poster at SASM 2013, entitled "Expression of rotavirus VP2 and VP6 structural proteins in yeast".

**Prof Hugh Patterton:** The kinetoplastid trypanosome *Trypanosomabrucei* causes African sleeping sickness in extensive parts of sub-Saharan Africa. The total infected human population is estimated at 300 000 to 450 000 individuals. *T. brucei* is transmitted to humans from a *Glossina* spp. during a blood meal, and invades the bloodstream. Left untreated, African sleeping sickness is lethal.

In this project, the epigenome of bloodstream and insect form *T. brucei* was studied to understand the role of the epigenome in allowing the parasite to continually evade the human immune system. The epigenome, encoded by reversible histone and DNA modifications, is central to the regulation of DNA function. Misregulation of the epigenome is known to be involved in numerous diseased states in humans, including Fragile X-syndrome, carcinogenesis, myotonic dystrophy, and the autism spectrum of disorders. Over the last few years it has become apparent that the epigenome represents a powerful therapeutic target, making the identification of new epigenetic agents an exceptionally active research area.

We have isolated nucleosomal DNA from numerous *Trypanosomabrucei* LISTER 427 strains and sequenced nucleosome-length fragments by the paired-ends method. The sequences were used to identify the positions occupied by nucleosomes in the genome of *T. brucei*. We have developed detailed maps of the nucleosomal organisation surrounding tRNA, 45S rRNA, and polymerase II transcription units. *T. brucei* encodes structural genes in large polycistrons. Polymerase II typically initiates at such divergently transcribed polycistrons and terminates at convergent regions. We have shown that a nucleosome-depleted region exists close to polymerase II initiation sites, and is present at specific positions at the termini. We have also analysed the distribution of nucleosomes with reference to polymeric sequences, and found a clear avoidance of nucleosomes of regions with runs of oligo-d[A.T], oligo-d[AT] and oligo-d[G.C]. Interestingly, runs of oligo-d[G.C] display a high correlation to polymerase II start sites, suggesting that basal transcriptional machinery or transcriptional activators are recruited to such sites. Johannes Maree, who completed his MSc on the project, published a paper in *Biochimica et Biophysica Acta - Gene Regulatory Mechanisms*, entitled "The epigenome of *Trypanosomabrucei*: A regulatory interface to an unconventional transcriptional machine". The continuation of this work is currently funded with a project grant in the H3Africa call of the NIH. The bioinformatics support for the project is funded by an independent grant via H3ABioNet, also in the H3Africa programme. Bioinformatics tools development is funded by the Functional Genomics and Bioinformatics programme of the NRF.

Funding was also acquired from NIH to contribute 50% to the procurement of a Q-Exactive mass spectrometer fronted with a nanoflow HPLC, significantly expanding the proteomic capabilities of the cluster.

**Dr Elize Patterton:** Dr Patterton undertook a project to investigate the contribution of the epigenome to lifespan extension. Many studies have appeared in recent years implicating calorific restriction and poly-phenols such as epigallocatechin-3-gallate (EGCG), a component of green tea, in the expansion of lifespan in model organisms. A link to the epigenome was shown with the removal of the acetyl from K16 of histone H4, which decreased replicative lifespan. In this project, Dr Patterton undertook an exhaustive analysis of the role of the histone H3 and H4 epigenome, using a *Saccharomyces cerevisiae* library of individually bar-coded histone H3 and H4 mutants. By culturing the mixed library, and recovering samples at intervals for up to two months in the stationary phase, followed by barcode sequencing, the proportional representation of the different histone mutants was quantitated. Several residues in H3 and H4 associated with extended chronological lifespan were identified and shown to be present on the lateral surface of the nucleosome. This suggests that these mutants could interfere with the binding on non-histone proteins to the lateral surface of the nucleosome. Dr Patterton also undertook the analysis of the proteome of chronological aging and showed that many stress-related proteins are up-regulated in quiescent cells during aging. The proteome of aging in yeast was presented by PhD student Mzwanele Ngubo at the EMBO/FEBS course on Nuclear Proteomics at Kos, Greece.

**Prof Garry Osthoff:** Mr Moses Madende completed his MSc degree on a project that investigated the proteome of African elephant (*Loxodontaafricana*) milk. Milk is a complex and nutritionally complete food for the specific requirements of the neonate. The milk of the African elephant displays several unique properties. In this research

the proteome of the milk was investigated, with a focus on α-lactalbumin and the caseins, in order to shed light on the mentioned unique properties. The proteomics approach was used, which includes gel electrophoresis and mass spectrometry. Computer modelling was also employed.

The major proteins $\alpha_{s1}$-, $\alpha_{s2}$-, β-casein, α-lactalbumin, β-lactoglobulin and serum albumin of African elephant milk were identified with one-dimensional electrophoresis and mass spectrometry. Better results were obtained with two-dimensional electrophoresis and orbitrap mass spectrometry, with which α-lactalbumin, lactoferrin, β- and κ-casein were also identified.

The multiple sequence alignment of α-lactalbumins showed that there are six amino acid positions that are unique to the African elephant. Most of the amino acid substitutions in this protein were found to be conserved, and structure modelling of the African elephant α-lactalbumin was found to be homologous to the X-ray crystallography structures of several species. Consequently, the structure model of β-1,4-galactosyl transferase 1 and the lactose synthase complex was built, again showing homology to crystallographic data from other species. It may therefore be concluded that structures of α-lactalbumin and β-1,4-galactosyl transferase 1 are highly conserved amongst species. The saccharide synthesis in the African elephant milk would probably not differ from that of other mammals, and may therefore not be the reason for high levels of oligosaccharides in its milk.

**Dr Gabré Kemp:** Dr Gabré Kemp undertook a pilot project to search for peptide markers in the saliva of children infected with a disease affecting many children in developing countries. Of all the human herpes viruses described to date, the human cytomegalovirus (CMV) is a beta herpes virus that arguably causes the majority of morbidity and mortality. Although primary infection with this agent generally does not produce symptoms in healthy adults, several high-risk groups, including immune-compromised organ transplant recipients and individuals infected with human immunodeficiency virus (HIV), are at risk of developing life-threatening and sight-threatening cytomegalovirus disease. In recent years, this disease has emerged as the most important cause of congenital infection in the developed world; its importance as the leading infectious cause of mental retardation and other abnormalities such as deafness in children has been emphasised by its categorisation by the Institute of Medicine (IOM) as a Level I vaccine candidate. In this study, conducted in conjunction with the paediatric department at the Kimberley Hospital, saliva was collected from 113 HIV positive and negative children up to 15 years of age. Their CMV status was determined by PCR from where ten CMV positives and 12 CMV negative controls were selected. The sub 5kDa peptidome from the saliva were identified by LC-MS/MS during a research visit to the Complex Carbohydrate Research Centre at the University of Georgia, USA. The data were processed and will be presented as a poster at the 2014 SASBMB conference.

## Staff

**Director:** Prof Hugh Patterton.

**Affiliated Researchers:** Profs Jan van der Westhuizen, Martie Smit, Jacobus Albertyn, Derek Litthauer, Esta van Heerden, Paul Grobler, Felicity Burt, and Andrew Marston.

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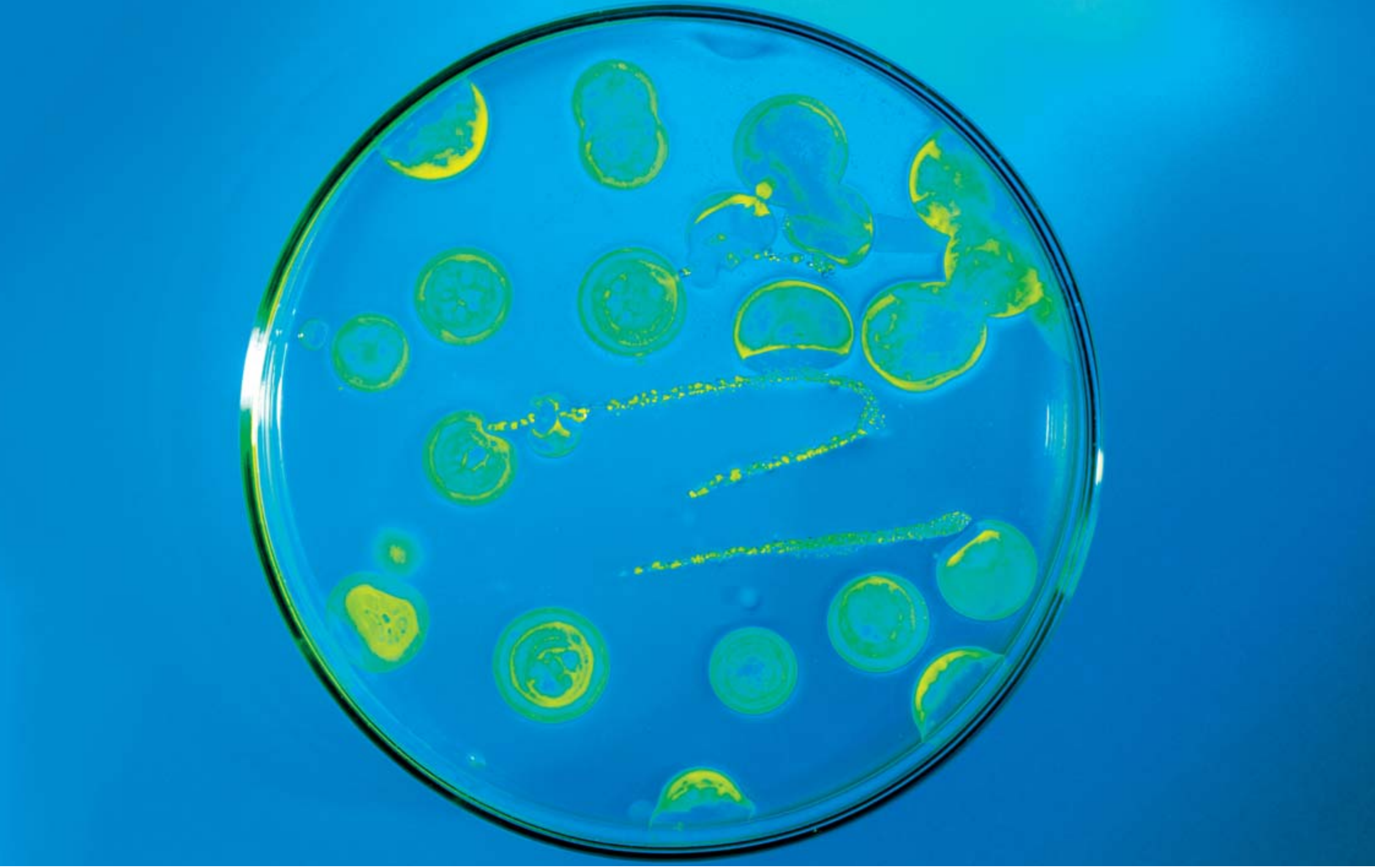


Strategic Academic Cluster:

# Materials and Nanosciences (MNS)

## Overview

The UFS Materials and Nanosciences (MNS) Strategic Academic Cluster had a narrow focused research and included three focus areas, *i.e.* Nano Solid State Materials, Green Petrochemicals, and Polymers.

Unfortunately, the termination of the UFS Cluster initiative has left the MNS Cluster, which was clearly a leading entity at the UFS in terms of research outputs, with a significant loss in dynamics and in particular with respect to the psychological momentum. For all members of the MNS Cluster, this was a sad day. Nevertheless, the decision was accepted.

The MNS Cluster had the following characteristics during 2013, as defined in the UFS cluster initiative drive and negotiated in early 2005 to 2007:

- It had a central focus.
- It was multidisciplinary by nature with a critical mass of people working around a theme.
- It included three focus areas.
- It provided a framework for the academic training of particularly postgraduate students, research, and community engagement.
- It was based on recognised institutional competence and national, regional and institutional priorities.

The principal objective of the MNS Cluster was the development of new materials and chemicals in the nanometer-sized regime, exhibiting pre-designed physical and chemical characteristics. It had its origin in the fascinating "nanoworld" of many chemical and physical processes.

*Prof Hendrik Swart was awarded the SARCHi Chair in Solid State lighting by Mr Derek Hanekom (SA Government Minister of Science and Technology; left) and Mr Kgalema Petrus Motlanthe (Deputy President of South Africa).*

Research was focused on aspects of these processes and the materials required to perform these that can and will have different impacts on society.

In spite of the overarching focus being natural scientific, it also strived to address relevant environmental, social, ethical and even judicial issues which could benefit from the activities of the MNS Cluster. The broader focus was never achieved due to a number of reasons, in part due to a lack of interest and enthusiasm by researchers outside the Faculty of Natural and Agricultural Sciences. It was managed by a part-time cluster director (Prof A Roodt) and a management committee consisting of the focus area leaders.

## Structure and Activities in the MNS Cluster

The research in the MNS Cluster for 2013 involved more than 25 different projects, of which 25% were intra-cluster collaborations. With these focused projects, the MNS Cluster produced significant outputs and established itself as the most productive entity on campus. The outputs include top-level articles in some of the most important international literature, as well as keynote lectures at leading international venues.

The focus area leader of Nano Solid-state Materials was Prof Hendrik Swart, Department of Physics, NRF SARChi chair (successfully applied for under the MNS Cluster) supported by Profs Koos Terblanche, Martin Ntwaeborwa, Francis Dejene (Qwaqwa Campus) and Dr Ted Kroon.

Research within the Nano Solid-state Materials focus area included the development of luminescent nanomaterials that should improve the quality of life and add to high-technology development, such as solid-state lighting and included, amongst others, light-emitting diodes, EL devices, nanocatalysts, sensor technology and biomedical probes.

During 2013 the Nano Solid-state Materials group focused on the establishment of research capacity in luminescent nanoparticles through basic and applied research initiatives, which involved multiple projects connected by the experimental and theoretical skills of the researchers involved and also included links with other institutions. This focus area addressed both fundamental and industrial research through the development of technical knowledge in determining physical and chemical surface properties.

Another successful year with several research outputs and awards passed. The equipment funded with Cluster funds again contributed to the increase in publication numbers and the higher impact factors in which the papers appeared. A SARChi chair was awarded to the group due to the track record of the Cluster focus area leaders. Several new phosphors were produced and several milestones were reached to develop white phosphors for LEDs and OLEDs. Pioneering work was done on the defect-related luminescent properties of metal oxides. Keynote and invited talks followed at international conferences.

The focus area leaders in the (green) Petrochemicals thrust were Prof André Roodt (Homogeneous Catalysis, supported by Prof Deon Visser and Drs Johan Venter, Alice Brink, and Marietjie Schutte-Smith), and Prof Jannie Swarts

**The MNS Cluster operated during 2013 as illustrated by the flow chart as shown in Figure 1.**

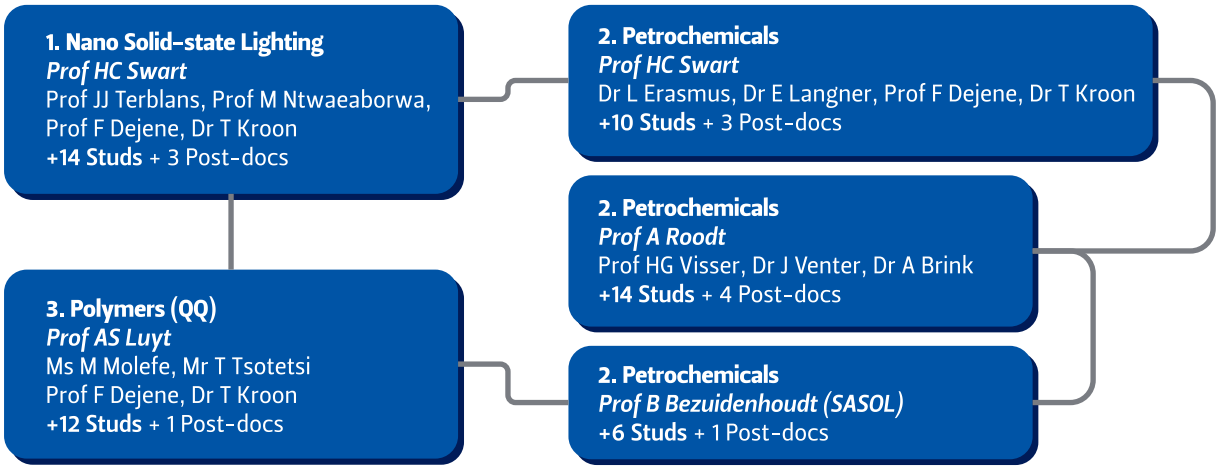



**Figure 1:** *Simplified illustration of MNS Cluster group structure during 2013.*

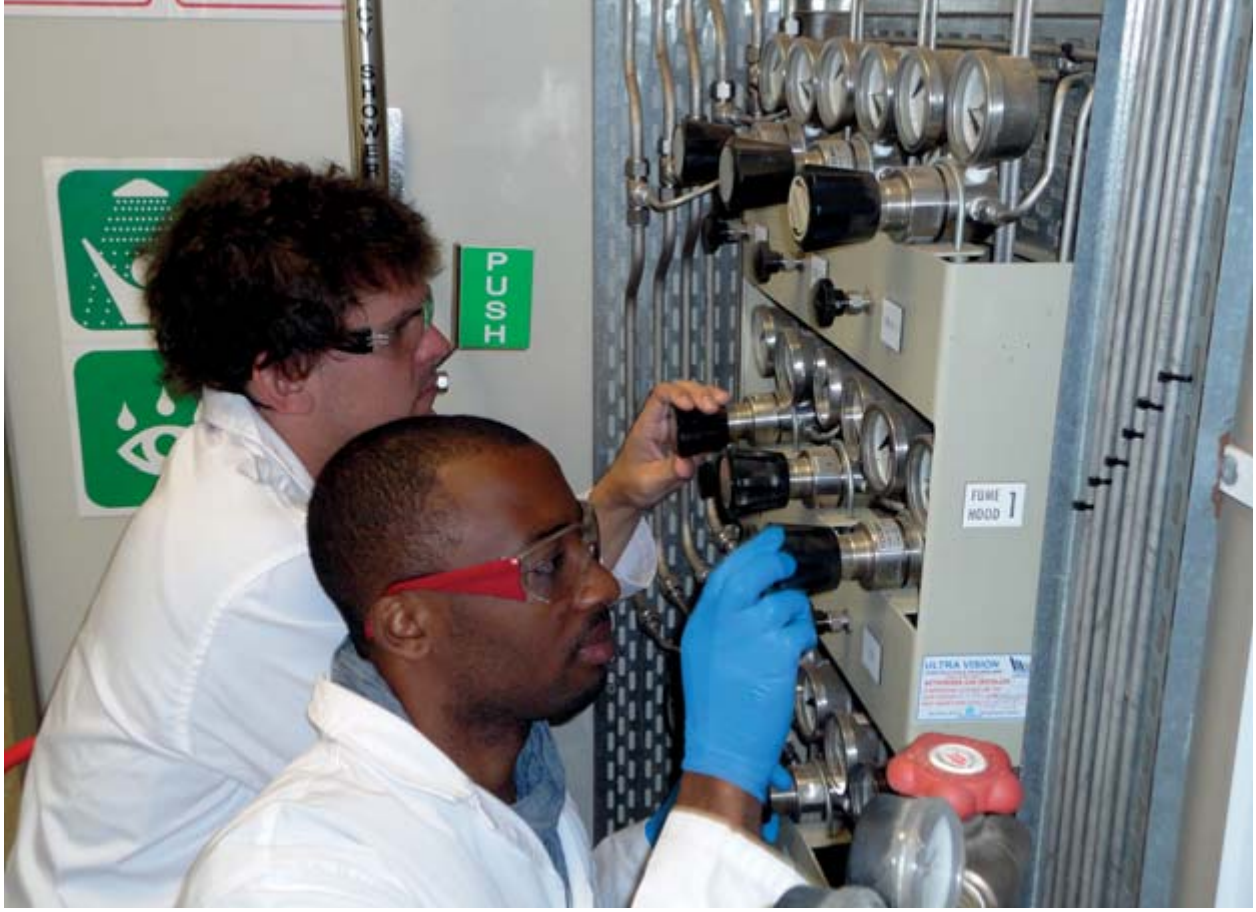
(Heterogeneous Catalysis, supported by Prof Jeanet Conradie and Drs Ernie Langner, Lizette Erasmus, and Eleanor Fourie), in the Department of Chemistry at the Main Campus. These two thrusts were further supported by the Synthesis Group of Prof Ben Bezuidenhoudt, SASOL professor in Process Chemistry.

The (green) Petrochemicals thrust focused on homogeneous and heterogeneous catalysis and synthesis, which aimed to develop processes to convert basic building blocks of the sub-/ lower-nano-scale size into value-added downstream nanochemicals, relevant to the synthetic petrochemical industry. It focused on the integration of different chemical conversions to dramatically increases the rate of formation (of new compounds/solvents/ detergents/materials), as well as selectivity (specific characteristics) of tailor-made products. Moreover, it pursued clean operating systems, from both economic and environmental considerations, to yield pure products with higher yields and minimising waste, which ensured minimum environmental impact in the pursuit of "Green Chemistry".

The Homogeneous Catalysis group focused on the integrated investigation of reaction mechanisms through the use of crystallography, spectroscopy, computational chemistry and reaction kinetics, in particular applications to industrial reactions/homogeneous catalysis/applied process chemistry and the development of separation technology. The focus was on the conversion of simple feedstock molecules using transition metals (especially middle to late) into value-added products via carbonylation, hydroformylation, olefin metathesis and oligomerisation. The Heterogeneous Catalysis group, on the other hand, further focused on synthetic and physical chemistry aspects of multinuclear metallocenes, which included industrial studies on carboxylato complexes and heterogeneous catalysis of systems supported on two-dimensional supports in collaboration with SASOL. These also included porphyrin and phthalocyanine compounds bearing metallocene substituents, such as titanocene, zirconocene, hafnocene and ferrocene derivatives, especially in association with rhodium, iridium, silver, gold and copper, and focused on electrochemical, kinetic and thermal analyses of these complexes. The Swarts group was involved with synthetic and electrochemistry aspects of ferrocenyl alcohols and thiols (sulphides), phthalonitiles and phthalocyanines as catalysts. They were also involved with the electrochemistry of carbene catalysts and silicon supports for rhodium catalysts, surface science, and the evaluation of catalytic particles supported on flat surfaces.

The focus area leader of the Polymers thrust was Prof Riaan Luyt, Department of Chemistry at the Qwaqwa Campus, who was supported by Mr Tsietsi Tsotetsi and Ms Mpondi Molefe. This focus area covered new materials designed and obtained from the blending of different polymeric and composite materials and mixing with a variety of fillers (especially natural fibres) in the absence or presence of modifiers. It explored the inclusion of nano-sized particles into different matrices; modifying the morphology and physical properties of the polymers and composite materials.

Three important projects of the Polymer Science research group focused on the *in situ* generation of fillers within polymer matrices via an innovative way to reinforce plastics (an official, NRF-funded collaboration). They also concentrated on morphology and properties of $TiO_2$ and $ZrO_2$ nanoparticle-reinforced polymetyl-methacrylate, and electrically and thermally conductive polymer nanocomposites and the improved dispersion of nano-structured graphite in polyolefins by chemical modification.




*PhD student Renier Koen and MSc student Paul Bungu adjusting gases in the high-pressure autoclave reactor in the Homogeneous Catalysis Laboratory.*

## Special Achievements and Activities

Some highlights of the MNS Cluster over the past year were as follows:

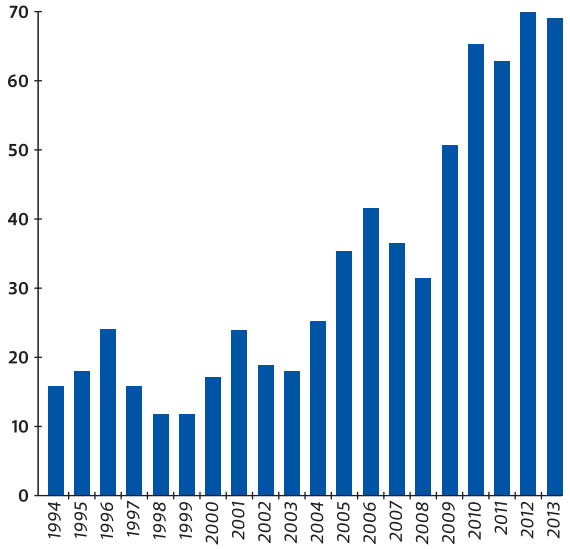
- The three focus areas in the MNS Cluster collaborated with more than 20 national and international research groups in more than 12 countries.
- Research from the MNS Cluster was presented locally and internationally on more than 30 occasions during the past year.
- The MNS Cluster was also indirectly associated with more than 60 students via the focus area leaders' research groups.
- Prof Hendrik Swart, who was awarded a SARChi Research Chair in Nano Solid-State Lighting (worth R2,5 million per annum for 10 years), significantly expanded the focus area of solid-state lighting with his group.
- A large number of new hybrid materials that are polymer and nano-material based and which exhibit interesting new properties, have been produced.
- More than 30 students received bursaries under the MNS Cluster for 2010 to 2013 (including two prestige scholarships), which resulted in more than 50 papers published in international scientific literature.
- The MNS Cluster expanded its unique facilities, and a particular strength of the research group was the ability to do surface-characterisation studies on phosphor nanomaterials and industrial steel and alloy samples.
- The total funding raised by the cluster in 2013 exceeded R12 million, including R1 million from SASOL, R3 million from the NRF, and R1 million from PETLabs Pharmaceuticals.
- The experimental setup available for homogeneous, heterogeneous and process chemistry boasts an internationally competitive portfolio of equipment and expertise, in many ways unique, even from an international perspective.

Figure 2 illustrates the papers published and citations (ISI Web of Knowledge) received by the senior researchers in the MNS Cluster. It is clear that in particular over the last four years, a significant growth was observed. The five senior researchers in the MNS Cluster has again co-authored around one-third of the total papers produced

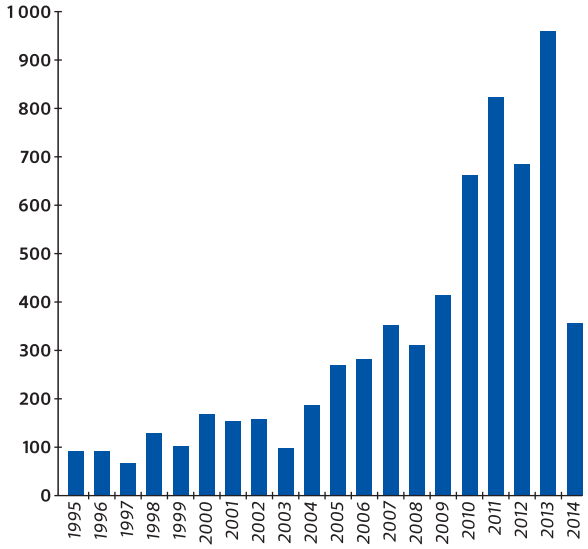
by the UFS Faculty of Natural and Agricultural Sciences. The activity regarding papers has virtually doubled, as illustrated for 2013 by the 66 papers and more than 1 000 citations received, respectively. The cumulative h-index increased from 2012 with three units to 36.

The overarching conclusion from the above is that the MNS Cluster was a viable entity which produced significant outputs under a flagship research theme of the UFS. Sadly, this thrust was formally terminated during 2013.

**A:**




**B:**




**C:**

| Search Item | Number | Search Item | Number |
|---|---|---|---|
| Number of papers published | 752 | Citing articles without self-citations: | 3 964 |
| Sum of the times cited | 7 470 | Average citations per item: | 9,93 |
| Sum of times cited without self-citations | 5 348 | Cumulative h-index : | 36 |
| Citing articles | 4 476 | | |

**Figure 2:** *ISI Web of Knowledge search results for Profs Hendrik Swart, Riaan Luyt, Jannie Swarts, Ben Bezuidenhoudt and Andreas Roodt by end 2013, with (a) number of papers per annum, (b) number of citations per annum and (c) summary table with specific numbers.*

# Research Outputs

## Research Articles

**Ahmad, E.E.M., Djoković, V. & Luyt, A.S.** 2013. Thermal and dynamic mechanical properties of biobased poly(furfuryl alcohol)/sisal whiskers nanocomposites. *Polymer Bulletin* 70: 1265-1276.

**Bedyal, A.K., Kumar, V., Lochab, S.P., Singh, F., Ntwaeaborwa, O.M. & Swart, H.C.** 2013. Thermoluminescence kinetic parameters of γ-irradiated $Sr_4Al_{14}O_{25}:Eu^{2+};Dy^{3+}$ phosphors. *Radiation Effects and Defects in Solids* 168(11-12): 1022-1029.

**Bedyal, A.K., Kumar, V., Pitale, S.S., Coetsee, E., Duvenhage, M.M., Ntwaeaborwa, O.M. & Swart, H.C.** 2013. Spectral and surface investigations of $Mn^{2+}$ doped $SrZnO_2$ nanocrystallline phosphors. *Journal of Material Science* 48(9): 3327-3333.

**Bedyal, A.K., Kumar, V., Sharma, V., Ntwaeaborwa, O.M. & Swart, H.C.** 2013. Luminescence and surface properties of $Tb^{3+}$ doped $Sr_3(VO_4)_2$ nanophosphors. *Journal of Integrated Science and Technology* 1(1): 5-8.

**Bondioli, M.F., Luyt, A.S., Mokhothu, T.H. & Messori, M.** 2013. Preparation and characterization of EPDM rubber modified with in situ generated silica. *Journal of Applied Polymer Science* 128: 2525-2532.

**Bozanic, D.K., Luyt, A.S., Trandafilovic, L. & Djokovic, V.** 2013. Bioconjugates of glycogen and gold nanoparticles: Controlled plasmon resonance via glycogen induced nanoparticle aggregation. *RSC Advances* 3: 8705-8713.

**Brink, A., Visser, H.G. & Roodt, A.** 2013. Activation of Rhenium(I) toward substitution in *fac*-[Re(N,O'-Bid)$(CO)_3(HOCH_3)$] by Schiff-Base Bidentate Ligands (N,O'-Bid). *Inorganic Chemistry* 52: 8950-8961.

**Brink, A., Visser, H.G. & Roodt, A.** 2013. Novel imino rhenium(I) tricarbonyl complexes of salicylidene-derived ligands: Synthesis, X-ray crystallographic studies, spectroscopic characterization and DFT calculations. *Polyhedron* 52: 416-423.

**Claus, R., Lewtak, J.P., Muller, T.J. & Swarts, J.C.** 2013. Structural influences on the electrochemistry of 1,1'-di(hydroxyalkyl) ferrocenes: Structure of $[Fe\{C5H_4\text{-}CH(OH)\text{-}(CH_2)_3OH\}_2]$. *Journal of Organometallic Chemistry* 740: 61-69.

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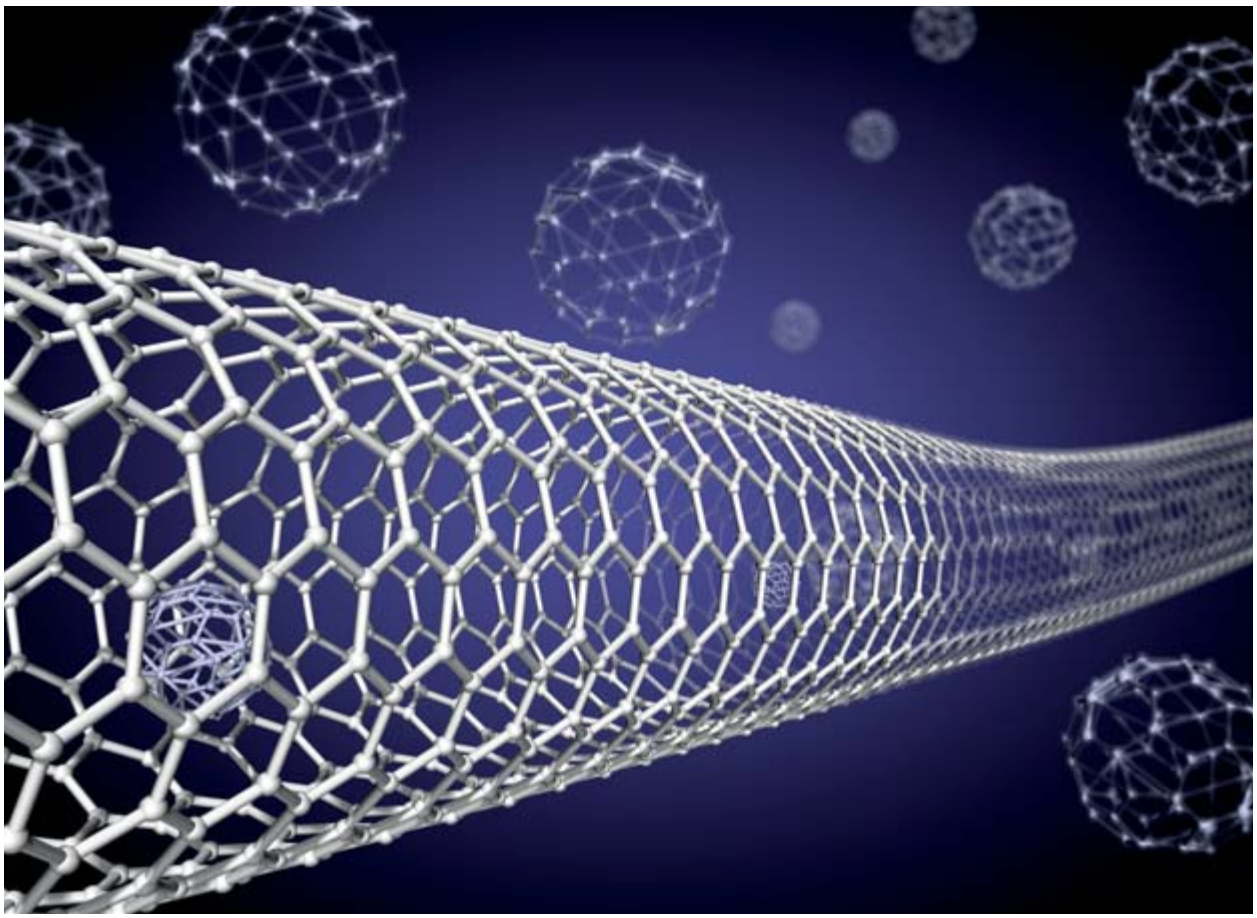

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Strategic Academic Cluster:

# Technologies for Sustainable Crop Industries in Semi-arid Regions

## Overview

The Cluster funded 24 projects with 11 resorting under Focus Area 1 (Production Technologies for Managing Crop Environments), six under Focus Area 2 (Genetic Technologies for Crop Improvement), and seven under Focus Area 3 (Technologies for Adding Value to and Improving Crop Product Quality). The projects were managed by 18 principal investigators who individually acted as supervisors for a total number of 40 students - of which 16 received cluster bursaries. Of the latter, seven were MSc bursaries, two PhD bursaries, five Prestige PhD bursaries and two Prestige Post PhD bursaries.

In terms of outputs generated by the Cluster, papers and posters were presented at a total of six national congresses and six international congresses. Four students received degrees funded by the Cluster in terms of bursaries and/or running costs.

## Activities and Achievements

### Focus Area 1: Production Technologies for Managing Crop Environments

- Dr Marieta Cawood conducted a study in collaboration with the Department of Plant Biochemistry and Biotechnology, Westfälische Wilhelms-Universität Münster (Germany) and the ARC-Small Grain Institute, on the role of chitosan oligomers acting as elicitors in the resistance response of wheat to the Russian wheat aphid. The study formed part

*Mrs Chrisna Steyn (PhD student) inoculating soybeans with a fungal pathogen.*

of the MSc projects of Mr Lubabalo Saba and Mr Khotso Mokheseng.

- Dr Marieka Gryzenhout attended the 11th International Fusarium Laboratory Workshop at Kansas State University, USA. This workshop facilitated the identification of the *Fusarium* cultures in the culture collection of the Department of Plant Sciences (division of Plant Pathology). During her visit, Dr Gryzenhout established networks with some of the world's *Fusarium* experts. She also visited the facilities of the Bacterial Foodborne and Mycology Unit of the United Stated Department of Agriculture in Preoria, USA. Researchers at this facility focus largely on research on grain pathogens in the *Fusarium graminearum* species complex.
- An MSc study by Ms Mudzuli Mavhunga was completed under the supervision of Prof Neal McLaren. The thesis was entitled "*Fusarium graminearum* mycotoxins associated with grain mould of maize and sorghum in South Africa."
- Mr George van Zijl in the Department of Soil, Crop and Climate Sciences completed his PhD under supervision of Dr Piet le Roux. The title of the thesis was "Developing a land type disaggregation protocol for South Africa".

## Focus Area 2: Genetic Technologies for Crop Improvement

- Dr Botma Visser gave a lecture at the 3rd South African Cereal Rust workshop held in Worcester. The title of the talk was "Genotyping *Puccinia graminis* f. sp. *tritici* and *Puccinia triticina* in Southern Africa".
- A project plan workshop was held with stakeholder Dr Antony Jarvie at PANNAR in Greytown on 16 and 17 May 2013 and a Memorandum of Understanding between the UFS and PANNAR was officially signed on 21 May 2013.
- Dr Botma Visser was invited to co-present a talk on stem rust genotyping at the 2013 BGRI technical workshop in New-Delhi, India, during August. The talk was presented with Prof LJ Szabo from the Cereal Disease Laboratory, USDA-ARS, St. Paul, MN, USA, with the title "Understanding the genetic landscape of *Puccinia graminis* f. sp. *tritici*, from a global to country perspective".

## Focus Area 3: Technologies for Adding Value to and Improving Crop Product Quality

- In the research group of principal investigator Dr Carina Bothma (Department of Biotechnology and Biochemistry), a master's student, Ms Makamohelo Semuli, was awarded a prize for best poster at the 11th International SAAFECS Conference, held in Pretoria in March 2013. The poster was entitled "A comparison between the nutritional composition of *Agave americana* flowers and edible flower vegetables cauliflower and broccoli."
- Ms Albie du Toit obtained her MSc (*cum laude*) in June 2013 with a dissertation entitled "Antioxidant content and potential of fresh and processed cladodes and fruit from different coloured cactus pear (*O. ficus-indica* and *O. robusta*) cultivars" under the supervision of principal investigator Dr Maryna de Wit (Department of Biotechnology and Biochemistry).

- Dr Maryna de Wit's outstanding research on the development of products made from cactus pears (*Opuntia ficus-indica*) was showcased at the SAAFoST Biennial International Congress and Exhibition held in October in Pretoria, where four posters were presented. At the VIII$^{th}$ International Congress on Cactus Pear and Cochineal held in Palermo, Italy, in October 2013, two posters and two papers were presented. These outputs will be published as four publications in *Acta Horticulturae* as part of the congress proceedings.
- In the research group of Prof Arno Hugo (Department of Biochemistry and Biotechnology) where ground-breaking work on the use of plant oils produced in semi-arid regions to produce stable animal feed for safe and nutritious human food is being conducted, Mr M Cluff graduated with a MSc degree (*cum laude*) with a dissertation entitled "Natural and synthetic fortification of salami with conjugated linoleic acid from sunflower origin". Prof Hugo's lab can also boast with the publication of eight articles in prestigious journals.
- Dr Celia Hugo was a new addition as principal investigator to Focus Area 3 in 2013 with the interesting research topic entitled "The chemical, microbial and sensory evaluation of lucerne (*Medicago sativa* L.) for human consumption." The work of her PhD student, Ms A Mielmann, was presented as a poster at the South African Association of Family Ecology and Consumer Science held in Pretoria.

*Mr Alex De Gouveia (Honors student) taking out frozen DNA samples for molecular analysis.*

# Research Outputs

## Research Articles


**Booyens, K.E., Einkamerer, O.B., Van der Merwe, H.J., Hugo, A., Slippers, S.C. & Fair, M.D.** 2013. The effect of dietary lipid saturation and antioxidant source on the nutrient digestibility of lamb finishing diets. *South African Journal of Animal Science* 43(5): 22-26.

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**Quaedvlieg, W., Verkley, G.J.M., Shin, H.-D., Barreto, R.W., Alfenas, A.C., Swart, W.J., Groenewald, J.Z. & Crous, P.W.** 2013. Sizing up Septoria. *Studies in Mycology* 75: 307-390.

**Qwele, K., Hugo, A., Oyedemi, S.O., Moyo, B., Masika, P.J. & Muchenje, V.** 2013. Chemical composition, fatty acid content and antioxidant potential of meat from goats supplemented with Moringa (*Moringa oleifera*) leaves, sunflower cake and grass hay. *Meat Science* 93(3): 455-462.

**Rothman, M., De Wit, M., Hugo, A. & Fouché, H.J.** 2013. The Influence of cultivar and season on cactus pear fruit quality. *Acta Horticulturae* 995: 201-212.

**Van der Merwe, R., Labuschagne, M.T., Herselman, L. & Hugo, A.** 2013. Stability of seed oil quality traits in high and mid-oleic acid sunflower hybrids. *Euphytica* 193(2): 157-168.

**Van Schalkwyk, C.P.B., Hugo, A., Hugo, C.J. & Bothma, C.** 2013. Evaluation of a natural preservative in a boerewors model system. *Journal of Food Processing and preservation* 37: 824-834.

*Mrs Riana Viljoen (PhD student) and Amelia Shata (MSc student) doing Real-time PCR to analyse gene expression in wheat.*

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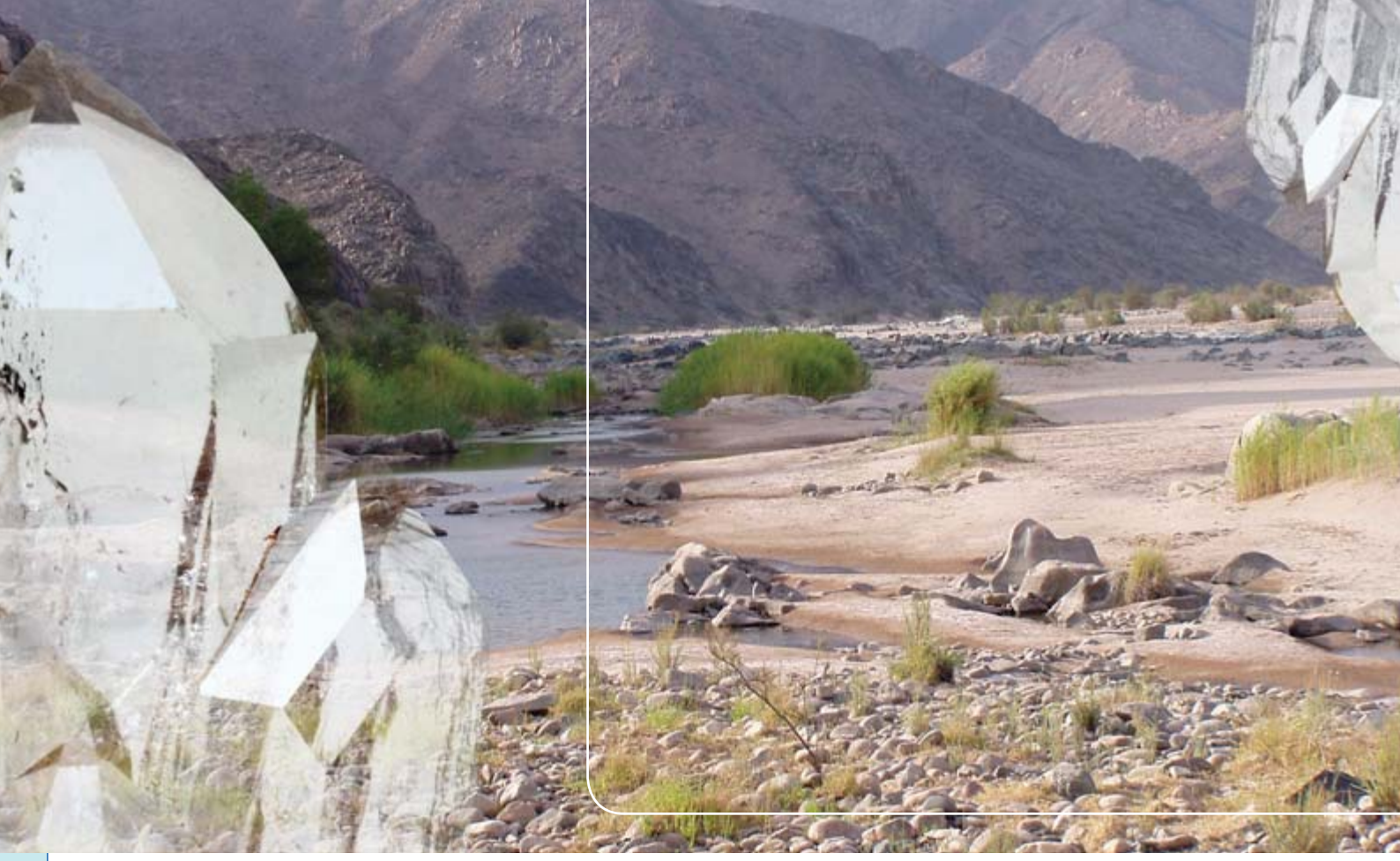

Strategic Academic Cluster:

# Water Management in Water-scarce Areas

## Overview

At the time of writing, it is evident that the present Strategic Academic Cluster initiative is being phased out, though the exact details are uncertain and whether the concept will be reinstituted in a different guise is not known. It is nevertheless clear that cooperative and transdisciplinary academic programmes, and not specifically research programmes, is at the centre of any successful academic initiative at this university.

The UFS has a long (40 year plus) history of water research; on groundwater, freshwater ecology and agriculture in particular. So the UFS was predisposed to the development of a water cluster. In addition, there is a strong existing focus on water in water-scarce areas, considering that the UFS Main Campus in Bloemfontein is geographically the best situated of all university campuses in South Africa to conduct research on water-scarce areas.

- Motivation of the Cluster's focus:
- Water remains a vital life-sustaining resource.
- Food security is totally water-dependent.
- By 2020, two-thirds of the world's population will live under water stress.
- Communities are under pressure: the Department of Water Affairs' Green Drop and Blue Drop Reports show a dismal record of sewage treatment and drinking water treatment.
- Water for development is in short supply: 70% of the world's fresh water is already allocated.

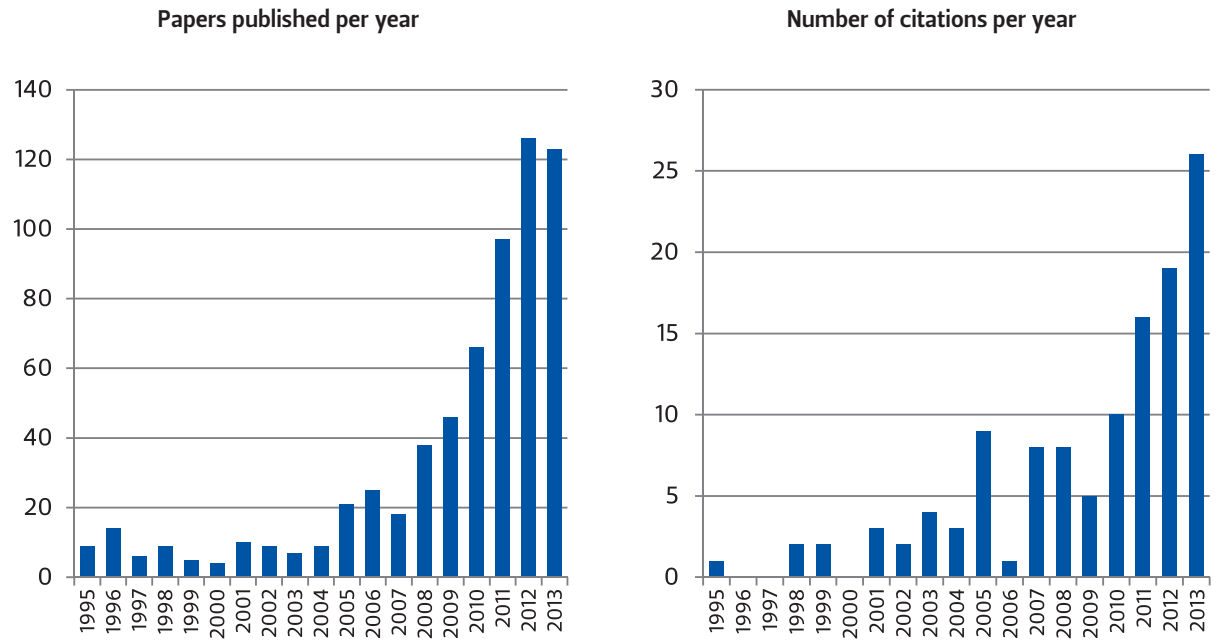


*Figure 1: Number of papers published by six focus leaders in the UFS Water Cluster (Seaman, M.T.; Van Rensburg, L.D.; Du Preez, P.J.; Walker, S.; Grové, B. & Jordaan, A.),*

- Freshwater habitats are under pressure: this resource is threatened.
- The dry west of Southern Africa is under particular pressure.

## Cluster Description

The present Cluster name is Water Management in Water-scarce Areas. A new name for the Cluster was proposed, but not yet implemented, in order to tighten its focus, namely "Efficient and Sustainable Use of Water in Water-scarce Areas". In essence, the Cluster has given attention to the risks related to the availability of the water resource in its natural and utilisable states in water-scarce areas.

## Vision

To create sustainable solutions to water-use challenges in order to improve the quality of life in the water-scarce areas of (sub-Saharan) Africa (and, where feasible, globally).

## Mission Statement

Through its power to mobilise, coordinate and negotiate, the Cluster would – in collaboration with government, industry and civil society – carry out innovative, demand and needs-driven transdisciplinary research that would deliver the capacities and knowledge needed to find sustainable water management solutions for water-scarce areas in sub-Saharan Africa within a reasonable time frame.

The mission statement will be accomplished by:

- Delivering graduates and postgraduates able to address the question of water-scarcity in Africa;
- Providing innovative solutions to questions related to sustainability and the improvement of lives in the water-scarce areas of Africa;
- Engaging all levels of government and industry in assessing and addressing questions related to the efficient management of water-scarcity in Africa; and
- Encouraging efficient, cooperative research through strategic alliances and partnerships.
- It should be a major development of the Cluster to establish a strong committed core. At present the Centre for Environmental Management acts as that core but its functions are not restricted to water, and its allocation of staff is highly inadequate. Therefore a core institute has been motivated and needs to be created urgently, within which all members are committed to the vision, mission and strategy of the Cluster. The creation of such an institute requires the directive of the UFS and cannot simply be a loose, temporary agreement. Furthermore, this institute needs to be in a building of its own, where a clear sense of belonging and common purpose can exist.

## Water Cluster Successes

The publications of the Water Cluster's focus leaders are used as a proxy for the success of the Water Cluster. The massive increase in the publications and citations over the period covering the lead-up to and existence of the Water

Cluster are greatly supportive of the Cluster initiative. The full success of the Water Cluster mirrors the success of the focus leaders.

ISI Web of Science listed; and full subsidy-bearing and corresponding citations per annum.

## Financial Inputs and Outputs

### (Sources of Revenue and Expenses)

The Water Cluster's (and the proposed Institute's) sources of revenue are as follows:

FTEs derived from students doing water-related studies:

- Structured master's degrees
- Thesis master's degrees
- PhDs
- Publication credits
- Third-stream income
  - NRF funding
  - WRC and related institutional funding for research
  - Commercial funding
  - Training courses

The Water Cluster's major costs are:

- Maintenance of the Water Cluster office
  - Salary of the director
  - Limited office running costs
- Bursaries
- Project running costs
- The Orange River Basin Symposium

The critical success factors and assumptions for making the contribution model work are based partly on the universally supported fact that a Water Cluster at the UFS is certainly needed to focus on the university's role in the water management field in a water-scarce area where the proper use of water is becoming ever more critical.

The nonfinancial contributions by the Water Cluster to the UFS are its relevance to its local and broader communities, its positive marketing benefits as a focussed institution, and its critical mass in producing water solutions.

The contribution of the Water Cluster is difficult to measure in direct terms because the Cluster borders are fuzzy – *i.e.* contributors do not yet make a fixed commitment to the Cluster, which would be solved when the proposed Institute for Integrated Water Management comes to fruition.

Nevertheless, the numerous bursaries lead in almost all cases to a master's or doctorate degree, while the small amount of running costs spent makes the work delivered economical; seeing as this expenditure is viewed as seed money and is in all cases augmented by other funding derived from larger projects.

In all cases, M, PhD and post-Doctoral, there is a delayed delivery of publications, making accounting difficult in the short term.

*Fish sampling in Sepane Spruit between Botshabelo and Bloemfontein.*

## Staff

**Director:** Prof Maitland Seaman.

**Focus Area Leaders:** Profs Benny Grové, Sue Walker, Leon van Rensburg, Johann du Preez, and Andries Jordaan.

## Contact Details

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Agricultural

# Sciences

Department of

# Agricultural Economics

## Overview

2013 was a year full of excitement and new challenges. The year was especially good for the department due to the fact that we had a large number of PhD students who completed their degrees. Some of these were staff members within the department. The department also increased the research publications with a considerable amount.

The Department of Agricultural Economics worked closely with various companies within the agricultural sector. These companies did not only assist with bursaries and funding, but also assisted in terms of new research ideas and research opportunities. With the help of the following companies: ABSA Agribusiness, Agbiz, Beefmaster, BKB, Cape Wools, GWK, Protein Research Foundation, Potatoes SA, RPO, SenWes Silostrat and Veeplaas, more than R500 000 was used to assist students. We are always grateful to be associated with the leaders in the agricultural sector.

In Agricultural Economics the staff work together as a team and as a family, which ensures that we teach independent entrepreneurial students and farmers based on internationally recognised research and expertise. This makes the department a word class department. We are sure that we will do even better in 2014.

## Activities and Achievements

### Safex Courses

Dr Dirk Strydom presented several SAFEX grain marketing courses on and off the University Campus during 2013, which

*Prof Johan Willemse (Management Award), Dr Philemon Akach (Management Award), the Honourable Mr Justice Faan Hancke (Ambassador Award), and Loraine Kriek (Vice Chairperson: UFS Alumni).*

included farmers, ABSA, Farmsecure, the Department of Agriculture, Fisheries and Forestry, OVK, GWK, Unigrain, Nedbank, SenWes and BKB. The department is also a registered SAIFM exam centre for the SAFEX Exams and has had more than 450 attendees completing the course.

## Agricultural Outlook Workshops

Quarterly Agricultural Workshops were hosted on campus by Prof Johan Willemse where farmers, agribusiness and industry shareholders met and topics such as "Forecasts for 2013" were discussed. Guest speakers included Mr Johan van der Berg of Santam Agri, Nicky Weimar, senior economist of Nedbank, and Mr Jaco Kirstein from KG Auditors. About 150 guests attended these workshops each quarter on the campus of the University of the Free State. The workshops were sponsored by the banking sector and other agribusinesses and form part of the network, which in turn helps to fund our bursary scheme.

## Achievements of Students

Marcil Venter, a master's student in the Department of Agricultural Economics, successfully reached the summit of Kilimanjaro, climbing from 9 September from the base camp to reach the summit on 14 September. It took seven days to reach the summit and to return to base camp.

## Annual Prize Giving

The following students received prizes: M Brink.

- Best undergraduate student over all four years of study in Agricultural Economics – M Venter.
- Best fourth-year student in Agricultural Economics – N Mgabi.
- Best honours student in Agricultural Economics – WA Lombard.
- Best final-year BAgric Student in Agricultural Management – NL Tamane.
- Best second-year student in Statistics – P Madende.

## Special Achievements

Mr FA Maré was appointed as the Southern African Council member of the International Farm Management Association during the IFMA annual conference held in Poland from 21 to 26 July 2013.

Prof Johan Willemse received the Executive Management Award at a Gala Dinner on 18 October 2013, from the Kovsie Alumni Trust, for exceptional service to the University of the Free State.

## Other Activities

Many national conferences and farmer days were attended by staff members such as Dr Dirk Strydom, Prof Johan Willemse, Dr Antonie Geyer, and Mr Frikkie Maré.

The third-year students in the Department of Agricultural Economics participated in a study tour to Itau Milling in Bloemfontein to become acquainted with the milling process.

The Department of Agricultural Economics hosted an Industry Day on 8 October 2013 at the Centenary Complex of the University of the Free State to acknowledge the generous contributions with regard to bursaries made by industry players such as The Protein Research Foundation, Potato SA, Standard Bank, Land Bank, FNB, ABSA and Nedbank. Cooperatives such as OVK, GWK, SenWes, BKB as well as Itau Milling, Silostrat, Veeplaas, RPO Free State, John Deere (PTY) Ltd., Agribiz, Beefmaster and Cape Wools are very important contributors to the bursary scheme. The Industry Day was also a platform to introduce the new three-year BSc Agricultural Economics degree, the three-year BAgric Agricultural Management degree, as well as the three-year Bagric Agricultural Economics degree which includes courses such as Tax, Commercial Law, and Accounting and Entrepreneurship. The Industry Day was also an opportunity to create awareness of the projects undertaken by the Department of Agricultural Economics.

In the department we also have 16 bursary students who received bursaries from various agribusinesses. All of the students within the bursary programme graduated with exceptionally good marks.

### Community Service

The University of the Free State's Department of Agricultural Economics is recognised internationally for its programmes that prepare students for careers in the agribusiness industry. Our students are sought after throughout the world for their knowledge of agriculture and the business environment and are a popular choice for work opportunities.

The department is committed to improving the welfare of the community by impartially applied economic problem solving. The department also believes in creating a feeling of community by continuous recognition of diversity and devotion to an uncompromising level of inclusivity. The department pledges to support businesses in the agribusiness sector through its farm management programmes.

Courses offered by the Department for Economic Development, Tourism and Environmental Affairs and the International Labour Organisation are:

- one-day course in farm management/business management;
- one-day course in enterprise budgeting;
- one-day course in cash-flow management; and
- one-day course in balance sheet preparation.

The department has an internationally recognised staff of researchers and lecturers who are tasked with teaching these courses.

Lecturers in the Department of Agricultural Economics assisted agricultural schools in the Free State to draw up business plans for their respective schools to enable them to apply for funding from the Department of Education.

## National and International Collaboration

Three Department of Agricultural Economics staff members were invited to Minnesota University, USA, in December 2013. Dr Dirk Strydom, Academic Head of Department, accompanied HN van Niekerk and F Human to visit the Department of Applied Economics of the Minnesota University and met with lecturers who were assigned to become study leaders for a PhD student and a master's student in the Department of Agricultural Economics. A strong collaboration has been formed with Mississippi State University and Minnesota University alike.

## Postgraduate Students

The Department of Agricultural Economics was proud to have four PhD candidates graduating in 2013, which brings the total of PhD staff members in the department to six.

The department's honours class has grown to 54 students in 2013 notwithstanding the strict admission requirements set by the Department.

## Research

The following research projects were undertaken in the department:

Prof Bennie Grové: A research project for the Water Research Commission with the title "Optimisation of electricity usage in water systems".

Dr Henry Jordaan: Researching the topic "Cooperation within small-scale farmers – value chain analysis for the Water Research Commission".

Frikkie Maré: Research on behalf of the Red Meat Producers' Organisation of the Free State on "Price transmission of red meat".

Dr AC Geyer: Research for the Red Meat Research Development Trust regarding "Establishment of economic and management study groups".

Walter van Niekerk: Research for the Red Meat Research Development Trust and the National Agricultural Marketing Committee on "International agri-benchmark – Red Meat".

Walter van Niekerk: Research for the Red Meat Producers' Organisation of the Free State on the "Economic impact of predation on large livestock".

Frikkie Maré: Research on the "Feasibility Nguni small-scale farmer project" for the Industrial Development Commission.

Dr Dirk Strydom: Research on "Protein demand for animal feed forecast".

Nicky Matthews: Research for the Water Research Commission on "The development of an integrated modelling approach to prediction of agricultural non-profit source (NPS) pollution from field to catchment scales for selected agricultural NPS pollutants".

## Staff Matters

Dr DB Strydom was appointed as Academic Head of Department at Agricultural Economics on 1 June 2013.

# Research Outputs

## Research Articles


**Bahta, Y.T.** 2013. Modelling the Lesotho economy: A social accounting matrix approach. *International Journal of Food and Agricultural Economics* 1(1): 49-62.

**Bahta, Y.T. & Haile, B.O.** 2013. Determinants of poverty of Zoba Maekel of Eritrea: A household level analysis. *International Journal of Food and Agricultural Economics* 1(2): 73-84.

**Bahta, Y.T., Willemse, B.J. & Grove, B.** 2013. Structure of South Africa's agricultural trade. *Sky Journal of Agricultural Research* 2(4): 40-55.

**Baiphethi, M.N., Kundhlande, G., Viljoen, M.F. & Manona, S.** 2013. The potential for land exchange in communal areas to support the adoption of rainwater harvesting practices for crop production: A case study of Thaba Nchu, Free State Province. *Irrigation and Drainage* 61: 119-128.

**Israel-Akinbo, S.O., Matthews, N., Jordaan, H. & Kundhlande, G.** 2013. The economic cost of air pollution in Mangaung metro municipality: A case study in South Africa. *African Journal of Environmental Science and Technology* 7(7): 718-724.

**Jordaan, H. & Grové, B.** 2013. Exploring social capital of emerging farmers from Eksteenskuil, South Africa. *Development Southern Africa* 30(4-5): 508-524.

**Jordaan, H. & Grové, B.** 2013. Maximizing the contribution of irrigated agriculture to poverty alleviation: The case of smallholder cabbage producers from Zanyokwe Irrigation Scheme. *Outlook on agriculture* 42(4): 285-290.

**Jordaan, H. & Grové, B.** 2013. Transaction cost analysis of raisins marketing by emerging farmers from Eksteenskuil, South Africa. *Agrekon* 52(4): 21-42.

**Jordaan, H., Grové, B. & Matthews, N.** 2013. Investigating potential financial gains from using production inputs more efficiently. *Agrekon* 52(1): 87-100.

**Mare, F.A., Taljaard, P.R. & Jordaan, H.** 2013. Consumer preferences for beef with specific reference to fat colour: The case of Cape Town, South Africa. *International Journal of Agricultural Management* 2(3): 141-148.

**Morris, L. & Mare, F.A.** 2013. Developing a collaborative marketing strategy for sheep farmers in Namibia. *Agrekon* 52(1): 118-132.

**Ogundeji, A.A., Viljoen, M.F., Booysen, H. & De Villiers, G.D.T.** 2013. Impact of climate change on planning and dealing with flood disasters in South Africa: A case study of Soweto on sea. *Agrekon* 52(1): 111-132.

**Toure, A., Groenewald, J.A., Seck, P. & Diagne, A.** 2013. Analysing policy-induced effects on the perfomance of irrigated rice. *African Journal of Agricultural and Resource Economics* 8(1): 68-77.

**Venter, M., Strydom, D.B. & Grové, B.** 2013. Stochastic efficiency analysis of alternative basic grain marketing strategies. *Agrekon* 52(Supplement 1): 46-63.

**Wessels, J.S.F. & Willemse, B.J.** 2013. The impact of changed land use on farmland values and farmland valuations: an example from the South-Eastern Nama Karoo. *Agrekon* 52(Supplement 1): 133-151.



*Marcil Venter is a master's student in the Department of Agricultural Economics who successfully reached the summit of Kilimanjaro.*

### Staff

**Professors:** Prof BJ Willemse, and Prof B Grové.
**Senior Lecturers:** Dr AC Geyer, Dr H Jordaan, Dr DB Strydom, and JJ van Staden.
**Lecturers:** JIF Henning, N Matthews, P Mokhatla, and HN van Niekerk.
**Junior Lecturers:** FA Maré, M Venter, WA Lombaard, and NM Mdungela.
**Lecturer Units:** Dr L Terblanche.
**Researcher:** Dr YT Bahta.
**Secretary:** Mrs LP Hoffman.
**Officers: Professional Services:** Mrs C van der Merwe, and Ms CS Combrinck.

### Contact Details


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Department of

# Animal, Wildlife and Grassland Sciences

## Overview

The Department of Animal, Wildlife and Grassland Sciences is comprised of the disciplines Animal Nutrition, Animal Breeding, Animal Physiology, and Grassland Science and Wildlife Management – all focused on improving and creating more efficient livestock and wildlife production systems in Southern Africa, while not compromising the quality of the animal products and animal welfare, and maintaining the natural resources. To address production needs in the community and industry then requires a high standard of knowledge transfer and creative research. As the students produced by the department reflect the high level of academic excellence, it is essential that the standard of training and research be maintained. It is thus pleasing to see the leadership positions some of the former students of the department occupy in the industry.

During 2013, a total of 16 postgraduate students in the department obtained their degrees (10 BScAgric honours students and six MScAgric students) in the respective disciplines – an indication of the productivity of the academic staff in the department. Time management and financial constraints, however, remain the major stumbling blocks throughout. With the structuring of the department into the different disciplines, centres of excellence have been created which facilitate aspects of teaching, research, and community service.

With the Department of Animal, Wildlife and Grassland Sciences at the UFS being one of the largest departments in Africa (14 lecturing academic staff), this department has the potential and expertise to be a leading unit in animal and wildlife production. This is reflected by the collaboration with the industry (contract research, funding, farmers' days,

training, etc.) and other tertiary institutions (external examiners, moderators, and joint post graduate projects). To sum up the activities, it can be said that the Department was active both nationally and internationally (three national and three international congresses were attended, and this is also indicated by two international and three national extraordinary professors in the Department).

## Activities and Achievements

Amongst the various activities, it should be mentioned that the Department hosted the annual International Congress of the South African Society for Animal Science (SASAS), which was attended by 238 delegates from Africa and abroad. Short courses (sheep and cattle AI) were presented to students and farmers, while members of the Department (Profs Johan Greyling, Frikkie Neser, and HO de Waal) were invited as keynote speakers (National Bonsmara Day, Brangus Day, Opuntia Information Day). Other members of the Department were involved in discussions with Grootfontein Agricultural College regarding the possible offering of a BAgric degree in Animal Production by the College. The Department was also invited to participate in discussions of the Free State Department of Agriculture to help facilitate their strategic planning – a big compliment and indicative of the high regard that Provincial Government has for the work being done regarding more efficient animal and wildlife production in the province and South Africa.

### Achievements of Students

The most important product of the Department is the high-quality students produced. Some of the achievements included postgraduate bursaries in Animal Nutrition (Charne Buitendach) from the Protein Research Trust and Marike van Zyl (Lucerne Research Trust) for research done at the Outeniqua Agriculture Research Institute. Charne Buitendach also received a prize for emergent female researchers at the annual AFMA Symposium from Chemunique.

### Special Achievements

Some of the special achievements in the Department included invitations, for example, to Prof Frikkie Neser to be guest speaker at the Namibian Meat Producers' School in Windhoek and the South African Meat Producers School at Aldam. Similarly, Prof Johan Greyling presented a guest lecture at the annual National Bonsmara Symposium at Nampo.

The soil seed bank data set of Prof Hennie Snyman was published in 2013 regarding the disturbance impact on the longevity of grass seeds in semi-arid South African rangelands. This was done in collaboration with the Imperial College London, the United National Environmental program – World Conservation Monitoring Centre, and others to develop improved models of how biodiversity impacts human activities. These models aim to collate records of the abundance of species and the composition and diversity of communities in order to model, on a global scale, the local response of biodiversity to human threats.

The comprehensive paper (26 published pages): "Snyman, H.A., Ingram, L.J. and Kirkman, K.K. 2013. "*Themeda triandra* keystone grass species", published in *African Journal of Range and Forage Science* 30(3): 99-125, deserves special


*A pig information day organised in conjunction with the industry.*

*The establishment of a new cactus pear orchard at Oppermansgronde (Photo: Prof HO de Waal).*

emphasis. This paper, written in collaboration with a highly rated Australian ecologist (Dr Ingram), includes all research done on this grass in South Africa and Australia. Comments from the editor (Prof Vetter) include: "Congratulations on an important and epic piece of work, which I am sure will be cited for years to come." Professor Brian Roberts, well-known rangeland scientist from Queensland University, Australia, also commented: "Your *Themeda* overview is the best I have seen on a single grass species."

## Activities

The University of the Free State (UFS), in partnership with the Agricultural Research Council (ARC-API, Bloemfontein) and the Free State Department of Economic Development, Tourism and Environmental Affairs, initiated a research and development programme on the spineless cactus pear (*Opuntia ficus-indica*). During the past decade, major progress was made in support of the cactus pear industry in South Africa. As part of this initiative, scientists associated with the programme have attended several international congresses abroad. Recently five scientists also attended the VIII International Congress on Cactus Pear and Cochineal from 28 to 31 October 2013 in Palermo, Italy. Scientific progress and practical applications made in South Africa were presented in theatre presentations, as well as posters by the team comprised of Dr Maryna de Wit, Dr Herman Fouché, Dr Gesine Coetzer, Mrs Albie du Toit, and Prof HO de Waal. Dr Herman Fouché (ARC-API) represents the Sub-Saharan Africa Region of the FAO-ICARDA International Technical Cooperation Network on Cactus (FAO-ICARDA CACTUSNET). During both formal and informal discussions with specialists and members of the FAO-ICARDA CACTUSNET, it was suggested that South Africa should consider arranging an international workshop on the cactus pear with broad attendance by specialists from other countries. The UFS has subsequently extended an invitation to host an International Workshop on its Main Campus in Bloemfontein. Provisionally the date has been set for February 2015. Official attendance by a wide spectrum of international entities will be secured. The workshop will focus on aspects such as horticultural practices, pests and diseases, genetic resources, animal fodder, human food, pharmaceuticals, medicine, and industrial uses.

Several farmers' days were attended and presentations were made (locally and in Namibia) by Profs Hennie Snyman, Frikkie Neser, and Johan Greyling. For example, Prof Snyman has gained national recognition for his expertise regarding the intruder bush, also called the bankrupt bush. Profs Japie van Wyk and Frikkie Neser attended the International Genetics Congress in Nantes, France, and collaboration with INRA in France emanated from their discussions. The Department of Animal, Wildlife and Grassland Sciences has collaborated with a number of institutions through the years in various ways, for example, the ARC at Irene, Grootfontein, Elsenburg as well as the universities of Pretoria, North West and Stellenbosch. Furthermore, Prof Frikkie Neser presented Animal Breeding short courses in Namibia. All this collaboration is indicative of how highly rated the expertise of the Department is by other institutions and the industry.

## Community Service

One of the flagships of the Department remains the Nguni Project in the Northern Cape (65 farmers/farm groups) and Free State (15 farmers) – managed by Prof HO de Waal. In conjunction with the Industrial Development Corporation (IDC), this project remains a highlight of the Department in training emerging farmers. Prof HO de Waal is also prominent in the establishment of opuntia orchards for emerging farmers at Oppermansgronde. Opuntia (cactus pear) is being investigated as a supplementary animal feed. Furthermore, all the short courses (sheep and cattle AI and Animal Breeding) presented can be seen as community service – reaching out to students and farmers. Contributions at farmers' days remain one of the main advertising strategies of the Department.

## National and International Collaboration

The staff of the Department collaborates with many national government institutions, tertiary institutions and international institutions (e.g. INRA, University of Wagenen, University of Namibia) and several SADC (Southern African Development Communities) countries.

*MSc student, Vivian Butler (left), with helpers from the Department during the collaring of a kudu bull for his research project (Photo: Beanélri Janecke).*

*Dr Beanélri Janecke and Mrs Jossie van der Merwe on a donkey car in Tosca during a departmental visit to a research project in the Kalahari (Photo: Beanélri Janecke).*

## Postgraduate Students

Several international postgraduate students are accommodated in the Department (Lesotho, Botswana, Namibia, Nigeria, and Mozambique). The importance of these linkages cannot be underestimated. Most of these research projects are applied research and relevant to their respective countries.

## Research

Within each discipline, focused research projects are being undertaken. For example, Animal Physiology is focused on improving the efficiency of reproduction (cattle, sheep, and chickens); while Animal Nutrition investigates alternative feed sources and supplements (chickens and sheep). The Animal Breeding group, in conjunction with the ARC, is involved in evaluating the heritability and the selection for certain traits using different models. In Grassland Science and Wildlife Management, the impact of certain grass species on production efficiency, and the conservation of the eco-system, are being researched. The grazing habits and utilisation of plants by the giraffe is a PhD project of Francois Deacon.

## Staff Matters

During December 2013 a former colleague, Prof Hentie van der Merwe, passed away after a fight against cancer. He was, until the time of his death, the promoter of two PhDs and study leader of a MSc. He will be sadly missed.

# Research Outputs

## Research Articles

**Bergman, D.L., De Waal, H.O., Avenant, N.L., Bodenchuck, M.J. & Marlow, M.C.** 2013. 2013. Need to address black-backed jackal and caracal predation in South Africa. *Proceedings of the 15th Wildlife Damage Management Conference*, Clemson, South Carolina. 25-28 March 2013.

**Booyens, K.E., Einkamerer, O.B., Van Der Merwe, H.J., Hugo, A., Slippers, S.C. & Fair, M.D.** 2013. The effect of dietary lipid saturation and antioxidant source on the nutrient digestibility of lamb finishing diets. *South African Journal of Animal Science* 43(5 / Supplement 1): S22-S26.

**Buitendach, G.C., De Witt, F.H., Hugo, A., Van Der Merwe, H.J. & Fair, M.D.** 2013. Effect of dietary fatty acid saturation on egg production at end-of-lay. *South African Journal of Animal Science* 43(5): 126-130.

**De Waal, H.O., Combrinck, W.J. & Fouché, H.J.** 2013. Preserving mashed cactus pear (*Opuntia ficus-indica*) fruit with wheat straw, maize hay or lucerne hay. *Proceedings of the VIII International Congress on Cactus Pear and Cochineal*, Palermo, Italy. 28-31 October 2013.

**De Waal, H.O., Schwalbach, L.M.J., Combrinck, W.J., Shiningavamwe, K.L. & Els, J.** 2013. Commercialisation of sun-dried cactus pear (*Opuntia ficus-indica*) cladodes in feedlot diets for Dorper wether lambs. *Acta Horticulturae* 995: 343-349.

**Du Toit, A.N., Einkamerer, O.B., Hugo, A., Van Der Merwe, H.J. & Fair, M.D.** 2013. The effect of dietary lipid saturation and monensin-Na on the CLA content of lambs' meat. *South African Journal of Animal Science* 43(5 / Supplement 1): S81-S87.

**Engelbrecht, A., Cloete, S.W.P., Bunter, K.L., Van Wyk, J.B. & Hoffman, L.C.** 2013. Genetic parameters for slaughter and meat traits in ostriches. *Proceedings of the 20th Conference of the Association for the Advancement of Animal Breeding and Genetics*, Napier, New Zealand. 20-23 October 2013.

**Fourie, P.J., Foster, L. & Neser, F.W.C.** 2013. Differences in physical traits such as coat score and hide thickness together with tick burdens and body condition score in four beef breeds in the Southern Free State. *Journal for New Generation Sciences* 11(1): 66-73.

**Grobler, S.M., Scholtz, M.M., Schwalbach, L.M.J. & Greyling, J.P.C.** 2013. Effect of synchronisation on calving date following natural mating in beef cattle. *Applied Animal Husbandry and Rural Development* 6: 15-17.

**Hendriks, J., Scholtz, M.M. & Neser, F.W.C.** 2013. Possible reasons for differences in residual feed intake: An overview. *South African Journal of Animal Science* 43(5): 103-106.

**Joubert, D.F., Smit, G.N. & Hoffman, M.T.** 2013. The influence of rainfall, competition and predation on seed production, germination and establishment of an encroaching *Acacia* in an arid Namibian Savanna. *Journal of Arid Environments* 91: 7-13.

**King, E.J., De Witt, F.H., Van Der Merwe, H.J., Hugo, A. & Fair, M.D.** 2013. The effect of lipid saturation on nutrient digestibility of layer diets. *South African Journal of Animal Science* 43(5): 126-130.

**Leesburg, V.L.R., MacNeil, M.D., Van Marle-Koster, E., Mapholi, O. & Neser, F.W.C.** 2013. Impact of Line 1 germplasm on South African Hereford cattle. *South African Journal of Animal Science* 43(2): 153-158.

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*The Sheep AI course for students and farmers presented by the Department.*

## Staff

**Professors**: Profs JPC Greyling, HO de Waal, FWC Neser, HA Snyman, GN Smit, and JB van Wyk.
**Senior Lecturer**: Dr AM Jooste.
**Lecturers**: Drs MD Fair and GDJ Scholtz, Messrs F Deacon, FH de Witt, OB Einkamerer, and PJ Malan.
**Junior Lecturer**: Mr MB Raito.
**Researcher**: Dr BB Janecke.
**Affiliated / Associate Professors**: Profs M MacNeil, and AZ van der Zijpp, Drs A Maiwashe, TL Nedambale, and MM Scholtz.
**Technician**: Mrs JAM van der Merwe.
**Main Officer**: Mr WJ Combrinck.
**Officer**: Professional Services: Mr G Janse van Rensburg.
**Senior Officers**: Mrs HMF Linde, and Mrs EJC Nel.
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Department of

# Plant Sciences

## Overview

The excellence of staff and students in the Department of Plant Sciences has inspired good performance and overall achievements. A postgraduate student, Ms Lisa Coetzee, was one of two candidates who represented Africa in a global summit in Canada and one of our senior lecturers, Dr Marieka Gryzenhout, received the "Distinguished Young Women: Life Sciences" award. The Department of Plant Sciences is divided into three disciplines; namely Botany, Plant Breeding, and Plant Pathology. All three disciplines offer undergraduate modules as well as postgraduate training from honours to postdoctoral level. The activities and achievements of these groups are reported in the following sections.

## Research Activities and Achievements

### Botany: Plant Physiology/Biochemistry and Molecular Biology

Several research projects are running within the Botany division and one of the major research areas is plant disease resistance. Dr Botma Visser's research group studies pathogenic fungi that cause rust diseases on wheat. These include stem, leaf and stripe rust. The various projects that fall under this banner include the genotyping of all new rust races in Southern Africa, the annual genotyping and monitoring of the rust populations in South Africa, and the identification of new rust fungi in the country. This work is

done in collaboration with Prof Zakkie Pretorius (Plant Pathology, UFS) and Dr Tarakegn Terefe (Agricultural Research Council: Small Grain Institute, Bethlehem). The aim is to establish a genotyping centre at the UFS for rust fungi for the Southern Africa region which would aid the international wheat growing community by disseminating the race information for the region. Currently, one MSc student (Mr Tonny Selinga) is involved in the project, which will be expanded to three PhD students in 2015. Based on this work, Dr Visser presented a combined talk with Prof Les Szabo (USDA-ARS) at the Fifth Annual Borlaug Global Rust Initiative (BGRI) Technical Workshop in New Delhi, India, in August 2013.

Dr Lintle Mohase is working on plant defence mechanisms of wheat to insect (aphid) infestations. Her work involves isolation and identification of the so-called elicitors of the resistance response in plants. Current results indicate the presence of specific elicitors in the saliva of different Russian Wheat Aphid biotypes, which mediate resistance responses only in specific wheat genotypes. Dr Mohase, in collaboration with Prof Amie van der Westhuizen (Plant Sciences, UFS), visited and delivered a lecture on this work in Prof Moerschbacher's laboratory in Germany (Department of Plant Biology and Biotechnology, Westphalian Wilhelm's University of Münster) in March 2013. On the same trip they attended the Mycology and Host Parasite Interactions Conference, where Dr Mohase presented a poster on aphid-derived elicitors of the Russian Wheat Aphid resistance response in wheat. The next phase of the project is the characterisation and identification of the elicitors.

Dr Marieta Cawood's research focuses on extraction and utilisation of plant secondary metabolites to enhance growth and development, as well as disease resistance to pests and pathogens in plants. She collaborates with various national and international scientists such as Drs J Alleman (Soil, Crop and Climate Sciences, UFS), A Jankielsohn (ARC-SGI, Bethlehem), Prof J van der Westhuizen (Chemistry, UFS), Prof ZA Pretorius (Plant Pathology, UFS), and Prof B Moerschbacher (Münster, Germany). Dr Cawood's research group involves students from honours to master's level and one of her MSc students (Mr Lubabalo Saba) received an award for Best Presentation by a Young Scientist at the Indigenous Plant Uses Forum (IPUF) conference in Nelspruit, South Africa, July 2013.

Dr Gerhard Potgieter's expertise comprises two fields of interest, namely seed physiology, and the hydroponic cultivation of plants. His projects on the control of reserve mobilisation during germination and early seedling establishment, especially in seeds that store lipids as reserve material, have contributed to the understanding of the importance of oxygen in controlling the lipid degradation process. The "oxygen sensing" mechanism(s) involved, and the control thereof, is currently under investigation. He is also involved in both theoretical and practical aspects of

*Mr Lubabalo Saba (left) with Prof Ben-Erik van Wyk (University of Johannesburg). Lubabalo received an award for Best Presentation by a Young Scientist at the IPUF conference in Nelspruit, South Africa, July 2013.*

the hydroponic cultivation of crops. Hydroponics is the ideal tool for investigating the effect of natural "bio-catalysts" on plant growth and yield. In collaboration with Dr Gert Marias (Plant Pathology, UFS), the effect of a metabolite, containing a fermented product from the fungus *Trichoderma,* on the development and yield of different hydroponically grown crops, are currently investigated.

Research in eco-physiology, recently established at the Department of Plant Sciences, emphasises influences of environmental conditions on the physiology of plants. Results of these studies could contribute towards enhancing existing agricultural practices and rehabilitation of disturbed areas. However, not much research has been done on the use of tree species in re-vegetation attempts. Ms Marguerite Westcott, in collaboration with Dr Marieka Gryzenhout (Plant Pathology, UFS) and the Centre for Tree Health Biotechnology (CTHB), studies the ecology, morphology and physiology of *Searcialancea* to establish its suitability for rehabilitating disturbed areas. Causal agents for malformations in the reproductive tissue of the latter species are also studied, as the success of establishing populations under stress conditions, is questionable.

## Botany: Plant Taxonomy and Molecular Systematics

The Plant Taxonomy research group, headed by Drs Lize Joubert and Mariëtte Jackson, focuses on taxonomic revisions, systematics and pollination biology of key genera of the African flora. Current projects of Dr Lize Joubert include systematics and pollination biology of the *Periplocoideae* (*Apocynaceae*) and systematics of South African endemic *Asteraceae* genera. A revision of *Cryptolepis*, the second-largest genus in the *Periplocoideae*, was completed and the first study of pollination biology in the *Periplocoideae* was undertaken between November 2012 and December

*Dr Lize Joubert processing specimens in the pollination biology laboratory, University of KwaZulu-Natal.*

2013 in collaboration with Dr Tatyana Livshultz (Drexel University, USA) and Prof Steven Johnson (University of KwaZulu-Natal). This is the first detailed pollination study to be done on the *Periplocoideae* and has significance for the interpretation of floral adaptations and evolution of plants as a result of climate change and aridification. Furthermore, taxonomic revisions were also completed for the genera *Garuleum* and *Steirodiscus* (*Asteraceae*). The latter was done in collaboration with Dr John Manning (Compton Herbarium, Kirstenbosch). A preliminary molecular phylogeny was also presented for *Garuleum*. Both these genera are priority taxa for systematic revision and this work makes a small but significant contribution to the taxonomy of the South African flora. A total of 24 000 specimen records from the main collection in the Geo Potts Herbarium were transferred from the old database PRECIS to a new, internationally used BRAHMS database. This will facilitate the development of a dedicated herbarium website where specimen information can be disseminated to the broad scientific community.

The research of Dr Mariëtte Jackson involves the Systematics of the *Asteraceae* (genera *Steirodiscus, Garuleum*and *Curio*) and *Raphionacme* (*Periplocoideae*, *Apocynaceae*) families as well as DNA fingerprinting of Devil's Claw, where she collaborates with Dr Pieter Zietsman (Bloemfontein National Museum – Devil's Claw project). A student, Ms Juanita van Zyl (Garuleum) completed her MSc studies under Dr Jackson's supervision. Prof Johan Venter and Dr Andor Venter are running a project on the taxonomic revision of African, Asian and Australian *Periplocoideae* (*Apocynaceae*). They both supervised Dr Lize Joubert who received her PhD in 2013. The group (AM Venter, L Joubert and M Jackson) together with Dr Botma Visser, supervised two students who received their MSc degrees in 2013.

## Botany: Paleo-botany and Ecology

Prof Louis Scott collaborates with members of an international team studying past environmental conditions at the Wonderwerk Cave near Kuruman. The team consists of Michaela Ecker, Prof Julia Lee-Thorp (Oxford University), and Dr Lloyd Rossouw (Bloemfontein National Museum), who also presented a poster at the Third Annual Meeting of the European Society for the Study of Human Evolution, Vienna, Austria. A paper by Dr Frank Neumann *et al.* (co-authored by Prof Scott), showing the transition from fynbos vegetation to the current grassland of a mountain wetland near Bulwer (KwaZulu-Natal) over an 18 000 year period, was accepted by *Vegetation History and Archaeobotany*. With the help of Prof Scott, Andri van Aardt is studying a fossil pollen record from spring deposits at Baden near Dealesville as part of her PhD study on the vegetation of the north-western Free State. A Russian PhD student (Luidmila Shumilovskikh, University of Göttingen) visited the palynology laboratory in October 2013 to collaborate in studies of fossil pollen and fungal spore records in the Eastern Cape and Limpopo.

Prof Johann du Preez's research focuses on the reclassification of the Free State's vegetation and the refinement of a vegetation map for the province, as well as the monitoring of the grazing impacts on the peatlands of Lesotho. He collaborates nationally

and internationally with scientists such as Dr Piet-Louis Grundling (director of the Centre for Wetland Research and Training - WETREST) and Profs Leslie Brown (UNISA), Jan Sliwa (Wetland expert, Munchen University), and Laco Mucina (University of Western Australia). Two of Prof du Preez's students, Ms L Koikoi and Mr H Fourie, received their MSc degrees in 2013. The book "*Die Verhaal van Lewe en die Omgewing: 'n Afrika-perspektief*" was nominated for the *Suid-Afrikaanse Akademie vir Wetenskap en Kuns* Havenga prize.

## Plant Breeding

Several research projects are running within the division of Plant Breeding. Dr Minnaar-Ontong received funding from Thuthuka to do research on Fusarium head blight on wheat in South Africa with a project entitled "The evaluation of wheat cultivars under irrigation for mycotoxin levels and FHB resistance". Collaborators on this project include Prof Dilantha Fernando (University of Manitoba, Canada), Prof John Leslie (Kansas State University, USA), Dr Antonio Logrieco (ISPA-CNR, Bari, Italy), Dr Bradley Flett (ARC-Grain Crops Institute, Potchefstroom), and Mrs Wilmarie Kriel (Starke Ayres).

### Plant Breeding: Molecular Plant Breeding

Prof Liezel Herselman focuses on a project where marker-assisted breeding is used to introgress different rust resistance genes as well as Fusariumhead blight (FHB) resistance into South African wheat cultivars. Introgression of resistance genes is confirmed using different molecular marker breeding techniques. One of the aims is to introduce stem rust resistance genes effective against the new virulent race Ug99 (TTKSK) and related derivatives into existing lines containing at least four rust resistant genes or quantitative trait loci (QTL). Most of these rust genes are also being introduced into an agronomically adapted South African line together with four QTL for FHB resistance. A number of promising lines with a high number of rust or FHB resistance genes/QTL have been developed and these lines were also tested for good bread-making quality characteristics. Both biochemical and molecular marker techniques were applied to determine the bread-making quality characteristics of single seeds. Promising lines will be made available to the industry for incorporation into their breeding programmes. This project will have an impact on the wheat industry in South Africa in the form of the release of resistant cultivars. Mrs Ansori Maré obtained her MSc degree *cum laude* working on one of Prof Herselman's projects.

### Plant Breeding: Protein Quality and Abiotic Stress

Prof Maryke Labuschagne studies the effects of abiotic stress on protein composition and baking quality characteristics in wheat. Prof Labuschagne and Dr Angeline van Biljon are also involved in projects regarding the nutritional value of some bread wheat cultivars in South Africa, with the focus on Vitamin E content and its components. This project is done in collaboration with the Swedish University of Agriculture in Alnarp, Sweden, and the ARC-SGI in Bethlehem and involved the training of a MSc student, Miss Nomcebo Mkhatywa, in Sweden. Prof Labuschagne has received funding from the Winter Cereal Trust to characterise South African commercial wheat cultivars in all production areas in terms of protein quality and protein quantity and how this reflects in bread-making quality. This project was initiated after a request from the industry and is done in collaboration with the ARC-SGI in Bethlehem. Postdoctoral fellow Joyce Maloi concluded a project for South African Maltsters and Breweries where she studied the possible reasons for the failure of barley to germinate.

In collaboration with CIMMYT in Zimbabwe and Kenya, a number of PhD students are doing projects on breeding for tolerance to abiotic stress in maize in sub-Saharan Africa. These projects are already making an impact in the region with the release of new abiotic stress-tolerant hybrids and open pollinated varieties to small scale farmers.

Dr Angeline van Biljon received training in the analysis of beta carotene in maize at CIMMYT in Mexico from world experts in this area. She will now establish a laboratory at Plant Breeding for beta carotene analysis. Prof Maryke Labuschagne visited the protein and quality laboratories at CIMMYT, Mexico, at the same time. Before this they both attended the American Association for Cereal Chemists International meeting in Albuquerque, USA, where Prof Labuschagne gave an oral presentation co-authored by Dr van Biljon. Profs Labuschagne and Herselman attended the International Wheat Genetics Symposium in Japan, where they both presented posters. Prof Herselman presented posters at both the 5th BGRI Technical Workshop in New Delhi, India, and the 12th International Wheat Genetics Symposium in Pacifico Yokohama, Japan, in September 2013 on her disease-resistance breeding research programme. Mrs Chrisna Steyn gave an oral presentation at the 15th *Sclerotinia* workshop in Wuhan, China, which she and Dr Minnaar-Ontong attended. In the process they made contact with Prof James Steadman (University of Nebraska), who will advise them on starting a *Sclerotinia* initiative in South Africa.

Dr Rouxléne van der Merwe has initiated a breeding programme for soya beans for human consumption called Edamame in collaboration with Dr Michiel Smit of the Edamame Development Project in Durban. She focuses on nutritional value and drought tolerance breeding in this crop.

### Plant Pathology: Cereal Rust Diseases

Prof Zakkie Pretorius works on cereal rust and is involved with the mapping of stem rust resistant genes in doubled haploid wheat populations, identification of a resistance gene that failed to stem rust race TTKSF, inheritance of

stem rust resistance in South African wheat and triticale, phenotyping of stripe rust resistance in a large $F_3$ population for fine mapping purposes, testing of leading South African wheat cultivars and lines for rust response, and analysis of new pathotypes of *Pucciniatriticina* from Zambia, Zimbabwe and South Africa. Prof Pretorius collaborates both nationally (ARC, Sensako, Pannar, and CenGen) and internationally (USDA-ARS, Chinese Academy of Sciences, Cornell University, Sainsbury Laboratory, and Tel Aviv University). Prof Pretorius has been a panel member of an NRF specialist committee and served on the editorial board of SA Journal of Plant and Soil (until July 2013). During the year he presented a course on Wheat Rust Research in Kathmandu, Nepal. He also provides the risk guidelines for rust diseases to the South African wheat industry annually. As part of an international team funded by the Sustainable Crop Production Research for International Development programme, Prof Pretorius attended a workshop in London, UK. He also attended the 5th annual BGRI Technical Workshop in New Delhi, India, where he authored or co-authored several poster presentations.

### Plant Pathology: Mycology

The Mycology group, headed by Dr Gert Marais, focuses on the study of fungi occurring in natural environments, their socio-economic effects on people living in Southern Africa, and their possible applications in the medical, agricultural and food industries. One project, in collaboration with the CTHB centre of excellence at the University of Pretoria, deals with the occurrence of the fungus *Epicoccumsorghi*, which is connected to the Onyalai disease; a blood platelet disorder of humans in northern Namibia. In 2013 an extensive survey was done in the Ovambo region of Namibia to study the occurrence of this fungus on cultivated crops (millet and sorghum) and indigenous vegetation such as *Acacia mellifera*. A collaborative project between the divisions Plant Pathology and Entomology (UFS), as well as the South African Pecan Producers Association (SAPPA) on the insects and fungal pathogens occurring in pecan orchards in South Africa indicated the existence of a close association between stink bugs and specific pathogens not seen before in pecans. Additionally, a study was initiated in 2013 to investigate the effect of plant growth enhancing metabolites of *Trichoderma* species from South Africa. Indications are that some of these fungal isolates produce significant amounts of these metabolites and have proven in the field to increase yields in crops such as maize, wheat, vegetables, and fruit. A master's project was also launched to study the presence of mycotoxin producing fungi in maize and wheat products during storage. One group of fungi that was being studied intensively is *Penicillium* species; where at least 19 different species are associated with South African maize products. A collaborative study with the Plant Breeding division was done in 2013 to investigate the distribution of mycotoxin producing fungi in Zimbabwe. A study on mycotoxigenic fungi in abalone feed in the Western Cape area was done in collaboration with the University of Stellenbosch.

Dr Marieka Gryzenhout's research focuses on disease and mycotoxin-producing fungi of the *Fusarium* and *Alternaria* genera in plants. Her field of expertise lies in the diagnostics of these various species and she is developing identification schemes to rapidly identify these groups. These involve at least three postgraduate projects on *Amaranthus* diseases and endophytes, and the interaction of endophytes and diseases of native plants with non-native crops. An exciting new postgraduate project studies the causal agents and effects of malformations on indigenous trees of South Africa. These symptoms can be caused by fungi, bacteria, viruses and insects, leading to complex interactions with other organisms and the host. During April 2013 she attended the Centraalbureau voor Schimmelcultures (CBS) council meeting of the International Mycological Association as Regional Representative from Africa held at Utrecht, Netherlands.

### Plant Pathology: Epidemiology

The Epidemiology group of Prof Neal McLaren concentrates on sorghum grain moulds and maize cob rots and concomitant mycotoxin and grain quality issues. These programmes run in collaboration with the Sorghum Trust, ARC-Grain Crops Institute, Texas Agrilife, and the Buffet Foundation. Also in collaboration with Texas Agrilife and Buffet Foundation is a legumes x grains rotation study aimed at evaluating soil health, root condition and systemic mycotoxin translocation to grains, as well as a germplasm evaluation programme for disease resistance. During the report period, two PhDs and a MSc (Agric) associated with these programmes were finalised and three PhDs and a MSc (Agric) are still in progress. Five local and five international congress papers were presented and four journal articles were submitted. Prof McLaren attended the ISM-MycoRed International Conference "Europe 2013: Global Mycotoxin Reduction Strategies" in Martina Franca, Italy, in May 2013 at which he presented an invited paper, and the International Congress of Plant Pathology in Beijing in August 2013, at which two poster presentations were made.

## Community Service

Dr Botma Visser is involved annually in a Career Day for grade 11 learners, organised by the Round Table and held at Eunice High School, where he presents a lecture on Biotechnology. Prof Johann du Preez presented popular lectures on "Poisonous plants and animals" at the Free State branch of Bird Life SA, and was a guest speaker at the Free State Institute of Evaluators' Annual Conference, with a speech entitled "Alien plants and their impact on the value of properties". Dr Visser also presented "Talk on the Environment" at President CR Swart School, Brandfort. Dr Rouxléne van der Merwe judged projects at the Eskom Expo for Young Scientists.

## Additional Achievements

Prof Maryke Labuschagne was a runner-up in the Women in Science Awards organised by the Ministry of Science and

*Prof Zakkie Pretorius with participants at the 2013 SAARC Wheat Rust Training Course, Kathmandu, Nepal (DRRW project, Cornell University).*

Technology and was nominated for the "Africa's most influential women in business and government 2013" award. Dr Rouxlene van der Merwe was a finalist for the best paper of the year in the *SA Grain* magazine. Profs Labuschagne and Herselman, and Dr Van der Merwe presented a four-day refresher course in plant breeding to researchers at PANNAR Seed in Greytown. Prof Labsuchagne presented an Agrobase training course to staff of Klein Karoo Seed Marketing. Dr Marieka Gryzenhout, a member of the South African Young Academy of Scientists, president of the African Mycology Association, secretary of the International Society for Fungal conservation, and council member of the South African Node of DNA Bar coding, received the TW Kambule NRF-NSTF award for an emerging researcher with an outstanding contribution to SETI through research and outputs over a period of up to six years after obtaining a PhD. She was also an alternate candidate for the Fulbright Scholarship (USA) in 2013 and received an award as "Distinguished Young Women: Life Sciences". Prof Zakkie Pretorius presented the 2013 SAARC Wheat Rust Training Course "Defending the breadbaskets of South Asia against rust" (Kathmandu, Nepal), which provided intensive training on wheat rust monitoring and disease management. The workshop intended to foster regional collaboration and equip South Asian scientists with the tools and knowledge to manage the threat of wheat rusts.

Ms Lisa Coetzee, a first-year MSc student in the Plant Pathology division, was one of two South African applicants selected to attend the global 4-H Youth Ag-Summit in Canada (19 to 25 August 2013), sponsored by Bayer Crop Science and 4-H Canada, a non-profit organisation. Applicants submitted an assay/video clip describing a plan to feed a hungry planet. Globally, 120 young adults were selected (40 of which had to be Canadian citizens and of these 20 had to be 4-H Canada members/alumni). Her philosophy on relieving hunger and increasing food safety is to increase the efficiency of crop production, ensure crop security and reduce mycotoxins in food crops. Furthermore, Ms Coetzee is also a voice for the "farming women" of the world, as 43% of the globe's farmers are women. Mr Lubabalo Saba, an MSc student in Botany received an award for best presentation by a Young Scientist at the Indigenous Plant Uses Forum (IPUF) conference in Nelspruit, South Africa.

## Staff Matters

Dr Lize Joubert received her PhD and Ms Magdil Pienaar received her MSc at the UFS. Dr Angeline van Biljon was promoted to senior lecturer, and Dr Rudo Ngara was appointed as a lecturer in Botany at the Qwaqwa Campus.

## Postgraduate Students

The Department of Plant Sciences had one postdoctoral student in 2013, Dr Joyce Maloi. Six PhD students, namely Abdu Issa, Lize Joubert, Godwill Makunde, Dimakatsu Masindeni, Hangwani Muedi and Riana Viljoen obtained their degrees in 2013.

Nine MSc students, namely Ansori du Plessis, Herman Fourie, Likeleli Koikoi, Mudzuli Mavhunga, Sidney Nwigwe, Tyson Phalafala, Magdil Pienaar, Kobus Scholtz and Karen Wolmarans, obtained their degrees in 2013.

# Research Outputs

## Research Articles

**Brand, R.F., Brown, L.R. & Du Preez, P.J.** 2013. High altitude montane wetland vegetation classification and description of the Eastern Free State, South Africa. *South African Journal of Botany* 88: 223-236.

**Brown, L.R., Du Preez, P.J., Bezuidenhout, H., Bredenkamp, G.J., Mostert, T.H.C. & Collins, N.B.** 2013. Guidelines for phytosociological classifications and descriptions of vegetation in southern Africa. *Koedoe* 55: 1-10.

**Cawood, M.E., Pretorius, J.C., Visser, B. & Van der Westhuizen, A.J.** 2013. Induced gene expression in wheat seedlings treated with a crude extract of *Agapanthus africanus* L. prior to leaf rust infection. *African Journal of Plant Biotechnology* 12: 2876-2883.

**Combrink, N., Bijzet, Z. & Labuschagne, M.T.** 2013. Variation of fruit size and shape in Kiyomi Tangor families. *Scientia Horticulturae* 162: 357-364.

**Jami, F., Slippers, B., Wingfield, M.J. & Gryzenhout, M.** 2013. Greater Botryosphaeriaceae diversity in healthy than associated diseased *Acacia karroo* tree tissues. *Australasian Plant Pathology* 42: 421-430.

**Kawuki, R.S., Herselman, L., Labuschagne, M.T., Nzuki, M., Ralimanana, I., Bidiaka, M., Kanyange, M.C., Gashaka, G., Masumba, E., Mkamilo, G., Gethi, J., Wanjala, B., Zacarias, A., Madabula, F. & Ferguson, M.E.** 2013. Genetic diversity of cassava (*Manihot esculenta* Crantz) landraces and cultivars in southern, eastern and central Africa. *Plant Genetic Resources* 11: 170-181.

**Kemler, M., Garnas, J., Wingfield, M.J., Gryzenhout, M., Pillay, K-A. & Slippers, B.** 2013. Ion Torrent PGM as tool for fungal community analysis: A case study of endophytes in *Eucalyptus grandis* reveals high taxonomic diversity. *PLOS ONE* 8: e81718.

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## Chapters in books

**Gryzenhout, M.** 2013. Other cankers caused by *Cryphonectria* and sibling species. In: *Infectious forest diseases*, edited by P. Gonthier. UK: CABI. pp. 340-358.

**Nagel, J.H., Slippers, B., Wingfield, M.J. & Gryzenhout, M.** 2013. The occurrence and impact of *Phytophthora* on the African continent. In: *Phytophthora: A global perspective on the infamous plant destroyer*, edited by K. Lamour. UK: CABI. pp. 204-214.

**Van der Merwe, R. & Hugo, A.** 2013. Sources of oleic acid and their technological and health implications. In: *Oleic acid dietary sources functions and health benefits*, edited by P. Luciano. New York: Nova Science Publishers, Inc. pp. 105-126.

## Book

**Van As, J., Du Preez, P.J., Brown, L.R. & Smit, N.** 2013. *Die verhaal van lewe en die omgewing: 'n Afrika perspektief*. Cape Town: Randomhouse Struik.

*Prof Zakkie Pretorius with delegates from the Chinese Academy of Sciences. They visited field trials at Pannar Research Station in Greytown.*

*Prof Liezel Herselman, Dr Botma Visser, Prof Zakkie Pretorius, Dr Francois Koekemoer (Sensako), Dr Toi Tsilo, and Prof René Prins attended the 5th BGRI Technical Workshop in New Delhi, India.*

## Staff

**Distinguished Professor:** Prof Zakkie Pretorius.

**Professors:** Profs Maryke Labuschagne, Neal McLaren, and Wijnand Swart.

**Associate Professors:** Profs Johann du Preez, and Liezel Herselman.

**Professor Extraordinary (contract):** Prof Pedro Crous.

**Affiliated Associate Professors:** Profs Renée Prins, Michelle van der Bank, Koos van Rensburg, and Marvellous Zhou.

**Affiliated Researchers:** Drs Lloyd Rossouw, and Toi Tsilo.

**Lecturers:** Drs Marieta Cawood, Marieka Gryzenhout, Mariëtte Jackson, Gert Marais, Adré Minnaar-Ontong, Lintle Mohase, Gerhard Potgieter, Angeline van Biljon, Rouxléne van der Merwe, Botma Visser, Ms Lize Joubert, and Marguerite Westcott.

**Contract Staff:** Profs Johan Grobbelaar, Louis Scott, Amie van der Westhuizen, Johan Venter, and Dr Andor Venter.

**Technical and Support Staff**: Cornel Bender, Hilda Dlamini, Sadie Geldenhuys, Nelmari Janse van Rensburg, Lillian Molosi, Reanette Rademeyer, Chrisna Steyn, Zelda van der Linde, Magdil Pienaar, Dirk Jansen, Gerald Moshodi, and Hendri Pretorius.

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Department of

# Soil, Crop and Climate Sciences

## Overview

The Department of Soil, Crop and Climate Sciences specialises in the disciplines of Agrometeorology, Agronomy and Soil Science; contributing to the agricultural programme of the Faculty of Natural and Agricultural Sciences of the University of the Free State (UFS). In addition to undergraduate and postgraduate teaching in the four disciplines, the Department also contributes to teaching at the Centres for Sustainable Agriculture, Rural Development and Extension, Environmental Management, Disaster Management, and the Department of Quantity Surveying and Construction Management at the UFS.

Over the past few years, the Department has shown gradual growth not only in the number of undergraduate students but also in the number of postgraduate students. In 2013 an average of 40 postgraduate students were enrolled. Approximately 40% of these students come from Botswana, Eritrea, Ethiopia, Germany, Kenya, Lesotho, Malawi, Mauritius, Swaziland, the United States of America, Zambia, and Zimbabwe. We are proud of six master's and five doctoral students who obtained their degrees.

Research in the Department is aimed at various aspects of the soil-crop-atmosphere system. Approximately R5 million was spent on research in 2013; of which only 10% came from the Central Research Fund of the UFS. The rest of the funding came from institutions like the National Research Foundation (NRF), Water Research Commission (WRC), German Research Foundation (GRF), Protein Research Trust (PRT), Winter Grain Trust (WGT), SAB Miller, Bayer, Montsanto, Syngenta, Omnia Fertilizer Ltd., Potatoes SA, and Agraforum. Research findings were published in books and scientific journals as outlined in the research outputs. A wide range of oral and poster

presentations were also made and they amounted to 17 at national conferences and nine at international conferences.

## Activities and Achievements

### Agrometeorology

The staff and students of this section made valuable contributions to the Agricultural Modelling Intercomparison and Improvement Project in Sub-Saharan Africa and South Asia (AgMIP). AgMIP is approved and sponsored by UKaid through its Department of International Development (DFID), UK, and the United States Department of Agriculture – Agricultural Research Service (USDA-ARS); and executed by the trustees of Columbia University (CU) in New York, USA. Research projects funded by AgMIP address the modelling of crop-livestock intensification in Southern Africa in the face of climate change. The main goal was to identify pathways to improve food security in Southern Africa's mixed crop livestock systems and to develop adaptive management strategies to reduce climate-induced risks and to increase systems resilience.

As was mentioned in the previous report, the FAO contracted Agrometeorology to train agricultural extension officers at two sites in Mpumalanga. The main objective of the training was to focus on climate-related influences on agriculture and how to use crop and climate information to improve on-farm decision making. A repeat of the training presented in Mpumalanga took place in Durban, KwaZulu-Natal, where employees from the departments of Environmental Affairs, Agriculture, Forestry and Fisheries, and the South African Weather Service attended in two separate weeks (24 to 28 June and 8 to 12 July 2013). Mr Stephan Steyn, Ms Linda De Wet and Mr Pieter van Heerden (irrigation specialist and doctoral student) lectured to and workshopped with the attendees and the interaction and feedback was favourable and encouraging. Mr Van Heerden, accompanied by Ms Cassia Mlangeni (honours student) and Ms Tumi Phatudi-Mphahlele (intern) made pre and post-site visits in order to assess the training needs, to assist trainees and farmers with real problems, and to judge the eventual impact of the training.

In 2013 Agrometeorology once again hosted an intern from the DST-NRF Internship programme, Ms Phatudi-Mphahlele. This year-long (April to March) programme is highly successful as interns gain experience and life skills in the workplace as well as the opportunity to further their studies in Agrometeorology. Interns are exposed to all aspects of the tertiary environment, i.e. scientific, technical, administrative, data analysis, presentation and writing skills, conferences and workshops. The interns do their best and are evaluated on a three-month basis with feedback on how to improve their performance as employees.

Dr László Lakatos participated in a five-month Fulbright Scholarship to the USA (Cornell University, Ithaca) between 1 April and 31 August 2013. The aim of his research work was to investigate the effects of evaporative cooling irrigation on orchard micro-climate parameters. He also investigated how extreme weather events have changed during the last few decades at the main fruit growing districts in the State of New York. During this time Dr Lakatos worked with Prof David Wolfe's six-member research group at the Institute of Plant Sciences in the Department of Horticulture. The main task of the research team was the measuring and modelling of soil carbon turnover at various horticultural and field crops. In addition, the department dealt with cold hardiness and phenological phases of fruit trees, especially of apple varieties.

*Prof Gerrit Hooogenboom at the agrometeorological station of AgWeatherNet.*

During the Fulbright scholarship, Dr Lakatos won an Occasional Lecturer Fund (OLF) to the Washington State University (WSU). Subsequently, he spent a week at the University of Washington in Prosser and met with Prof Gerrit Hoogenboom, the head of the AgWeatherNet Department of WSU.

A trip to the nearby Doornink Fruit Ranch – an 80 hectare orchard where mostly apples, cherries and apricots are

*Prof Gerrit Hooogenboom at the agrometeorological station of AgWeatherNet.*

cultivated – confirmed some of Dr Lakatos' research results on the use and efficiency of different irrigation systems in frost protection. The whole orchard was irrigated and equipped with frost protection and cooling sprinkler heads. In addition, for frost protection, 25 meter high natural gas propulsion wind machines are also employed if necessary.

### Agronomy

During the past year, four research projects were completed in the Agronomy section, resulting in the awarding of one doctoral degree (interdisciplinary with Plant Sciences) and three master's degrees. Two research papers and a poster were delivered at the Combined Congress of the South African Society for Crop Production, the Southern African Weed Science Society, the Soil Science Society of South Africa, and the South African Horticultural Society. On the international scene, two posters were exhibited at the 8th International Congress on Cactus Pear and Cochineal convened in Palermo, Italy, while one paper and a poster were presented at the 1st International Conference on Bio-stimulants conducted in Strasbourg, France.

Research into the allelopathy of *A. cruentus* has progressed well, and is now the subject of an interdisciplinary study between this section and the Botany section of the Department of Plant Sciences. A project evaluating two methods of determining the effect of planting depth on crop injury caused by pre-emergence acetachlor applications was completed; together with a study investigating the damage caused to dry bean cultivars by mesotrione. Herbicide research, concentrating on the chloroacetamide herbicide group (important graminicides), continues.

Projects investigating the effect of high soil temperature on sunflower germination, the response of maize to phosphorus and nitrogen fertilisers on a low phosphorus status soil, as well as temperature and drought stress effects on the germination of Amaranth seeds and early seedling growth, were completed during the course of the year. Results from these projects have assisted in elucidating practical problems that were encountered during germination and early growth of these crops. Treatment of chemically contaminated soils with bio-stimulants to determine if microbial biodiversity can be increased and so reduce the contamination is under investigation as part of a continuing project carried out in a number of countries.

A literature study on the control of volunteer potatoes for Potatoes South Africa was completed, and a project to identify an alternative systemic herbicide for the control of volunteer potatoes for the same organisation has commenced. An investigation into the yield and quality response of barley to sub-optimal temperatures was also completed during the course of the year. An investigation of an alternative method to study amaranth allelopathy was successfully concluded in collaboration with the Botany section of the Department of Plant Sciences.

The Physiology research team under the leadership of Prof Seef Pretorius either completed or made good progress on five projects, *viz.* i) the growth response of groundnut seedlings to seed treatment with heavy metals and a natural bio-stimulant, ii) the elucidation of the mechanism of action of a prototype fungicide developed by the team, iii) *in vivo* control of pathogens in three crops as a seasonal follow-up of previous trials, iv) determination of saponin breakdown in crops treated with the prototype fungicide, and v) remediation of herbicide phytotoxicity on crops and soil organisms through the application of natural bio-stimulants. Regarding (i), it was shown that seedling growth was significantly increased, either through increasing fresh mass or enhanced root and coleoptile length, by treatment with heavy metals not normally used in agriculture. This is a breakthrough for future research. With project (ii), it was shown that the active compound in the patented prototype fungicide, a saponin, controls fungal growth by completely breaking down the membranes in fungal hyphae. In project (iii) three field trials were completed to evaluate the control of blackspot in Citrus, Botrytis rot in grapes, and early blight in potatoes by the prototype fungicide. The positive results confirmed results obtained during the previous season, and will be used for registration as a commercial product. Project (iv) confirmed that the saponin contained in the prototype fungicide is broken down in treated grape and tomato plants within the minimum time allowed. Finally, project (v) confirmed that the addition of a bio-stimulant partially alleviated herbicide damage in the test crop while increasing the number and population diversity of soil microbes.

## Soil Science

The research group of Prof Leon van Rensburg consists of Dr Johan Barnard, Dr Sabelo Mavimbela, Dr Zaid Bello, Dr Mussie Zerisghy, Dr Andries Gouws (Barari Forest, UAE), Ms Andri van Aardt, and Prof Rianto van Antwerpen (SASRI), as well as a number of master's and doctoral students. Dr Sabello led the research on the hydro-physical properties of selected ecotopes at the Kolomela iron mine near Postmasburg. The long-term project is aimed at providing answers on how rainfall is partitioned between runoff, drainage, evaporation, transpiration and deep drainage. Most of the fieldwork was completed and the emphasis shifted to illustrating how the soil water balance processes interact with the dewatering activities of the open-cast mine. Farmers complain that the dewatering of the mine impacts negatively on the groundwater supply and hence on their farming activities. Drs Zerisghy and Gouws have developed a computer model to manage irrigation of trees using poor-quality water in arid parts of Abu Dhabi. Barari Forest Management is responsible for the management of about 140 000 hectares of trees in the Abu Dhabi Emirate. Groundwater is the main water source in this arid environment and the annual yield is less than the abstraction for irrigation. In addition, the groundwater at some places has the same salinity as sea water. Lessons learned on managing poor water quality will help South Africa in the future. Water in semi-arid

South Africa is also scarce and demands optimal use. Dr Bello focused on the water footprint of beer, a project sponsored by the Winter Cereal Trust and SAB Miller. This project focused on the irrigation scheduling of barley and consisted of glasshouse and field studies. The glasshouse studies were completed and irrigation-scheduling strategies at farms in Douglas and Jan Kempdorp are being tested.

*Irrigation-scheduling experiment at Jan Kempdorp – Mr Fagen Scheepers preparing the soil for installing probes to monitor soil water during the growing season of barley.*

*Dr Sabello and technicians conducting rainfall simulation experiments at the Kolomela mine near Postmasburg.*

*Cornie van Huyssteen with melting permafrost soil in East-central Russia (Yakutsk). Melting collapses the soil, totally destroying the vegetation and permanently changing the landscape.*

Pedology research verified morphological indicators of hydrological processes in soils using recent indicators of soil processes; for example: soil pH. The hydrological classification of soilscapes was improved in the process. Digital soil mapping was developed to map the spatial distribution of first order controls of hillslope hydrology and was applied in the Kruger National Park. These results are not only important to hydrology in general but also to ecohydrology specifically as it improves the understanding of soil's services to the ecosystem.

The Wetland Research section focuses on the improvement of soil indicators for wetland identification and delineation. These soil indicators are currently not well defined and are not substantiated by research. On the other hand, the pressures on wetlands are increasing due to mining, as well as urban, industrial and agricultural development. The situation is further exacerbated by the fact that South Africa is a water-scarce country. A project, completed at Florisbad, close to Bloemfontein, conclusively proved that soil reduction sets in when 70% of soil pores are saturated with water. This was the limit also distinguished between obligate wetland and upland vegetation. Another project was based on the soils from the northern Maputaland coastal aquifer where soils do not have the expected morphology associated with long periods of water saturation. Laboratory experiments have shown that these sandy soils contain enough organic material and iron to reduce. It was hypothesised that redoximorphic features form in these soils, but are not necessarily always identifiable during field surveys. The last project is being conducted in the Kruger National Park to test the applicability of the "Indicator of Reduction in Soil" (IRIS) for the identification and delineation of wetlands in South Africa. Initial results are not encouraging. Much abrasion has occurred on the sandy soils, making interpretation difficult while the high pH in other soils prohibited reduction on the IRIS tubes. It is expected that these results will inform the proposed new wetland delineation manual. During 2013 Prof Cornie van Huyssteen attended an editor's meeting of the World Reference Base in Rome, a core working group meeting of the Universal Soil Classification System in Brazil, and a World Reference Base workshop on Cryosols (frozen soils) in Yakutsk, Russia.

The first phase of the research project, "Vulnerability and resilience of soils under different rangeland use", financed by the Research Foundation of Germany (RFG), was completed under the leadership of Profs Wulf Amelung and Chris du Preez. Ms Elmarie Kotzé made a large contribution to the fieldwork in the grassland biome at Thaba 'Nchu and in the savannah biome at Kuruman. The second phase of this project was approved by the RFG and will be financially supported from 2014 until 2017.

Under the supervision of Profs Du Preez, Snyman (Animal, Wildlife and Grassland Sciences) and Ms Kotzé, a master's

student (Ms Portia Phohlo, employed by Woodland Dairies in Humansdorp), and a doctoral student (Mr Pieter Swanepoel, employed by the Western Cape Department of Agriculture in George) are investigating soil quality of cultivated pasture in the eastern and southern Cape regions. In these regions cultivated pastures form the base of dairy production. Most of South Africa's milk is produced here and the research is therefore funded in a joint effort by the public and private sector, and will continue for a number of years.

Ms Tesha Mardamootoo, a doctoral student supervised by Prof du Preez, is involved in a project that focuses on the developing of an index for phosphorus loss from sugarcane soils in Mauritius. This project is funded by the European Union and somewhat complemented the recently completed WRC project on modelling non-point source pollution in agriculture from field to catchment scale. Prof du Preez is also a member of a team commissioned by the WRC to developed risk-based water quality guidelines for irrigation in South Africa.

# Research Outputs

## Research Articles


**Barnard, J.H., Van Rensburg, L.D., Bennie, A.T.P. & Du Preez, C.C.** 2013. Simulating water uptake of irrigated field crops from non-saline water table soils: Validation and application of the model SWAMP. *Agricultural Water Management* 126: 19-32.

**Bosekeng, G. & Coetzer, G.M.** 2013. Response of onion (*Allium cepa* L.) to sowing date. *African Journal of Agricultural Research* 8: 2757-2767.

**Cawood, M.E., Pretorius, J.C., Visser, B. & Van Der Westhuizen, A.J.** 2013. Induced gene expression in wheat seedlings treated with a crude extract of *Agapanthus africanus* L. prior to leaf rust infection. *African Journal of Biotechnology* 12: 2876-2883.

**Cheng, Y., Amijo, T., Dalian, W., Tsubo, M. & Nakamura, T.** 2013. Phytosociology of Hulunbeier grassland vegetation in Inner Mongolia, China. *Phytocoenologia* 43: 41-52.

**Coetzer, G.M., Ntsane, S.M. & Fouche, H.J.** 2013. Comparison of cactus pear (*Opuntia* spp.) cultivars for fruit yield and quality in the Central Free State, South Africa. *Acta Horticulturae* 995: 225-228.

**Dewitte, O., Jones, A., Spaargaren, O., Breuning-Madsen, H., Brossard, M., Dampha, A., Deckers, J., Gallali, T., Hallett, S., Jones, R., Kilasara, M., Le Roux, P.A.L., Michéli, E., Montanarella, L., Thiombiano, L., Van Ranst, E., Yemefack, M. & Zougmore, R.** 2013. Harmonisation of the soil map of Africa at the continental scale. *Geoderma* 211: 138-153.

**Han, L., Tsunekawa, A. & Tsubo, M.** 2013. Shifting of frozen ground boundary in response to temperature variations at northern China and Mongolia, 2000–2007. *International Journal of Climatology* 33: 1844-1848.

**Han, L., Tsunekawa, A., Tsubo, M. & Zhou, W.** 2013. An enhanced dust index for Asian dust detection with MODIS images. *International Journal of Remote Sensing* 34: 6484-6495.

**Han, X., Tsunekawa, A., Tsubo, M. & Shao, H.** 2013. Responses of plant–soil properties to increasing N deposition and implications for large-scale eco-restoration in the semiarid grassland of the northern Loess Plateau, China. *Ecological Engineering* 60: 1-9.

**Haregeweyn, N., Tsunekawa, A., Tsubo, M., Meshesha, D. & Melkie, A.** 2013. Analysis of the invasion rate, impacts and control measures of *Prosopis juliflora*: A case study of Amibara District, Eastern Ethiopia. *Environmental Monitoring and Assessment* 185: 7527-7542.

**Jennings, K. & Van Huyssteen, C.W.** 2013. Relating the onset of reduction to degree of soil water saturation. *South African Journal of Plant and Soil* 30: 157-161.

**Kosters, R., Preger, A., Du Preez, C.C. & Amelung, W.** 2013. Re-aggregation dynamics of degraded cropland soils with prolonged secondary pasture management in the South African Highveld. *Geoderma* 192: 173-181.

**Kotze, E., Sandhage-Hofmann, A., Meinel, J., Du Preez, C.C. & Amelung, W.** 2013. Rangeland management impacts on the properties of clayey soils along grazing gradients in the semi-arid grassland biome of South Africa. *Journal of Arid Environments* 97: 220-229.

**Kuenene, B.T., Van Huyssteen, C.W. & Le Roux, P.A.L.** 2013. Selected soil properties as indicators of soil water regime in the Cathedral Peak VI catchment of KwaZulu-Natal, South Africa. *South African Journal of Plant and Soil* 30: 1-6.

**Loke, P.F., Kotze, E. & Du Preez, C.C.** 2013. Impact of long-term wheat production management practices on soil acidity, phosphorus and some micronutrients in a semi-arid Plinthosol. *Soil Research* 51: 415-426.

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**Moeletsi, M.E. & Walker, S.** 2013. Agroclimatological suitability mapping for dryland maize production in Lesotho. *Theoretical and Applied Climatology* 114: 227-236.

**Moeletsi, M.E., Moopisa, S., Walker, S. & Tsubo, M.** 2013. Development of an agroclimatological risk tool for dryland maize production in the Free State Province of South Africa. *Computers and Electronics in Agriculture* 95: 108-121.

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**Stigter, C.J., Winarto, Y., Ofori, E., Zuma-Netshiukhwi, G., Nanja, D. & Walker, S.** 2013. Extension agrometeorology as the answer to stakeholder realities: response farming and the consequences of climate change. *Atmosfera* 4: 237-253.

**Swanepoel, P.A., Botha, P.R., Du Preez, C.C. & Snyman, H.A.** 2013. Physical quality of a podzolic soil following 19 years of irrigated minimum-till kikuyu-ryegrass pasture. *Soil and Tillage Research* 133: 10-15.

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**Tshikolomo, K.A., Nesamvuni, A.E., Walker, S., Stroebel, A. & Groenewald, I.B.** 2013. Development of a water management decision model for Limpopo province of South Africa based on congruence between sector challenge and service organization capacity. *American International Journal of Contemporary Research* 3: 126-141.

**Van Der Watt, E. & Pretorius, J.C.** 2013. A triglyceride from *Lupinus albus* L. seed with biostimulatory properties. *African Journal of Biotechnology* 12: 5431-5443.

**Van der Westhuizen, R. & Van Rensburg, L.D.** 2013. Rapid procedure to calibrate EC-10 and EC-20

capacitance sensors in coir. *Water SA* 39: 733-737.

**Van Huyssteen, C.W.** 2013. Soil Science in South Africa. *Horizons* 54: 1-2.

**Van Huyssteen, C.W., Turner, D. & Le Roux, P.A.L.** 2013. Principles of soil classification and the future of the South African system. *South African Journal of Plant and Soil* 30: 23-32.

**Van Rensburg, L.D., Strydom, M.G., Bennie, A.T.P. & Du Preez, C.C.** 2013. Parameters for use of BEWAB+ programme to schedule irrigation of pea (*Pisum sativum* L.). *Journal of Agricultural Science and Technology* A3: 622-632.

**Van Tol, J.J., Barnard, J.H., Van Rensburg, L.D. & Le Roux, P.A.L.** 2013. Soil depth inferred from electromagnetic induction measurements. *African Journal of Agricultural Research* 8: 519-524.

**Van Tol, J.J., Hensley, M. & Le Roux, P.A.L.** 2013. Pedological criteria for estimating the importance of subsurface lateral flow in E horizons in South African soils. *Water SA* 39: 47-56.

**Van Tol, J.J., Le Roux, P.A.L., Lorentz, S. & Hensley, M.** 2013. Hydropedological classification of South African hillslopes. *Vadose Zone Journal* 12: 1-10.

**Van Zijl, G.M., Le Roux, P.A.L. & Turner, D.** 2013. Disaggregation of land types using terrain analysis, expert knowledge and GIS methods. *South African Journal of Plant and Soil* 30: 123-129.

**Walker, S., Nesamvuni, A.E. & Tshikolomo, K.A.** 2013. Prospect for developing water storage through analysis of runoff and storage capacity of Limpopo and Luvuvhu-Letaba water management areas of South Africa. *International Journal of Applied Science and Technology* 3: 70-79.

**Waswa, G., Clulow, A., Freese, C., Le Roux, P.A.L. & Lorentz, S.** 2013. Transient pressure waves in the vadose zone and the rapid water table response. *Vadose Zone Journal* 12: 1-18.

**Winarto, Y. & Stigter, C.J.** 2013. Science field shops to reduce climate vulnerabilities: An inter- and trans-disciplinary educational commitment. *Collaborative Anthropologies* 6: 419-441.

**Winarto, Y., Stigter, C.J., Dwisatrio, B., Nur Haga, M. & Bowolaksono, A.** 2013. Agrometeorological learning increasing farmers' knowledge in coping with climate change andunusual risks. *Southeast Asian Studies* 2: 323-349.

**Yada, G.L., Ceronio, G.M. & Van Rensburg, L.D.** 2013. Ultra-fast maize (*Zea mays* L.) hybrid growth response to plant population density. *Journal of Agricultural Science and Technology* 3: 334-343.

**Zerizghy, M.G., Le Roux, P.A.L., Hensley, M. & Van Rensburg, L.D.** 2013. Prediction of soil distribution on two soilscapes in land type Dc17 east of Bloemfontein, South Africa. *South African Journal of Science* 109: 1-5.

**Zerizghy, M.G., Van Rensburg, L.D. & Anderson, J.J.** 2013. Comparison of neutron scattering and DFM capacitance instruments in measuring soil water evaporation. *Water SA* 39: 183-190.

**Zuma-Netshiukhwi, G., Stigter, C.J. & Walker, S.** 2013. Use of traditional weather/climate knowledge by farmers in the South-Western Free State of South Africa: Agrometeorological learning by scientists. *Atmosfera* 4: 383-410.

## Books

**Jones, A., Breuning-Madsen, H., Brossard, M., Dampha, A., Deckers, J., Dewitte, O., Gallali, T., Hallett, S., Jones, R., Kilasara, M., Le Roux, P.A.L., Michéli, E., Montanarella, L., Spaargaren, O., Thiombiano, L., Van Ranst, E., Yemefack, M. & Zougmore, R.** 2013. *Soil Atlas of Africa.* Luxembourg, Belgium: Luxembourg, European Union.

**Le Roux, P.A.L., Du Plessis, M., Turner, D., Van der Waals, J. & Booyens, H.** 2013. Field book for the classification of South African soils. South Africa, Wandsbeck: Reach Publishers.

## Staff

**Professors:** Profs CC Du Preez, JC Pretorius, and LD Van Rensburg.
**Associate Professors:** Profs PAL Le Roux and CW van Huyssteen.
**Senior Lecturers:** Drs J Allemann, GM Ceronio, GM Coetzer, and L Lakatos.
**Lecturers:** Dr JH Barnard, Ms L De Wet, Ms E Kotzé, and Mr AS Steyn.
**Affiliate Professors:** Profs CJ Stigter and S Walker.
**Affiliate Associate Professors:** Profs M Tsubo and R van Antwerpen.
**Research Associate:** Dr JH van der Waals.
**Senior Officers: Professional Services:** Ms YM Dessels and Dr E van der Watt.
**Officer: Professional Services:** Mr JW Hoffman.
**Senior Assistant Officers:** R Etzebeth, L Henning, and GC van Heerden.
**Technical Assistants:** Messrs TDD Mavuya, TE Moeti, TG Mokoena, and EC Nthoba.

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# Building

# Sciences

Department of

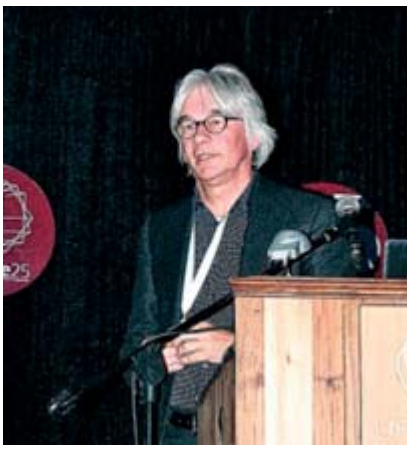
# Architecture

## Overview

The Department of Architecture is a leading Architectural Learning Site and accredited with the South African Council for the Architectural Profession, as well as internationally with the Commonwealth Association of Architects. In 2013, the Department served a total of 144 undergraduate students, and 97 for both BArchStud. (honours) and master's Architecture (professional), as well as two master's Architecture (research) and four PhD candidates.

The year 2013 was a busy and successful year for the Department. This year saw the 25th Sophia Gray memorial lecture; an event the Department initiated. To mark the occasion, the memorial lecture was incorporated with the annual student congress and the Des Baker student design competition to form Dialogue25. The coordination and planning of this event, which included the attendance of over 300 students from across the country, was a challenge the staff easily met. The event showcased Bloemfontein to students from other architectural learning sites and created a platform for interaction, collaboration, and dialogue.

Dialogue25 included speakers from various fields, including architecture, urban design, photography, film, and music. Artists Willem Boshoff, Pauline Gutter and Ryan Arenson, as well as local and international architects, academics and creative, created a lively atmosphere for discussion with topics ranging from Martina Viljoen's paper on Jack Parow's rap identity to urban design considerations by Diaan van der Westhuizen and film screenings by Curtain Film Club. On Friday 30 August the event culminated with three keynote speakers. The minister of Cooperative Governance and Traditional Affairs, Andries Nel, spoke eloquently on the


*Andries Nel, Mels Crouwel, Philippa Tumubweinee, and Prof Jonathan Jansen at the last day of Dialogue25.*

need for innovate thinking and engaging dialogue between government and professionals. The UFS rector and vice-chancellor, Prof Jonathan Jansen, spoke on the role of space and transformation on campus, engaging with the students and professionals.

Architect Kate Otten served as the 25th Sophia Gray laureate. She once again proved the high standard of the profession with her lecture "Architecture for every day". The Southern African Institute of Steel Construction speaker was Mels Crouwel. He is a noted international architect of the firm Benthem Crouwel Architeken, based in Amsterdam, and concluded the events with an overview of his work.

## Activities and Achievements

In order to strengthen the relationship between the Department and the profession, an expo was hosted at the Department in collaboration with the Free State Institute of Architects. The expo provided an opportunity for students and professionals to interact, and for manufacturers and specialists to present their products to the industry.

## Student Achievements

The *AMag*, a publication run by students since 2009, featuring student work and edited by the A5 student council, served as the main publication for Dialogue25. It included the Dialogue25 programme in addition to the usual content. It was also included with *Architecture SA* (the journal of the South African Institute of Architects) as a supplement and served as excellent marketing for the Department.

The Des Baker Student Design competition formed part of the Dialogue25 congress. The work of all the participating universities was exhibited at the Main Campus. These dialogue boxes were designed to engage and facilitate dialogue between diverse groups. The interaction and excitement shown by students from other faculties that had little knowledge of the work of architecture students was encouraging and once again proved the unique abilities of design students to create opportunities for new interactions.

The master's Architecture Professional (5th year) class of 2013 produced work of an exceptionally high standard. The regional winner of the prestigious Corobrik student competition for final-year students was Wynand Viljoen with his scheme "Raptured: a burial complex for the evacuees of the inhabitants of Pripyat in the Ukraine". Theo Gutter was the first runner-up with "Re-rigging: a movable exploration base for Virgin Oceanic expeditions", and Handre de la Rey was the second runner-up with his scheme "Kinetica Art Lab: art and technology inspiring innovation". Aleksander Troskolanski received the award for the best use of clay masonry in his scheme "Symposium for participatory democracy: translating a site of protest". Five candidates of the 2013 class received distinctions for both the design and construction components of their dissertations.


*Kate Otten at the opening of the 25th Sophia Gray exhibition at Oliewenhuis.*

*The UFS Des Baker team with the dialogue box entry.*

## Special Achievements

Staff members once again proved that the Department has both excellent academics and practicing architects to draw from. Academic Department Head Henry Pretorius received the Free State Institute of Architects (FSIA) Award for Architecture for the renovation of the Architecture Department building. Prof Jan Smit received the FSIA award for the crèche on the UFS campus, as did lecturer Katie Salzmann for the Kathu building and the new Physio building on the UFS campus.

## Community Service

The annual Winter School was once again a success with 31 learners attending. These learners gained valuable insight into the Bachelor Archicture Studiorum (undergraduate) course and what the architectural profession entails. In this way, potential students can make informed decisions about their future career.

## National and International Collaboration

Gerhard Bosman, along with Zack Wessels and Jan-Hendrik Nel, presented papers at the International Conference on Vernacular Heritage and Earthen Architecture (CIAV2013/7$^{0}$ATP/VerSUS) in Vila Nova de Cerveira, Portugal. The conference was divided into six categories and Gerhard Bosman and Jan-Hendrik Nel received the award for the best paper in the category "education and new research".

Mr Bosman also served as a facilitator for a session and as a reviewer on the scientific committee of the CIAV2013 conference.

Prof Walter Peters presented at several local and international conferences and once again served as editor of *KZNIA* journal.

Jako Olivier served on the peer review panel for the publication *Masters Projects: Architecture and Urbanism, Volume 1,* edited by Diaan van der Westhuizen and Jonathan Noble.

Student and staff member Wynand Viljoen presented his Masters Architecture Professional work at the Monstrous Geographies II conference in Prague.

Staff members also attended several local conferences. Prof Peters, Kobus du Preez, and Wanda Verster presented papers at the Conference of the South African Cultural History Society in George and Prof Peters and Mr du Preez also presented papers at the South African Journal for Art History's annual conference in Port Elizabeth.

## Postgraduate Students

The continued focus on postgraduate study and the value of the weekly research seminars served the Department well. Both Colleen Steenkamp and staff member Wanda Verster obtained their Masters Architecture (Research) degrees in 2013.

## Staff Matters

Henry Pretorius was appointed as the new Academic Head of the Department and Zack Wessels was appointed as a full-time junior lecturer.

The Department mourned the loss of Prof Banie Britz, architect, lecturer and head of the Department from 1992 to 2000, who even in retirement found the time to assist students in design. Prof Britz passed away on 27 March 2013. We are honoured that he donated his extensive library to the Department.

## Creative Output

Pretorius, HB. (Typology Architects) Free State Institute of Architects Award of Architecture. *UFS DHET Department of Architecture Renovation*, Bloemfontein.

Smit, JD. (Sm!t Architects) Free State Institute of Architect Award for Architecture. *Pre-primary school and crèche, UFS*, Bloemfontein.

Salzman, K. (Cube Architects) Free State Institute of Architects Award for Architecture. SIOC CDT Office Development, Kathu.

Salzman, K. (Cube Architects) Free State Institute of Architects Award for Architecture, *New Skills Centre UFS*, Bloemfontein.

# Research Outputs

## Research Articles

**Olivier, J.I.** 2013. Economic management sciences building, UFS: Reflecting on urbanity and porosity. *Architecture SA* 61: 26-29.

**Olivier, J.I.** 2013. Office Building, Kathu: Casting a tree-like silhoette in the Kalahari. *Architecture SA* 62: 20-23.

**Peters, W.** 2013. KZ-NIA Award for Architecture. *Journal of the KwaZulu-Natal Institute for Architecture* 1: 1-10.

**Peters, W.** 2013. Luderitz: The Jugendstil Star of the South. *Coup de Fouet: The Art Nouveau European Route Magazine* 21: 33-37.

**Peters, W. & Chennels, G.** 2013. Spilt Milk Edition. *Journal of the KwaZulu-Natal Institute for Architecture* 2: 1.

**Peters, W. & Kotze, P.** 2013. NG Kerk Welkom-Wes: Reforming Unity Temple. Part 1: What the building wants to be. *The Journal of the South African Institute of Architects* 59: 35-43.

**Peters, W. & Kotze, P.** 2013. NG Kerk Welkom-Wes: Reforming Unity Temple. Part 2: The noble room for worship. *The Journal of the South African Institute of Architects* 60: 40-45.

**Van der Vyver, Y.** 2013. *Agora of Asia Minor. South African Journal of Art History* 28(2): 275-293.

**Verster, W.** 2013. Converting space: Changes in the liturgical spaces of the Reformed Churches of Bloemfontein. *Tydskrif vir Christelike Wetenskap / Journal for Christian Scholarship* 49(1 + 2): 111-139.

## Chapters in Books

**Bosman, G.** 2013. Earth construction. In: *Architective: Building construction standards for South Africa.* Architective Publications: Johannesburg. pp. 484-502.

## Book

**Peters, W.H. & Du Preez, J.L.** (eds). 2013. *Richmond 2013: A Study in conservation.* Department of Architecture UFS: Bloemfontein.

*The UFS Des Baker team with the dialogue box entry.*

## Staff

**Department Chair:** Mr Henry Pretorius.

**Professor:** Prof Walter Peters.

**Affiliated Professor:** Prof Ora Joubert.

**Associate Professor:** Prof JD Smit.

**Senior Lecturers:** Ms Martie Bitzer, Ms Philippa Tumubweinee, Mr Kobus du Preez, and Ms Annemarie Wagener.

**Lecturers:** Mr Gerhard Bosman and Mr Jan Ras.

**Junior Lecturers:** Mr Jako Olivier, Mr Rudolf Bitzer, Mr Jan Nel, Mr Hein Raubenheimer, and Mr Zack Wessels.

**Contract Lecturers:** Mrs Madelein Stoffberg, Ms Katie Salzmann, Mr Jacobus Smit, Mr Shaun Moffat, and Mr Wynand Viljoen.

**Computer Lab Assistant:** Mr Lindewe Keswa.

**Assistant Officer: Professional Services**: Ms Wanda Verster.

**Secretary:** Ms Yolanda Pretorius.

**Departmental Assistant:** Ms Zelda Bronkhorst.

**Messenger:** Ms Joyce Mohatlane.

## Contact Details

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Department of

# Quantity Surveying and Construction Management

## Overview

Prof Basie Verster, HOD, retired after 33 years. The new HOD is Prof Kahilu Kajimo-Shakantu.

The year 2013 was a "mixed basket" for the Department of Quantity Surveying and Construction Management as there were some gains and losses. The Department was involved in various activities, events and projects, and experienced a number of highlights.

## Programme Accreditation

The Department prides itself on the fact that its programmes are accredited with five professional bodies respectively. These include:

**National:**

- South African Council for Project and Construction Management Professions (SACPCMP);
- South African Council for Quantity Surveying Profession (SACQSP); and
- South African Council for Property Valuers Profession (SACPVP).

**International:**

- Royal Institutions of Chartered Surveyors (RICS); and
- Chartered Institute of Building (CIOB).

The Department is fully committed to ensuring that programme accreditation is maintained. This is because professional recognition of the programmes reflects, among other things, that: the Department has acceptable standards

*From left to right: Mr Hendrik van Vuuren (lecturer), Mr Henno Furstenburg (recipient), Mr Stephen Ramabodu (lecturer), Mr Dwayne Lemmer (recipient), Ms Natalia van der Westhuizen (recipient), Ms Lize de Witt (recipient), and Prof Kahilu Kajimo-Shakantu (HOD).*

and quality of student selection into programmes; students enjoy a high-quality teaching environment and exposure to innovative ideas through teaching and research; the curricula are relevant to professional practice and produces good student graduates who are "marketable" and can find employment in the labour market both locally and internationally.

In terms of staff involvement with professional bodies, Mr Ramabodu serves on the South African Board of Quantity Surveyors. Mr Pierre Oosthuizen is currently the chairman of the Free State Chapter of Association of South African Quantity Surveyors. Mr Kobus Le Roux, one of our module lecturers, was elected to represent the Free State on the CIOB Africa board.

## Achievements of Students

Some outstanding students in the Department performed with excellence and were awarded various prizes sponsored by the Department, professional bodies, and other stakeholders at the faculty prize-giving ceremony held in April 2014.

At a national level, Ms Elana Malherbe, who completed her BScHons in Quantity Surveying in 2012 with an average mark of 86% was awarded the national gold medal from the Association of South African Quantity Surveyors. This was held at a gala event in Cape Town in June 2013.

## Student Activities

A number of social and academic activities took place in the last year to enhance students' learning experience:

### Departmental orientation and welcoming braai

First-year students, together with their families, were treated to a welcoming function. This included presentations, "inspection" of the facilities, and drinks. On 8 February the Department held a social braai, championed by Mr Pierre Oosthuizen, who is responsible for the student engagement portfolio, to welcome all students to the Department.

### Field trips/site visits

There were two coordinated site visits arranged for students in April and August. Site trips are crucial to students' learning as it gives them first-hand experience of some of the aspects they are taught in class.

*Prof JJP (Basie) Verster, Ms Elana Malherbe, and Mrs Hilda Verster.*

## Undergraduate students

Of the undergraduates, a total of 110 students received their degrees in the Department (both Foundation BSc and BScHons) as follows: BSc Construction Management: 11; BSc QS: 29; BScHons construction management: 11; and BScHons Quantity Surveying: 61.

## Postgraduate Students

Three doctoral degrees were awarded; one master's degree by Research and eight MProp degrees (taught master's).

## Student Conference Attendance

A selected number of QS students were afforded the opportunity to attend the 7th SACQSP Research Conference held at the Vineyard hotel in Cape Town in June 2013. The conference theme was sustainability (Green vision 20/20), which is an emergent and important theme. A selected number of Construction Management and QS students attended the Construction and Project Management Conference held at Gallagher Estate in Johannesburg. At this prestigious event the students managed the departmental stall where our programme offerings were exhibited. Both conferences gave the students good exposure to current research questions, evolving practices, challenges, and potential solutions. They also interacted with potential employers and sponsors.

In line with the Department's ongoing efforts to give our students as much exposure to industry and profession, a selected number of QS students attended the ASAQS Free State Chapter AGM in Bloemfontein.

## Community Service and Short Learning Programmes

Alongside the degree programmes, the Department also offers various registered short programmes and certificate courses as additional training activities. The short learning programmes are mainly targeted at people who are working and/or who would ordinarily not have entered University via the "normal" route. Aside from offering a third income stream, the Department does this as part of community engagement.

Short programmes such as the Facilities Management Programme (FMP) and Intensive Project Management Programme (IPMP) are supported by the South African Property Owners Association (SAPOA).

In 2013, 60 students were registered for the QCP distance learning programme. Five students of the QCP programme graduated in Namibia and a ceremony to celebrate this achievement was held at the Safari hotel in Windhoek in April 2014. This function was sponsored by the Institute of Namibian Quantity Surveyors at which the Department was represented by Prof Kajimo-Shakantu, Mr P Oosthuizen, Mrs O du Preez, and Mr L Mahlomola.

## Research and Congress Participation

The Department had representation at the following Quantity Surveying, Construction Management, Project Management, Cost Engineering and Sustainability international and national congresses last year: RICS COBRA in Delhi, India; Pacific Association of Quantity Surveyors (PAQS) Congress, Xian, China; CIB W113 2013, WBC13 World Building Congress, Brisbane, Australia; the 27th IPMA World Congress, Dubrovnik, Croatia; AACE International 2013 Annual Meeting, Washington, USA; the 7th Built Environment Conference, ASOCSA 2013, Cape Town; SB 2013 Southern Africa Conference: Creating a Resilient and Regenerative Built Environment, Cape Town; and the SACQSP Research Conference 2013, Green Vision, 20/20, Cape Town.

The *Acta Structilia* housed by the Department is a fully South African accredited scientific journal, endorsed by the South African Council for the Quantity Surveying Profession (SACQSP) and the Royal Institution of Chartered Surveyors (RICS). In 2013, the journal celebrated its 20th year. This journal offers publication opportunities for independent, peer-reviewed articles by local and overseas researchers in the fields of physical and development sciences. Since 1993, 101 research articles and 26 review articles have been published.

In 2013, the 29th publication of the student journal, *Bouvaria*, was published. This publication creates a platform for honours students to publish articles derived from their theses. With this initiative, the Department wishes to sensitise students to the process of research.

## Staff Matters

The Department bid farewell to three of its staff members last year. Prof Verster, who was the head of the department for almost 33 years retired at the end of March 2013. His leadership and loyal service to the Department and the University did not go unnoticed. He made significant contributions not only to the Department but also to the Quantity Surveying profession. It is no wonder that his commitment to furthering education and the profession was recognised by the ASAQS in 2012 when he was awarded the Rhino award for services rendered to the profession and education. While his warm presence will be missed, Prof Verster has been retained as a Research Fellow in the Department - a consolation to some extent for now.

Mr Carl van Zyl, who was the acting HOD from April 2013, retired at the end of December. He was with the Department for almost eight years and was very passionate about teaching and developing Construction Management programmes. The Department will miss his experience, insights, and contributions.

Mrs Jill Kruger retired at the end of June 2013 after being with the Department for nearly ten years. She was mainly responsible for facilitating conference logistics, capturing research publications and some aspects of financial management. Her professionalism and soft-natured personality is greatly missed.

The Department also mourned the loss of two students who died in a vehicle accident towards the end of the year. Andrew Elsmere and Charlbert Sassenberg received their BScHons degrees posthumously.

*Prof Kajimo-Shakantu (in green jacket, picture left) with first-year students on a site visit.*

## Theses and Dissertations

The following theses and dissertations were completed in 2013:

- Burger, M. Project management in the built environment: The need for industry-specific knowledge. PhD Thesis.
- Mabesa, M. Timber-framed construction as an alternative to masonry brick walls construction for reconstruction and development programme houses; an analytic effective of timber. MSc Dissertation.
- Zulch, B.G. The construction project manager as communicator in the property development and construction industries. PhD Thesis.
- Orando, M. The influence of human behavior factors on construction productivity in Botswana as in South Africa. PhD Thesis.


*Prof Kahilu Kajimo-Shakantu and Dr Stephen Ramabodu with the students who attended the SACQSP Research Conference held at the Vineyard hotel in Cape Town in June 2013.*

### Academic Staff

**Professor:** Prof Kahilu Kajimo-Shakantu.

**Contract Professor:** Prof AC (Dries) Hauptfleisch (Midrand).

**Senior Lecturer:** Dr BG Zulch.

**Lecturers:** Mr HJ van Vuuren, Mr MS Ramabodu, Mr PM Oosthuizen, Mrs MM Els, and Mr L Mahlomola.

**Junior Lecturer:** Mrs E Jacobs.

**Contract Lecturers:** Mrs ORC du Preez.

**Research Fellow:** Prof JJ Verster.

## Research Outputs

### Research Articles

**Oosthuizen, P.M. & Berry, F.H.** 2013. Five maturity pillars of a Quantity Surveying Company. *International Journal of Project Organisation and Management (IJPOM). Special issue on "Project Cost and Contract Management"* 5(1/2): 25-47.

**Ramabodu, M.S. & Verster, J.J.P.** 2013. Factors that influence cost overruns in South African public sector mega-projects. *International Journal of Project Organisation and Management (IJPOM). Special issue on "Project Cost and Contract Management"* 5(1/2): 48-56.

**Verster, J.J.P., Ramabodu, M.S. & Van Zyl, C.H.** 2013. Problems, preferences and processes related to Dispute Resolution in Construction in S.A. *International Journal of Project Organisation and Management (IJPOM). Special issue on "Project Cost and Contract Management"* 5(1/2): 127-144.

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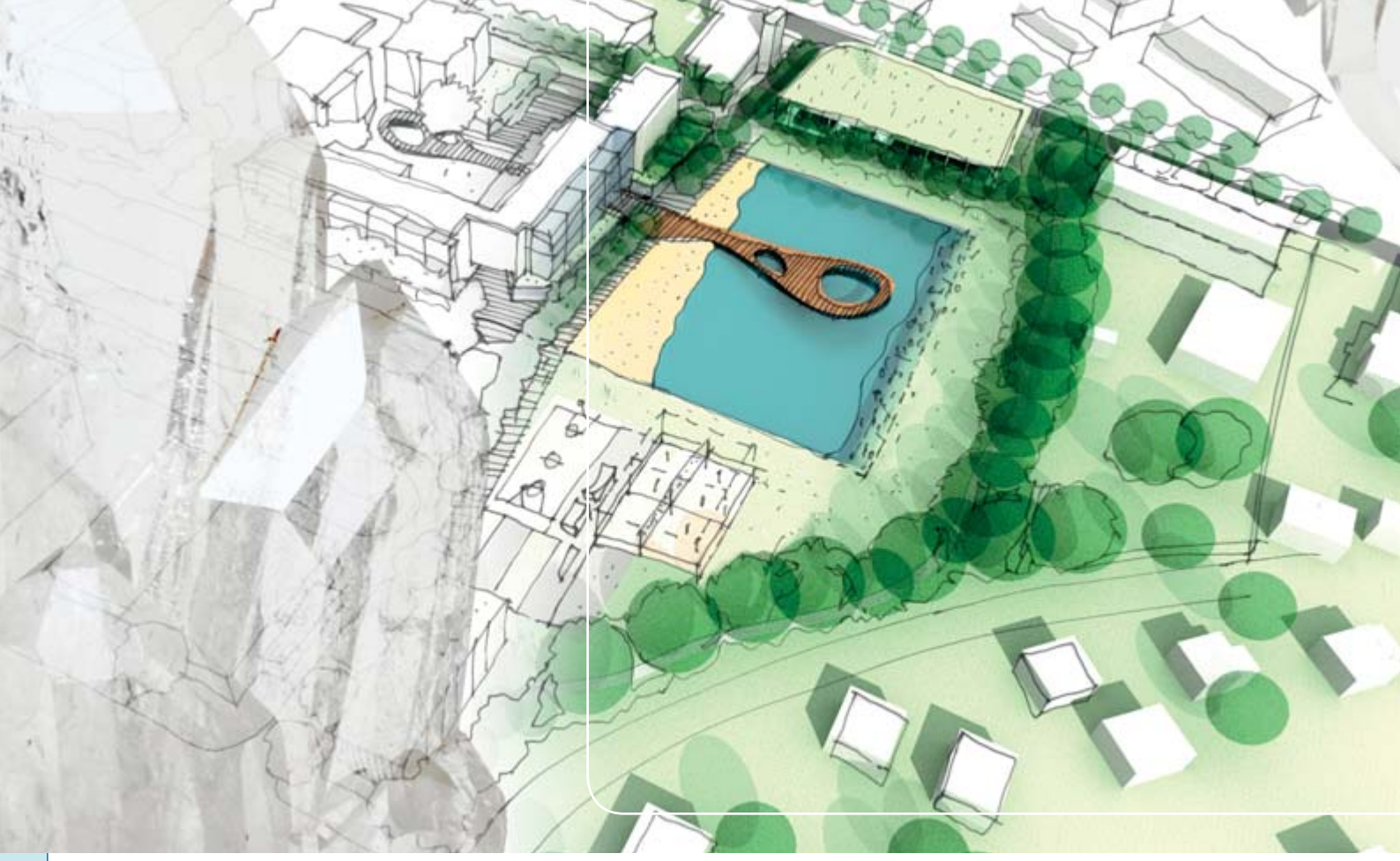

Department of

# Urban and Regional Planning

## Overview

As with most urban and regional planning departments in the country, this Department is small; it has only five academic staff members. The main programmes offered by the Department are: honours degree in Spatial Planning, and a master's degree in Urban and Regional Planning – both through course work.

Although 35 students were selected in 2013 for the honours degree in Spatial Planning, only 21 registered. Graduates on whom degrees were conferred in 2013 include the following: Honours in Spatial Planning – 12 (three with distinction); Baccalaureus in Land and Property Development Management (Housing) honours – 5; Master's degree in Urban and Regional Planning (professional) – 18 (two with distinction); Master's in Urban and Regional Planning (research) – 2. In addition, PhD degrees in Urban and Regional Planning were conferred onto two of the Department's staff members, namely Dr Lize Barclay and Dr Yandisa Mashalaba, during the July 2013 graduation ceremony.

In addition to the course work programmes, the Department also offers a research master's degree in Urban and Regional Planning and in Housing. In 2013, three students were registered as PhD candidates in the department.

## Student Achievements

Students Olebogeng Mojaki and Owethu Pantshwa both contributed papers to international conferences.

*Dr Yandisa Mashalaba, Prof Verna Nel, and Dr Lize Barclay at the June 2013 graduation.*

## Activities

Dr Maléne Campbell participated in the following workshops: Shack/Slum Dwellers International (SDI) & Association of African Planning Schools (AAPS), 2013; and Collaborative Studio Teaching, University of Cape Town: Cape Town, 5 to 7 February.

The Public Affairs Research Institute (PARI) and the UFS jointly hosted a workshop on New Communities in the Free State and Gauteng on 30 October 2013. The workshop was held on the UFS campus and brought together researchers and students from the NRF Chair in Local Histories and Present Realities, PARI students (including Ms Thulisile Mphambukeli from the Department of Urban and Regional Planning), and researchers and social scientists from the UFS. Ms Thulisile Mphambukeli and Dr Lize Barclay delivered presentations during the workshop.

Dr Johnny Coetzee of the University of Pretoria delivered a paper prepared jointly with Prof Verna Nel to the International Academic Association on Planning, Law and Property Rights (PLPR) conference in Portland, Oregon, held 13 to 15 February 2013. Prof Nel also presented a paper to the International Association for Impact Assessment (IAIA) (Free State Branch) on 26 February 2013 and another to the International IAIA conference held at Black Mountain, Thaba 'Nchu, from 16 to 18 September 2013.

Prof Verna Nel was a key speaker at the South Africa Planning Institute (SAPI) skills training workshops in Bloemfontein and Kimberley.

Prof Verna Nel serves on the South African Council for Planners (SACPLAN), the statutory body for planning professions. She also serves on the local SAPI committee and chairs the Committee of Heads of Planning Schools.

Mr Pieter Potgieter visited Mossel Bay for discussions on the proposed new PetroSA pipeline.

## Special Achievements

Dr Maléne Campbell qualified for the Supervisors Hall of Fame of the Postgraduate School of the University of the Free State.

## Community Service

For the BEH612 Housing module the honours students developed a Housing chapter for the Integrated Development Plan (IDP) of Kwanonqaba in Mossel Bay. The proposed housing project will be the first of its kind in Mossel Bay and it is expected that the People's Housing Programme (PHP) approach will be the way forward for housing provision in this region. PHP is a self-help housing programme which allows groups to work together, pooling their resources and contributing their labour (sweat equity) to build homes. By supplementing the standard housing subsidy with savings, additional loans or labour, communities implementing the PHP are able to build bigger and better quality houses. The aim is to construct ± 200 houses on a well-located property, close to urban opportunities. An objective of the project is to get the community of Mossel Bay involved in housing provision projects in order to create a sense of ownership. It is believed that this community has the required skills and competency needed in the People's Housing Programme


*Field trip to the Maluti-a-Phofung Local Municipality for the Applied Regional Planning Project (TSP793) service learning module.*

and that the proposed Kwanonqaba Housing Project can be successfully implemented. Dr Campbell is the facilitator of this module.

## National and International Collaboration

Dr Maléne Campbell visited the Rural New York initiative at Cornell University, New York State, USA. The purpose of the visit was to review related research methodologies and literature of ongoing as well as completed research. This was done to gain information about the approach of Cornell's researchers who conducted work similar to what Dr Campbell is doing in Maluti-a-Phofung; to reveal how the community came on board; as well as how the community was serviced. An NRF Knowledge Interchange and Collaboration grant funded the visit.

## Postgraduate Students

For the Applied Regional Planning Project (TSP793), a service learning module, students had to compile a regional development plan for a local municipality. Dr Maléne Campbell tasked the 2013 master's degree students to research sustainable rural livelihoods for the Maluti-a-Phofung Local Municipality. The regional development plan was compiled to unlock the development potential of the study area with the objective of attaining social cohesion, as well as self-sufficient rural communities.

## Research

The following reflects the Department's research programmes:

- **Prof Verna Nel:** Land use management in an African Context; resilience from an urban planning perspective;
- **Dr Campbell:** Affordable housing; The influence of urban development zones on inner city development and housing; and
- **Dr Barclay:** Teaching and learning in urban and regional planning; regional planning; local economic development.

## Staff Matters

Ms Thulisile Mphambukeli was appointed as research assistant in 2013.

# Research Outputs

## Research Articles

**Hauptfleisch, A.C. & Campbell, M.M.** 2013. Public private partnerships: A sustainable procurement option for highways. *Proceedings of the Association for the Advancement of Cost Engineering (AACE) International Annual Meeting*, 30 June to 3 July. Washington, DC.

**Mojaki, O. & Campbell, M.M.** 2013. Social and rental medium density housing as a tool to integrate low-income households into South African cities: The case of Community Residential Units (CRU) in Mangaung Metropolitan Municipality. *Proceedings of the South African Housing Foundation (SAHF) International Conference: Public Private Partnerships.* 15-19 September. Cape Town, South Africa. p. 9.

**Pantshwa, A.O. & Campbell, M.M.** 2013. Addressing the impact of migration and urbanisation on housing delivery in small towns through public private partnerships. *Proceedings of the South African Housing Foundation (SAHF) International Conference: Public Private Partnerships.* 15-19 September. Cape Town, South Africa. p. 8.

## Report

**Nel, V.J., Campbell, M.M. & Mphambukeli, T.** 2013. Witbank: The city of coal. In: *Intermediate Cities*, edited by L. Marais. Johannesburg: SA Cities Network. pp. 1-64.


*One of our students, Mr Dumisane Ndaba, graduating in traditional dress.*

## Staff

**Professors:** Prof VJ Nel.

**Senior Lecturers:** Dr MM Campbell.

**Lecturers:** Dr E Barclay, Dr YB Mashalaba, and Mr PJ Potgieter.

**Research Assistant:** Ms T Mphambukeli.

**Secretary:** Ms EC Hugo.

**Senior Officers:** Ms C Coetzee.

**Senior Assistant Officer:** Ms LA Nel.

## Contact Details

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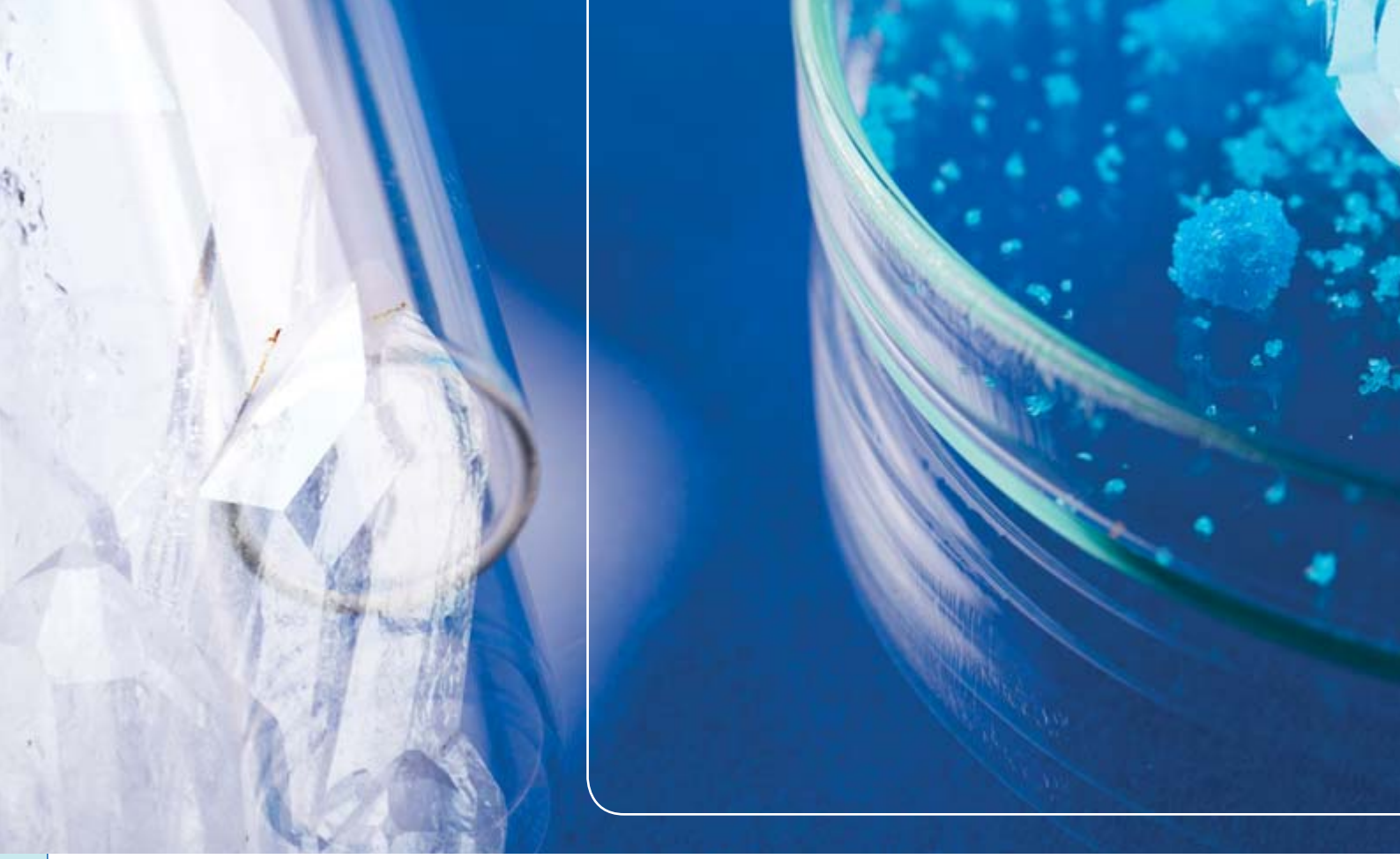
Natural

# Sciences



Department of

# Chemistry

## Overview

The Department of Chemistry continued to focus on the strategic priorities of the UFS and the Faculty of Natural and Agricultural Sciences, and is proud to illustrate with this report the sustained quality and excellence in teaching, research, and community involvement. The postgraduate core of Chemistry for 2013 on the Main Campus consisted of 11 postdoctoral associates, 25 MSc and 25 PhD students in different sub-disciplines; of whom 11 PhD and seven MSc students graduated during 2013. A significant and sustained research output for 2013 was maintained; as manifested by the 69 research articles published in internationally accredited journals and 83 presentations made at local and international conferences.

The enthusiasm and commitment of Chemistry's personnel and students were clearly illustrated by activities throughout 2013. The continued support of the faculty and senior UFS management to achieve even higher levels of success is gratefully acknowledged.

The collaboration between the UFS and SASOL, which supported the extended secondment of Prof Ben Bezuidenhoudt as SASOL professor in Organic Chemistry to the Department until May 2014, and PetLabs Pharmaceuticals, continued. An achievement under this agreement was the successful application of "Applied Process Chemistry" to the South African National Research Foundation's (NRF) Technology and Human Resources for Industry Programme (THRIP) from combined inputs of Inorganic, Physical

and Process Chemistry (by Profs Roodt, Swarts, and Bezuidenhoudt). This has sourced an additional R1,5 million for the upgrade of equipment, student support, and the development of young capacity in the Department.

Teaching aspects at undergraduate level have also been a focus of the Department. The continued teaching in parallel medium on the Main Campus was quite demanding and challenged lecturers to improve constantly; with respect to using more sophisticated teaching methods, methodology, and technology during classes.

Undergraduate courses are constantly revisited and upgraded, and to expose our students to the newest techniques and knowledge, Dr Pieter van Heerden and Mr Philip Gibson from SASOL presented a course in heterogeneous catalyses to our honours degree students.

## Structure of and Activities in Chemistry

The Department of Chemistry on the Main Campus has four divisions, *i.e.*, Analytical Chemistry, Inorganic Chemistry, Organic/Process Chemistry, and Physical Chemistry. The management committee of Chemistry consists of Profs André Roodt (Departmental Chairperson), Jannie Swarts, Ben Bezuidenhoudt, and Walter Purcell.

**Analytical Chemistry** has Prof Walter Purcell (NRF C3-rated researcher (ISI H-index=16) as division head, Dr Karel von Eschwege (ISI H-index=5), and Dr Rebotsamang Shago (ISI H-index=2), and the division was supported by two PhD and six MSc students.

The group was involved in a number of analytical and inorganic projects. The former involved the dissolution, quantification and method validation of a number of inorganic and ore samples such as zircon, tantalite and columbite to establish methods to accurately identify and quantify the different elements in these samples. Some of these projects are done in close cooperation with partners such as the Nuclear Energy Corporation of South Africa's (NECSA) Advanced Metals Initiative (AMI), and Mintek.

Microwave and acid dissolution procedures were employed while Inductively Coupled Plasma (both Optical Electronic and Mass Spectroscopy; OES and MS), Graphite Furnace Atomic Absorption Spectroscopy (GFAAS), UV/visible and IR spectroscopy were used for the identification and quantification of the different elements - with ISO 17025 criteria as benchmark. Techniques such as X-Ray Diffraction and Fluorescence (XRD, XRF), Differential Scanning Calorimetry (DSC), and Thermal Gravimetric Analysis (TGA) were also used during these studies.

Elements which are currently being investigated are niobium, tantalum, zirconium and rhodium. Numerous samples were also analysed for private people, as well as local and national companies. The LECO micro-analyser is extensively used for C, H, N, O, and S analyses on a number of organic and organometallic compounds. The analytical section also performed different element analyses for private companies such as SA Truck Bodies.

The group is further involved in a number of inorganic chemistry projects, such as kinetic and structural studies of organometallic complexes of Ir(I) and Rh(I) oxidative addition reactions, kinetic and structural studies of Re(V) and Os(VI) cyano complexes, as well as some Co and Cr aqueous chemistry. All of these studies utilised XRD, IR UV/vis, NMR, and computational methods.

Another study involves the investigation of photochromic reactions in different transition metal complexes, with

*At the Winter Graduation Ceremony on Main Campus: six PhD degrees conferred* in Chemistry; front, from left: Dr Dudu Saku*, Prof Ben Bezudenhoudt, Dr Charlene Marais, Dr Truidie Venter*, Dr Susan Bonnet, Dr Maryam Amra-Jordaan*; back: Dr Cyril Young*, Prof André Roodt, Dr Elana Engelbrecht*, Dr Theunis Muller* and Prof Jan van der Westhuizen.*

*The Physical Chemistry Group at the Convention of the South African Chemical Institute in Durban, July 2013. Group leader Prof Jannie Swarts (back; 3rd from left) and to his immediate right, back: Drs Blenner Buitendach (Post-doc), Elenor Muller and Ernie Langner (Both senior lecturers).*

*The 28th European Crystallographic meeting in Warwick, England, was attended by members of the Inorganic Group, and three oral and four poster presentations were made. From left: Ms Carla Pretorius, Mr Paul Bungu, Mr Renier Koen, Dr Alice Brink, Prof André Roodt and Dr Nagarajan Loganathan.*

*In the Laboratory distilling solvents are PhD students. From left: Mr Johannes van Tonder and Elen Kuo, Prof Ben Bezuidenhoudt and Mr Rudi Swart.*

potential applications in high density optical molecular switching mechanisms. Instrumental techniques such as Pulsed Laser, UV/visible, IR, NMR, Cyclic-Voltammetry, Quantum Computational Chemistry (ADF & Gaussian), and X-ray Crystallography are employed in these studies. The Analytical section was responsible for the element analyses for the other groups in the Department of Chemistry, as well as Geology, Physics, and Microbiology.

The **Inorganic Chemistry** division focuses on Coordination Chemistry and the integrated investigation of *Reaction Mechanisms* through the use of crystallography, spectroscopy, computational chemistry, and reaction kinetics. Three research sub-thrusts concentrate on the applications to medicine (radiopharmaceutical and chemotherapeutical agents), industrial reactions/homogeneous catalysis/applied process chemistry, and the development of metal beneficiation technology.

This research continued in the group of Prof André Roodt (NRF C1 rated researcher; ISI H-index=29) - holder of an NRF-rated researcher grant; supported by Prof Deon Visser (ISI H-index=11), Dr Johan Venter (ISI H-index=6), Dr Alice Brink (ISI H-index=5) - holder of a THUTHUKA research grant, and Dr Marietjie Schutte-Smith (ISI H-index=7). The group also has four postdoctoral associates, 17 MSc and PhD students; of whom four PhD and three MSc students graduated during 2013. Both Dr Brink and Dr Marietjie Schutte-Smith are UFS prestige scholars.

Prof Deon Visser, Prof André Roodt, Dr Johan Venter, and Dr Alice Brink presented invited lectures at the International RheManTec-II Symposium in Saas-Grund, Switzerland, during February 2013; while Dr Marietjie Schutte-Smith gave an oral presentation at the 2nd Conference of the European Association for Chemical and Molecular Sciences (EuCheMS) in Inorganic Chemistry in Jerusalem, Israel, 7 to 11 July 2013. Dr Alice Brink gave an invited oral presentation at the young scientist's satellite meeting to the 28th European Crystallographic Meeting (ECM 28), University of Warwick, United Kingdom, 25 to 29 August 2013.

Other highlights from the Inorganic Division include more than 25 research articles published in the international chemistry literature (ISI journals), and the presentation of more than 30 invited lectures and conference posters at venues in Scotland, Switzerland, England, Croatia, Ethiopia, South Africa, France, and Israel.

The **Organic and Process Chemistry** division is headed by Prof Ben Bezuidenhoudt (ISI H-index=16, SASOL seconded professor in Organic Chemistry), Prof Jan van der Westhuizen (NRF L-rated; ISI H-index=7), and Dr Susan Bonnet (ISI H-index=6) as senior lecturer, Dr Anke Wilhelm-Mouton as lecturer, and Mr Rudi Swart as technical officer. Fourteen MSc and PhD students were studying towards higher degrees; of whom four graduated with their PhD degrees during 2013.

Prof Bezuidenhoudt and a group of his students attended the 2nd Binational Organic Chemistry Conference in Tutzing, Germany, from 29 September to 4 October. Prof Bezuidenhoudt gave an invited lecture, while the three students (Johannes van Tonder, Maretha du Plessis, and Tanya Pieterse) contributed poster presentations.

Prof Jan van der Westhuizen and Drs Anke Wilhelm-Mouton and Susan Bonnet attended workshops in Münster, Germany (hERGscreen project), and Durban (MUTHI project). Dr Wilhelm-Mouton also paid a research visit to the University of

*During the excursion at RheManTec-II in Saas-Grund in the Swiss Alps are Inorganic Group members showing their skills on skis. From left: Mr Tinus Viljoen, Dr Elana Engelbrecht, Mr Flip van den Bergh and Dr Alice Brink. All four gave oral presentations at the international symposium sponsored by the Swiss National Science Foundation and the South African NRF.*

*Concentrating in the laboratory at a delicate adjustment of the high-temperature oven are PhD students Mr Ebrahiem Botha and Mr Nqeba Magqi (from SASOL) under the watchful eye of Prof Jannie Swarts (left).*

Innsbruck, Austria (December 2013 – February 2014) as part of the hERGscreen International Research Staff Exchange Scheme (IRSES) to establish collaboration between the project partners, while Dr Bonnet visited the Department of Pharmacognosy at the National and Kapodistrian University of Athens from 10 December 2013 to 9 February 2014 as part of the Framework 7 hERGscreen project.

The **Physical Chemistry** section has four distinct and separate research groups which are independently headed by Prof Jannie Swarts, Prof Jeanet Conradie, Dr Ernie Langner, and Dr Lizette Erasmus.

Prof Swarts is C1-rated by the NRF and has an ISI H-index of 26. Prof Conradie is rated C3 by the NRF and has an ISI H-index of 21, while Dr Erasmus is Y2-rated (ISI H-index = 8). Dr Langner and Dr Müller are still unrated but have ISI H-indexes of 4 and 6, respectively.

The division published 29 publications in high-impact journals in Physical Chemistry, attended five conferences during 2013, presented six oral presentations, and made 17 poster contributions.

Profs Swarts and Conradie are both holders of two NRF research grants (Rated Researcher and Competitive Rated Researcher) and Dr Erasmus is holder of a Rated Researcher NRF grant. Dr Langner and Dr Müller are holders of a ThuThuka NRF grant. The Swarts, Erasmus and Langner groups were also funded by research grants from SASOL. The Swarts group also has THRIP funding.

The principle research question of the research group of Prof Swarts concerns synthetic and physical chemistry aspects of multinuclear metallocenes. The focus is on five projects: i) porphyrin and phthalocyanine compounds bearing metallocene substituents; ii) titanocene, zirconocene, hafnocene, ferrocene, ruthenocene and osmocene derivatives, especially in association with rhodium, iridium, silver, gold and copper; iii) electrochemical, kinetic and thermal analyses of these complexes; iv) medicinal aspects of these complexes; and v) industrial studies on carboxylato complexes and heterogeneous catalysis of systems supported on two-dimensional matices in collaboration with SASOL. The research in the group under Prof Conradie focuses on the characterisation of known and unknown transition metal complexes and intermediates by synthetic and computational chemistry. Transition metal porphyrin and related compounds, O,O'-Chelated titanocene and titanium complexes, Beta-diketonato-carbonyl complexes of rhodium(I) and rhodium(III), and Dithizonato compounds of transition metal complexes are currently being investigated. The research group of Dr Erasmus focuses on heterogeneous catalysis of especially model catalysts on flat surfaces and materials characterisation with XPS techniques. Conversely, Dr Langner focuses on studies of Metal Organic Frameworks (MOFs) especially for catalysis, gas adsorption and desorption studies and thermal analysis thereof.

During research visits to Europe, Prof Swarts visited Prof Henry Lang at the Chemnitz Technical University, Germany (electrochemistry), and Prof Hans Niemantsverdriet of the Schuit Institute of Catalyses at the Technical University, Eindhoven, The Netherlands (heterogeneous catalysis). Prof Conradie visited the Department of Physical Chemistry, University of Tromsø, Norway. During these visits, she presented research lectures and furthered research collaboration.

## Achievements of Students

Mr Tinus Viljoen from Inorganic Chemistry won the prize for the best oral presentation by a student at the National Conference of the Advanced Metals Initiative from the DST/NRF held in Cape Town during October 2013; while MSc students Ms Tembani Twala and Mr Flip van den Bergh, and PhD students Ms Kina van der Merwe, Ms Carla Pretorius, Mrs Janine Suthiram, Mr Tinus Viljoen, and postdoctoral associate Dr Ilana Engelbrecht, all from the Inorganic Chemistry section, gave invited oral presentations at the International RheManTec-II Symposium in Saas-Grund in Switzerland during February 2013. Dr Nagarajan Loganathan, postdoctoral associate in Inorganic Chemistry, gave an oral presentation at the Inorganic Conference of the South African Chemical Institute (SACI; INORG2013) in Durban, held 30 June to 4 July 2013. Dr Lohanathan and Ms Carla Pretorius gave oral presentations at the Young Scientist's satellite meeting at the 28th European Crystallographic Meeting (ECM 28), University of Warwick, United Kingdom, 25 to 29 August 2013.

PhD student Chris Joubert from Physical Chemistry was awarded the prize for third-best poster contribution at this meeting. MSc student Hendrik Ferreira won second prize for his oral presentation in Afrikaans at the Natural Sciences Symposium for Postgraduate Students, University of Pretoria, Pretoria, held on 7 and 8 November 2013, on "An Electrochemical and Computational Study of Thenoyl-containing Rh(I) ß-diketonato Complexes".

## Special Achievements

Prof Jeanet Conradie was ranked number one of the top ten researchers at UFS in terms of published outputs per impact factor of journals, and number ten of top ten researchers in terms of number of publication output units (POUs). She also presented two keynote lectures at two local conferences. Prof Swarts was ranked number nine of top ten researchers at UFS in terms of published outputs per impact factor of journals.

Prof André Roodt presented two keynote lectures at the 22nd Croation-Slovakian Meeting in Biograd in Croatia during June, and at the Inorganic Conference of the South African Chemical Institute (SACI; INORG2013) in Durban, held 30 June to 4 July 2013. He also presented invited lectures in June 2013 at the Spanish International Union of Crystallography planning meeting in Santander, Spain, and at the African Materials Research Conference in Addis Ababa in December 2013. He further hosted and presented, together with Ms Carla Pretorius and Mr Renier Koen, a workshop on Small Molecule X-ray Crystallography as a satellite to the conference in Addis Ababa, attended by 26 delegates.

Prof Roodt acted as dean of the prestigious South African Young Scientist Summer School Programme (SA-YSSP) for the three-month period of 24 November 2013 to 23 February 2014. The SA-YSSP was hosted by the UFS under the auspices of the NRF and the International Institute for Applied Systems Analysis (IIASA) in Austria. This occasion was only the second time that this school was held outside Austria, and it included 38 supervisors from 17 countries and hosted 33 international students (selected from 80 applications) from 12 countries. Prof Roodt also visited the headquarters of IISASA in Läxenburg, Austria, for discussions during June. As president of the European Crystallographic Association (ECA), he chaired the executive meetings of the European Crystallographic Association in Budapest, Hungary, in February, and Warwick in England in August, as well as the council meetings of the European Crystallographic Association in Warwick in the United Kingdom during August. Prof Roodt was also awarded the Faculty of Natural and Agricultural Sciences' research prize for 2013.

## Activities

Different researchers of the Department of Chemistry participated in the Material and Nanosciences Cluster (MNS). Profs Jannie Swarts and André Roodt are two of the three focus area leaders, with Prof Roodt as the Cluster director. Ten students were supported under the MNS Cluster during 2013 and Chemistry published more than 20 research papers under this Cluster. Dr Alice Brink (prestigious postdoctoral), Ms Ellen Kuo, and Ms Carla Pretorius (prestigious PhD scholarship) received special support under the MNS Cluster initiative.

Physical Chemistry visited SASOL for a day where SASOL members and Physical Chemistry students gave presentations on their research projects. Valuable research discussions followed. Physical Chemistry also attended five conferences during 2013 and six oral presentations and 17 poster contributions were presented. Moreover, the Division published 29 periodicals in high-impact journals during this period.

Prof Roodt served on the international editorial board of the Journal of Coordination Chemistry and sits on behalf of the ECA on the council (20 members) of the Initiative for Science in Europe, which includes more than 330 000 scientists as members.

A significant number of colleagues acted as external reviewers for different international chemistry journals and served on the faculty and UFS committees for the NRF; while others made their contributions as external examiners for a number of universities at undergraduate and postgraduate level, and represented the UFS on international research councils.

Prof Roodt acted as an external examiner for 15 Spanish MSc students at the occasion of their final presentations in Santander, Spain, during June 2013.

# Community Service

Most lecturers were involved in continuous career guidance and laboratory demonstration sessions to individuals and school group learners. Colleagues at both campuses contributed to the University's open and expo days. Dr Karel

von Eschwege and Dr Rebotsamang Shago assisted different learners with Eskom Science Expo projects.

Dr Johan Venter and Dr Ernie Langner, assisted by Dr Blenner Buitendach, presented the Chemistry Magic Show on seven occasions at different Bloemfontein schools and other venues. This initiative illustrates different aspects of simple but exciting experiments in a tangible way to create awareness for Chemistry and to inspire primary and secondary school learners' and teachers' interest in the subject. This show was also presented as part of the UFS first-year teaching initiative across all subject disciplines, UFS101, where Prof Roodt presented lectures on the Main Campus and Qwaqwa Campus from a chemist's perspective under the broad theme "How green is green". Drs Venter, Langner and Buitendach took responsibility for the Chemistry Magic Show for approximately 2 500 students.

Prof Deon Visser was again coordinator and principal negotiator for new apparatus purchases for research for the Faculty of Agricultural and Natural Science, while Mrs Ina Du Plessis assisted in organising a Minquiz session at the Department of Chemistry. Minquiz is one of the Faculty's five community service flagships. All colleagues from Physical Chemistry, with special efforts from Dr Ernie Langner and Dr Blener Buitendach (postdoctorate) contributed to this effort to make it a big success.

Prof Conradie was the chairperson of the Interest group for High Performance Computing (HPC) at the University of the Free State, and the representative of HPC on the Academic IT Workgroup.

Many first-year Chemistry students experience problems with Physical Chemistry, in particular with the more mathematical topics like thermodynamics, quantum chemistry, and chemical kinetics. To help them to develop their skills in the first-year Physical Chemistry curriculum, Prof Conradie wrote several computer-based question and answer quizzes. All these quizzes are currently incorporated in the ILEARN programme at the University of the Free State, which also enables access for the students to test and examination papers and answers, as well as semester and test marks.

Prof Conradie's group and Dr Erasmus assisted four learners with their Eskom EXPO projects.

Dr Langner was the secretary for all meetings for the HPC group during 2013. He was also a judge at the Expo for Young Scientists and assisted a learner from Eunice High School with a project for the National Expo. While attending the Third International Conference on Multifunctional, Hybrid and Nanomaterials (Hybrid Materials 2013) in Sorrento, Italy, 3 to 7 March 2013, valuable research discussions were held with Profs J Long, G Ferey, and Van der Voort from the University of Ghent, Belgium.

Dr Müller started the new RC1 reactor for catalysis research and proceeded research thereon. She is also in charge of maintenance of all Physical Chemistry's advanced research equipment.

*Prof Herman Potgieter (far right), Head of Engineering at the Manchester Metropolitan University in the UK, hosted Dr Johan Venter (left) and prof Walter Purcell, and was instrumental to establish funding for a PhD student in Analytical Chemistry at UFS Main Campus.*

A significant number of colleagues acted as external reviewers for different international chemistry journals, and for MSc and PhD degrees of candidates at other universities. Similarly, they act as reviewers for the NRF, and served on the faculty and UFS committees; while others made their contributions as external examiners for a number of universities on undergraduate and postgraduate level, and represented the UFS on international research councils. Prof Swarts also serves in this capacity for the Irish Health Board.

Dr Johan Venter serves as the programme director of Physical Sciences (Chemistry and Physics) in the faculty, as well as on the Time Table Committee of the faculty and annually sets the test time table for the faculty.

The Safety Committee of the Department of Chemistry is chaired by Prof Ben Bezuidenhoudt; with representatives in the groups as follows: Dr Johan Venter (Inorganic), Dr Eleanor Müller (Physical Chemistry), Dr Marianne Conradie-Bekker (Analytical), and Mr Rudi Swart (Organic).

## National and International Collaboration

Dr Von Eschwege collaborated with Prof H Schwoerer at the National Laser Research Institute at Stellenbosch University and Dr C Woywod at the University of Tromsø, Norway; while Prof Walter Purcell and Dr Johan Venter visited Prof Herman Potgieter at the Manchester Metropolitan University for collaborative research, and also collaborated with Dr JT Nel at Necsa Ltd.

The Swarts group collaborates with Prof Mike Cook (University of East Anglia, Norwich, England, on phthalocyanines); Prof Manuel Aquino (Saint Francis Xavier University, Antigonish, Canada, on metal carboxylates); Prof Bill Geiger (University of Vermont, Vermont, America, on electrochemistry), Prof Henry Lang (Chemnitz Technical University, Chemnitz, Germany, on metal carboxylates and electrochemistry), Prof Hans Niemantsverdriet (Schuit Institute of Catalyses at the Technical University, Eindhoven, The Netherlands, heterogeneous catalysis), and Dr Daniela Bezuidenhout (Pretoria University, carbene electrochemistry). The Conradie group has international collaboration with Prof Abhik Ghosh and Dr Katherine Hopman (Department of Chemistry and Centre for Theoretical and Computational Chemistry, University of Tromsø, Norway); Prof Todd C Harrop (Department of Chemistry, University of Georgia, Athens, Georgia, USA, on computational chemistry), and Prof Penny Brothers (Auckland, New Zealand). Dr Lizette Erasmus has collaboration with Prof B Gates of the University of California, Davis, USA.

The medical research focus in the Inorganic Chemistry research group of Prof Roodt, in collaboration with Dr Hendrik Engelbrecht from Precision Nuclear in Tennessee, USA, the University of Zürich, Switzerland (Prof Roger Alberto), NECSA, under the Nuclear Technologies in Medicine and the Biosciences programme (NTeMBi), and PETLabs Pharmaceuticals/Klydon Gas (Dr Gerdus Kemp), showed good progress. The project "Development of Novel Nuclear Pharmaceuticals" from Profs Roodt and Visser with Prof Roger Alberto (Zürich) sourced more than R3 million from PETLabs Pharmaceuticals, the NRF, and the Swiss National Science Foundation (NSF) for a three-year collaboration project. Prof Deon Visser established research collaboration with Dr Fabio Zobi from the University of Fribourg, Switzerland, and Prof Demetrius Papadopoulus, Athens, Greece.

Similarly, the homogeneous catalysis research in the Inorganic group was driven in close collaboration with SASOL and the Department of Science and Technology at the University of Cape Town's Centre for Excellence in Catalysis, in collaboration with the University of Lund, Sweden (Prof Ola Wendt). The focus is on the conversion of simple feedstock molecules into value-added products and includes studies such as carbonylation, hydroformylation, olefin metathesis and oligomerisation. Collaboration with SASOL forms part of this thrust, and significant funding was sourced under the Applied Process Chemistry theme. An industrial related project with the Nuclear Energy Corporation of South Africa (NECSA) under the Advanced Metal Initiative (AMI) for selected metal beneficiation of the South African Government's Department of Science and Technology's (DST) continued and sourced over R600 000 for bursaries and project expenses for four PhD students.

The Organic Chemistry group collaborates with the Medical Research Council (MRC), (MUTHI project), as well as with Dr Merlin Wilcox from the University of Oxford and Dr DG Reid of Cambridge University. Other international collaborations include the Framework 7 Muthi at the University of Oslo, University of Bergen, University of Bamako, Makerere University, University of the Western Cape, University of Amsterdam; as well as under the Framework 7 hERGscreen project with the University of Innsbruck, National and Kapodistrian University of Athens, University of Basil, Biomedical Research Foundation of the Academy of Athens, and the University of Vienna. Prof Ben Bezuidenhoudt also collaborates with Chemical Process Technologies, Pretoria & Wildlife Pharmaceuticals, Nelspruit.

## Staff Matters

Prof Andrew Marston sadly passed away unexpectedly in March 2013.

Prof Walter Purcell was promoted to full professor at the end of 2013, while Prof Ben Bezuidenhoudt was appointed as professor in Organic Chemistry in the Department of Chemistry following his retirement from SASOL at the end of May 2013.

Mrs Amanda-Lee Volmink-Manicum was appointed as lecturer in Inorganic Chemistry in October, while Prof Jan van der Westhuizen retired from the Department at the end of December 2013.

# Research Outputs

## Research Articles

**Bezuidenhout, D.I., Fernández, I., Van der Westhuizen, B., Swarts, P.J. & Swarts, J.C.** 2013. Electrochemical and computational study of Tungsten(0) Ferrocene Complexes: Observation of the Mono-Oxidized Tungsten(0) Ferrocenium Species and Intramolecular Electronic Interactions. *Organometallics* 32: 7334-7344.

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**Warsink, S., Roodt, A., Venter, J.A., Kotze, P.D.R. & Otto, S.** 2013. Crystal structure of (*N*-benzoyl-*N'*-(2,4,6-trimethylphenyl)thiourea-$\kappa$S)chloride(h4-cycloocta-1,5-diene) rhodium(I), $C_{25}H_{30}ClN_2ORhS$). *Zeitschrift fur Kristallographie: New Crystal Structures* 228: 335-336.

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## Patent

**Van der Westhuizen, J.H., Bonnet, S.L. & Achilonu, M.C.** 2013. *Method for the preparation of C-4 coupled flavonoids, proanthocyanidins and analogues thereof*. US 8,501,970 B2, 2013.

*The Chemistry postgraduate students and personnel at the end-of-the-year spit barbecue function in December.*

## Staff

**Distinguished Professor:** Prof André Roodt.

**Senior Professor:** Prof Andrew Marston.

**Professors:** Profs Jannie Swarts, Ben Bezuidenhoudt, and Jeanet Conradie.

**Affiliated Professors:** Profs Daneel Ferreira, Louis Ackerman, Connie Medlen, Thys Botha, and Fanie Otto.

**Associate Professors:** Profs Walter Purcell, Robert Dennis, Jan van der Westhuizen, Deon Visser, and Gideon Steyl.

**Senior Lecturers:** Drs Karel von Eschwege, and Susan Bonnet.

**Lecturers:** Drs Johan Venter, Ernie Langner, Lizette Erasmus, Rebotsamang Shago, Eleanor Fourie, Linette Bennie, Alice Brink, Marietjie Schutte-Smith, Charlene Marais and Ms. Anke Wilhelm-Mouton.

**Subject Coordinators:** Dr Marietjie Versteeg (Programme director: Main and South campus), Ms Rina Meintjes (Programme director: South campus) Dr Johan Venter (Programme director: Main campus).

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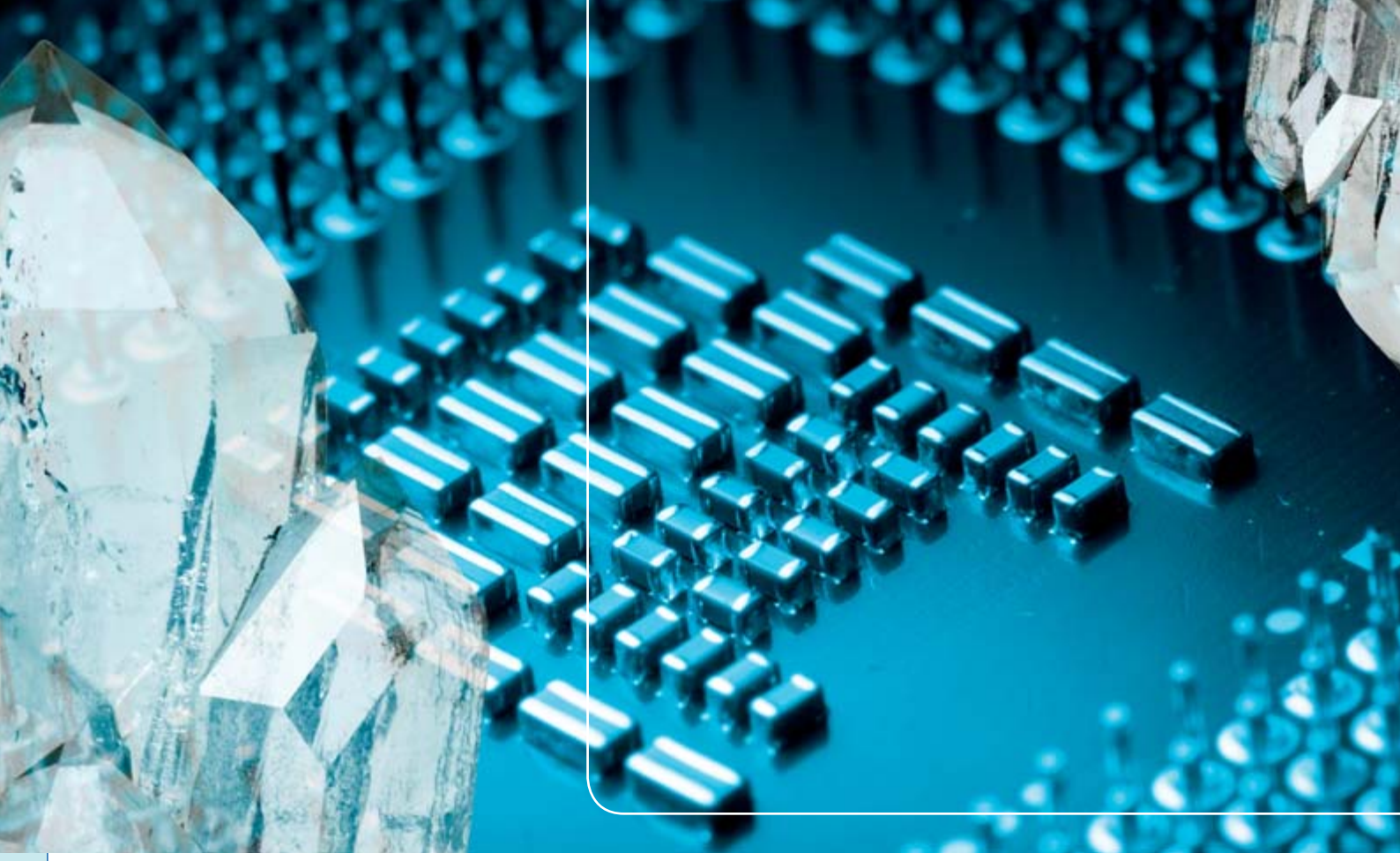

Department of

# Computer Science and Informatics

## Overview

The Department of Computer Science and Informatics specialises in the training of students who want to apply their knowledge of technology in scientific environments (Computer Science) or in the corporate world (Informatics). The Department delivers highly trained information technologists with technical skills in programming, system design and analysis, as well as database and network management.

The powerful combination of Computer Science with Mathematics and/or Mathematical Statistics provides the student with a solid knowledge base and excellent background for a career in the IT industry, as well as academicals and research institutions such as universities, the CSIR, ARC, etc. In combination with Physics and/or Chemistry, students are equipped for a career as information technologists in industry, for example in the manufacturing sector. The connection with geographical information systems prepares a student for a challenging career in diverse directions such as defence, planning, agriculture, tourism, the environment, and resource management.

Students who combine modules from our Department with modules from the Faculty of Economical and Management Sciences will be able to apply the general theory of Information Technology as it pertains to the business world or in a corporate environment to support the cause and purpose of the organisation where he or she will be employed.

## Activities and Achievements

The Department held two strategic planning sessions in 2013. The first took place at Emoya Estate on 28 and 29 October; while the follow-up was held at Qwantani in the Eastern Free State on 27 November. The Emoya session was facilitated by Prof André Calitz from NMMU. It included an overview of the Department's performance and outputs over the past few years. Sessions presented by specialists in human resources and industrial psychology provided the staff with an insight into the dynamics of interpersonal relationships and potential that need to be explored. The follow-up session at Qwantani resulted in a detailed strategic plan to serve as a guideline for the following five years with respect to undergraduate and postgraduate training, research, and marketing.

*Staff members in discussion during a strategic planning session.*

*Eugene Bothma with his self-built super computer.*

### Achievements of Students

Third-year student Eugene Bothma succeeded in building his own super computer or cluster to solve complex problems by combining the processing power of several computers. He was also one of the winners of Dell's student competition to raise HPC (High-performance Computing) awareness. He won a trip to Dell's headquarters in Austin, Texas, USA, and the Texas Advanced Computing Centre.

*The team at the Telkom Centre of Excellence with a BCI (brain-computer interface) device. From left to right: Dr Tanya Beelders, Mr Daniël Wium, Dr Lizette de Wet, and Prof Pieter Blignaut.*

### Special Achievements

The THRIP project "Using Technology to improve Usability" in collaboration with industrial partner, Telkom, was the runner-up for the second consecutive year at the Annual Technology Awards Ceremony of the Department of Trade and Industry (DTI). This project was also selected as one of six from more than 600 THRIP projects countrywide to feature in THRIP's annual report.

### Activities

Dr Liezel Nel collaborated with the UFS Centre for Teaching and Learning (CTL) on the UFS iPad Project. The aim of this project is to investigate how tablet devices such as iPads can be utilised in Computer Science classes to enhance student engagement and address various challenges that exist in the current UFS teaching and learning context. During the pilot phase, which ran in the second semester of 2013, the new iPad lab – consisting of 25 iPad mini devices – was utilised in the RIS164 (Introduction to the Internet and Web Page Development) module. The main objectives of the pilot phase were (1) to establish a workflow for the configuration, deployment, and management of the iPad devices; and (2) to test multiple ways in which the devices could be utilised to facilitate in-class collaborative activities.

*First-year students at work with their iPads.*

The Department of Computer Science and Informatics initiated the establishment of a national interest group for eye tracking, ETSA (Eye Tracking South Africa), and organised the first International Conference on Eye Tracking in South Africa. The conference was held in Cape Town during August 2013. Members of the Department also presented a workshop at this conference to introduce the basic aspects of this technology to the audience.

## Community Service

As part of the curriculum, the Department offers a service learning module to second-year students in which they have to teach members of the community to work with computers. Through this initiative, members of the community were awarded with certificates in Computer Literacy. Students in this module also visited schools and presented lectures on the dangers of social media.

The Department is active in promoting computing and programming skills amongst high school learners through its Python project. One of the learners in this project, Jandewet Linde, was the first learner from the Free State since 1994 who went through to the final round of the South African Computer Programming Olympiad.

## National and International Collaboration

Lecturers in the Department act as regular reviewers for national and international conferences and journals. They also act as external moderators and examiners for various other universities in South Africa.

The Department has a standing relationship with Tobii, the Swedish manufacturer of eye tracking equipment, to test new models of eye trackers before they are released on the market. Tobii also assisted the Department to equip a laboratory to do quality assurance tests.

## Postgraduate Students

The 2013 group of honours students was the best class in many years with 6 out of 12 students achieving distinctions for their projects; namely Brendus Bresler (75%), Abraham van der Linde (90%), Silas Verkijika (85%), Jan van der Linde (85%), David Marais (80%), and Francois van Greunen (97%).

Francois van Greunen's mark of 97% was the highest ever in the Department. He developed a 3D game as an application of artificial intelligence. The characters in the game exhibit various behavioural characteristics. The characters also use a specially adapted algorithm to determine the most efficient path between two points. The game is specifically developed to enhance the interaction possibilities by human users – thus increasing the experience of satisfaction.

Many of our master's and doctoral students do technically demanding and outstanding work; some of them of which are listed below:

JP du Plessis worked on the development of a low-cost, high-speed eye tracker. His focus is specifically on the development of software to identify a person's eyes and determine the location of the pupils and corneal reflections. The challenge lies in determining these feature points in real time at a frequency of 300 data samples per second without slowing down the computer or impede other computing activities.

Gavin Dollman did amazing research on the interaction between humans and machines by manipulating a small Lego robot through brainwaves. He specifically looked at the question of whether previous exposure to technology has any influence on the effectiveness and accuracy with which people can use their thoughts to control devices. This futuristic research has consequences with regard to security, computer games, and any real-time interaction between humans and technology.

Ntima Mabanza is working on educational software with human characteristics for the purpose of assisting a learner in the completion of his/her tasks in a socially engaging manner. He is specifically evaluating the extent to which a variety of educational agents could assist adult computer illiterate learners in acquiring basic computer skills.

Rouxan Fouché is comparing the effectiveness of the traditional mouse and keyboard interfaces with other means of interaction during game play, such as gestures, eye tracking, as well as brainwaves and facial recognition. As a vehicle to test his theories, Rouxan uses a 2D shooter game which he developed himself.

Tlholohelo Nkalai used a glove with electronic sensors to determine computer anxiety through measurement of sweat, heart rate, and body temperature. She was specifically interested to determine how results obtained in this way compares with traditional computer anxiety questionnaires with regard to reflecting the true state of mind of a computer user.

Gerald Muriithi worked on the use of business intelligence (BI) to allow organisations to leverage the huge amounts of transactional data at their disposal and turn them into a powerful decision support mechanism to give them a competitive advantage. Barriers of high cost, complexity and lack of in-house expertise discourage many firms from adopting BI systems. Gerald argues that adopting a cloud computing model, where BI is offered as a service over the internet, can lower these barriers and accelerate the pace of BI adoption.

## Staff Matters

Mr JP du Plessis was appointed to present the new Engineering courses.

Mrs Marina Botha was appointed as junior lecturer.

Mr Fred Mudavanhu was promoted to lecturer.

Mr Benedict Sebastian received the faculty award for Teaching and Learning at the Qwaqwa Campus.

Ms Erna Dippenaar received the faculty award for administrative staff.

Prof Pieter Blignaut was invited to deliver a keynote speech at the International Eye Tracking Conference in Noosaville, Australia.

Mr Wynand Nel was invited to attend a seminar on electronic voting (e-voting) and counting technologies hosted by the Independent Electoral Commission (IEC) of South Africa.

Mrs Engela Dednam was invited to the Course Technology Conference in San Diego, California, USA. This conference was arranged by the distributers of the online assessment software that we use for our computer literacy modules. Mrs Dednam was the chosen South African delegate with all expenses paid by the organisers.

*Mrs Engela Dednam in front of the Marriott Hotel in San Diego, California, USA.*

## Research Outputs

### Research Articles

**Bere, A. & Rambe, P.** 2013. Extending technology acceptance model in mobile learning adoption: South African university of technology students' perspective. *Proceedings of the 8th International Conference on E-learning*, Cape Town, South Africa. 27-28 June 2013.

**Blignaut, P.J.** 2013. A new mapping function to improve the accuracy of a video-based eye tracker. *Proceedings of the South African Institute for Computer Scientists and Information Technologists (SAICSIT 2013)*, East London, South Africa. 7-9 October 2013.

**Blignaut, P.J. & Wium, D.J.** 2013. The effect of mapping function on the accuracy of a video-based eye tracker. *Proceedings of the Eye Tracking South Africa Conference (ETSA)*, Cape Town, South Africa. 29-31 August 2013.

**Dollman, G.J., De Wet, L. & Beelders, T.R.** 2013. Effectiveness with EEG BCIs: Exposure to traditional input methods as a factor of performance. *Proceedings of the South African Institute for Computer Scientists and Information Technologists (SAICSIT 2013)*, East London, South Africa. 7-9 October 2013.

**Haskins, B.P. & Nel, W.** 2013. Development of an online portal for conference management. *Proceedings of the 15th Annual Conference on World Wide Web Applications*, Cape Town, South Africa. 10-13 September 2013.

**Muriithi, G.M. & Kotzé, J.E.** 2013. A conceptual framework for delivering cost effective business intelligence solutions as a service. *Proceedings of the South African Institute for Computer Scientists and Information Technologists (SAICSIT 2013)*, East London, South Africa. 7-9 October 2013.

**Nel, W. & De Wet, L.** 2013. An investigation into the internet and search engine experience of a diverse group of first year university students. *Proceedings of the 15th Annual Conference on World Wide Web Applications*, Cape Town, South Africa. 10-13 September 2013.

**Rambe, P.** 2013. Converged social media: Identity management and engagement on Facebook mobile and blogs. *Australasian Journal of Educational Technology* 29(3): 315-336.

**Rambe, P. & Bere, A.** 2013. Using mobile instant messaging to leverage learner participation and transform pedagogy at a South African university of technology. *British journal of educational technology* 44(4): 544-561.

**Rambe, P. & Bere, A.** 2013. Using social embeddedness to explore ubiquitous learning in mobile environments at a South African university of technology. *Proceedings of the 8th International Conference on E-learning*, Cape Town, South Africa. 27-28 June 2013.

**Rambe, P. & Chipunza, C.** 2013. Using mobile devices to leverage student access to collaboratively-generated resources: A case of Whats App instant messaging at a South African university. *Proceedings of the 2013 International Conference on Advanced Information and Communication Technology for Education*, Hainan, China. 20 September 2013.

**Rambe, P., Chipunza, C. & Bere, A.** 2013. Towards a Novel perspective on the academic use of mobile learning applications: a case of university student perspectives. *Proceedings of the Global Business and Technology Association Fifteenth Annual International Conference*, Helsinki, Finland. 2-6 July 2013.

**Rambe, P. & Nel, L.** 2013. A reality check on student mobile adoption and content creation

in resource-constrained environments. In: *Proceedings of the 12th European Conference on E-Learning (ECEL 2013).* Edited by M. Ciussi and M. Augier. Reading, UK: Academic Conferences and Publishing International Limited (ACPI). pp. 401-410.

**Rambe, P. & Nel, L.** 2013. Student perceptions on the usefulness of educational technologies at a South African university. In: *Proceedings of the 12th European Conference on E-Learning (ECEL 2013).* Edited by M. Ciussi and M. Augier. Reading, UK: Academic Conferences and Publishing International Limited (ACPI). pp. 411-419.

## Chapters in Books

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**Rambe, P.** 2013. Exploring the architecture of appropriation of emerging technologies at South African universities: A critical review. In: *Leveraging educational quality in South African educational systems: A practitioner's perspective*, edited by M. Mawere and P. Rambe. Camaroon, Bamenda: Langaa RPCIG. pp. 63-106.

**Rambe, P.** 2013. Towards a blended mobile social media model to deepen authentic, contextualised learning in South African higher education. In: *Leveraging educational quality in South African educational systems: A practitioner's perspective*, edited by M. Mawere and P. Rambe. Camaroon, Bamenda: Langaa RPCIG. pp. 155-206.

**Rambe, P.** 2013. Using Web 2.0 technologies to support blended collaborative learning of critical citizenship at a South African university. In: *Leveraging educational quality in South African educational systems: A practitioner's perspective*, edited by M. Mawere and P. Rambe. Camaroon, Bamenda: Langaa RPCIG. pp. 107-154.

## Research Reports

**Wium, D.J. & Blignaut, P.J.** 2013. Testing of four Tobii X2 eye trackers: Quantification of accuracy, precision and trackability for different head and gaze positions. Commisioned by: Tobii Eye Trackers, Sweden.

## Workshops

**Blignaut, P.J., Beelders, T.R., Du Plessis, J.L., Wium, D.J. & Brown, R.W.** 2013. Demystifying the Black Box: From raw data to applications. *Proceedings of the Eye Tracking South Africa Conference* (ETSA2013), Cape Town, South Africa. 29-31 August 2013.

## Staff

### Main Campus:

**Professor:** Prof PJ Blignaut.

**Affiliated Professor:** Prof HJ Messerschmidt.

**Senior Lecturers:** Dr TR Beelders, Dr L de Wet, Dr JE Kotzé, Dr L Nel, and Dr A van Biljon.

**Lecturers:** Mr A Burger, Mr RW Brown, Mrs EH Dednam, Mr W Nel, and Mr RW Brown.

**Junior Lecturers:** Mrs M Botha, Mr JL du Plessis, Mr R Fouché, Mr J Marais, and Mr DJ Wium.

**Secretaries:** Mrs S Opperman and Mrs S de Klerk.

**Administrative Officer:** Ms E Dippenaar.

**Technical assistants:** Mr V Grobler, Mr G Zherizghy, and Mr C Cilliers.


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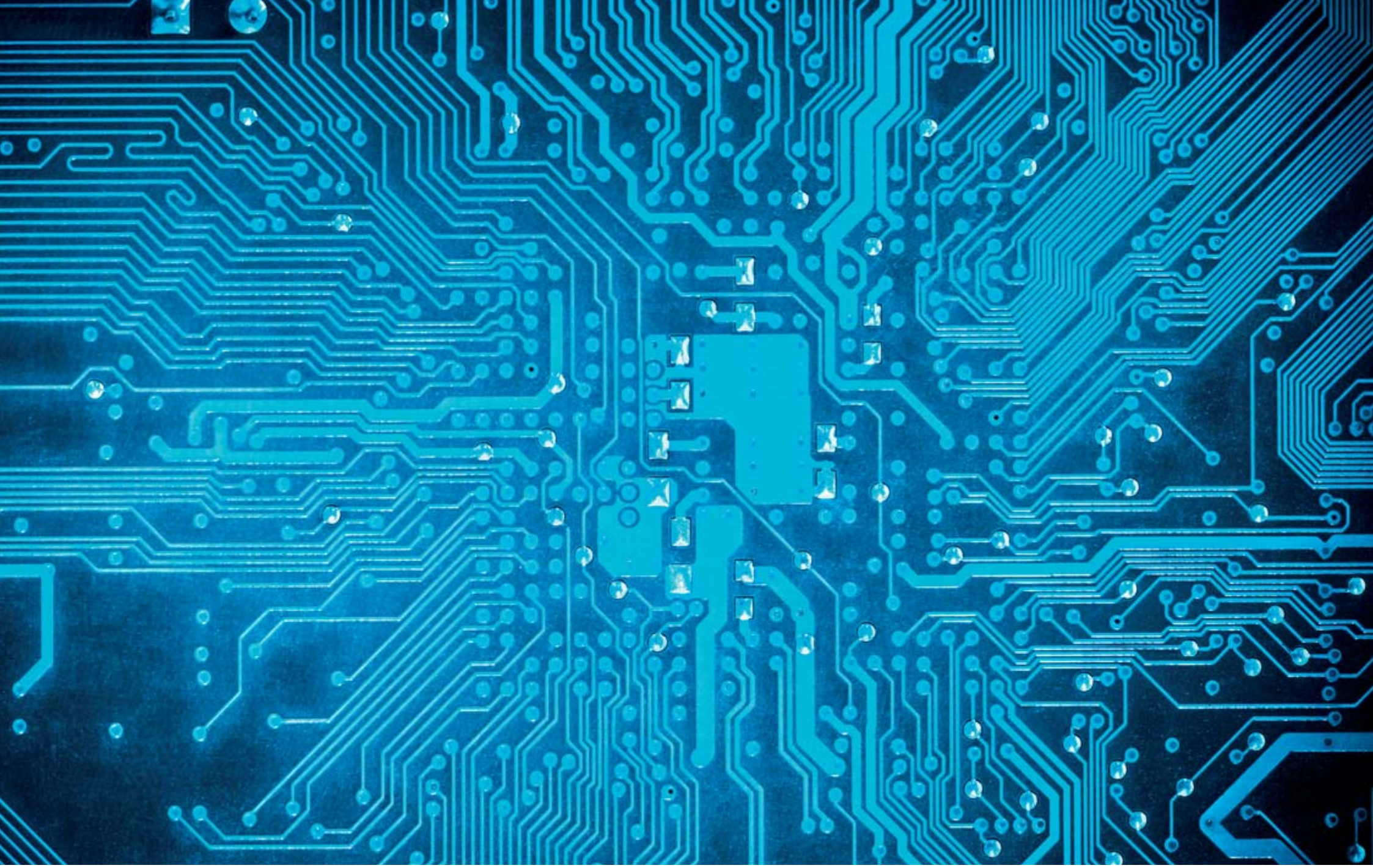

Department of

# Consumer Science

## Overview

The Department of Consumer Science seeks to equip undergraduate students with the knowledge to identify and understand the needs of individuals and families regarding food, clothing and housing, and the skills needed to help them fulfil these needs with the available resources. The Department also strives to motivate and lead postgraduate students to undertake research projects to strengthen the scientific basis from which the consumer can benefit in the field of textiles and foods. Regular revision of modules and module content is necessary in order to keep the qualification relevant. The different degree programmes offered by the Department of Consumer Science were revised in 2013. Food security, food preservation, and food product development previously offered as parts of other modules were developed as individual modules considering the importance of it for the consumer scientist today.

The Department of Consumer Science offers three undergraduate programmes and three postgraduate degrees. In the B Consumer Science (General) programme, 120 students were registered in 2013; 25 students in B Consumer Science (Foods); and nine in BSc Home Economics (Foods). A total of 16 students were registered for the BScHons in Home Economics, two students registered for the MSc in Home Economics programme, and four students for a PhD.

## Activities and Achievements

At the 6th Annual International Federation for Home Economics Africa regional meeting held on 27 February in

Pretoria, Prof HJH Steyn was elected vice-president for Africa of the International Federation for Home Economics for the term July 2014 to July 2018.

## Community Service

The Department of Consumer Science continued with the Mamello community development programme in the "old milkshed" on the experimental farm of the University of the Free State.

Final-year Consumer Science students take part in a community development programme each year in the first semester. The expected outcome of this programme for the students is the knowledge and practical experience of the factors to be taken into account in community development and programme planning. They learn how to work independently, how to implement a project, and how to evaluate the success thereof. Furthermore, they apply different presentation methods, compile and apply teaching aids, and evaluate and distinguish between different articles and products.

The benefit of the programme for the community members participating in this project is the development of skills and basic knowledge which they can apply to the benefit of their families or to earn an income or to gain an employment opportunity. During the programme community members often get the opportunity to earn some money when some of their products are sold. The women are eager to learn and develop skills that will bring some relief to their families. Some of the women are able to generate an income from the work they do.

The 2013 group wanted to develop skills in specific aspects of food preparation. The community members, along with the students and their supervisors, Mrs Ismari van der Merwe and Mrs Doretha Jacobs, identified a number of projects for the year. For the demonstrations the students then taught the women how to bake rusks, make fudge, make fine pastries, cook jam, bake different breads, and preserve vegetables.

In the accompanying photographs the community members and the students can be seen in action.

*Elizabeth Mnwana and Elandré Fourie.*

*Nellie Moletsane making pastries.*

*Elzaan Myburgh teaching Alina Ralehokodia the skills of measuring and using electrical beaters to make icing on the stove.*

*Phakiso Mafata enjoying the cooking experience.*

*Cathy Maasdorp and Nellie Moletsane with a successful end-product.*

*Phakiso Mafata and Palesa Mokoena.*

*Elizabeth Mnwana and Martiné Jacobs baking chocolate cake.*

*Nellie Moletsane and Mariska Norval.*

## National and International Collaboration

Prof HJH Steyn took part in the efforts of the programme committee Household Technology and Sustainability of the International Federation for Home Economics to compile "best practices" for household activities. She is responsible for best practices in hand laundering to be published on the website of the International Federation for Home Economics (IFHE).

Mrs JS van Zyl also took part in the efforts of the programme committee Household Technology and Sustainability of the International Federation for Home Economics to compile "best practices" for household activities. She and Dr C Bothma (Department of Biotechnology) are responsible for best practices in home food preservation to be published on the website of the IFHE.

## Research

Research done in the Department of Consumer Science in 2013 are mainly projects:

- that investigate the possibility of using electro chemically-activated water (anolyte and catholyte) as an alternative detergent and the effect of the treatment on the properties of the textile fibres;
- on natural textile fibres and fabrics available in Southern Africa. Projects on *Gonometa Postica* silk and *Alpaca Huycaya* fibres are currently in progress;
- on consumer perceptions of the quality of consumer products; and
- on food-product development done by Consumer Science postgraduate students, as well as with joint supervision of lecturers in Food Biotechnology and Consumer Science.

## Staff Matters

Ms N Tinta and Mrs N Cronje were appointed as junior lecturers from January 2013. Ms C Denner was appointed as officer of academic services from February 2013.

*Ms N Tinta and Mrs N Cronje.*

*Ms C Denner.*

## Research Outputs

### Research Article

**Cronje, N., Steyn, H.J.H. & Schall, R.** 2013. A comparison of the influence of Catholyte Phosphate detergent on the mechanical properties of Polyamide 6,6 woven fabric. *Journal of Family Ecology and Consumer Sciences* 41: 1-10.

### Staff

**Associate Professor:** Prof HJH Steyn.
**Lecturers:** Dr J Vermaas and Mrs I van der Merwe.
**Junior Lecturers:** Mrs JS van Zyl, Mrs PZ Swart, Ms N Tinta, and Mrs N Cronje.

**Senior Officer: Professional Services:** Mrs D Jacobs.
**Officer: Professional Services:** Ms C Denner.
**Assistant Officer:** Mrs W van der Walt.

### Contact Details

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Department of

# Genetics

## Overview

Student numbers in the Department of Genetics grew steadily during the past year. The number of final-year students grew from 71 per module in 2010 to 124 in 2013 despite enforcing stricter prerequisites for the different modules. Similarly, the number of honours students increased from 23 to 35 during the same period, master's students from 18 to 26, and doctoral students from three to nine.

The number of students is expected to increase further with the implementation of a new degree in Forensic Sciences, with the first students for this degree enrolling in 2014. Two lecturers, Laura Heathfield and Tinus Viljoen, were appointed to establish the BSc in the Forensic Science course.

The number of peer-reviewed papers published in accredited journals increase every year. Limiting factors in the Department are insufficient infrastructure (especially physical space). However, this factor should be addressed in 2014 due to funds obtained for a new building.

## Activities and Achievements

Two lecturers completed their MSc dissertations and both passed *cum laude*; Laura Heathfield completed her MSc in Forensic Science at the University of Strathclyde, Scotland, and Letecia Wessels her MSc in Genetics at the University of the Free State.

Drs Desire Dalton and Paula Spies attended a one-week training workshop in Ghana as finalists for the International Foundation of Science (IFS) research grant.

Prof Grobler, in collaboration with researchers from the National Zoological Gardens and the University of Pretoria, received a grant of R417 000 from the South African National Biodiversity Institute (SANBI) to investigate hybridisation between blue wildebeest and black wildebeest.

Prof Grobler was appointed as the subject editor: Conservation and Genetics for the journal Mammalian Biology from the Elsevier group.

Dr Dalton and Prof Kotze were appointed as members on the National Project Committee for the Google DNA Barcoding project.

Several workshops, from Phylogenetic Networks and Working with the Human Genome to Academic Writing and Intellectual Property, were attended by various staff members and postgraduate students.

Prof Grobler organised and co-presented a short course on "Applied Conservation Genetics" at the Biosciences eastern and central Africa hub of the International Livestock Research Institute (BeCA-ILRI) hub in Nairobi, Kenya. The course also involved presenters from the USA (Dr Jamie Rogerts, Virginia Tech) and Austria (Dr Frank Zachos, Natural History Museum). The course was attended by delegates from Kenya, Nigeria, Malawi, Mexico, and Belgium; and will be presented annually in different African countries.

## Community Service

Prof Grobler was invited by the National Department of Environmental Affairs to serve on a panel which aims to delineate historical patterns of distribution of mammals in South Africa. This committee aims to formulate policies for the translocation of game in South Africa.

## National and International Collaboration

Prof Grobler spent two months with Dr Frank Zachos at the Natural History Museum in Vienna, Austria. They collaborated on a project aimed at finding genetic markers for atypical (white and black) coat colour in springbok. They also engaged in planning for a short course in Conservation Genetics.

Prof Trudy Turner from the University of Wisconsin-Milwaukee, visited the Department in July to engage in joint publication writing with Prof Grobler. The department also hosted three visitors from Kenya: Dr Romulus Abila and Ms Emily Chemoiwa from the South Eastern University, and Mr James Barasa from the University of Eldoret. These researchers are involved in a joint project with Prof Grobler and Ms Van der Westhuizen on the population genetic structure of catfish in Kenya and South Africa.

Locally, the strong collaboration between the Department of Genetics and researchers from the National Zoological Gardens continued. This collaboration involves Profs Grobler and Kotze (NZG) and Dr D Dalton (NZG). This collaboration involves several joint research projects, as well as joint supervision of postgraduate students. Current joint projects are focused on the ground hornbill, pangolin, black wildebeest, white rhino, and penguin.

Prof A Kotze led a South African team to Kenya under the Kenyan South African bilateral agreement in December 2013.

Ms Laura Heathfield collaborated with Jo Millington (Manlove Forensics Ltd.) on accredited DNA-controlled forensic examinations: strategy, management, and implementation.

## Postgraduate Students

Mr A Nel completed his PhD on aspects of quantitative genetics of pine. At MSc level, the following projects were completed: Mr R Spies on founder effects and re-introduction of oxpeckers; Ms Z Odendaal on genetic aspects of human aggressive behaviour; Mrs L Wessels on the use of microsatellite markers to identify hybrid wildebeest; and Ms C de Beer on genetic variation of the ground pangolin.

## Research

Research in Conservation Genetics (Prof Paul Grobler and Ms Hesmari van der Westhuizen) is focused on several areas. First is the study of genetic structure and connectivity among population fragments. This project aims to describe genetic connectivity among populations and test the power of genetic markers to detect real population boundaries. Current projects in this field involve vervet monkeys, mopane worms and molluscs. The second major focus is the phenomenon of hybridisation in wildebeest. This project is aimed at assessing the genetic purity of blue and black wildebeest in South Africa, and researchers at several South African institutions are collaborating to find a molecular, statistical and management framework to address this problem. Smaller current projects involve: i) genetic diversity in fragmented populations under different management regimes; ii) the genetic mechanism of morphological diversity in springbok; iii) the characterisation of indigenous breeds of farm animals; and iv) wildlife forensic investigations.

Conservation genetic studies by affiliated lecturers from the National Zoological Gardens (Prof A Kotze and Dr DL Dalton) concentrated on genetic variation in Tankwa goats, sungazers, penguins, the southern ground hornbill, and Temminck's ground pangolin.

Forensic Genetics (Dr Karen Ehlers and Mrs Letecia Wessels) studies molecular phenotyping of humans and gene expression analysis of larvae of certain forensically important fly species to provide a better estimate of the age of the larvae. This can then be used to calculate a more accurate postmortem interval. The study is conducted in

conjunction with Dr S Brink at the Department of Zoology and Entomology.

In Forensic Sciences, Ms Laura Heathfield studied accredited DNA-controlled forensic examinations: strategy, management, and implementation and is busy examining the effect of haemolytic diseases on DNA profiling.

The research fields of human genetics (Mrs Sue-Rica Schneider) and behavioural genetics (Prof Johan Spies and Ms Zurika Odendaal) explore the molecular basis of the aetiology of aggression, ADHD, schizophrenia, depression, suicidal behaviour, bipolar disorder, and metabolic syndrome in South African populations. The aim is to help delineate the biological pathways involved, thereby identifying possible genetic markers, and furthermore to identify the genetic contribution involved which will hopefully head to the development of new diagnostic criteria based on genetic aetiology, as well as identify possible at-risk individuals through genetic marker testing. The genetic information generated will also allow for the development of new preventative and treatment strategies thereby alleviating the emotional and socioeconomic burden of these disorders.

Mr Frank Maleka (Molecular Genetics) and his students conducted research aimed at elucidating the genetics of flower pigmentation in *Clivia* species. The biggest challenge has been the analyses of large-scale sequence data that was generated following the sequencing of the *C. miniata* flower transcriptome. Experiments aiming to validate the expression of several key flavonoid biosynthetic genes (identified during the previous phase of the study as indicated above) were initiated in 2013. Preliminary findings confirmed the null hypothesis; that flavonoid biosynthetic genes are expressed largely in flower tissues and less so in other parts of the plant, e.g. leaves, roots, stems. However, to substantiate these observations, further experiments are currently underway.

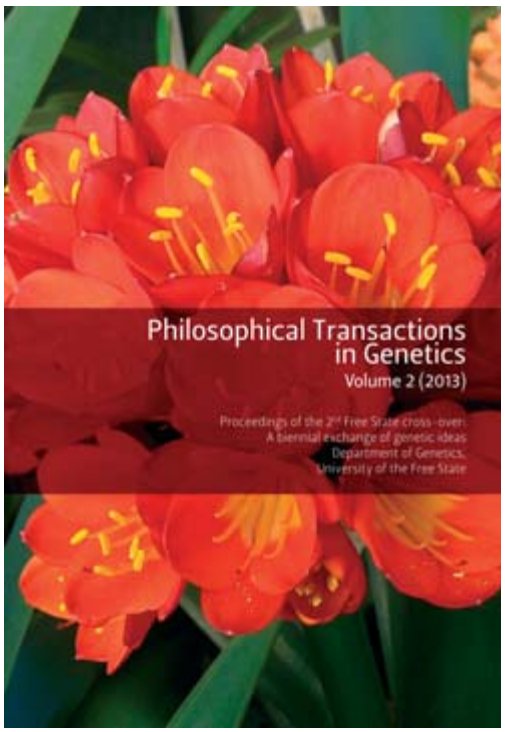
The Cytotaxonomy and Molecular Systematics group (Prof Johan Spies and Mrs Paula Spies) concentrated their research on the phylogenetics of *Clivia* and *Lachenalia*. Both these projects are nearly completed and several theses and papers are being prepared for publication.

## Staff Matters

Two new lecturers were appointed to give momentum to the new undergraduate learning programme in Forensic Science. They are Laura Heathfield (MSc in Forensic Science, University of Strathclyde, Scotland) and Tinus Viljoen (MSc in Chemistry, UFS).

Zurika Odendaal and Hesmari van der Westhuizen were promoted to lecturers.

*Laura Heathfield at the graduation ceremony in Glasgow (University of Strathclyde) where she obtained her Msc: Forensic Science with honours (cum laude).*




*Volume 2 of the journal published by the Department: Philosophical Transactions in Genetics.*

*Course attendees in Kenya during the presentation of a short course on Population Genetics in Nairobi. Organiser: Prof Paul Grobler.*

# Research Outputs

## Research Articles


**Brettschneider, H., Voster, J.H., Lane, E.P., Van Wilpe, E., Biden, P., Dalton, D.L. & Kotze, A.** 2013. Molecular detection of yaba monkey tumor virus isolated from a vervet monkey (*Chlorocebus pygerythrus*) in South Africa. *Journal of the South African Veterinary Association* 84: 1-5.

**Cramer, J.D., Gaetano, T., Gray, J.P., Grobler, J.P., Lorenz, J.G., Freimer, N.B., Schmitt, C.A. & Turner, T.R.** 2013. Variation in scrotal color among widely distributed vervet monkey populations (*Chlorocebus aethiops pygerythrus* and *Chlorocebus aethiops sabaeus*). *American Journal of Primatology* 75: 752-762.

**Creux, N.M., De Castro, M.H., Ranik, M., Maleka, M.F. & Myburg, A.A.** 2013. Diversity and *cis*-element architecture of the promoter regions of cellulose synthase genes in *Eucalyptus*. *Tree Genetics and Genomes* 9: 989-1004.

**Crottini, A., Bollen, A., Weldon, C., Dalton, D.L., Kotze, A., Noel, J. & Andreone, F.** 2013. Amphibian survey and current absence of *Batrachochytrium dendrobatidis* (Bd) in the Parc Ivoloina, Toamasina (Madagascar). *African Journal of Herpetology* 62: 1-9.

**Dalton, D.L., Charruau, P., Boast, L. & Kotzé, A.** 2013. Social and genetic population structure of free-ranging cheetah in Botswana: implications for conservation. *European Journal of Wildlife Management* 59: 281-285.

**Danzy, J., Gaetano, T., Grobler, J.P., Gray, J.P., Schmitt, C.A., Lorenz, J., Freimer, N. & Turner, T.** 2013. Variation in signal development and content among widely distributed vervet monkey populations (*C. a. pygerythrus* and *C. a. sabaeus*). *American Journal of Primatology* 75: 752-762.

**Grobler, J.P.** 2013. Using Microsoft Excel as a simulation tool during population genetics training. *Philosophical Transactions in Genetics* 2: 39-54.

**Heathfield, L.J., Lacerda, M., Nossek, C., Roberts, L. & Ramesar, R.S.** 2013. Stargardt disease: Towards developing a model to predict phenotype. *European Journal of Human Genetics* 21: 1173-1176.

**Labuschagne, C., Kotzé, A., Grobler, J.P. & Dalton, D.L.** 2013. A targeted gene approach to SNP discovery in the White Rhino (*Ceratotherium simum*). *Conservation Genetic Resources* 5: 265-266.

**Labuschagne, C., Van Wyk, A.M., Kotze, A., Grobler, J.P. & Dalton, D.L.** 2013. Isolation and characterization of species-specific microsatellite loci in African penguin (*Spheniscus demersus*). *Conservation Genetic Resources* 5: 169-171.

**Lane, P., Huchzermeyer, F.W., Govender, D., Bengis, R.G., Buss, P.E., Hofmeyr, M., Myburgh, J.G., Steyl, J.C.A., Pienaar, D.J. & Kotze, A.** 2013. Pansteatitis of unknown etiology associated with large-scale Nile crocodile (*Crocodylus niloticus*) mortality in Kruger National Park, South Africa: pathologic findings. *Journal of Zoo and Wildlife Medicine* 44: 899-910.

**Laubscher, N., Odendaal, Z., Schneider, S. & Spies, J.J.** 2013. A family study of reactive and proactive aggression in a South African population. *Philosophical Transactions in Genetics* 2: 1-16.

**Lucassen, A., Ehlers, K., Grobler, J.P. & Shezi, A.L.** 2013. Allele frequency data of 15 autosomal STR loci in four major population groups of South Africa. *International Journal of Legal Medicine* 128: 275-276.

**Ma, D., Jasinska, A., Kristoff, J., Grobler, J.P., Turner, T.R., Jung, Y., Schmitt, C., Raehtz, K.,**

**Feyertag, F., Sosa, N.M., Wijewardana, V., Burke, D.S., Robertson, D.L., Tracy, R., Pandrea, I., Freimer, N. & Apetrei, C.** 2013. SIVagm infection in wild African Green Monkeys from South Africa: epidemiology, natural history, and evolutionary considerations. *PLOS Pathogens* 2013 9: e1003011.

**Maleka, M.F., Albertyn, J. & Spies, J.J.** 2013. Understanding flower pigmentation towards the effective use of ornamental crops in the floriculture industry. *Philosophical Transactions in Genetics* 2: 55-110.

**Odendaal, Z., Spies, P., Schneider, S. & Spies, J.J.** 2013. Quantitative measurement of behaviour by using the Aggression Questionnaire and Adult Temperament Questionnaire. *Philosophical Transactions in Genetics* 2: 17-38.

**Theron, N., Dalton, D.L., Grobler, J.P., Jansen, R. & Kotze, A.** 2013. Molecular insights on the re-colonization of the Limpopo Valley, South Africa, by Southern Ground-Hornbills. *Journal of Ornithology* 154: 727-737.

**Theron, N., Jansen, R., Grobler, J.P. & Kotze, A.** 2013. The home range of a recently established group of Southern ground-hornbill (*Bucorvus leadbeateri*) in the Limpopo Valley, South Africa. *Koedoe* 55: 1-8.

**Van Wyk, A., Kotzé, A., Randi, E. & Dalton, D.L.** 2013. A hybrid dilemma: a molecular investigation of South African bontebok (*Damaliscus pygargus pygargus*) and blesbok (*Damaliscus pygargus phillipsi*). *Conservation Genetics* 14: 589-599.

**Viljoen, C.D., Snyman, M.C. & Spies, J.J.** 2013. Identification and expression analysis of chalcone synthase and dihydroflavonol 4-reductase in *Clivia miniata*. *South African Journal of Botany* 87: 18-21.

**Viljoen, J.A., Visser, H.G., Roodt, A. & Engelbrecht, I.** 2013. Crystal structure of tetrakis(5,7-dibromoquinolin-8-olato-$K^2N,O$)-hafnium(IV) dimethylformamide trisolvate, $C_{45}H_{37}Br_8HfN_7O_7$. *Zeitskrift für Kristallograpkie – New Crystal Structures* 228: 485-487.

**Woogeng, I.N., Grobler, J.P., Etchu, K.A. & Ndamukong, K.J.N.** 2013. The perception of climate and environmental change on the performance and availability of the edible land snails: a need for conservation. *African Journal of Agricultural Research* 8: 1457-1465.

## Staff

**Professors:** Profs JJ Spies and JP Grobler.

**Affiliate Professor:** Prof TR Turner.

**Affiliate Associate Professor:** Prof A Kotze.

**Lecturers:** Dr K Ehlers, Ms LJ Heathfield, Mr MF Maleka, Ms Z Odendaal, Mrs SR Schneider, Mrs P Spies, Ms HM van der Westhuizen, and Mr JA Viljoen.

**Junior Lecturer:** Mrs L Wessels.

**Affiliate Lecturers:** Dr DL Dalton, Lt Col A Lucassen.

**Secretary:** Mrs B Henn.

**Senior Officer: Professional Services:** Mrs SMC Reinecke.

**Administrative Officer:** Mrs V Nuttall.

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-FORUMS
-SHOP
-BUY
-NETWORK


Department of

# Geography

## Overview

The Society of South African Geographers (SSAG) Student Conference 2013 was hosted by the University of the Free State's Geography Department on the Main Campus. A number of students from universities around South Africa participated in both oral and poster presentations. The students also enjoyed exploring both the human and physical geographical aspects of Bloemfontein and the Free State through the field trips organised by UFS staff members.

In 2013 the Geography Department on the Main Campus revamped the GIS Lab. The new state-of-the-art facility is now able to host up to 70 students

A new programme in Geo-informatics was developed as part of the UFS' re-curriculation programme. The programme, which offers Geography and Computer Information Systems as majors, was submitted to the Education Advisory Committee of the South African Council for Professional and Technical Surveyors and was accredited at the end of 2013. The programme will produce GISC technologists (in training) on undergraduate level and GISC Practitioners (in training) at honours level.

Students from the honours class gave presentations at the International Association of Impact Assessors (IAIA) South Africa conference, as well as the GIS SA conference.

Gustav Visser presented lectures and seminars at Utrecht University (The Netherlands), and the universities of Oulu (Finland) and Umea (Sweden) during the last part of 2013.

Ruth Massey received her doctorate from Stellenbosch University at the end of 2013. The focus of her thesis was the upgrading informal settlements in Cape Town and its impact on women's social networks. She was also accepted as a postgraduate fellow of the Royal Geographical Society. Anneri Pretorius received her master's degree from Maastricht University in the Netherlands in 2013.

Sheffield University students visited the Geography Department during 2013 as part of the field class led by Dan Hammett and Dan Vickers.

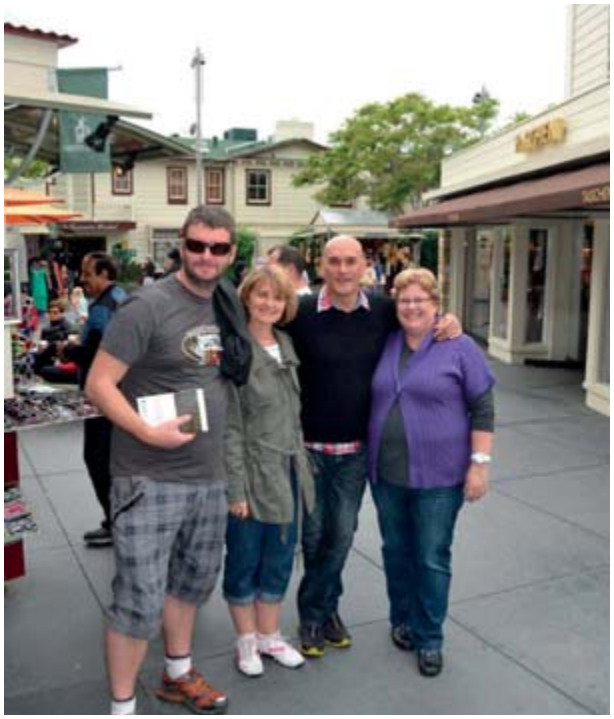
## Staff Matters

Prof Peter Holmes and Dr Hennie Claassen retired at the end of 2013.

The Main Campus welcomed three new staff members in 2013: Adriaan van der Walt, Anneri Pretorius, and Ruth Massey.

*Prof Dieter Muller (Dean of Science at Umea University), Prof. Visser and Dr Zetterstrom (Umea University).*

*Prof. Visser leading another of the SSAG Student Conference field trips.*



*Prof Visser with fellow Geographers at the Association of American Geographers' Annual Meeting (2013) in Los Angeles, USA.*

*Prof Holmes leading one of the SSAG Student Conference field trips.*

# Research Outputs

## Research articles

**Donaldson, R., Du Plessis, D., Spocter, M. & Massey, R.** 2013. The South African area-based urban renewal programme: Experiences from Cape Town. *Journal of Housing and the Built Environment* (Special Issue) 28(4): 605-613.

**Donaldson, R., Kotze, N. & Visser, G.** 2013. An uneasy match: Neoliberalism, gentrification and heritage conservation in Bo-Kaap, Cape Town, South Africa. *Urban Forum* 24(2): 173-188.

**Donaldson, R., Mehlomakhulu, T., Darkey, D., Dyssel, M. & Siyongwana, P.** 2013. Relocation: To be or not to be a black diamond in a South African township? *Habitat International* 39: 114-118.

**Massey, R.** 2013. Competing rationalities and informal settlement upgrading in Cape Town, South Africa: A recipe for failure. *Journal of Housing and the Built Environment* (Special Issue) 28(4): 629-638.

**Visser, G.** 2013. Challenging the gay ghetto in South Africa: Time to move on? *Geoforum* 49: 268-274.

**Visser, G.** 2013. Looking beyond urban poor: The new terra incognita for urban geography. *Canadian Journal of African Studies* 47: 75-93.

## Book

**Visser, G. & Ferreira, S.** (eds.). 2013. *Tourism and crisis*. London: Routledge.

## Chapters in Books

**Visser, G.** 2013. The crisis of induced uneven development through South African tourism marketing strategies. In *Tourism and crisis*, edited by G. Visser and S. Ferreria. London: Routledge. pp. 129-139.

**Visser, G. & Ferreira, S.** 2013. Tourism and crisis: A never-ending story? In *Tourism and crisis*, edited by G. Visser and S. Ferreria. London: Routledge. pp. 1-11.

## Staff

**Professors:** Profs Peter Holmes and Gustav Visser.
**Senior Lecturers:** Dr Charles Barker.
**Lecturers:** Dr Ruth Massey, Ms Eldalize Kruger, and Mrs Tobeka Mehlomakulu.
**Junior Lecturers:** Mr Adriaan van der Walt, Mrs Anneri Pretorius, and Ms Mulalo Rabumbulu.
**Administrators:** Mrs Sandra Brits and Ms Nolene van Dyk.

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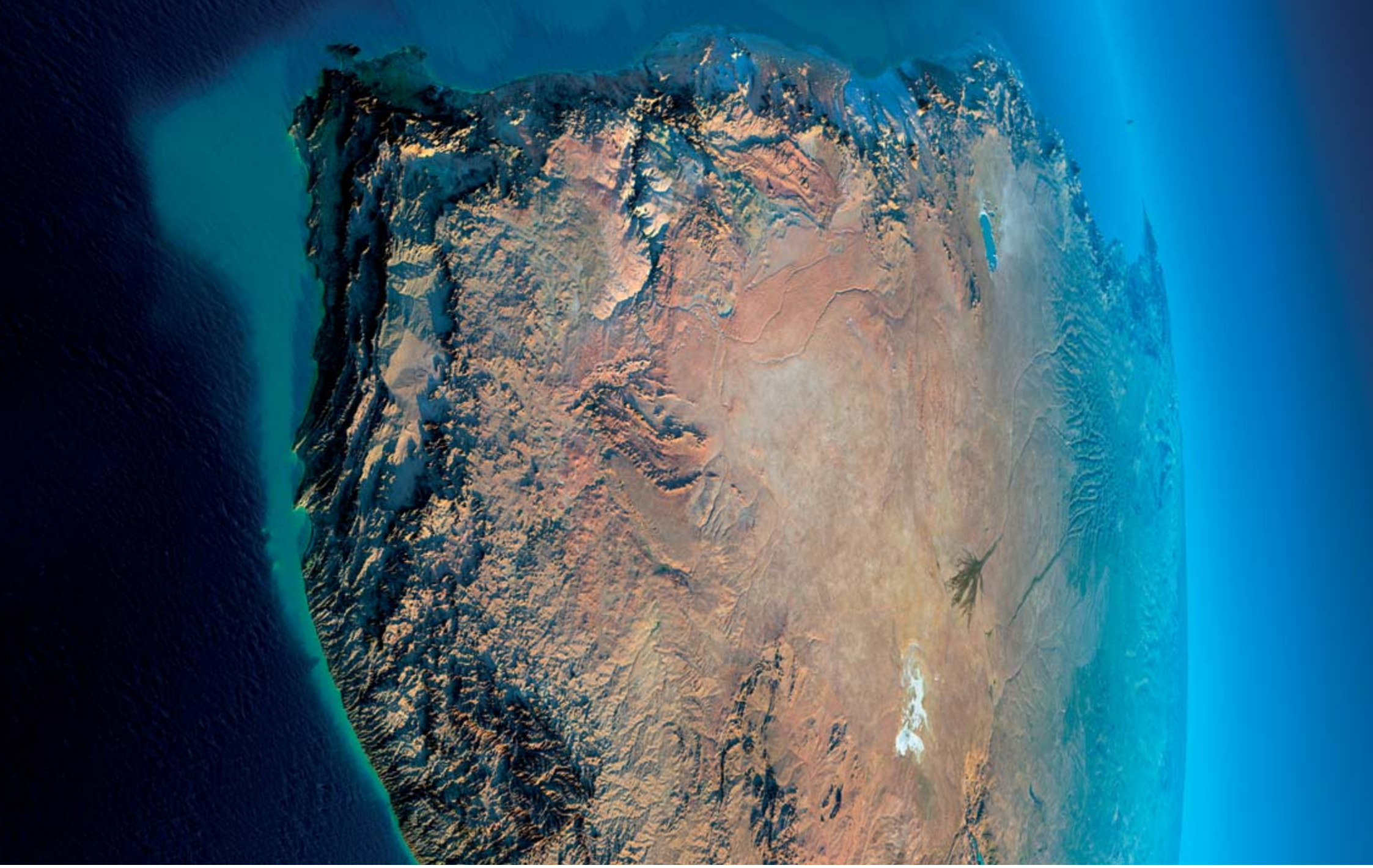

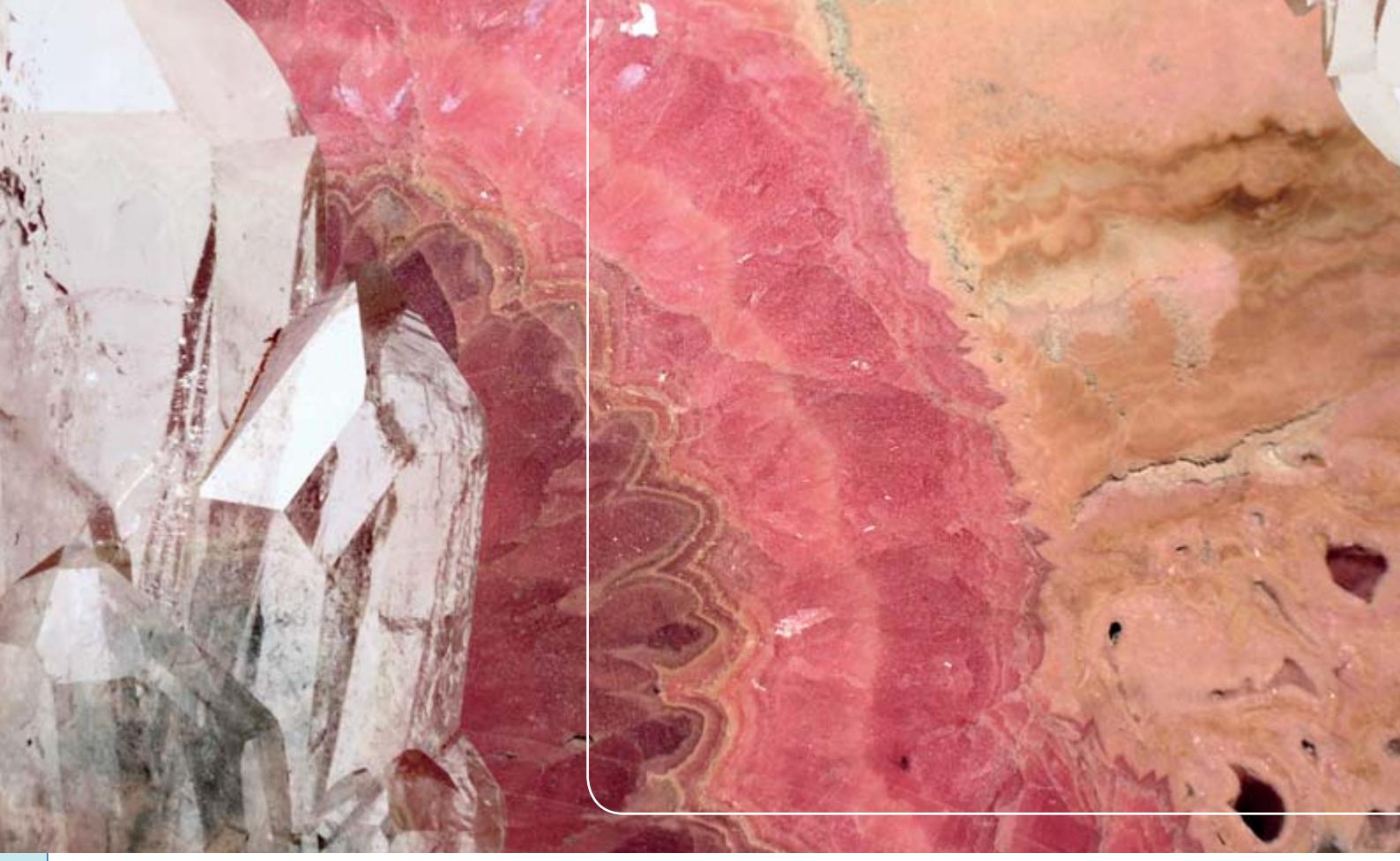

Department of

# Geology

## Overview

The Department of Geology's vision is the transformation of lives through a focus on quality rather than quantity in geoscience education and research. The Department hopes to achieve this vision through the development of our staff to provide high-quality, confident geoscience graduates that are capable of making positive contributions to the South African and international labour markets and who can act as drivers of change, through excellence in teaching, research and community service, and through relevant exposure of students to the world beyond the confines of the classroom. The permanent academic staff of the Department collectively has more than 200 years of relevant industry, research, and teaching experience. This collective experience is augmented by the utilisation of a number of affiliated industry experts to ensure that students are provided with some of the best, most relevant and up-to-date geoscience education on offer in South Africa and on the continent. The Department offers undergraduate and postgraduate programmes up to PhD level in Geology, Geochemistry, Environmental Geology and Mineral Resource Throughput Management; the latter starting at NQF level 9 with our flagship MRTM degree that is offered to experienced industry professionals from a variety of backgrounds relevant to the mining and mineral beneficiation industries.

The year 2013 was a year characterised by continued high student numbers, an increased focus on research, and a number of staff changes. A total of 97 students enrolled for first-year modules taken as part of the undergraduate

programmes in Geology, Environmental Geology, and Geochemistry. Corresponding numbers for second-year and third-year modules were 106 and 112, respectively. Forty students enrolled for honours modules. A total of 55 students enrolled for modules as part of their MRTM studies in 2013. The Department additionally supervised one doctoral candidate and 12 research master's candidates over the course of the year. One hundred and seven degrees were conferred by the Department over the course of the year; with 65 students receiving BSc degrees, 33 honours degrees, four MSc degrees, and five MRTM degrees. The number of scientific articles and peer-reviewed conference proceedings generated by the Department increased significantly from previous years and we trust that this trend will continue through a focus on the recruitment of quality postgraduate students and the utilisation of scientifically productive research collaborators and affiliated researchers.

Staff changes included the appointment of Dr Frederick Roelofse as Head of Department in August and the retirement of Prof Marian Tredoux at the end of 2013. Prof Willem van der Westhuizen is thanked for his contributions to the Department throughout the 15 years as Head of Department and for having built the Department to what it is today. Prof Tredoux will continue to contribute to both teaching and research in the Department on a full-time contractual basis in 2014 and hopefully beyond. Mr Peet Roodt, control technician with more than 30 years' service in the Department, retired at the end of 2013. The Department wishes him well in his retirement. Mr Andries Felix was promoted to senior assistant officer in December 2013.

One of the highlights of 2013 was the handing over of the Department's new core storage facility in August, which was erected on the Main Campus at a cost of R1,4 million and that will be used to house drill core material for both teaching and research. The 472 $m^2$ building was made possible through donations received from the Minerals Education Trust Fund (METF) and AngloGold Ashanti Ltd. The continued support from both the METF and mining companies in general is a reflection of the contributions made by the Department to the mining industry through the education of geologists capable of making positive contributions to the industry and through research endeavours focused on solving problems facing the industry.

## Activities and Achievements

There was a busy start to the year, with the Department playing host to 60 scientists and students from seven of the country's geology departments attending the 5th Igneous and Metamorphic Studies Group Meeting that was held over the period 21 to 23 January. A total of 53 talks covering a wide range of topics were presented as part of the conference. A number of delegates attended the conference field trip to Kimberley's Big Hole and to the Roberts Victor mine under the expert guidance of Dr Jock Robey.

From 7 to 8 March 2013, 18 honours students took part in an applied mineralogy excursion that included a visit to the Gold One Modderfontein East processing plant and Anglo American research laboratory, as well as an afternoon seminar at the University of Johannesburg with a number of invited speakers mostly from the industry. This forms part of the honours mineralogy module and a similar excursion has been arranged for this course since 2009.

The annual MRTM workshops were held in March and September 2013 in Pretoria. A new module, Virtual Mining Simulation, was introduced and was accepted well by the students. The number of students enrolling for the course is increasing despite a downturn in the mining industry. At the end of 2013 there were just over 70 students enrolled in the programme.

Honours students enrolled for the structural geology module attended a week-long short course in the Vredefort Dome over the period 18 to 22 March, presented by Prof W Colliston, where the students received practical training in structural mapping and geometric analysis.

First-year students visited Austins Post in the Edenburg district on 27 April, where they were introduced to a variety of sedimentary, igneous and metamorphic features occurring within the Beaufort group. They also visited the Jagersfontein district on 31 August, where additional instruction was given on the sedimentological interpretation of fluvial and deltaic deposits.

The MRTM team in association with the Southern African Institute of Mining and Metallurgy hosted and presented the first "Optimisation of mine value chain from resource to market" symposium during 7 to 9 May 2013 in Pretoria. The MRTM team comprising lecturers and affiliated lecturers presented eight papers during a very successful symposium.

The annual economic geology field trip for honours students took place in June under the guidance of Prof C Gauert, with students being exposed to eight mines and mineral processing facilities in KwaZulu-Natal over the duration of the seven day long field trip. The following commodities were focused on: dimension stone, cement/colour additives, coal, iron/steel, heavy minerals, and diamonds. In October, third-year economic Geology students visited the No. 2 and 3 shafts at Beatrix Gold Mine, where they were exposed to the realities of underground gold mining.

Ms J Magson visited Dr Iain McDonald at Cardiff University in July in order to perform PGE determinations as part of her Impala Platinum-sponsored MSc project aimed at quantifying variations in PGE tenor across the Merensky Reef in the Western Limb of the Bushveld Complex.

The Department of Geology hosted its second winter school for students in the MRTM programme from 8 July to 10 July 2013. Twenty-five students and delegates from the industry attended the school, which included practical workshops and a mini-symposium. Case studies on mining optimisation, change management in the mining environment, and report writing presented by Dr L Bergh were some of the topics covered during the school.

Dr F Roelofse was invited to attend a field conference in the Kiglapait intrusion, Labrador, Canada, between 27 July and 2 August. The conference was attended by a number of scientists and students active in the field of layered intrusions under the expert guidance of Prof Tony Morse (University of Massachusetts, USA), the "father" of the Kiglapait intrusion.

During the period September 2013 to November 2013 the MRTM team visited Total Coal Operations in Mpumalanga. The visits allowed an opportunity to introduce the MRTM methodology to the company.

Second-year students visited the Barkley East district over the period 21 to 25 September, where they underwent instruction on the principles of geological mapping and fieldwork techniques. They were also introduced to aspects of physical volcanology, sedimentology, stratigraphy, and structural geology as present in the upper parts of the Karoo Supergroup (Drakensberg, Clarens, Elliot, and Molteno formations).

Third-year students undertook a visit to the Vredefort Dome on 4 and 5 October as part of their metamorphic petrology module, where students were able to see the effects of tectono-thermal and impact metamorphism on a variety of protoliths.

Mr AI Odendaal was responsible for the organisation of a mini-congress aimed at undergraduate and honours students entitled "Geology at work", which was held on 4 October. Several guest speakers delivered talks aimed at exposing students to a variety of aspects related to the geological profession.

Mr AI Odendaal, Dr H Praekelt and Profs W Colliston and A Schoch conducted a two day long reconnaissance field work trip to Namaqualand on 10 and 11 October as part of their research agendas and in order to prepare for the arrival of two new MSc students expected to join the Department in 2014.

Ms Megan Purchase (teaching/research assistant and MSc student) visited the German Research Centre for Geosciences (GFZ) in Potsdam from 19 October to 9 November in order to receive training on their newly-acquired Cameca 1280-HR secondary ion mass spectrometer. The Department continued negotiations with GFZ for the establishment of a remote node on the Main Campus from where users will be able to produce publication quality results without the need to travel to Germany to do so.

Mr AI Odendaal conducted field work in the Sutherland and Merweville districts on a number of occasions during 2013 as part of his MSc degree, which is aimed at elucidating the stratigraphic relationships of the Karoo Supergroup along the Great Escarpment. He also attended a number of Shell-sponsored short courses at Rhodes University where he was introduced to aspects of biostratigraphy and seismic interpretation applied to the analysis of sedimentary basins.

Prof C Gauert visited the Nkomati Nickel Mine in Mpumalanga twice to further his research efforts aimed at gaining a better perspective on the downdip geology of the deposit and the contact aureole of the deposit. He was also asked to present a lecture on the geology of the Uitkomst Complex to geologists working for the mine and also took the time to market the master's degree in Mineral Resource Throughput Management. Prof Gauert was also invited to present a short course on the geology of the Uitkomst Complex to honours students at the University of Pretoria in October. He also attended a short course on the geology of India at the University of Pretoria.

Prof M Tredoux spent two weeks at the Eugen Stumpfl Electron Microprobe laboratory at the University of Leoben in August with her collaborator, Dr F Zaccarini, studying microscopic mineral phases present in the Bon Accord NiO body (Barberton Mountainland).

## Achievements of Students

Ms Bianca Kennedy, MSc student of Prof M Tredoux, was honoured as one of the best student presenters at the 5th Igneous and Metamorphic Studies Group Meeting that was hosted by the Department in January with a talk entitled "PGE nano structures in natural Ni-Cu-S systems". Ms Jarlen Beukes, MSc student of Prof CDK Gauert was a recipient of a prestigious Erasmus Mundus scholarship, which allowed her to spend five to six months at the Karl-Frantzens University of Graz in Austria, where she took advanced level courses in petrology and environmental geology and furthered her research into the petrology and geochemistry of the "brown sugar" norite at Two Rivers Platinum Mine, Mpumalanga, South Africa. Mr Pelele Lehloenya, who completed his honours degree with the Department in 2012, published the results of his honours project in the international journal, *Chemie der Erde*, an uncommon achievement for an honours student.

## Special Achievements

Prof M Tredoux was a collaborator on a paper entitled "Noble metal nanoclusters and nanoparticles precede mineral formation in magmatic sulphide melts" that was accepted for publication in the eminent journal, *Nature Communications*. Prof WA van der Westhuizen was invited to deliver a keynote address entitled "Mineral resource throughput management and the 'zone' " at a conference of the Southern African Institution of Mining and Metallurgy held in May. Dr F Roelofse was selected onto the Vice-Chancellor's Prestige Scholars

Programme, a programme aimed at accelerating the scholarship of young academics. He was also elected a co-opted committee member of the Mineralogical Association of South Africa.

## Community Service

The Department once again hosted the Free State leg of the Minquiz National Science Competition that was held on 8 May 2013. A total of 29 schools (mostly from the Free State), each represented by three learners, took part in the competition. The learners were also afforded the opportunity of visiting the departments of Chemistry, Physics and Geology in order to showcase what these departments have on offer for prospective students. Prof M Tredoux successfully raised funds from the Geological Society of South Africa Research, Education and Investment Trust Fund for an EarthWise intervention planned for 2014, which will see local teachers receiving geoscience appreciation and enrichment training.

## National and International Collaboration

The Department is active in the search for both national and international collaborators interested in addressing research questions relevant to both the South African and international contexts. Collaborative efforts are, however, not only focused on research, but also excellence in teaching and the exposure of students to some of the best analytical facilities the world has to offer. The Department currently has active collaborations with the following institutions and mining companies:

- University of California, San Diego, USA: Cr-isotopic investigations;
- University of the Witwatersrand, South Africa: Bushveld Complex research; and X-Ray-computed tomographic studies of vesicular basalts for palaeobarometric reconstruction;
- Natural History Museum (Berlin, Germany): Gold fingerprinting, Bushveld Complex research;
- GFZ (Potsdam, Germany): Bushveld Complex research;
- Institute of Geology (Czech Academy of Science, Czech Republic): Bushveld Complex and Uitkomst Complex research;
- Karl-Frantzens University (Graz, Austria): Provisioning of joint postgraduate degrees;
- Council for Geoscience, Pretoria: Geochemistry of Hg in igneous rocks; geophysics of the Namaqua mobile belt;
- University of Gothenburg (Sweden): Geochronology of the Namaqua mobile belt;
- Harmony Gold: Rock mechanics;
- Impala Platinum: Bushveld Complex research;
- University of Leoben, Austria: Mineralogy of microscopic phases in the Bon Accord NiO body (Barberton Mountainland);
- Bonn University, Germany: PGM research; and
- Martin-Luther University of Halle-Wittenburg, Germany: Joint research/master's projects and mutual student internships.

## Postgraduate Students

Five students, four at MSc level and one at PhD level, participated in Phase 3 of the Inkaba ye Africa programme. Financial support to the tune of R121 000 was received to fund their research in 2013, to add to the R150 000 which was received in 2012.

## Research

Staff and students of the Department continued research in virtually all of the major sub-disciplines of the subject area. The major current research foci of the Department are: i) petrology, geochemistry, and mineralisation of the Bushveld Complex and associated intrusives (e.g. the Uitkomst Complex); ii) geology, sedimentology, and stratigraphy of the Karoo Supergroup; iii) stratigraphy, geochronology, and structural geology of the Namaqualand province; iv) gold fingerprinting; v) the geochemical behaviour of mercury in magmatic systems; vi) PGE geochemistry and mineralogy; vii) the Bon Accord NiO Ore body; viii) emerald gemmology; ix) experimental petrology in the system Ni-Cu-S-PGE; x) the relationship of pseudotachylite and its host rocks within the Vredefort Dome; and xi) soil geochemistry as a way to infer pollution vectors in urban areas.

The Department and MRTM students are also actively engaged in research related to the optimisation of mining value chains through the application of mineral resource throughput management principles.

Staff of the Department, most notably Prof Christoph Gauert, contributed to a successful bid towards an International Continental Drilling Programme (ICDP) workshop on the Bushveld Complex that will be held in Johannesburg in September 2014. The focus of the workshop will be the delineation of potential drilling targets in the Bushveld Complex, which, if funded, will see major research spinoffs being generated.

The Department is currently equipped with the following analytical infrastructure: i) JEOL JSM-6610 scanning electron microscope (SEM) with Thermo Scientific Ultradry energy-dispersive and Magnaray wavelength dispersive X-ray spectrometers; ii) Panalytical Axios wavelength dispersive X-ray Fluorescence spectrometer; iii) Panalytical Empyrean X-ray diffractometer; and iv) a variety of light microscopes including a gemmological microscope and one set up for fluid inclusion microthermometric work that is equipped with a Linkam heating-cooling stage. The Department also has access to a variety of analytical instruments housed within the departments of Chemistry and Physics.

*Mr AI Odendaal highlighting an upward coarsening cycle typical of deltaic environments to first-year students in the Jagersfontein district.*

*Third-year students examining pseudotachylite occurring within granitic gneisses of the Vredefort Dome, the largest known terrestrial meteorite impact site.*

*Excavations for the Department's new core storage facility. Prof W van der Westhuizen can be seen inspecting the excavations (middle, back).*

*Honours students on the annual economic geology field trip organised by Prof C Gauert at Richards Bay Minerals.*

*Participants at the 5th Igneous and Metamorphic Studies Group meeting that was hosted by the Department in January 2013.*

# Research Outputs

## Research Articles

**Claassen, J.O.** 2013. Yield improvement at a mid-sized coal mine. *The Journal of the Southern African Institute of Mining and Metallurgy* 113: 761-768.

**Colliston, W.P. & Schoch, A.E.** 2013. Wrench shearing during the Namaqua Orogenesis – Mesoproterozoic late stage deformation effects during Rodinia assembly. *Precambrian Research* 233: 44-58.

**Gauert, C.D.K., Van der Westhuizen, W.A., Claassen, J.O., Viljoen, S. & Grobler, J.** 2013. A progress report on ultra-high-pressure waterjet cutting underground: The future of narrow reef gold and PGE mining. *The Journal of the Southern African Institute of Mining and Metallurgy* 113: 441-448.

**Helmy, H.M., Ballhaus, C., Fonseca, R.O.C., Wirth, R., Nagel, T. & Tredoux, M.** 2013. Noble metal nanoclusters and nanoparticles precede mineral formation in magmatic sulphide melts. *Nature Communications* 4: 2405.

**Lehloenya, P.B. & Roelofse, F.** 2013. Mercury distribution amongst co-existing silicates within the Bushveld Complex. *Chemie der Erde* 73: 261-266.

**Mathur, R., Gauert, C.D.K., Ruiz, J. & Linton, P.** 2013. Evidence for mixing of Re-Os isotopes at <2.7 Ga and support of a remobilized placer model in Witwatersrand sulfides and native Au. *Lithos* 164-167: 65-73.

**Prinsloo, H.B. & Claassen, J.O.** 2013. The use of change management and behaviour-based training in an improvement project aimed at creating organizational sustainability in a multicultural mining environment in Zambia. *The Journal of the Southern African Institute of Mining and Metallurgy* 113: 747-759.

**Roelofse, F.** 2013. Comments on the paper 'Mineralogical and geochemical analyses of the healing elements in clayey soils from Isinuka traditional spa in Port St Johns, South Africa'. *Transactions of the Royal Society of South Africa* 68(3): 175-176.

**Roelofse, F. & Saunders, I.** 2013. A first report on meteor-generated seismic signals as detected by the SANSN. *South African Journal of Science* 109(5/6): Art. #0022.

## Chapter in book

**Coetzee, H., Kotoane, M., Atanasova, M. & Roelofse, F.** 2013. Interactions between dolomite and acid mine drainage in the Witwatersrand basin – Results of field and laboratory studies and the implications for natural attenuation in the West Rand Goldfield. In: *Reliable mine water technology, Volume 1.* Edited by A. Brown, L. Figueroa and C. Wolkersdorfer. Publication Printers: Denver, Colorado. pp. 307-312

**Gauert, C.D.K., Kotze, E., Beukes, J.J. & Giebel, H.** 2013. Reef disturbances of Critical Zone rocks of the eastern Bushveld Complex in the vicinity of the Steelpoort fault, South Africa – petrogenetic implications. *Proceedings of the 12th Biennial SGA Meeting: Sweden Mineral Deposit Research for a High-tech World Volume 3, edited by E. Jonsson.* Uppsala, Sweden, 12-15 August 2013. pp. 989-992.

**Guenther, C. & Gauert, C.D.K.** 2013. The spatial distribution and geochemical characteristics of the talc-carbonate alteration of the Uitkomst Complex. *Proceedings of the 12th Biennial SGA Meeting: Sweden Mineral Deposit Research for a High-tech World Volume 3, edited by E. Jonsson.* Uppsala, Sweden, 12-15 August 2013. pp. 993-996.

## Staff

**Professor:** Prof WA van der Westhuizen.

**Associate Professors:** Profs WP Colliston, CDK Gauert, and M Tredoux.

**Senior Lecturers:** Drs JO Claassen, HE Praekelt, and F Roelofse.

**Junior Lecturers:** Mrs J Magson, HCF Pretorius, and Mr AI Odendaal.

**Affiliated Academic/Research Staff:** Profs GJ Beukes, DE Miller, R Scheepers, and AE Schoch, Drs JC Loock, L Nel, PJ Pretorius, and H Prinsloo, Messrs AC Dunne, PJ Grobler, PG Laurens, and MJAR Vrijens.

**Secretary:** Mrs PS Swart.

**Administrative Officer:** Mrs R Immelman.

**Technical Support Staff:** Messrs J Choane, A Felix, D Radikgomo, and PH Roodt.

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Department of

# Mathematical Statistics and Actuarial Science

## Overview

The Department of Mathematical Statistics and Actuarial Science has about 4 000 undergraduate and 40 postgraduate students. The Actuarial programme is accredited (Level 1) with the Actuarial Society of South Africa under a mutual recognition agreement with the Institute of Actuaries in the United Kingdom.

## Activities and Achievements

The Department finished the year with an excellent record in publication outputs with 13.4 publication units in scientific journals.

Prof Max Finkelstein, an international authority in the area of mathematical reliability, published (with Prof Ji Whan Cha, Ewha Women's University, Korea) a monograph on "Stochastic Modeling for Reliability: Shocks, Burn-in and Heterogeneous populations". The monograph appeared with the prestigious *Springer Publishers* in London. Prof Finkelstein was the main organiser and chairman of the Programme Committee of the 8th International Conference on Mathematical Methods in Reliability, Stellenbosch, 1 to 4 July 2013. Prof Finkelstein was the editor of the *South African Statistical Journal*.

In August 2013, Prof Finkelstein was promoted to Outstanding Professor.

In June 2013, Mrs Linda van der Merwe, senior lecturer in the Department, obtained her PhD (Interdisciplinary: Higher

Education Studies and Statistics) from the University of the Free State, with a thesis entitled "An analysis of the field of statistics education research with special reference to computer-assisted teaching and learning".

An honours student in Mathematical Statistics, Ms Tumelo Moreri, was awarded a Mandela Rhodes scholarship.

Prof Abrie van der Merwe was elected honorary member of the South African Statistical Association in November 2013.

Prof Robert Schall served as an associate editor of the *South African Statistical Journal*.

*Participants at the annual Workshop on Applications of Statistics and Probability in Energy, Finance and Actuarial Science.*

## Visitors to the Department

The Department received several national and international visitors; among them Profs Jan Dhaene and Jan Beirlant (both from the Catholic University of Louvain, Belguim) who presented lectures at the annual Workshop on Applications of Statistics and Probability in Energy, Finance and Actuarial Science, hosted by the Department in February 2013. The workshop was organised by Mr Frans Koning, leader of the Department's Actuarial Programme.

## International Collaborative Research Projects

Prof Max Finkelstein has three ongoing international research projects. The first project is with Prof JH Cha (Ewha Women's University, Korea) on "Burn-in and heterogeneous populations". The second project, with Profs J Vaupel and T Missov (Max Planck Institute for Demographic Research, Rostock, Germany) is on "Stochastic models for mortality"; collaboration includes annual visits to the Max Planck Institute for six weeks. Finally, Prof Finkelstein collaborates with the Reliability Unit (Dr Rozenhaus) of St. Petersburg Elektropribor Institute in Russia on "Reliability modeling of complex systems"; this project includes annual visits to the Elektropribor Institute for about two months.

Prof Robert Schall is a statistical consultant to Quintiles, an international clinical contract research organisation, to Boehringer Ingelheim, an international pharmaceutical company, and to TB Alliance, an international non-governmental organisation dedicated to the development of new treatments for tuberculosis. The joint project with TB Alliance (Dr Carl Mendel) involves the "Statistical characterisation of the early bactericidal activity of anti-tuberculosis drugs". Prof Schall collaborates with Dr Arne Ring of the University of Leicester, UK, in the area of "bridging methods for bioequivalence studies". During the year, Dr Ring was appointed as an affiliate professor at the University of the Free State.

*Department of Mathematical Statistics and Actuarial Science 2013.*

# Research Outputs

## Research articles

**Cha, J.H. & Finkelstein, M.** 2013. A note on the class of geometric counting processes**.** *Probability in the Engineering and Informational Sciences* 27: 177-185.

**Cha, J.H. & Finkelstein, M.** 2013. On generalized shock models for deteriorating systems. *Applied Stochastic models in business and industry* 29: 496-508.

**Cha, J.H. & Finkelstein, M.** 2013. On history-dependent shock models. *Operations Research Letters* 41: 232-238.

**Cha, J.H. & Finkelstein, M.** 2013. Results for burn-in of systems under external shocks. *IEEE Transactions on Reliability* 62: 662-771.

**Cha, J.H. & Finkelstein, M.** 2013. The failure rate dynamics in heterogeneous populations**.** *Reliability Engineering and System Safety* 119: 120-128.

**Chikobvu, D. & Chinhamu, K.** 2013. Random walk or Mean reversion? Empirical evidence from the crude oil market *iSTATiSTiK*. *Journal of the Turkish Statistical Association* 6: 1-9.

**Chikobvu, D. & Sigauke, C.** 2013. Modelling effect of temperature on daily peak electricity demand in South Africa. *Journal of Energy in Southern Africa* 24: 63-70.

**Chikobvu, D., Sigauke, C. & Verster, A.** 2013. Analysis of the same day of the week increases in peak electricity demand in South Africa. *ORION* 99: 125-136.

**Cronjé, N., Steyn, H.J.H. & Schall, R.** 2013. A comparison of the influence of catholyte vs phosphate detergent on the mechanical properties of poyamide 6,6 woven fabric. *Journal of Family Ecology and Consumer Sciences* 41: 1-11.

**Finkelstein, M.** 2013. Lifesaving, delayed deaths and cure in mortality modelling. *Theoretical Population Biology* 83: 15-20.

**Finkelstein, M.** 2013. On dependent items in series in different environments. *Reliability Engineering and System Safety* 109: 119-122.

**Finkelstein, M.** 2013. On some comparisons of lifetimes for reliability analysis. *Reliability Engineering and System Safety* 119: 300-304.

**Joubert, H., Viljoen, M. & Schall, R.** 2013. Performance of first-year accounting students: Does time perspective matter? *Acta Academica* 45: 242-267.

**Schall, R. & Weatherall, D.** 2013. Accuracy and fairness of rain rules for interrupted one-day cricket matches. *Journal of Applied Statistics* 40: 2462-2479.

**Shaffie, M., Finkelstein, M. & Zuou, M.J.** 2013. Optimal burn-in and preventive maintenance warranty strategies with time-dependent maintenance costs. IIE *Transactions (Institute of Industrial Engineers)* 45: 1024-1033.

**Sigauke, C., Verster, A. & Chikobvu, D.** 2013. Extreme daily increases in peak electricity demand: tail quantile estimation. *Energy Policy* 53: 90-96.

**Van Zyl, J.M.** 2013. A simulation study to investigate the accuracy of approximating averages of ratios using ratios of averages. *Journal of Infometrics* 7: 907-913.

**Van Zyl, J.M.** 2013. A weighted least squares procedure to approximate least absolute deviation estimation in time series with specific reference to infinite variance unit root problems. *SA Statistical Journal* 47: 61-70.

**Van Zyl, J.M.** 2013. The generalized Pareto distribution fitted to research output of countries. *Scientometrics* 94: 1099-1109.

**Van Zyl, J.M. & Van der Merwe, S.** 2013. An empirical study to find an approximate ranking of citation statistics over subject fields. *GSTF Journal of Mathematics, Statistics and Operations Research (JMSOR)* 2(1).

**Verster, A. & De Waal, D.J.** 2013. The Generalized t-distribution: A generalization to the positive tail of the t distribution. *South African Statistical Journal* 47: 71-83.

## Staff

**Outstanding Professor:** Prof Max Finkelstein.

**Professors:** Profs Daan de Waal, Robert Schall, and Abrie van der Merwe.

**Senior Lecturers:** Drs Linda van der Merwe, Andréhette Verster, Delson Chikobvu, Martin van Zyl, and Mr Frans Koning.

**Lecturers:** Dr Morné Sjölander, Mss Elizabeth Girmay, Zani Ludick, Wallina Oosthuizen, Messrs Dries Naudé, Sean van der Merwe, and Michael von Maltitz.

**Part-time Lecturers:** Dr Ariane Neethling, Mrs L da Silva, Messrs Stefan Britz, and DB Fourie.

**Secretary:** Mrs Elize Mathee.

**Messenger:** Mr William Baranye.

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Department of

# Mathematics and Applied Mathematics

## Overview

The Department of Mathematics and Applied Mathematics offers a variety of modules – some with emphasis on the more abstract side of mathematics, and others on the applicable side of mathematics. Students that finish their studies in our department typically obtain the degrees BSc, BCom and sometimes even BA. We also offer service modules to many students that study in other scientific directions, such as Biology. Furthermore, we are intensively involved with bridging programmes to assist students who do not comply with the necessary entrance requirements for mainstream or other directions in mathematics. This creates better opportunities for them to enter these programmes.

The Department is also concerned with what is happening on school level. Some of the staff members are closely involved with the training of learners who are interested in mathematics olympiads.

## Activities and Achievements

Prof JH Meyer continued his research by visiting a colleague in Miskolc, Hungary, as well as a colleague at Texas A&M University in the USA. During the former visit, he also presented an invited talk at the Alfred Rényi Institute in Budapest, Hungary. A PhD student from Botswana under his

co-supervision finished his degree. Two research papers (one of which is already accepted for publication) were written due to these visits, and one from the thesis of the mentioned student. Furthermore, Prof Meyer was closely involved (for the past 20 odd years) with the training and setting of papers with respect to mathematics olympiads, nationally and internationally. He was the main organiser of an international conference on rings, near-rings and radicals that took place on the campus of the University from 7 to 13 July. He also reviewed several papers for *Zentralblatt Math*, as well as for *Math Reviews*. He was also appointed as the chairperson for the problem selection committee of the upcoming International Mathematical Olympiad to be held in South Africa in July 2014.

Dr S Dorfling collaborated with two PhD students in a project on Edge Equivalence. Two publications are expected to follow from it.

Prof TM Acho was appointed as an external examiner for Nelson Mandela Metropolitan University, and also acted as an external examiner for mathematics modules presented at the Central University of Technology in Bloemfontein. He also reviewed one paper for the *American Mathematical Society Math Review* database and another for the NRF.

## Research Outputs

### Research Articles

**Atangana, A. & Cloot, A.** 2013. Stability and convergence of the space fractional variable order Schrodinger equation. *Advances in Difference Equations* 2013: 80.

**Childs, S.J.** 2013. A set of discrete formulae for the performance of a tsetse population during aerial spraying. *Acta Tropica* 125: 202-213.

**Dorfling, M.J. & Dorfling, S.** 2013. Graph colourings with forbidden k-coloured subgraphs. *Quaestiones Mathematicae* 36(4): 537-548.

**Mavimbela, L., Van Rensburg, L. & Cloot, A.** 2013. Characterising vertical redistribution on irrigated furrows in the Tukulu soil. *Journal of Agricultural Science and Technology* A(3): 542-560.

**Oguoma, I.C. & Cloot, A.** 2013. Possible application of fractional order derivative to image edges detection. Journal of Life Science 10(4): 171-176.

**Schröder, J.** 2013. The two-parameter class of Schröder inversions. *Commentationes Mathematicae Universitatis Carolinae* 54(1): 5-19.

### Staff

**Professors:** Profs Johan Meyer (chair), Alain Cloot and Schalk Schoombie.

**Associate Professor:** Prof Thomas Acho.

**Senior Lecturers:** Dr Samantha Dorfling and Ms Julia van Niekerk.

**Lecturers:** Ms Ansa Kleynhans and Mr Christiaan Venter.

**Temporary Lecturers:** Prof Dana Murray, Dr Hubertus Bargenda, Mss Elizabeth Viljoen, Anita Swart, Marina Botha, Hermina Oosthuizen, Karen Junqueira, Messrs Jon Smit, Ben-Eben de Klerk, and Marco Fasondini.

**Post-doc Fellow:** Dr Simon Childs.


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Department of

# Microbial, Biochemical and Food Biotechnology

## Overview

The year started with the wonderful news that R22 million had been granted to the Department by the Department of Higher Education (DHE) towards the upgrade of the biotechnology building. There was a great need for a complete renovation of the building, and the plans also included the construction of a two-storey wing on the southern side of the building to house a new research laboratory, seminar room, and offices. Construction was scheduled to commence in the first half of 2014. This upgrade, together with the new undergraduate laboratories, built at a cost of R15,9 million (also from DHE) and taken into use at the beginning of 2012, will vastly improve the facilities for undergraduate training and graduate research in the Department.

Research in various fields yielded significant and novel findings. Academics from the Department received recognition and interacted with various organisations and institutions, both locally and abroad, as indicated below. The Department was also well represented by staff and students at various conferences. The Kovsie Microbrewers team, founded in 2013, entered the SA Breweries Intervarsity Beer-Brewing Challenge for the first time and won in one category against stiff competition. Furthermore, funding was granted for establishing a microbrewery at the UFS. Our fourth-year Food Science students also did well in the first Undergraduate and Honours New Product Development Competition during the SAAFoST congress in Pretoria by reaching the finals.

A total of 16 lectures and 17 posters were presented at 15 international conferences by staff and students; whereas 12 lectures and 16 posters were presented at 7 national conferences.

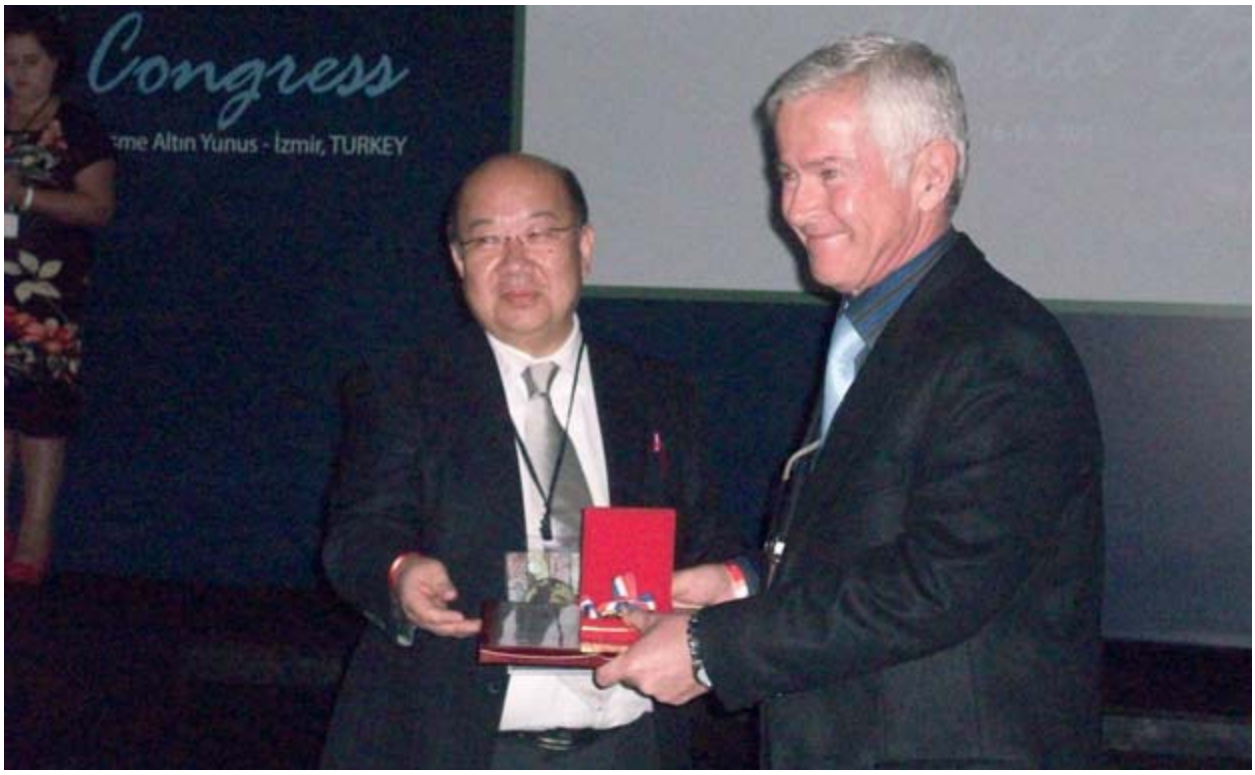
## Activities and Achievements

Our younger academics excelled. A Fulbright scholarship was awarded to Dr Olihile Sebolai for a research visit to the University of Missouri, Kansas City, USA, from 15 August to 31 December. Dr Chantel Swart was invited to present a paper at the 4th International Nanomedicine Conference in Sydney, Australia, in July 2013.

Prof Lodewyk Kock was honoured by his inclusion in the Supervisors' Hall of Fame of the UFS Postgraduate School, in recognition of his hard work and dedication to the professional advancement of postgraduate students at the UFS. He was also a finalist for an NSTF (National Science & Technology Forum) – BHP Billiton Award in the category of "TW Kambule Award sponsored by the NRF: Individual through research and its outputs over the last 5 to 10 years". Further honours was bestowed upon Prof Kock when the academic council of the International Association of Advanced Materials (IAAM) awarded him the IAAM Medal for his outstanding contribution to the field of Materials Science and Technology. The medal was presented during the opening ceremony of the Advanced Materials World Congress (AMWC 2013) on 17 September 2013 in Turkey. Prof Kock also presented the IAAM Medal Lecture at this international congress. His nomination was mainly based on his nanotechnology research, which was a team effort with Prof Kock as project leader in collaboration with Profs Hendrik Swart (Department of Physics), Pieter van Wyk (Centre for Microscopy), Carlien Pohl, and Dr Chantel Swart (both of the Department of Microbial, Biochemical and Food Biotechnology) and Dr Liza Coetsee (Department of Physics), as well as many postgraduate students.

Dr Trudi O'Neill attended a NRF/EFI workshop held in Mozambique as part of the Mozambique/South Africa Research Cooperation Programme to strengthen research activities between the two countries. Dr O'Neill holds a SA/MOZ bilateral grant for the whole genome characterisation of Mozambican rotavirus field strains. Dr O'Neill also co-organised an EFINTD (European Foundation Initiative into Neglected Tropical Diseases) Discussion Group Meeting in Kumasi, Ghana, from 4 to 7 August 2013. The purpose of this workshop was to discuss the future of the EFINTD fellows in Sub-Saharan Africa. Together with a follow-up meeting in Hannover, Germany, in October, this workshop resulted in the formation of the African Research Network for Neglected Tropical Diseases (ARNTD) with initial financial support from EFINTD. Dr O'Neill is currently a member of the Executive Committee of ARNTD.

Prof James du Preez attended meetings in January and April in Brussels as a member of a grant evaluation panel of the European Research Council. He was also invited to present




*Prof Lodewyk Kock receiving the IAAM Medal at the AMWC congress in Turkey for his outstanding contribution in the field of Materials Science and Technology.*

*The EFINTD group discussion meeting held in Kumasi, Ghana, from 4 to 7 August 2013. Pictured here are 17 EFINTD fellows, three representatives from the Volkswagen Foundation, and one representative from the Nuffield Foundation.*

a talk in London, UK, at a symposium for journal editors of BioMed Central Publishers, who publish 257 open access journals, in his capacity as joint editor-in-chief of the journal *Biotechnology for Biofuels*. Subsequently, he was appointed to serve for a two-year period on the BioMed Central Editors Advisory Group, comprising ten editors-in-chief. In February Prof du Preez was invited to present a talk on biotechnology at the newly founded Instituto Superior Politécnico de Manica (ISPM) in Chimoio, Mozambique, and also to consult with the staff of this institution on establishing training and research in biotechnology. A follow-up visit to the University of the Free State by a small delegation from ISPM was undertaken in October. This project was funded by the Netherlands Initiative for Capacity Development in Higher Education.

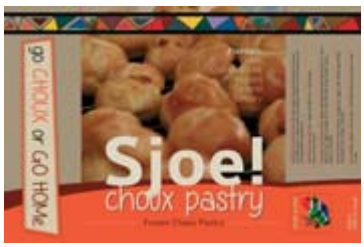
Prof Rob Bragg, Ms Charlotte Boucher, and four postgraduate students attended the World Veterinary Poultry Association (WVPA) congress in Nantes, France, in August, giving two oral and six poster presentations. Funding was from the South African Poultry Association, the Hougton Trust, and TradeVet.

Research findings making headlines included the work of Prof Kock's group who, using a new imaging nanotechnology called Auger-architectomics, discovered the accumulation of gas bubbles inside yeast cells. The latter is considered a paradigm shift in biology and medicine. This finding caught the attention of scientists at the Tumor Angiogenesis and Vascular Biology Research Centre of the Mayo Clinic in the USA, resulting in collaboration with the UFS group. These findings were published in *FEMS Yeast Research*, the leading international journal on yeast research, and an image from this paper was selected for display on the cover page of all the 2013 issues of this journal.

Other interesting research was reported in the journal *South African Food Science and Technology* regarding the effect of conjugated linoleic acid (CLA) supplementation on the quality of fermented sausages. Based on the MSc work of Donald Cluff, under the supervision of Profs Arno and Celia Hugo, this article showed that dietary supplementation of pigs with CLA improved the technological properties of pork backfat to such an extent that it was more suitable for use in fermented sausages such as salami. Furthermore, partial replacement of pork back fat and the direct addition of CLA to salami proved to be an effective method of increasing CLA to a level that salami could be considered a functional food with nutraceutical properties without compromising product quality.

During the biennial conference of the South African Society for Microbiology (SASM) that took place in Bela-Bela on 24 to 27 November, Ruan Fourie and Thabiso Motaung were awarded the SASM national prizes for the best BScHons and best MSc students in microbiology, respectively. This meeting was attended by six academics and 15 postgraduate students from the Department. At the conference, Prof Koos Albertyn was elected president of SASM and Dr Chantel Swart as a new council member. Profs Carlien Pohl-Albertyn (treasurer) and James du Preez are current members of the SASM council.

Three groups of fourth-year Food Science students reached the final of the first Undergraduate and Honours New Product Development Competition, held during the SAAFoST (South African Association for Food and Science Technology) congress in Pretoria from 7 to 9 October 2013. The products that were entered included "Amaize cakes" (savoury filled maize flour "vetkoeke"), "African Secrets" (cupcakes with




*Labels of three products entered in the New Product Development Competition at the SAAFoST conference, Pretoria.*

traditional local fillings like milktart, milkstout, and coconut ice) and "Sjoe! Choux Paste" (flavoured frozen choux pastry) (see photos).

The Department's Kovsie Microbrewers team won the beer bottle labelling category of the annual SA Breweries (SAB) Intervarsity Beer-Brewing Challenge held in Gauteng, 30 to 31 August. The winning set of labels not only had to be appealing but also technically correct for the particular style of beer (see photos). In the six years since the inception of the first official SAB Intervarsity Beer-Brewing Challenge, the competition has grown into a prestigious event with 12 university teams competing in various categories in 2013 and in 2014 a couple of teams from abroad will also enter the competition. In addition to the R10 000 prize, certificate and floating trophy for the winning label, Prof James du Preez also received a grant of R40 000 from SAB and the South African Stainless Steel Development Association (SASSDA) towards the design and construction of a microbrewery at UFS. With such a new facility, the Kovsie Microbrewers team hopes to have at least one of the Kovsie brews placed among the three best beers at the next competition. It is also envisaged that this microbrewery would be employed as a valuable teaching aid for honours and possibly also undergraduate students, since the brewing process incorporates aspects of Biochemistry, Microbiology (specifically yeast physiology), and Food Science; which are the three disciplines accommodated in the department, and would therefore serve as an excellent vehicle to integrate these three disciplines in the tuition of the students.

This year was an exception in that we had no PhD graduates, but eight MSc students received their degrees.

*The Kovsie Microbrewers team. Front, fltr: Armand Bester, Jan-G Vermeulen, and Errol Cason. Back, fltr: Katlego Mthethwa, James du Preez, and Antonie Meyer.*


*The winning beer label at the SA Breweries Intervarsity Beer-Brewing Challenge.*

*Agave americana* ***during various stages of flowering.***

## Research

The Department comprises two divisions, namely Microbiology and Biochemistry, and Food Science. Within these divisions there are various research groups. Activities of some of these research groups not reported before are indicated below.

In the **Food Science** Division**,** the research of Prof Celia Hugo on the microbial quality of food is ongoing, especially on the chryseobacteria and their significance in food. In 2013 a new species was described, namely *Chryseobacterium carnipullorum*, isolated from chicken meat. It was also found that this species has keratinolytic activity that can break down poultry feathers. Such a novel keratinolytic isolate has potential for biotechnological use in processes involving keratin hydrolysis.

Prof Arno Hugo and his postgraduate students continued with investigations into the manipulation of the lipid component of diets of farm animals with the aim of improving the technological and/or health properties of fat tissue from such animals. A project in collaboration with the University of Fort Hare demonstrated that the inclusion of *Moringaolifeira* leaf meal improved the oxidative stability of goat meat. In another research project, the preservative action of a commercial extract of the Bergamot orange was evaluated for its preservative and antioxidant effect on South African boerewors. The rationale behind this project was the fact that the modern health-conscious consumer rejects the use of chemical preservatives in food, but still demands food with an acceptable shelf life. There is therefore an urgent need for innovative research on the preservative effect of natural compounds from animals, plants and even micro-organisms.

In the Sensory and Product Development laboratory, Dr Carina Bothma investigated the sensory profiling of the flowers of the *Agave americana* plant, after undergoing various treatments such as steaming, stir frying and pickling. The nutritional composition was also determined and new products developed, namely agave flower stew, battered deep-fried agave flowers and flourless chocolate cake. A poster from this study was named best poster at the SAAFECS (South African Association of Family Ecology and Consumer Science) conference in Pretoria, 27 February to 1 March 2013. In collaboration with Prof Celia Hugo, lucerne was also tasted by a consumer panel of 400 members to determine the acceptability of this animal feed for human consumption. In collaboration with Dr Maryna de Wit, mucilage from the cladodes of the cactus pear was used in combination with other hydrocolloids in the manufacturing of marshmallows. Very promising results were obtained and it seems evident that the best results will be achieved when this mucilage is used in combination with a hydrocolloid such as xanthan gum. In the food industry, more than one hydrocolloid is often used to get the desired result.

The research of Dr Maryna de Wit and her co-workers focused on an investigation of the antioxidant quality (content and potential) of the fruit (pulp, peel, and seeds) and cladodes from cactus pears (*Opuntia ficus-indica* and *Opuntia robusta*). The project was further expanded to include the effect of processing (juicing, drying, whole preserves, pickling, and chutney making) on the antioxidant content and potential of the fruit and cladodes. Currently, the cladodes are being investigated as a source of nutraceutical compounds. The use of cladodes in vegetable juice processing was also investigated. Mucilage, a major compound in cactus pear fruit and cladodes that is responsible for the slimy appearance, was investigated for its role as a water binder and gelling agent in food products such as marshmallows. Cactus cladode flour is rich in dietary fibre and was investigated for use in baked products such as health bread. Waste products, such as the seeds, were also investigated in terms of protein and amino acid content, as well as to characterise these proteins.

The **Extreme Biochemistry Group**, where the TIA/UFS Metagenomics Platform is hosted, decided on a name change to incorporate a description of current activities. The new platform name will be SAENSE Platform (this is a Sotho word for "science" but can be used as elegant acronym to describe the research – Screening Applications and Novelty in Specialised Environments). The current TIA (Technology Innovation Agency) funding will continue until 2017.

Deep subsurface sampling continued with funding from the Deep Carbon Observatory, as well as the Alfred P Sloan Foundation. The research specifically addresses microbial carbon transformations in subsurface environments. This research also links with the South African efforts SACCCS (South African Centre for Carbon Capture and Storage) and UGCG (Underground Coal Gasification) to investigate the influence that terrestrial carbon sequestration will have on active biomes. The group was also involved in collecting data and managing the equipment associated with the German collaboration in the NELSAM (National Earthquakes in South African Mines) programme. Several water quality monitoring programmes were also established in the research group to do analyses such as microbial diversity, plate counts, geochemical analysis, estrogen determinations, etc. in collaboration with Bigen Africa.

The efforts to scale up bioremediation reactors were enhanced by industrial site visits together with Prof Mary deFlaun of Geosyntec Consultants, USA, to secure two additional pilot plant projects (heavy metals and AMD) for the platform and to negotiate a third benchmark project. The group also submitted a patent application where sulphate-reducing bacteria will play a role in the remediation of acid mine drainage (AMD). This national and international collaborative network enhances projects and student development.

During 2013, Prof Esta van Heerden was appointed at North West University as distinguished professor in the Unit for Environmental Sciences and Management. She also lectured a four-part series with the Department's affiliated professor, Mary DeFlaun, at a workshop of the Institution of Engineers in Kuala Lumpur, Malaysia, in January on Biodiversity and Bioremediation of Heavy Metal Contamination. Dr Peter Williams presented the group's work at the 2nd Water Research conference in Singapore, and PhD student Mariana Erasmus was invited to a specialised workshop on high-pressure bioreactors in Annecy, France.

In the **Food Biotechnology** research group led by Prof Bennie Viljoen, research continued to focus on indigenous fermented foods and beverages with emphasis on food security in rural areas. The projects aim to improve the livelihoods and incomes of rural communities and small-scale processors through improved technologies for processing and development of fermented maize and dairy products that have the potential to be utilised as weaning and/or complementary foods for children. The projects cover a broad area in Southern Africa, such as Lesotho, Swaziland, Zambia, Botswana, etc. The projects include different activities to come up with appropriate technologies for adding value and handling technologies for fermented maize products processing, as well as fermented milk products. Successful field trips to Swaziland, Zambia, and Botswana were initiated in 2013 to collect various products and implement existing technologies. The activities included identifying the processing procedures and the problems faced so as to come up with appropriate technologies that are demand driven. The projects also determine the required conditions for the implementation of the proposed processing technologies and promote institutional arrangements for technology transfer.

The **Lipid Biotechnology** research group (including its community service unit, SAFOI), under the leadership of Profs Lodewyk Kock and Carlien Pohl-Albertyn and Dr Chantel Swart, was very productive in 2013 (see overview above and *www.ufs.ac.za/myoilguide*). In line with their mission, this group concentrated on the development of novel medicines such as anti-fungal and anti-cancer drugs. Here, yeasts are used as biosensors and linked to nanotechnology, specifically Nano Scanning Auger Microscopy (NanoSAM), to uncover medicines such as new antifungal, anti-cancer, and anti-malarial drugs. Nanobiotechnology methods utilising Scanning Electron Microscopy in conjunction with NanoSAM and targeted ion etching have been further developed in collaboration with Profs Hendrik Swart and Pieter van Wyk of the UFS Department of Physics and UFS Centre for Microscopy, respectively. The applicability of NanoSAM to nanomedicine has been identified as a research priority and will be researched in collaboration with the Mayo Clinic based in Rochester, USA. This research was presented at the 4th International Nanomedicine Conference in Sydney, Australia, in July and the Advanced Materials World congress (AMWC 2013) in Turkey in September.

A second research focus is the metabolism of lipids by pathogenic fungi. Some of these fungi are able to produce lipid hormones – a virulence factor important in host pathogen interaction. This group found that certain chemicals produced by a variety of bacteria can influence the production of lipid hormones by pathogenic yeasts. This may be important in understanding multispecies infections.

The **Molecular Virology** research group of Dr Trudi O'Neill continued research activities into the development of alternative rotavirus vaccines. Dr O'Neill presented results that stemmed from the EFINTD Senior Fellowship she was awarded for 2008–2013 at the 5th European Rotavirus Biology Meeting in Valencia, Spain, from 6 to 9 October 2013. During August to September, Valerie Oberhardt, a graduate student from the Ruprecht-Karls-Universität Heidelberg, Germany, did a six-week internship as part of the RISE worldwide programme of DAAD (German Academic Exchange Service).

The current research focus within the **Clinical Biochemistry** group, led by Dr Frans O'Neill, is human cellular detoxification and sterol metabolism. The research to detect single nucleotide polymorphisms (SNPs) within the *GLYAT* gene of a South African cohort of African descent is ongoing. GLYAT is an important role player in the second phase of detoxification where it deactivates substrates by conjugating them to

glycine and in doing so renders them ready for excretion. A project in collaboration with Prof Garry Osthoff to determine the phytosterol levels in milk from a variety of species was initiated. Data gained from this project will shed light on the phytosterol metabolism of the different species.

The **Fermentation Biotechnology** research group is led by Profs James du Preez and Stephanus Kilian, with group members Ms Laurinda Steyn and Mr Du Toit Schabort. Further research, in collaboration with Prof Koos Albertyn, on the phenotypic effects and functional genomics of multiple alcohol dehydrogenase (ADH) deletion mutations of *Saccharomyces cerevisiae* during aerobic or anaerobic growth in glucose or ethanol-limited continuous cultures revealed that when mutant strain Q5 (with only ADH5), was grown on glucose, the reduction of acetaldehyde to ethanol was apparently rate-limiting, and the use of a carbon-limited chemostat culture to facilitate growth of strain Q5 on ethanol proved successful; indicating that a previous observation of the inability of this strain to grow on ethanol was likely due to the accumulation of acetaldehyde. Phenotypic microarray analysis provided a deeper understanding of the possible functional substitution of five adhisozymes by comparing the lost or gained ability of the mutant strains to utilise substrates compared to the reference strain.

Building on the recent genome reconstruction of the yeast *Kluyveromyces marxianus*, Mr Schabort developed bioinformatics programmes for the automated completion of genome-scale metabolic pathway models and flux balance analysis simulation. Together, these systems biology methods bridge the gap between genomics and bioinformatics, and the more experimentally driven fermentation biotechnology. In addition, software was developed to extend the use of the recently acquired Omnilog phenotype microarray system for the validation and improvement of genome-scale models of metabolic pathways.

Prebiotics beneficially modify the intestinal microbial population when ingested, resulting in an improvement of the individual's health. Prof Kilian's research remained focused on prebiotic oligosaccharides produced by a yeast from sucrose. Three oligosaccharides were produced. Mass spectrometric analysis confirmed the identity of one of the oligosaccharides as a trisaccharide and another as a tetrasaccharide. The nature of the third oligosaccharide, presumably a trisaccharide, remains to be confirmed. A fractional factorial design was used to investigate the effects of several variables on the conversion of sucrose into oligosaccharides. The highest concentration of oligosaccharides obtained was 113 g $l^{-1}$, which is one of the highest reported for this type of conversion.

The aim of the **Biocatalysis** research group of Prof Martie Smit and Dr Dirk Opperman is to develop excellent biocatalysts for the introduction of oxygen into molecules. The group focuses on the oxyfunctionalisation of various natural and petrochemical hydrocarbons including monoterpenes, alkanes and alkenes by cytochrome P450 monooxygenases, as well as the synthesis of esters and lactones from the corresponding ketones. This research is funded by the DST-NRF Centre of Excellence in Catalysis and SASOL. Two new postdoctoral fellows joined the group in 2013, namely Dr Alizé Pennec from France, and Dr Felix Ferroni from Argentina. A German DAAD RISE intern, Sophia Müller, also spent ten weeks with the group. Prof Smit and Dr Opperman presented their latest research findings at the Biotrans 2013 conference in Manchester, UK. Locally, Prof Smit organised the biocatalysis session for the Catalysis Society of South Africa (CATSA) annual conference.

The **Veterinary Biotechnology** research group of Prof Rob Bragg and Ms Charlotte Boucher had a very busy year during 2013. Much of the research effort was focused on the expression system project, and a very successful project in which two genes of interest were expressed for Prof Muriel Meiring of the Medical Faculty was undertaken. This work resulted in the establishment of a novel diagnostic kit which will be patented in 2014 by Prof Meiring. The work on the beak and feather disease virus also continued and the expressed coat protein gene was used for the development of a novel diagnostic test for the disease, which is in the process of being patented. The expressed antigen was also used to establish an ELISA test for the detection of antibodies in birds. Studies on the ability of the expressed antigen to elicit an immune response in birds were also successfully undertaken. It was also established that all strains of *Avibacterium paragallinarum* (the bacterium that causes infectious coryza in poultry), carry various phage genes. Further investigation into the role of these phage genes in virulence and protective immunity is now under investigation. The fact that Ms Boucher demonstrated that Toll-like Receptor 7 (TLR-7) is highly unregulated in chickens infected with the highly pathogenic serovar C-3 strain of *A. paragallinarum,* was also very exciting. TLR-7 is normally only up-regulated in response to infection with RNA viruses. The fact that TLR-7 was up-regulated when chickens were infected with *A. paragallinarum* raises the question whether the phages (or phage genetic elements) that have been detected in *A. paragallinarum* play a major role in pathogenicity. Dr Chris Theron joined the group as a post-doctoral during 2013 and he is mainly working on the expression system project.

# Research Outputs

## Research Articles


**Barbour, E.K., Shaib, H., Azhar, E., Kumosani, T., Iyer, A., Harakeh, S., Damanhouri, G., Chaudary, A. & Bragg, R.R.** 2013. Modulation by essential oil of vaccine response and production improvement in chicken challenged with velogenic Newcastle disease virus. *Journal of Applied Microbiology* 115: 1278-1286.

**Booyens, K.E., Einkamerer, O.B., Van der Merwe, H.J., Hugo, A., Slippers, S.C. & Fair, M.D.** 2013. The effect of dietary lipid saturation and antioxidant source on the nutrient digestibility of lamb finishing diets. *South African Journal of Animal Science* 43: 22-26.

**Bragg, R.R. & Kock, J.L.F.** 2013. Nanomedicine and infectious diseases. *Expert Review of Anti Infective Therapy* 11: 359-361.

**Buitendach, G.C., De Witt, F.H., Hugo, A., Van der Merwe, H.J. & Fair, M.D.** 2013. Effect of dietary fatty acid saturation on egg production at end-of-lay. *South African Journal of Animal Science* 43: 126-130.

**Charimba, G., Jooste, P., Albertyn, J. & Hugo, C.** 2013. *Chryseobacterium carnipullorum* sp. nov., isolated from raw chicken. *International Journal of Systematic and Evolutionary Microbiology* 63: 3243-3249.

**Du Toit, A.N., Einkamerer, O.B., Hugo, A., Van der Merwe, H.J. & Fair, M.D.** 2013. The effect of dietary lipid saturation and monensin-Na on the CLA content of lambs' meat. *South African Journal of Animal Science* 43: 81-85.

**Ells, R., Kemp, G., Albertyn, J., Kock, J.L.F. & Pohl, C.H.** 2013. Phenothiazine is a potent inhibitor of prostaglandin $E_2$ production by *Candida albicans* biofilms. *FEMS Yeast Research* 13: 849-855.

**Girhard, M., Tieves, F., Weber, E., Smit, M.S. & Urlacher, V.B.** 2013. Cytochrome P450 reductase from *Candida apicola*: versatile redox partner for bacterial P450s. *Applied Microbiology and Biotechnology* 97: 1625-1635.

**Huchzermeyer, K.D.A., Osthoff, G., Hugo, A. & Govender, D.** 2013. Comparison of the lipid properties of healthy and pansteatitis-affected African sharptooth catfish, *Clarias gariepinus* (Burchell) and the role of diet in pansteatitis outbreaks in the Olifants River in the Kruger National Park, South Africa. *Journal of Fish Diseases* 36: 897-909.

**Hugo, A. & Moholisa, E.** 2013. Moisture enhancement of pork: Quality improvement or adulteration? *Porcus* June/July: 10-13.

**Jansen, A.C., Boucher, C.E., Coetsee, E., Kock, J.L.F., Van Wyk, P.W.J., Swart, H.C. & Bragg, R.R.** 2013. The influence of didecyldimethylammonium chloride on the morphology and elemental composition of *Staphylococcus aureus* as determined by NanoSAM. *Scientific Research and Essays* 8: 152-160.

**King, E.J., De Witt, F.H., Van der Merwe, H.J., Hugo, A. & Fair, M.D.** 2013. The effect of lipid saturation on nutrient digestibility of layer diets. *South-African Journal of Animal Science* 43: 131-134.

**Kumwenda, B., Litthauer, D., Bishop, Ö.T. & Reva, O.** 2013. Analysis of protein thermostability enhancing factors in industrially important *Thermus* bacteria species. *Evolutionary Bioinformatics* 9: 327-342.

**Mlera, L., O'Neill, H.G., Jere, K.C. & Van Dijk, A.A.** 2013. Whole-genome consensus sequence analysis of a South African rotavirus SA11 sample reveals a mixed infection with two close derivatives of the SA11-H96 strain. *Archives of Virology* 158: 1021-1030.

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## Staff

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**Distinguished Professor:** Prof Lodewyk Kock.

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**Associate Professor:** Prof Carlien Pohl-Albertyn.

**Senior Lecturers:** Drs Frans O'Neill, Trudi O'Neill, Dirk Opperman, and André van Tonder.

**Lecturer:** Dr Olihile Sebolai.

**Junior Lecturers:** Ms Charlotte Boucher and Mr Du Toit Schabort.

**Researchers:** Dr Chantel Swart and Ms Laurinda Steyn.

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**Affiliate Associate Professor:** Prof Bettie Lodolo.

**Research Associate:** Prof Derek Litthauer.

**Secretary:** Ms Millie Cohen.

**Senior Officers: Professional Services:** Mr Sarel Marais and Ms Nel-Marie Aggenbag.

**Officers: Professional Services:** Mss Suzanne Brandt, Yvette Makaum, Christelle van Rooyen, Dalene van den Berg, and Andri van Wyk.

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**Division of Food Science**

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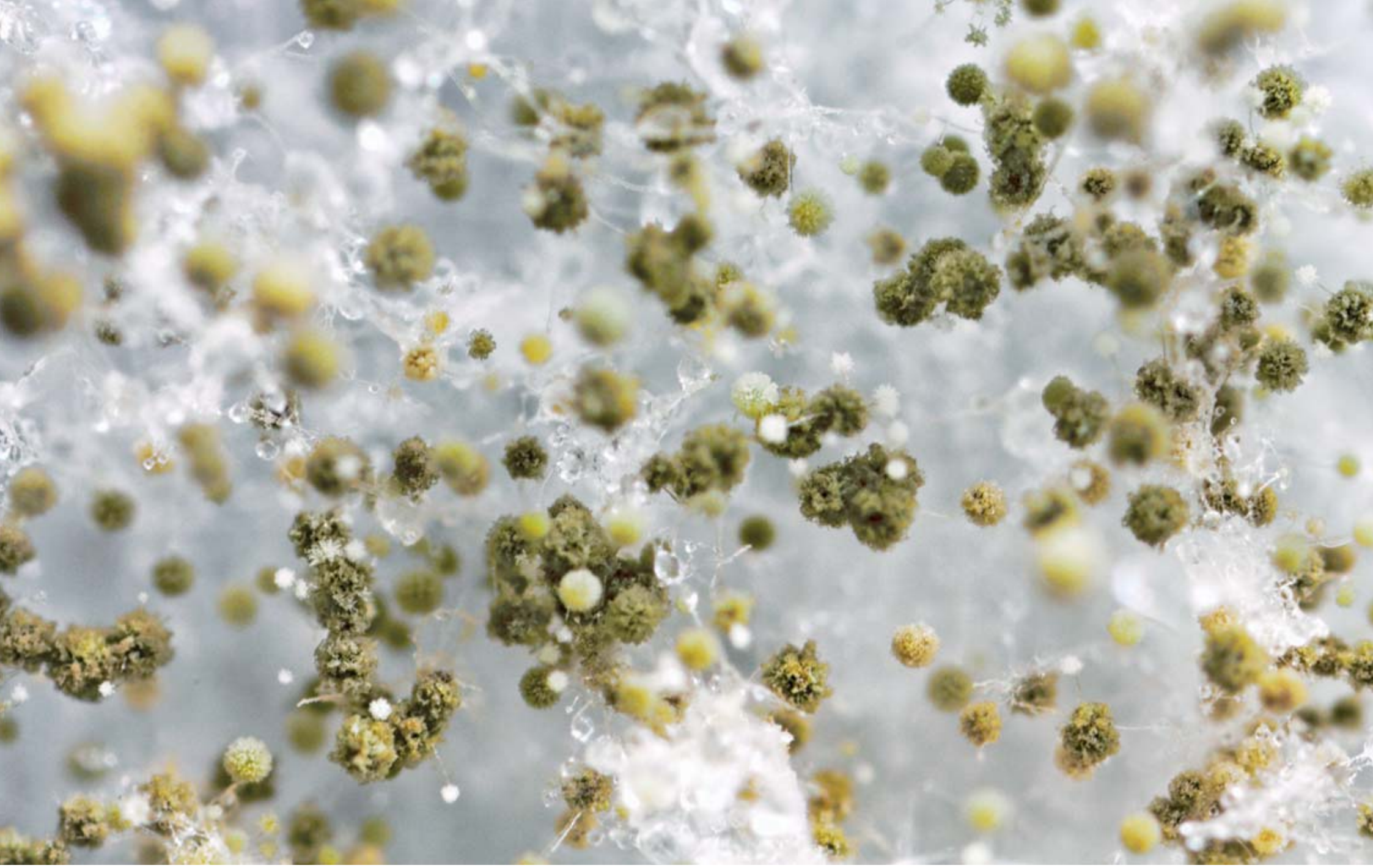

Department of

# Physics

## Overview

The Department of Physics is recognised internationally as one of the leading physics departments in astrophysics, phosphor, and solid state research. The Department hosts a very well-equipped nano-surface characterisation laboratory (with state-of-the-art research infrastructure) and an observatory (Boyden) with a 1,5 m telescope. The undergraduate and graduate programmes are challenging and well balanced; the students exiting these programmes are of a high quality and sought after by industry. Most of our staff members are also involved with the Boyden Science Centre and Naval Hill Planetarium which are actively involved with local, provincial, and national communities.

## Activities and Achievements

It was another successful year for the phosphor group. A Sarchi chair in Advanced and Luminescent Materials was awarded to Prof Hendrik Swart in the beginning of January 2013. With the award of the chair, an amount of at least R2 500 000 per year is guaranteed for the next five years and there is a possibility that it will be extended for another five years. The group was also successful in obtaining a few awards during the year.

Most of the staff and almost all the MSc and PhD students attended the SAIP'2013 (South African Institute of Physics) conference in Richards Bay, 9 to 12 July 2013, and submitted several papers. During the conference at the NLC (National

Laser Centre) feedback session awards were given to Prof HC Swart – the NLC Capacity Building award, and also for the most articles in accredited journals for 2012/2013. Prof FB Dejene received the award for the most MSc students.

Prof WD Roos was elected to the executive committee of the South African Spectroscopy Society (SASS). He will serve on the committee for the next four years. The Society is associated with the South African Chemical Institute and the South African Institute of Physics for purposes of closer collaboration between disciplines.

The Department helped organise and participated in the 5th South African conference on Photonic Materials at Kariega Game Reserve in the Eastern Cape, 29 April to 3 May 2013. Profs OM Ntwaeaborwa, HC Swart, JJ Terblans, and Dr Kroon were part of the organising committee and were in charge of the website and accompanying one of the invited speakers afterwards.

Dr RE Kroon made a contribution at the Southern African Powder Diffraction Conference and Workshop held at Wits, Johannesburg on 27 to 31 January.

Dr RE Kroon accompanied Prof OM Ntwaeaborwa to Europe to assess high-resolution field-emission scanning electron microscopes with cathodoluminescence, following the award of R10 million for such an instrument from the National Nanotechnology Equipment Programme. Visits were made to Zeiss in Oberkocken (Germany), FEI in Eindhoven (Netherlands), and JEOL in Paris (France). Another visit was made to Pretoria for a demonstration of the microscope manufactured by Tescan.

In 2013 the Astrophysics group became full members of two high-profile international high-energy gamma-ray research collaborations, namely the H.E.S.S. collaboration, with telescopes in Namibia, as well as the Cerenkov Telescope Array (CTA) collaboration.

During August 2013 two members of the UFS astrophysics group (PJ Meintjes and B van Soelen) attended a week-long H.E.S.S. meeting in Bordeaux, France. During December 2013, two UFS astrophysics group members, Dr B Van Soelen and his MSc student, Ms L Klindt, spent three weeks in Namibia for an observational run utilising the gigantic H.E.S.S. telescopes.

During 2013, members of the Astrophysics group made four invited presentations at international conferences, *i.e.* the multi-frequency behaviour of high-energy cosmic sources in Palermo, Italy, 25 May to 1 June 2013, as well as at the Cataclysmic Variables and Related Objects workshop in Palermo, Italy, 9 to 14 September 2013. All four presentations will lead to publications in a refereed international conference proceeding which will appear in 2014. Members of the Astrophysics group were also co-authors of several publications in high profile journals (see list of publications). Ms A Odendaal published a paper on part of her PhD work in the high-profile (impact factor 5.5) journal *Monthly Notices of the Royal Astronomical Society* (MNRAS), as well as a highly respected international conference proceedings. She also submitted three research proposals at the end of 2013 involving multi-wavelength observations on international facilities of some of the sources she is currently investigating. Ms A Odendaal also received an award during the 2013 SKA postgraduate student workshop in Stellenbosch in the category for PhD oral presentations. The newly appointed Dr B van Soelen is actively involved in graduate student supervision.

The year 2013 was a historical year for the Department of Physics with the opening of the digital planetarium located at the historic Lamont-Hussey Observatory on Naval Hill in Bloemfontein. (More details in the Boyden Observatory Science Centre & Planetarium Report).

## Achievements of Students

It was once again an excellent year for our postgraduate students at the Annual Conference of the South African Institute of Physics, where they won several prizes. The winners were:

- Ms MM Duvenhage won the best PhD publication in Solid State (Supervisors: Profs Swart and Ntwaeaborwa).
- Mr MJ Madito won the best MSc publication in Solid State (Supervisors: Profs Terblans and Swart).
- Ms PA Moleme won the best MSc publication in Semiconductors (Supervisors: Profs Ntwaeaborwa and Swart).
- Mr MJ Madito won the best PhD oral presentation (Supervisors: Profs Terblans and Swart).
- Ms PP Mokoena won the best MSc poster in Semiconductors (Supervisors: Profs Ntwaeaborwa and Swart).
- Ms AS Tebele won the best honours poster (Supervisors: Mr Mothloung and Prof Dejene).
- Ms A Odendaal won the second prize for the best oral PhD presentation at the 2013 SKA postgraduate student workshop held in Stellenbosch (Supervisor: Prof PJ Meintjes).
- Ms L Klindt, a BScHons student in 2013, won the prize for the best BScHons student in the Faculty of Natural and Agricultural Sciences during a recent graduation ceremony. (Supervisors: Prof PJ Meintjes and Dr B Van Soelen).

## Community Service

Prof MHJ Hoffman made a huge contribution to the community through the Boyden Observatory Science Centre & Planetarium and approximately 3 900 school children (55 groups) attended programmes at Boyden in 2013. Prof Hoffman participates on a weekly programme, *Sterre en Planete*, on Radio Sonder Grense, and a monthly programme on Radio Rosestad. (More details in the Boyden Observatory Science Centre & Planetarium Report).

*Prof Jorma Hölsa from the University of Turku, Department of Chemistry, Laboratory of Materials Chemistry and Chemical Analysis, Turku, Finland, and his wife, Helen, visited the Department of Physics for research purposes. He also gave a few talks on persistent luminescence while he was here.*

Members of the Astrophysics group are actively involved in the presentation of educational programmes at the UFS-Boyden observatory and the newly established Naval Hill Planetarium. Presenters for the Astrophysics group include Dr B van Soelen, Mr HJ van Heerden (PhD student), and Ms L Klindt (MSc student). Prof P Meintjes gave several radio interviews for RSG, Radio Rosestad (with Dr B van Soelen), as well as regular contributions to Radio Cosmos in Namibia.

## National and International Collaboration

### National

The Solid State Physics group is actively participating in a National Nanoscience Postgraduate Teaching Platform (NNPTP), a collaboration between three universities to train students in nanoscience. The students are selected from all over Africa.

The Astrophysics group is actively participating in a national programme for Astrophysics and Space Science (NASSP), a collaboration between ten universities to train top-class students in Astrophysics and Space Science. The students are selected from all over Africa.

### International

Prof Jorma Hölsa, on Luminescent Materials (phosphor), visited the Department, gave lectures, and participated in student discussions. He also visited the Qwaqwa Campus and had one interaction with the students and staff.

The Astrophysics group of the UFS is part of two major international research collaborations in High-Energy Astrophysics; firstly the H.E.S.S. collaboration, a partnership between 15 countries to study the highest energy sources in the Universe. The telescopes are situated in Namibia. Secondly we are also part of the newly created international collaboration, the Cerenkov Telescope Array (CTA) consortium, also a partnership between 20 countries, aimed at establishing a gamma-ray telescope network, similar to the SKA in radio wavelengths. In April 2014 a decision will be made by the CTA consortium as to whether this telescope network will be constructed in Namibia or Chile, Argentina. It can be mentioned that preliminary site selection studies revealed that Namibia hosts the current favourite site (the farm Aar) for this telescope array.

## Postgraduate Students

Mr SKK Shaat and Ms PS Mbule obtained their PhD degrees.

## Staff Matters

Dr Kroon was awarded an NRF research rating (C3).

## Naval Hill Planetarium Infrastructure

### Background of the Project

It has been a long-held dream that central South Africa – with its illustrious astronomical heritage and spectacular night skies – should have a planetarium. Detailed plans and strategies were drafted to establish the planetarium and the UFS launched a campaign to raise funds for the project in 2009. After consultation with local and provincial government, the optimal location for a planetarium for central South Africa was identified. The location is the historic Lamont-Hussey Observatory on Naval Hill in Bloemfontein. By late 2012, almost all funding for infrastructure was in place and the building project started on 12 November 2012.

### Planetarium Project Milestones 2013

- 7 January 2013: Construction of new digital planetarium commences after building recess.
- 4 March 2013: Final signatures on a 30-year concession by the UFS and the Mangaung Metropolitan Municipality, which allows the UFS to develop and operate the planetarium on the Lamont-Hussey Observatory site on Naval Hill.

- 11 June 2013: Arrival of customised perforated interior dome in Bloemfontein from the USA.
- 18 June 2013: Media launch of project.
- 21 June 2013: Arrival of the projection system from the USA.
- 13 July 2013: Completion of construction work on the building.
- 22 July 2013: Start of the installation of the interior dome under the supervision of Astro-tec.
- 23 September 2013: Arrival of Sky-Skan in Bloemfontein for the installation of projection system.
- 1 November 2013: Inauguration of the Naval Hill Planetarium.

## Capital expenditure contributions for project secured to date

As previously mentioned, the Mangaung Metropolitan Municipality granted the UFS a 35-year concession to the site to develop and operate the planetarium. Capital expenditure contributions for the infrastructure project were required for the following imported components: customised perforated aluminium interior dome, digital projection system, and conversions to the building. The following organisations made contributions:

| | |
|---|---|
| Free State DETEA | R6 000 000 |
| DST: National | R6 228 316 |
| Hermann Ohlthaver Trust | R125 000 |
| Old Mutual Foundation | R295 200 |
| Windmill CSI (Sun International) | R297 000 |
| Joan St Leger Lindbergh Trust | R100 000 |
| DST (SAASTA) | R100 000 |
| Raubex | R424 000 |
| Total Cash Contributions Received | R 13 569 516 |

## Contributions for operating expenses secured to date

While planetarium patrons will purchase tickets to attend presentations, like all other planetariums, this planetarium will need continued contributed (cash and in-kind) support to be sustainable since it is mainly an educational resource. Shows for school learners will be funded from educational grants. Operating expenses include utilities,

*From left to right: Minister of Science and Technology, Derek Hanekom, Prof Hendrik Swart and his Excellency Kgalema Motlanthe, the deputy president of South Africa, during the official announcement of the new Sarchi chairs.*

presenters and front-of-house personnel, marketing, the maintenance of the projection equipment and building, licenses for planetarium shows, cleaning, and security.

The University of the Free State has committed to the allocation of capacity for the overall implementation and management of the project at all levels. Functions that the UFS has funded and will continue to fund include project development and management, legal expenses, some marketing expenses, fundraising expenses, and partial funding for presenters.

In-kind contributions for operating expenses secured to date:

- Mangaung Metropolitan Municipality: Contract for defined use of electricity, water made available at no charge, and 24-hour security. The value according to 2013 tariffs is approximately R200 000 per year.
- University of Michigan: Department of Astronomy: 12-month licence for the show on Space Debris. Estimated value: R100 000.
- American Museum of Natural History: Two planetarium show licences for three years; one additional show from 2016. Estimated value: R1,3 million over the period (assuming Rand:Dollar 1:10).

# Research Outputs

### Research Articles


**Bedyal, A.K., Kumar, V., Lochab, S.P., Singh, F., Ntwaeaborwa, O.M. & Swart, H.C.** 2013. Thermoluminescence response of gamma irradiated sral2o4:eu2+/dy3+ nanophosphor. *International Journal of Modern Physics: Conference Series* (22): 365-373.

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**Bedyal, A.K., Kumar, V., Sharma, V., Pitale, S.S., Coetsee, E., Duvenhage, M.M., Ntwaeaborwa, O.M. & Swart, H.C.** 2013. Spectral and surface investigations of $Mn^{2+}$ doped $SrZnO_2$ nanocrystalline phosphors. *Journal of Material Science* 48: 3327-3333.

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**Dejene, F.B.** 2013. The effects of Eu ions and Eu:Dy ratio on the luminescence properties off blue–green $BaAl_xO_y:Eu^{2+},Dy^{3+}$ nano-phosphors. *Optical Materials* 35: 1893-1897.

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**Duvenhage, M.M., Swart, H.C., Ntwaeaborwa, O.M. & Visser, H.G.** 2013. Synthesis, crystal structure, luminescent properties and photo degradation of mer-tris(8-Hydroxy-quinolinato-N, O)-indium(iii) hydrate 0.5 methanol solvate. *Optical materials* 35: 2366-2371.

**Eassa, N., Betz, R., Coetsee, E., Swart, H.C., Venter, A. & Botha, J.R.** 2013. Surface modifaication of bulk n-InAs (111) A etched in bromine-methanol. *Current Applied Physics* 13: 366-370.

**Holloway, P.H., Swart, H.C. & Ntwaeaborwa, O.M.** 2013. Electron-stimulated surface chemical reactions on phosphors. *Journal of Vacuum Science and Technology* A 31(5): 050808 - 050808-12.

**Hwang, K-H., *et al.* (Meintjes, P.J.).** 2013. Interpretation of a Short-term anomaly in the gravitational microlensing event MOA-2012-BLG-486. *Astrophysical Journal* 788: 55-60.

**Jafta, C.J., Mathe, M.K., Manyala, N., Roos, W.D. & Ozoemena, K.I.** 2013. Microwave-Assisted Synthesis of High-Voltage Nanostructured $LiMn_{1.5}Ni_{0.5}O_4$ Spinel: Tuning the $Mn^{3+}$ Content and Electrochemical Performance. *ACS Applied Materials and Interfaces* 5(15): 7592-7598.

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**Kumar, V., Swart, H.C., Ntwaeaborwa, O.M., Kroon, R.E., Terblans, J.J., Shaat, S.K.K., Yousif, A. & Duvenhage, M.M.** 2013. Origin of the red emission in zinc oxide nanophosphors. *Materials Letters* 101: 57-60.

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## Patent

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## Chapter in Book

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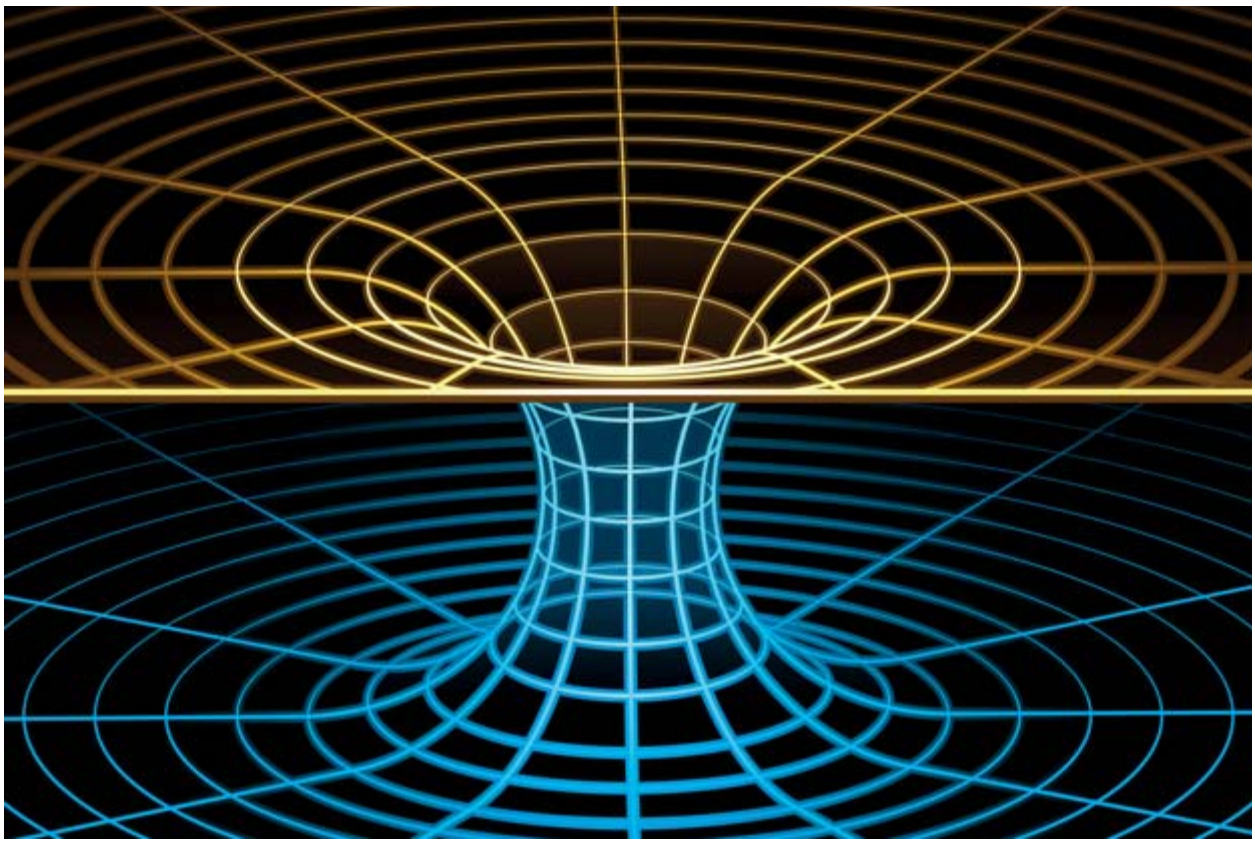

## Staff

**Senior Professor:** Prof HC Swart.

**Professors:** Profs JJ Terblans, OM Ntwaeaborwa, WD Roos, and PJ Meintjes.

**Associated Professors:** Profs MHJ Hoffman and BF Dejene.

**Affiliate Associate Professor:** Prof KT Hillie.

**Senior Lecturer:** Dr RE Kroon.

**Lecturers:** Dr B van Soelen, Mr RO Ocaya, Mr SV Motloung, and Mr KG Tshabalala.

**Junior Lecturer:** Mr LF Koao.

**Senior Researcher:** Dr E Coetzee-Hugo.

**Senior Assistant Officer: Professional Services:** Mr SJ Motloung.

**Officers: Professional Services:** Mr S Cronje and Mr HJ van Heerden.

**Officer:** Ms K Cronje.

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Department of

# Zoology and Entomology

## Overview

The department of Zoology and Entomology is organized into different research groups, each with its own objectives and specific study area. There is also a satellite department on the Qwaqwa Campus. The groups do, however, share common goals within the strategic priorities of the Faculty of Natural and Agricultural Sciences and the UFS.

## Aquatic Ecology Research Group

### Activities

The year's activities included the annual Ecology excursion to the De Hoop Nature Reserve of the third-year Zoology students. The excursion has been done at De Hoop since 1995. Since 2010 we do not use the facility at Potberg Environmental Centre anymore, instead camping at De Hoop and continuing with the academic activities on the rocky shores at Koppie Alleen.

Our research group conducted field surveys in the Okavango River, as well as in the upper part of the system in Namibia. The latter was in collaboration with Kumutjonga Inland Fisheries Institute (KIFI).

During 2013 field surveys and workshops were attended in collaboration with the Pabalelo Trust, Shakawe, Botswana. The workshops focused on the human-elephant conflict. Dr Anna Songhurst presented the project's introduction of Conservation Agriculture in Botswana, aimed at counteracting the human-elephant conflict which is characterised by problems that impact on agriculture, e.g. crop damage,

*DRK 314 students on Rocky shores at De Hoop Nature Reserve.*

fence damage, people putting fields in elephant coridors, injury and the killing of people, the killing of elephants, and damage to the environment. The project looks at elephant range expansion in terms of human development expansion and land use change, resulting in human-elephant conflict (HEC). This forms part of the PhD studies of Isabel Human (a project in collaboration with Zoology and the Centre for Africa Studies, UFS).

### National and International Collaboration

Some of our collaboration is very local in the sense that we take the second-year Zoology students to the National Museum in Bloemfontein, as part of the practical component of the course, where we spend the afternoon in the invertebrate section and the students are also introduced to different scientists who are doing research on mites, spiders and other invertebrates. We also had sad news as a very longstanding collaborator, Prof Angela Davies of the University of London, UK, unexpectedly passed away in December. She was the recipient of the prestigious Elsdon Dew medal of the Parasitological Society of Southern Africa (PARSA) for 2013. Prof Jo Van As, a previous recipient of this medal, had the honour of presenting the medal to her during the 44th Annual Symposium of PARSA, and that unfortunately was our last contact with her. She was involved as a supervisor and examiner for many of our previous students which include Prof Nico Smit from NWU, as well as Dr Johann van As from Qwaqwa.

## Arachnology

### Activities

During March 2013, four researchers from the Masaryk University in the Czech Republic visited the Arachnid Systematics and Ecology group for two weeks to conduct predation experiments on four spider families regarded as predatory specialists of termites, spiders and ants. The group was headed by Prof Stano Pekár, and included his former PhD student in Prague, Dr Stanislav Korenko, and two PhD students, Lenka Sentenska and Eva Liznarova. Fieldwork was conducted in the Free State and Northern Cape to sample spiders, which were taken to the laboratory for experiments on their diet, predatory activity, and hunting strategies.

During their visit, the four researchers each presented a talk to the Department of Zoology and Entomology on their research. This was a very stimulating session, and covered topics such as the evolution of predatory specialisation, predator-prey density response curves, sexual cannibalism in some ant-mimicking spiders, and wasp parasitism of spiders. The feedback received from staff and students of the Department was very positive.

Dr Charles Haddad and Mr Jan-Andries Neethling attended the 19th International Congress of Arachnology held from 23 to 28 June 2013 at the Howard Resort, Kenting National Park in Taiwan. This was the first international congress to be held in Asia and attracted more than 230 delegates from 42 countries. Dr Haddad presented an overview of the spider diversity in the Grassland Biome of South Africa, and Mr Neethling presented the preliminary results of his MSc study on the South African pseudoscorpions of the family Geogarypidae.

Following the congress, Mr Neethling visited the Western Australian Museum in Perth for three weeks to work with his co-supervisor, Dr Mark Harvey. Dr Harvey is the world expert on pseudoscorpion systematics, and provided valuable inputs into developing Mr Neethling's study.

He also worked in the molecular laboratory of Dr Gaynor Dollman, fine-tuning the procedures for successful extraction of DNA from the material he had collected for his study. The molecular work continued on his return to South Africa, where the CO1 and 28S genes were successfully extracted from almost all of the males and females of the 21 species included in his study.

### Achievements of Students

Jan-Andries Neethling won the prize for second-best paper presentation in the Taxonomy section of the 19th International Congress of Arachnology, held at Kenting National Park, Taiwan.

### Community Service

Dr Haddad continued with the identification of Corinnidae and Salticidae material from various collections, student projects and research projects, and reviewed manuscripts for more than ten scientific journals during 2013.

### National and International Collaboration

Collaboration continues with Dr Ansie Dippenaar-Schoeman and Ms Robin Lyle (ARC – Plant Protection Research Institute, Pretoria), and Dr Stefan Foord (University of Venda, Thohoyandou) on the biodiversity of South African spiders; with Dr Wanda Wesolowska (Wroclaw University, Poland) on the taxonomy of Afrotropical Salticidae spiders; with Dr Jiri Kral and Dr Franta Stahlavsky (Charles University, Czech Republic) on the karyology of South African arachnids; and with Dr Stano Pekar (Marusik University, Czech Republic) on the diet and predatory behaviour of myrmecophagous and termitophagous spiders.

### Postgraduate Students

Mr Jan-Andries Neethling (MSc Entomology): "A revision of the South African Geogarypidae (Arachnida: Pseudoscorpiones)".

Mr Leon Lotz (PhD Entomology): "The Afrotropical species of the sac spider genera *Cheiracanthium* and *Cheiramiona* (Araneae: Eutichuridae)".

### Research

Systematics and ecology of Afrotropical spiders of the families Corinnidae and Salticidae; biodiversity and ecology of South African spiders; and biology of myrmecophagous and termitophagous spiders.

### Staff Matters

Dr Charles Haddad was invited to join the Prestige Scholar Programme (PSP) of the UFS.

## Applied Agricultural Entomology

### Research

Recent research focuses on indigenous plant extracts to be used as botanical insecticides. The purified extracts from two plants, one an indigenous perennial and the other an ornamental plant, holds potential for further tests and delivered good results in preliminary trials conducted on the stable fly, *Stomoxyscalcitrans* (Diptera: Muscidae), an important veterinary pest. The eventual aim of the study is to find and isolate viable molecules for use as natural pesticides on several insect species of agricultural and veterinary importance.

### Activities

Mr Fourie submitted an article entitled "Solving problems in pesticide use" which was published in *Farmer's Weekly* of February 2013. The article deals with the role and future of botanical pesticides in the modern IPM environment. He also submitted an article entitled "*Laat die natuur vir jou werk*" which was published in *Landbouweekblad* of March 2013. The article deals with the uses of farmscaping as a tool in the modern agricultural IPM setup.

## Environmental Entomology

### Activities and Achievements

During 2013, research involved investigations into associations between stinkbugs (Hemiptera: Pentatomidae) and fungi in pecan (*Caryaillinoensis*) orchards in South Africa; the possible migration of economically important Lepidoptera borer species between citrus (*Citrus sinensis*) to pecan nuts (*Caryaillinoensis*), and vice versa, at Vaalharts, Northern Cape; an assessment of the association between the presence of *B. fusca* and *Fusarium. verticillioides* incidence on maize plants.

The following two projects were in partial fulfilment of Mr Jaco Saaiman's and Mr Andre van Rooyen's MSc degrees: Mr Jaco Saaiman's study involved research on the interactions between stinkbugs (Hemiptera: Pentatomidae) and fungi in pecan (Caryaillinoensis) orchards in South Africa. The main aim of his study was to determine the progression of fungal species occurring on the grey-brown stinkbug, *Coenomorpha nervosa* Dallas, during the production season of pecan nuts. In addition, he also investigated the role that soil, air, and the phylosphere may play in harbouring possible phytopathogens compared to stinkbugs. Several of the fungal species isolated from the various samples may be pathogenic on pecans or act as contaminants of the nuts. Overall, similar patterns of incidence were observed between the stinkbug, air and soil. The grey-brown stinkbug is associated with fungal pathogens of pecan. Secondly, the pathogenicity of *Alternariatenuissima*, *Cladosporiumcladosporioides* and *Neofusicoccumparvum* was determined on pecans. Both *Alternariatenuissima* and *Neofusicoccumparvum* are associated with the grey-brown stinkbug and are pathogenic on pecan nuts and pecan leaves. The study indicated that stinkbugs play a role in the dynamics of fungal populations within pecan orchards. Jaco Saaiman completed his MSc *cum laude* at the end 2013.

Mr Van Rooyen investigated the possible migration of economically important Lepidoptera borer species between

citrus (*Citrus sinensis*) and pecan nuts (*Caryaillinoensis*), at Vaalharts, Northern Cape. The false codling moth (FCM) Thaumatotibialeucotreta (Meyrick, 1913) (Lepidoptera: Tortricidae) and carob moth *Ectomyeloisceratoniae* (Zeller, 1839) (Lepidoptera: Pyralidae) are species of interest which are established pests on citrus and pecan nuts. The incidence of these two lepidopteran species in pecan orchards, adjacent to citrus orchards, is compared to pecan orchards which are non-adjacent to citrus orchards. So far evidence shows that carob moths are moving over to citrus fruit displacing the false codling moth as the dominant citrus borer pest. Carob moths were found to congregate in citrus orchards.

The South African Pecan Producers Association (SAPPA) has donated annually for research purposes from 2009 to 2013. Recent developments have led to the establishment of a statuary levy for research on pecan nuts. SAPPA and NRF (THRIP) are now financially supporting research conducted by Prof Gert Marais (Plant Sciences) and Mr Vaughn Swart regarding insects and fungi associated with pecan nuts in South Africa. Various projects were established.

### Achievements of Students

Jaco Saaiman won the prize for third-best student paper presentation at the 48th Congress of the Southern African Society for Plant Pathology.

### Postgraduate Students

- Mr Jaco Saaiman (MSc Entomology).
- Mr André van Rooyen (MSc Entomology).
- Ms Tshilidi Hlalele (honours Entomology).

## Forensic Entomology and Veterinary Entomology

### Research

The research in this field was mainly focused on decomposition and insect succession under various conditions. The effect of gunshot wounds, massive trauma, artificial surfaces, and burial on decomposition and insect succession was explored. The interesting results from the burial study will be explored further in subsequent projects

*Fieldwork in Namibia in collobation with staff from KIFI*

*Johann Du Preez, Barry Frey, Nico Smit, Leslie Brown, Alechea Engelbrecht, and Jo van As during the launch of the book "Die Verhaal van Lewe en die Omgewing".*

*Launch of the book "Die Verhaal van Lewe en die Omgewing" during the Vryfees, July 2013, with guest speaker Doks Briers.*

during 2014 and 2015. The study on the effects different feeding media had on the development and survival rates of some forensically important blow flies will not be explored further in the near future. However, the result from this study are informative for various other studies being conducted by the research group and benefits our insect rearing practises. Two projects were shared with the Genetics Department. This collaborative work fits in well with the new programme in Forensic Sciences being established at the University and will be expanded upon.

Mr Julian Liebenberg received his MSc in 2013 with a dissertation entitled "The species composition and bio-ecology of *culicoides* spp. frequenting livestock in the central Free State, South Africa". Various possible research questions were drawn from this work and an initial study was conducted into the reproductive events of *culicoides* spp.

Ms Elaine Allemann and Mr Shaun Hoffman completed their MSc studies during 2013.

The following honours students are pursuing their MSc degrees:

- Forensic Entomology: Ms Sylvia van der Merwe and Mr Jason Botham.
- Forensic Genetics (with Entomology): Ms Adri Barnard and Ms Cindy van der Westhuizen.
- Veterinary Entomology: Ms Marilie Esterhuyze.

Research members of the Forensic Entomology group are Dr Sonja Brink (Lecturer: Entomology), Dr Karin Ehlers (Lecturer: Genetics), Ms Letitia Wessels (Lecturer: Genetics), Ms Elaine Allemann (MSc student), Mr Shaun Hoffman (MSc student), Ms Sylvia van der Merwe (Hons student), Mr Jason Botham (Hons student), Ms Adri Barnard (Hons student), Ms Cindy van der Westhuizen (Hons student), and Ms Marilie Esterhuyze (Hons student).

## INSECTS ON NEW CROPS PROGRAMME (INCROP) AND SOIL ECOLOGY

### Activities and Achievements

The following activities took place during the year:

- Specific expertise was provided to farmers regarding pest management on new crops and arthropod soil ecology. In terms of soil ecology research, 12 sites containing cotton,

maize, wheat, lucerne, sunflower, and amaranth field crops have been sampled in the Free State, North West and Northern Cape provinces throughout the year and analyses of mesofaunal species assemblages under different agricultural practices were conducted. General fieldwork has now come to an end and only two field experiments on ecological home-field advantage and ecological trade-off, both using Collembola, are still underway.

- An investigation into the effect of nitrogen additives to the soils of amaranth cultivations on soil mesofauna assemblages and their underlying interactions, conducted in collaboration with the North West province Department of Agriculture & Rural Development, is still underway.
- From 4 to 7 March Dr Charlene Janion from the Centre for Invasion Biology, University of Stellenbosch, visited the Soil Ecology Lab to advise postgraduate students on Collembola sampling and extraction, identification, slide preparation, and husbandry. She also presented a seminar on "Springtail diversity in the Cape Floristic Region" to the broader Faculty, which was well attended and well received.
- Participation in the NuGrainSA Consortium initiative with regard to soil arthropod ecology expertise was continued and a consortium meeting and pseudo grain information day were attended at ARC-Roodeplaat, Pretoria (April) and North West Department of Agriculture & Rural Development, Potchefstroom (August), respectively.
- Prof Schalk Louw served as member of a panel that evaluated the Department of Conservation Ecology & Entomology at Stellenbosch University in September.
- A HortGro Science advisory panel member for Entomology reported back on 25 projects at a meeting in Stellenbosch in October.
- Contributed to the revision of Annecke & Moran's Insects and Mites of Cultivated Plants in South Africa. Three chapters covering amaranth, kenaf, and pistachio were accepted and are in print.
- Four papers (three by postgraduate students) and a poster on soil ecology topics were presented at the 18th Congress of the Entomological Society of Southern Africa at NWU, Potchefstroom.
- Co-organiser of the 2nd Workshop of the Soil Ecosystem Research Group held during the 18th Congress of the Entomological Society of Southern Africa. Emanating from this are two papers: i) Soil Health in South Africa (submitted and accepted by *SA Journal of Science*); ii) South African Soil Fauna Review (in preparation).
- Two papers (one by a postgraduate student) on soil ecology topics were presented at the Arid Zone Ecology Forum (AZEF 2013) hosted by the McGregor Museum, Kimberley.
- Prof Schalk Louw was elected as vice president to the executive committee of the Entomological Society of Southern Africa from 2013 to 2015.

### National and International Collaboration

Prof Louw collaborated on the following research activities:

- Mr William Weeks, North West Department of Agriculture & Rural Development, Potchefstroom (arthropod soil ecology).
- Dr Gerhard Prinsloo, research fellow at ARC – Plant Protection Research Institute, Pretoria (insects on South African crops).
- Dr John Wilson, SANBI, and University of Stellenbosch (botanist from the Centre for Invasion Biology contributing to soil health programme).
- Dr Ruan Veldtman, SANBI, and University of Stellenbosch (arthropod soil ecology).
- Mr Matthew Addison, HortGro Science, Stellenbosch (arthropod soil ecology application in the pome fruit industry).
- Ms Sarah Davis, University of Stellenbosch (zoologist from the Centre for Invasion Biology contributing to soil health programme).
- Dr Charlene Janion-Scheepers, University of Melbourne, Australia (collembola expert in soil health programme).

### Postgraduate Students

- Mr Vaughn Swart, part-time PhD (thesis on new crops and agribusiness).
- Mr De Villiers Fourie, part-time PhD (thesis on novel natural pesticide development).
- Mr Koos Steyn, part-time PhD (University of Venda) (thesis on soil ecology in an agroforestry case study).
- Ms Joan Adendorff, part-time PhD (interdisciplinary with Botany) (thesis on management of aphids on wheat).
- Mr Ruan du Preez, full-time MSc (dissertation on effects of additives on soil arthropod species assemblages).
- Mr Burgert Muller, part-time MSc [dissertation on taxonomy of *Atherigonas. l.* (Diptera: Muscidae)].
- Ms Hannelene Badenhorst, full-time MSc (dissertation on Collembola soil ecology).
- Ms Jehané Smith, full-time MSc (dissertation on Collembola soil ecology).
- Mrs Nicolene de Klerk, part-time MSc (dissertation on black maize beetle early warning system).

## Nematology

### Research

Research in this group is currently focused on plant parasitic and free-living freshwater nematodes occurring in the Free State province. The main focus of this study group was to make an inventory list of all nematode genera occurring in

*DRK 252 students during a visit to the National Museum, Bloemfontein.*

the Seekoeivlei Nature Reserve near Memel in the Free State. The study group hopes to increase the current knowledge on freshwater nematodes, especially from wetlands, as well as to increase the awareness of known invertebrates from the Seekoeivlei Nature Reserve. Since nematodes can be used as bio-indicators, we plan to use them as such to see whether they can assist in assessing the current ecological status of this very important wetland.

### Activities and Achievements

One field trip was undertaken during the year at the beginning of May 2013, to the Seekoeivlei Nature Reserve. One of the main purposes of the field trip was to collect data for Ms Vermeulen's MSc dissertation.

### Special Achievements

The authors, including Dr Candice Jansen van Rensburg, of the article "Die karst-ekologie van die Bakwenagrot (Gauteng)" in *SA Tydskrif vir Natuurwetenskap en Tegnologie* (*South African Journal for Science and Technology*), received the Douw Greeff prize for the article.

### Postgraduate Students

- Ms Anneke Vermeulen (MSc) and Ms Ayesha Mobara (MSc).

### Research members:

- Dr Candice Jansen van Rensburg (lecturer and researcher), Ms Anneke Vermeulen (MSc), and Ms Ayesha Mobara (MSc).

## Pesticide Resistance Testing and Research Facility

### Community Service

A presentation was made at a meeting of the Coombs farmers' association during April 2013 to inform farmers on the general aspects of tick biology and the danger of ticks developing resistance against chemical control due to inadequate resistance management strategies.

### National and International Collaboration

Collaboration with pharmaceutical companies, Bayer Virbac and Novartis, providing chemical control remedies to address the problem of resistance development, was re-established by trade visits. This collaboration faces the challenge of implementing adequate tick control management strategies and monitoring thereof.

Molecular determination of resistance development and the correlation to field resistance profiles was initiated in collaboration with Dr Christine Maritz of the Department of Genetics at the University of Pretoria

### Postgraduate Students

- S Terry: "A Taxonomic description of all stages of four *Ixodes* (Acari: Ixodidae) tick species". (Supervisor: IG Horak. Co-supervisor: EMSP van Dalen).
- BOOO Motlogeloa: "Management strategies and development of resistance to chemical control by the blue tick *Rhipicephalusdecoloratus*, in the Grahamstown (South Africa) area". (Supervisor: EMSP van Dalen).

### Research

The challenge of tick resistance development against chemical control, and tick species composition of different areas, is our main focus. Samples received from different problem areas in South Africa were tested and evaluated for developing resistance, as well as species composition to determine signs of displacement of *Rhipicephalusdecoloratus* by *Rhipicephalusmicroplus*. Growth regulators as means to control ticks also don't seem to be as effective as claimed anymore and projects to investigate this problem were initiated. The distribution of dip resistant blue ticks on one farm was also investigated.

### Staff Matters

The Pesticide Resistance Testing and Research Facility (PRTF) consists of Mss Ellie van Dalen (lecturer and researcher) and Christa du Rand (professional officer) - who left the group at the end of September to take up the position of medical writer at Parexel. Tseko William Lesaoana (assistant researcher) joined the group from January 2013, as well as Sharon Terry and Octavia Motlogeloa (part-time MSc students).

# Research Outputs

## Research Articles

**Dippenaar-Schoeman, A.S., Van Den Berg, A.M., Haddad, C.R. & Lyle, R.** 2013. Spiders in South African agroecosystems: A review. *Transactions of the Royal Society of South Africa* 68: 57-74.

**Dippenaar-Schoeman, A.S., Van Den Berg, A.M., Lyle, R., Haddad, C.R., Foord, S.H. & Lotz, L.N.** 2013. Die diversiteit van Suid-Afrikaanse spinnekoppe (Arachnida: Araneae): Dokumentering van 'n nasionale opname. *Tydskrif van die Suid-Afrikaanse Akademie vir Wetenskap en Kuns* 3 2(375): 1-7.

**Fourie, R., Haddad, C.R., Dippenaar-Schoeman, A.S. & Grobler, A.** 2013. Ecology of the plant-dwelling spiders (Arachnida: Araneae) of the Erfenis Dam Nature Reserve, South Africa. *Koedoe* 55(1113): 1-9.

**Haddad, C.R. & Bosmans, R.** 2013. Synonymy of the North African spider genus *Castanilla* Caporiacco, 1936 with *Micaria* Westring, 1851 (Araneae: Gnaphosidae). *Zootaxa* 3734: 397-399.

**Haddad, C.R. & Wesołowska, W.** 2013. Additions to the jumping spider fauna of South Africa (Araneae: Salticidae). *Genus* 24: 459-501.

**Haddad, C.R.** 2013. A revision of the ant-like sac spider genus *Apochinomma* Pavesi, 1881 (Araneae: Corinnidae) in the Afrotropical Region. *Journal of Natural History* 47: 2493-2529.

**Haddad, C.R.** 2013. A revision of the continental species of *Copa* Simon, 1885 (Araneae: Corinnidae) in the Afrotropical Region. *ZooKeys* 276: 1-37.

**Haddad, C.R.** 2013. Taxonomic notes on the spider genus *Messapus* Simon, 1898 (Araneae, Corinnidae), with the description of the new genera *Copuetta* and *Wasaka* and the first cladistic analysis of Afrotropical Castianeirinae. *Zootaxa* 3688: 1-79.

**Haddad, C.R., Dippenaar-Schoeman, A.S., Foord, S.H., Lotz, L.N. & Lyle, R.** 2013. The faunistic diversity of spiders (Arachnida: Araneae) of the Grassland Biome in South Africa. *Transactions of the Royal Society of South Africa* 68: 97-122.

**Jansen van Rensburg, C., Van As, J.G. & King P.H.** 2013. New records of digenean parasites of *Clarias gariepinus* (Pisces: Clariidae) from the Okavango Delta, Botswana, with description of *Thaparotrema botswanensis* sp.n. (Platyhelminthes: Trematoda)., *African Invertebrates*, 54: 431-446.

**Jansen van Rensburg, C., Van As, J.G. & King, P.H.** 2013. New records of digenean parasites of *Clarias gariepinus* (Pisces:Clariidae) from the Okavango Delta, Botswana, with description of *Thaparotrema botswanensis* sp. n. (Plathelminthes: Trematoda). *African Invertebrates* 54: 431-446.

**Král, J., Kořínková, T., Krkavcová, L., Musilová, J., Ávila Herrera, I.M., Forman, M., Vítková, M., Haddad, C.R., Hedin, M., Henriques, S. & Palacios Vargas, J.G.** 2013. Evolution of karyotype, sex chromosomes, and meiosis in mygalomorph spiders (Araneae: Mygalomorphae). *Biological Journal of the Linnean Society* 109: 377-408.

**Neethling, J.A. & Haddad, C.R.** 2013. Arboreal spider assemblages associated with four tree species in the Grassland Biome of central South Africa (Arachnida: Araneae). *Transactions of the Royal Society of South Africa* 68: 12-131.

**Wesołowska, W. & Haddad, C.R.** 2013. New data on the jumping spiders of South Africa (Araneae: Salticidae). *African Invertebrates* 54: 177-240.

## Books

**Dippenaar-Schoeman, A.S., Foord, S.H. & Haddad, C.R.** 2013. *Spiders of the Savanna Biome of South Africa*. University of Venda and ARC: Plant Protection Research Institute, Pretoria.

**Van As, J., Du Preez, J., Brown, L. & Smit, N.** 2013. *Die Verhaal van lewe en die omgewing – 'n Afrika perspektief*. Cape Town: Randomhouse Struik.

## Staff

**Professors:** Profs Jo van As, Linda Basson, and Schalk Louw.

**Associate Professor:** Prof Liesl van As.

**Extraordinary Professors:** Profs Leon Fourie and Gerhard Prinsloo.

**Lecturers:** Drs Candice Jansen van Rensburg, Charles Haddad, Sonja Brink, Mr Hennie Butler, and Mrs Ellie van Dalen.

**Junior Lecturers:** Ms Lindie Heyns, Mr Vaughn Swart, and Mr De Villiers Fourie.

**Affiliated Researchers:** Dr Jennifer Botha-Brink, Dr Johan van Niekerk, and Prof OB Kok.

**Professional Officer:** Mrs Isabel Human.

**Senior Assistants:** Mss Ina Erasmus and Sylvia Teele.

**Technical Assistant:** Mr Patrick Mohasi.

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Qwaqwa

# Campus

Department of

# Chemistry: Qwaqwa Campus

## Overview

The Department of Chemistry did well in terms of lecturing and research in 2013. However, the practical training of students still remains a challenge because of limited laboratory space and lack of equipment that are standard at most other universities. The Polymer Research Group in the Department has again done well during 2013. Several projects were completed and there were a number of research collaborations, both nationally and internationally, during the year. As part of these collaborations, a number of national and international visitors visited the Department at the Qwaqwa Campus. There was also close collaboration with the Polymer Institute at the University of Stellenbosch in terms of honours and master's degree training. Three staff members from this institute (Profs Pasch, Van Reenen, and Dr Beyers) visited the Qwaqwa Campus to lecture to the honours students. Prof Luyt spent two days at the University of Stellenbosch lecturing to their honours students. Prof van Reenen and Prof Luyt also co-supervised a doctoral degree student who was registered with the UFS. The highlight of the year was when Prof Luyt was invited to give a keynote lecture at EUROFILLERS 2013 in Bratislava, Slovakia. He also accompanied the vice-rector, Prof Hay, to Shenyang, China, for the signing of a bilateral agreement between the University of the Free State and the Shenyang University of Chemical Technology.

## Activities and Achievements

The lecture load was distributed as follows amongst the departmental staff members:

| Lecturer Responsible | Module(s) |
|---|---|
| Dr MA Jordaan | CEM224, CEM344 |
| Prof AS Luyt | CEM214, CEM334, CMP614, CMP634, CMP654, CMP644, CMP664, CMP684 |
| Mrs MA Malimabe | CEM214, CEM334, CMP |
| Mr RG Moji | CHE132, CHE142 |
| Mrs NF Molefe | CHE122, CEM242, CEM324 |
| Mr TA Tsotetsi | CHE112, CEM232, CEM314, CMP674 |

Mr SJ Sefadi was appointed on contract to assist with the UPP first-year lecturing. Mr TH Mokhothu was responsible for CHE151 and CHE161.

Teaching and learning within the Department went well, although we feel that there is room for improvement, and staff is encouraged to participate in the teaching and learning initiatives aimed at assisting them to improve their learning facilitation skills.

## Achievements of Students

Mr Mofokeng (MSc student) won the best poster prize at the 12th Annual UNESCO/IUPAC Workshop and Conference on Macromolecules & Materials in Stellenbosch, 24 to 28 March 2013.

## Special Achievements

Prof Luyt gave a keynote lecture at EUROFILLERS 2013 in Bratislava, Slovakia, 25 to 29 August 2013.

## Community Service

The Department participated in the Qwaqwa Campus open-day event and also participated in the Science Week exhibitions in conjunction with the Thabo Mofutsanyane District Department of Education.

## National and International Collaboration

### National collaborations

With Prof Albert van Reenen at the University of Stellenbosch on a project entitled "Affecting the morphology and properties of heterophasic ethylene-propylene copolymers by selective nucleation techniques". We shared a Qwaqwa PhD student on this project.

Profs van Reenen and Pasch and Dr Cor Beyers from Stellenbosch taught a number of topics to our honours students.

### International Collaborations

With the Vinća Institute of Nuclear Physics, Belgrade, Serbia (Dr Vladimir Djoković). We continuously collaborate on several projects and regularly publish together.

*Prof Luyt (far right) with his research group.*

*Two Chemistry postgraduate students setting up an NMR analysis experiment.*

With the University of Modena and Reggio Emilia, Modena, Italy (Prof Massimo Messori), on a project entitled "In situ generation of fillers within polymer matrices: an innovative way to reinforce plastics". This is an official, NRF-funded collaboration. A student of Prof Messori, Katia Paderni, spent 30 days in our laboratories during September 2013. Three of our students spent 14 days each in Modena during June 2013.

With the Institute of Polymer Research (IPF) in Dresden, Germany (Dr Jürgen Pionteck), on a project entitled "Electrically and thermally conductive polymer nano-composites: Improved dispersion of nano-structured graphite in polyolefins by chemical modification". This is an official, NRF-funded collaboration. Prof Luyt spent ten days in Dresden during August 2013, and two of his students spent 14 days each in Dresden during June 2013. Dr Pionteck and his student, Michael Müller, visited Qwaqwa for 14 days during November 2013.

## Postgraduate Students

### Postgraduate students who graduated during 2013

**Dr TE Motaung** (PhD in Polymer Science), with a thesis entitled "Effect of metal oxide nano-particles on the properties and degradation behaviour of polycarbonate and poly(methyl methacrylate)".

**Ms MA Sibeko** (MSc in Polymer Science), with a thesis entitled "Preparation and characterisation of vinyl silane crosslinked thermoplastic composites filled with nanoclays".

**Mr TC Mokhena** (MSc in Polymer Science), with a thesis entitled "Preparation and characterisation of vinyl silane crosslinked thermoplastic filled with natural fibres".

**Mr TS Motsoeneng** (MSc in Polymer Science), with a thesis entitled "The effect of crystalline phase morphology on the structure and properties of polypropylene impact copolymers".

### Postgraduate students who successfully finished their postgraduate research during 2013

**Mr TH Mokhothu** (PhD in Polymer Science), with a thesis entitled "In situ preparation and properties of rubber/inorganic oxide nanocomposites".

**Mr TG Mofokeng** (MSc in Polymer Science), with a thesis entitled "Preparation and characterisation of polymer nanocomposites with piezoelectric properties".

## Research

The Polymer Research Group in the Department of Chemistry is the most active research group in the Faculty at the Qwaqwa Campus. During 2013 it accommodated 14 master's and doctoral students, and one postdoctoral fellow. Prof Riaan Luyt, who heads this group, attended and presented at a number of international conferences, and the students presented a number of oral papers at the 12th Annual UNESCO/IUPAC Workshop and Conference on Macromolecules & Materials in Stellenbosch. The group published 12 papers in internationally accredited journals. Two more papers were published from the PhD research of a staff member, Mrs Molefe, who is not part of this group.

## Staff Matters

Dr MA Jordaan completed her PhD studies, and Mrs NF Molefe submitted her thesis for the same degree. However, Dr Jordaan resigned in November 2013.

The two professional officers in the Department, Mr Mngomezulu and Dr Motaung, resigned and were replaced by Mr Mochane and Mr Mosoabisane.

# Research Outputs

## Research Articles

**Ahmad, E.E.M., Djoković, V. & Luyt, A.S.** 2013. Thermal and dynamic mechanical properties of biobased poly(furfuryl alcohol)/sisal whiskers nanocomposites. *Polymer Bulletin* 70: 1265-1276.

**Bozanic, D.K., Luyt, A.S., Trandafilovic, L. & Djokovic, V.** 2013. Bioconjugates of glycogen and gold nanoparticles: Controlled plasmon resonance via glycogen induced nanoparticle aggregation. *RSC Advances* 3: 8705-8713.

**He, W., Zhuang, M., Li, Y., Luyt, A.S. & Ge, T.** 2013 In-situ polymerization organic-inorganic hybrid materials monomer casting polyamide 6 / nanorods yttrium hydroxide. *Advanced Materials Research* 662: 24-27.

**Klepac, D., Ščetar, M., Kurek, M., Mallon, P.E., Luyt, A.S., Galić, K. & Valić, S.** 2013. Oxygen permeability, ESR, AFM, DSC and PALS studies of uniaxially deformed PE-LLD film. *Polymer International* 62: 474-481.

**Morselli, D., Bondioli, F., Luyt, A.S., Mokhothu, T.H. & Messori, M.** 2013. Preparation and characterization of EPDM rubber modified with in situ generated silica. *Journal of Applied Polymer Science* 128: 2525-2532.

**Motaung, T.E., Luyt, A.S., Saladino, M.L. & Caponetti, E.** 2013. Study of morphology, mechanical properties and thermal degradation of polycarbonate-titania nanocomposites as function of crystalline phase and content of titania. *Polymer Composites* 34: 164-172.

**Motaung, T.E., Saladino, M.L., Luyt, A.S. & Chillura Martino, D.** 2013. Influence of the modification, induced by zirconia nanoparticles, on the structure and properties of polycarbonate. *European Polymer Journal* 49: 2022-2030.

**Ndlovu, S.S., Van Reenen, A.J. & Luyt, A.S.** 2013. LDPE-wood composites utilizing degraded LDPE as compatibilizer. Composites Part A: 51:80-88.

**Novák, I., Popelka, A., Luyt, A.S., Chehimi, M.M.,** Špírková**, M., Janigová, I., Kleinová, A., Stopka, P., Šlouf, M., Vanko, V. & Chodák, I. 2013. Adhesive** properties of polyester treated by cold plasma in oxygen and nitrogen atmospheres. *Surface & Coatings Technology* 235: 407-416.

**Ochigbo, S.S., Luyt, A.S., Mofokeng, J.P., Antić, Ž., Dramićanin, M.D. & Djoković, V.** 2013. Dynamic mechanical and thermal properties of the composites of thermoplastic starch and lanthanum hydroxide nanoparticles. *Journal of Applied Polymer Science* 127: 699-709.

**Sibeko, M.A. & Luyt, A.S.** 2013. Preparation and characterisation of vinylsilane crosslinked high-density polyethylene composites filled with nano clays. *Polymer Composites* 34: 1720-1727.

**Stuurman, N.F., Muller, A. & Conradie, J.** 2013. Conformational analysis of triphenylphosphine in square planar [Rh(b-diketonato)(CO)(PPh3)] complexes. Crystal structure of [Rh(PhCOCHCO(CH2)3CH3)(CO)(PPh3)]. *Inorganica Chimica Acta* 395: 237-244.

**Stuurman, N.F., Muller, A. & Conradie, J.** 2013. Structural trends in [Rh(PhCOCHCO(CH2)nCH3)(CO)(PPh3)](n50–3) and related complexes: crystal structure of [Rh(PhCOCHCO(CH2)2CH3)(CO)(PPh3)]. *Transition Metals Chemistry* 38: 429-440.

**Zanotto, A., Luyt, A.S., Spinella, A. & Caponetti, E.** 2013. Improvement of interaction in and properties of PMMA-MWNT nanocomposites through microwave assisted acid treatment of MWNT. *European Polymer Journal* 49: 61-69.

### Staff

**Professor:** Prof AS Luyt.

**Lecturers:** Mr TA Tsotetsi, Mrs MA Malimabe, Mrs NF Molefe, and Dr MA Jordaan.

**Junior Lecturer:** Mr RG Moji.

**Senior Officers: Professional Services:** Mr M Mosoabisane, Mr MJ Mochane, Ms JP Mofokeng, and Ms CE Clarke.


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Department of

# Computer Science and Informatics: Qwaqwa Campus

## Overview

The Department of Computer Science and Informatics completed the design of their new Computer Science degree: an exciting and updated programme integrating mobile technologies. A mobile laboratory was created and contains modern laptops and a teaching-friendly environment. The lab currently has wireless access and plans have been put in place to expand the lab to include tablets and smartphones to support the mobile aspect of our new degree. Staff qualifications have proceeded at a steady pace and our Department is known campus-wide as the leaders in teaching and learning. Start a BSc in Information Technology, succeed with our support, and lead our country's knowledge revolution.

## Activities and Achievements

Staff achievements for 2013 include the master's degree achieved by Mr Vushemadzoro Mudavanhu. Staff presented at conferences, including a usability paper on Brain-Computer Interfaces for SAICSIT and HELTASA conference papers on Exploring the Influence of Multifaceted Classroom Presentation Approaches on Student Learning Experience and Blackboard, as a means to promote teaching and learning in higher education. At the UFS' annual Teaching and Learning Awards ceremony, Mr Benedict Sebastian was given an excellence award.

*Students of the Department presenting at the open day.*

## Achievements of Students

Seven Computer Science students received awards for their academic performance from the Natural and Agricultural Sciences faculty.

## Activities

The Department held a great open day for 2013. Students from various schools were motivated and informed about the importance of a knowledge-based industry to local communities with the benefits associated with it. Our own students created a music video to that effect – the video is available at https://www.youtube.com/watch?v=BYA-QHwz8Rk.

The new mobility lab was designed and constructed on the Department floor. It is a modern learning space that is perfectly suited for lecturing and group work. We have state-of-the-art laptops, wireless Internet access, and a high resolution 3D projector. The lab will be further enhanced with mobile devices in the upcoming year to serve as the Department's flagship mobility laboratory.

School children listen to the presentation during the open day.

## Community Service

RIS242 is a course offered as service learning cum community service from the Department of Computer Science and Informatics. It is a semester course with eight credits. The objective of this course is to uplift the lifestyle of elderly and young people in the Qwaqwa community by teaching them to use computers and work with basic MS Word applications. This course is optional and there are seven to ten students every year for this course.

These students are purely taking this course because they want to and not because of their curriculum or programme. The University of the Free State had a show case day; at that event there were many exhibits from different companies and parties. RIS242 students of the 2013 batch also participated in it to exhibit the type of service we offer to the community, ranging from helping to maintain the computer labs to various other activities.

## Research

Research in the Department is broad and involves different disciplines in the field.

Mr Robert M Alfonsi is carrying out research on mobile applications for rural areas. He is also involved in research

*Students helping to maintain the computer labs.*

on the contribution role of Virtual Reality educational technologies in the learning of Computer Science in Qwaqwa - a previously disadvantaged context in the Eastern Free State.

Mr Gavin Dollman completed his research on the usability of a Brain-Computer Interface called the Emotiv to complete his MSc in Computer Information Systems. It was found that a person with little to no computer access could use the Emotiv with as little as 45 minutes of training.

Mr Fani Radebe is continuing his study on how mobile phones can be used by students to respond to classroom questions. He developed a system that the students can interact with by using their Bluetooth-enabled mobile phones or laptops that are provided in the mobile laboratory. This study is also a partial fulfilment of his structured master's degree.

Ms Ruth Wario is continuing her study (towards her PhD) to investigate the level of ICT use in the classroom at a rural South African University.

## Staff

**Lecturers:** Mr RM Alfonsi and Ms RD Wario.

**Junior Lecturers:** Mr GJ Dollman, Mr T Lesesa, Mr MB Mase, Mr FM Radebe, and Mr B Sebastian.

**Assistant Officers: Professional Services:** Ms MP Mahakoe, Ms NA Lesiba, and Mr MP Makhanya.

## Contact Details

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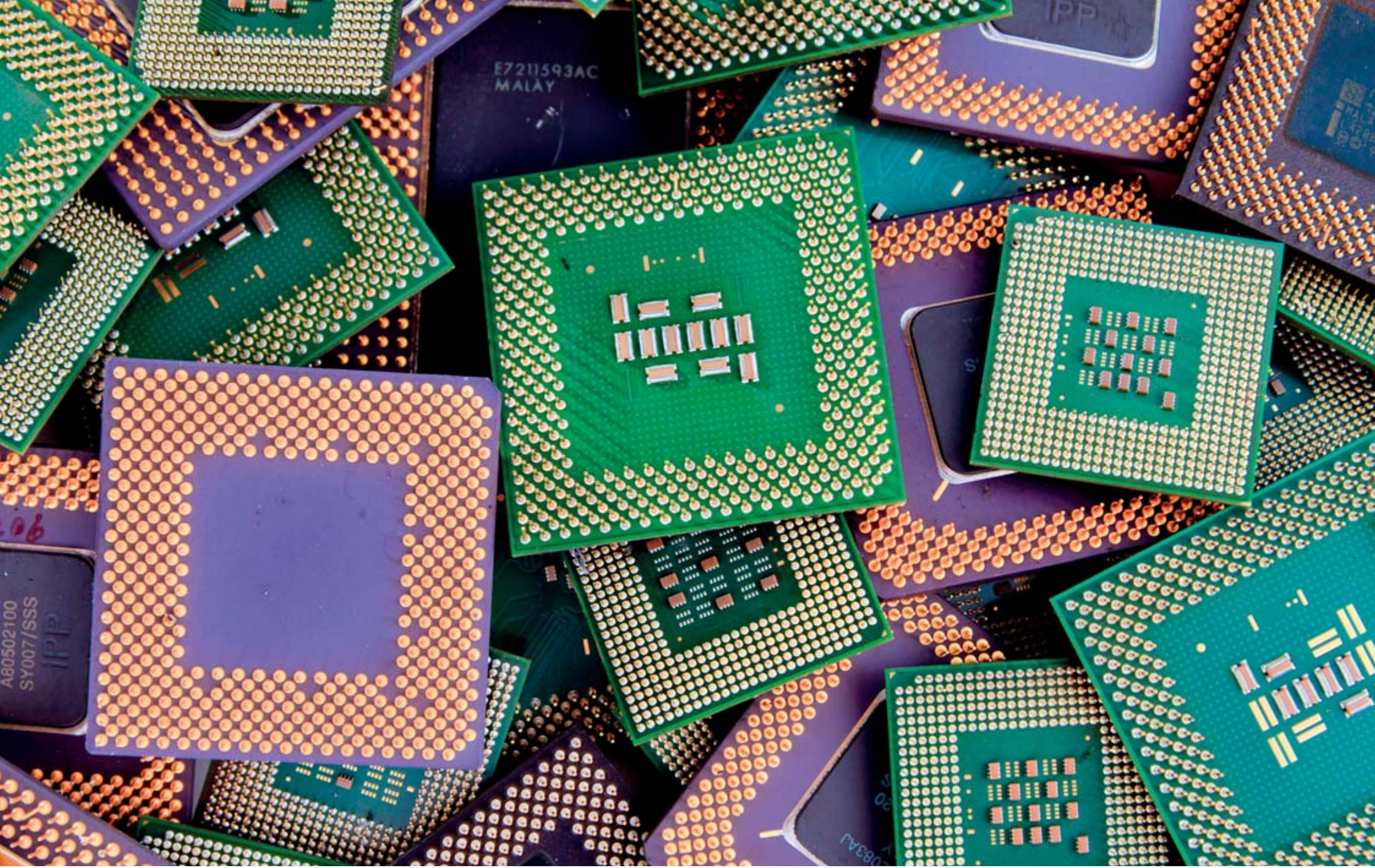
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Department of

# Geography: Qwaqwa Campus

## Overview

The year 2013 presented a number of opportunities and challenges to the Department of Geography at the Qwaqwa Campus. One important opportunity was the return of Prof Willie van Zyl to the Department after his long service in administration. The Department also managed to refine its Environmental Geography programme which was launched this year. Important highlights were the retirement of Dr Hennie Claassen at the end of the year, and the appointment of Dr Geofrey Mukwada as his replacement for the position of subject head. The Department also managed to recruit two postdoctoral research fellows, Dr P Taru and Dr WC Chingombe. They did research on environmental and palaeontological issues in the Eastern Free State region.

## Activities and Achievements

The major highlights of the activities and achievements of the year are as follows:

Approval by SANParks of the Department's research proposal to undertake research in the Golden Gate Highlands National Park. This research, which is spearheaded by Dr Mukwada, will last until 2016.

Completion of a solar water heater research project by Dr G Mukwada.

Dr Mukwada presented a paper at the International Conference on Renewable Energy Research and Applications, Madrid, Spain, 20 and 23 October 2013.

**Table 1**: Number of students enrolled at undergraduate level

| Level | Modules | Number of students | Pass rate (%) |
|---|---|---|---|
| First year | GEO 114 | 280 | 82 |
| | GEO 124 | 215 | 87 |
| Second year | GEO 214 | 200 | 56 |
| | GEO 224 | 177 | 72 |
| | TRM 214 | 235 | 88 |
| | TRM 224 | 148 | 73 |
| Third year | GEO 314 | 172 | 58 |
| | GEO 324 | 158 | 62 |
| | TRM 314 | 252 | 96 |
| | TRM 324 | 240 | 90 |

## Achievements of Students

The pass rate for GEO 224 improved. It rose from 60% in 2012 to 72% in 2013. This largely resulted from the increasing use of improved methods of teaching and learning in undergraduate courses within the Department, including the use of e-learning tools. Blackboard was used for the first time in the assessment of students, and there were additional tutorials and increased direct contact with the lecturers and student assistants.

## Activities

Dr Claassen, Dr Mukwada, and Ms Naidoo played an instrumental role in developing the new Environmental Geography programme that will be offered at the Qwaqwa Campus. The number of students remained relatively high at all the undergraduate levels, as noted in Table 1. This means that staff in the Department was overloaded with teaching and assessment.

The Department also managed to conduct several fieldwork excursions and educational tours, including one to Durban.

## Community Service

We launched the Witsieshoek Community Conservation Area partnership, involving the UFS, Maluti-Drakensberg Transfrontier Programme, tribal authorities, and several government departments to spearhead community

*From left to right: Mr A Adjei, Prof WF van Zyl, Ms N Mokhethi, Dr G Mukwada (incoming subject head), Dr JHD Claassen (outgoing subject head), Ms M Naidoo, and Mr P Mahasa.*

participation in natural resource conservation in the Witsieshoek area. The Department of Geography is playing an important role in the partnership and is well represented through the efforts of Dr Mukwada, Prof Van Zyl, Dr Taru, and Dr Chingombe.

## National and International Collaboration

As can be seen in the list of publications, there has been collaboration between individuals in the Department and professionals from other universities, especially from Zimbabwe.

## Postgraduate Students

Apart from the two postdoctoral research fellows that were recruited, the Department also managed to recruit two master's students, with the two bursaries that were secured from the Agricultural Research Council. These students are Sewela Malaka and Thabo Matela. Both students do research on the relationship between climate change and agriculture. The Department also managed to identify prospective students who can be enrolled in the future, depending on the availability of funding.

## Staff Matters

Due to the mismatch between staffing levels and student numbers, the Department recommended that the number of students enrolled at first-year level should be capped at 120. The burden of low staff levels compromised the research output from the Department. Recommendations were also made to recruit additional staff in preparation of the Environmental Geography programme that starts in 2014.

### Staff

**Associate Professor:** Prof WF van Zyl.
**Senior Lecturers:** Dr JHD Claassen and Dr G Mukwada.
**Lecturers:** Mr A Adjei and Ms M Naidoo.
**Junior Lecturer:** Mr PS Mahasa.
**Researchers:** Dr WC Chingombe and Dr P Taru.
**Assistant Officer Professional Services:** Ms NE Mokhethi.

## Research Outputs

### Research articles

**Mukwada, G. & Manatsa, D.** 2013. Geospatial and temporal analysis of drought years in Zimbabwe - 1940 to 1999. *Geographia Polonica* 86(4): 313-326.

**Taru, P., Chingombe, W. & Mukwada, G.** 2013. South Africa's Golden Gate Highlands National Park management plan: Critical reflections. South African Journal of Science 109(11/12).

**Taru, P., Mukwada, G. & Chingombe, W.** 2013. Microscopic hair characteristics of South African Blue wildebeest (Connochaetes taurinus), Black wildebeest (Connochaetes gnou) and Red rock hare (Pronolagus crassicaudatus). *Journal of Life Sciences* 5(2): 123-126.

**Taru, P., Mukwada, G., Somerai, P. & Chingombe, W.** 2013. QwaQwa community perceptions on the proposed dinosaur museum in the Golden Gate Highlands National Park, South Africa. *African Journal for Physical, Health Education, Recreation and Dance Supplement 2* (September): 187-198.

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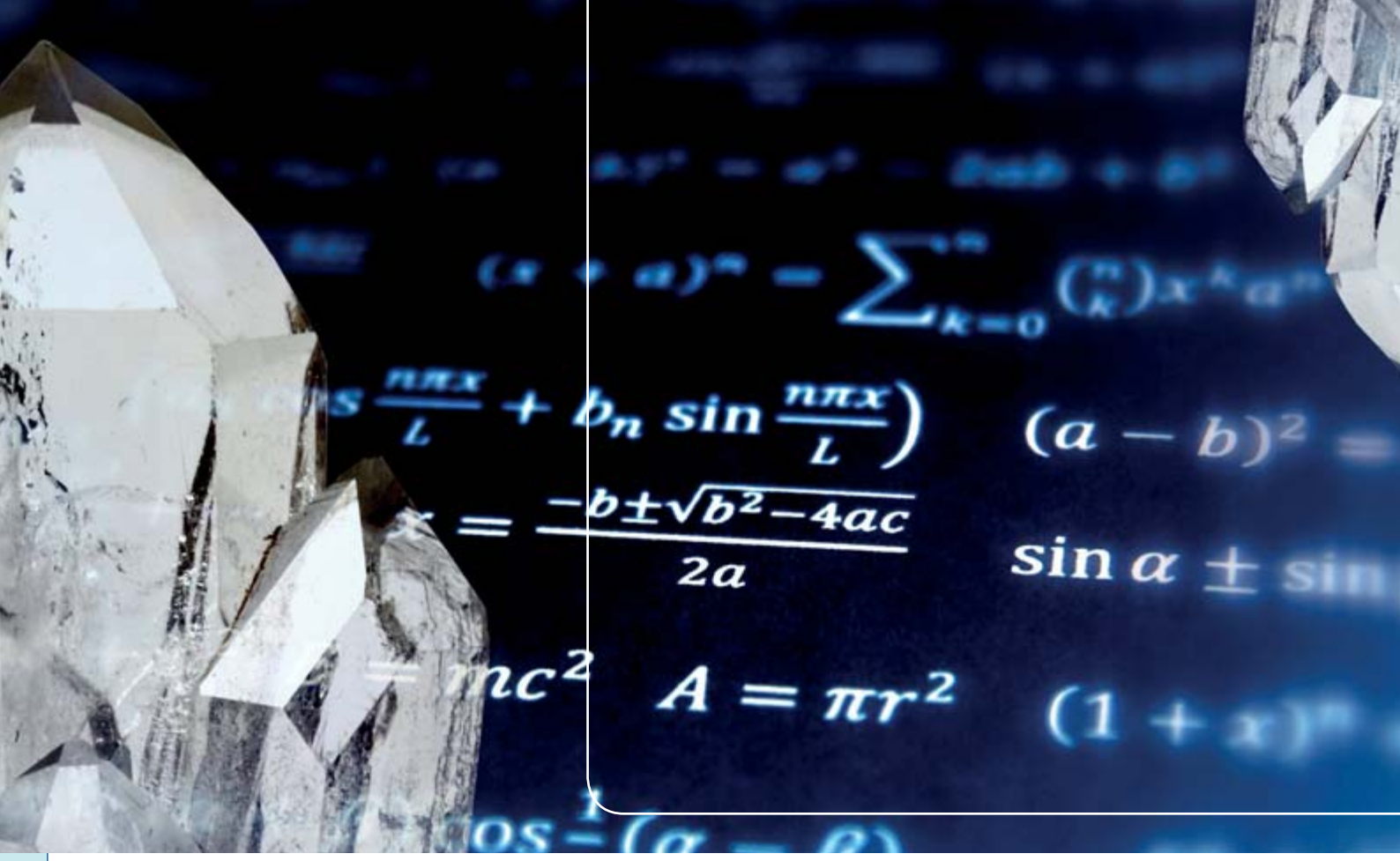



Department of

# Mathematics: Qwaqwa Campus

## Overview

The Department still struggles to find suitable Mathematics lecturers, and the student numbers at third-year level are extremely low. Because of this, the faculty programme committee took the unilateral decision to offer Mathematics only up to second-year level as from 2014.

## Special Achievements

Two students obtained more than 77% in WTW 134. Compared to previous years, this is excellent. The second semester WTW144 achieved much better results than in 2012. STK114 had a 100% pass rate.

## Activities

Special provision was made for students to join groups and prepare for the examinations over weekends. Their preparedness to sacrifice their weekends is evidence of their motivation to study Mathematics. A mathematics camp was also organised for the WTV extension programme students before the examinations, with good results. Those who attended all passed.

## National and International Collaboration

The staff of the University of KwaZulu-Natal was contacted and a friendly approach was made to see how their

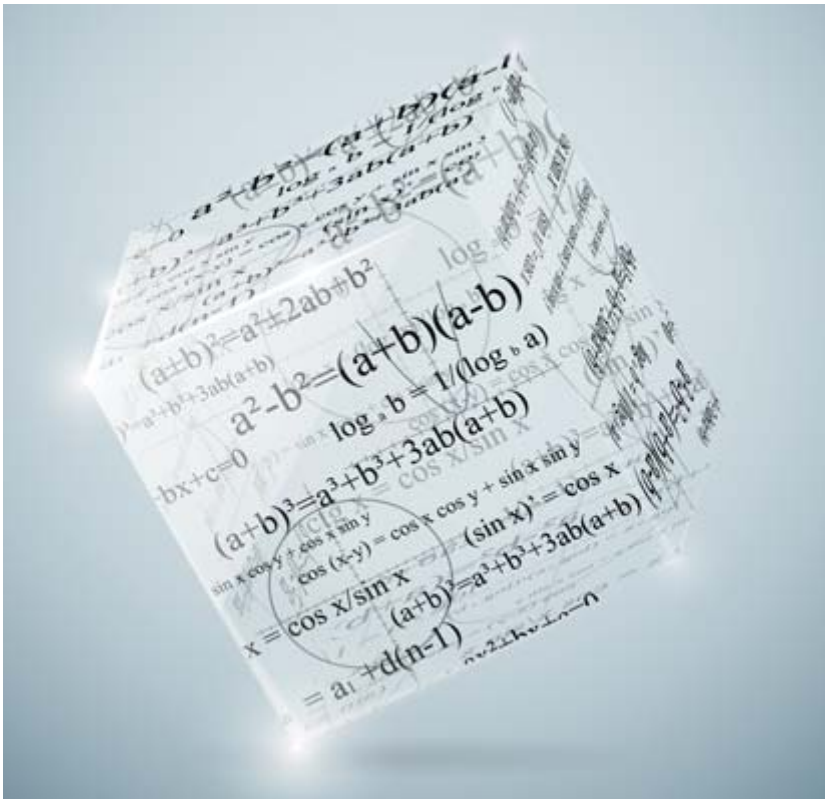
curriculum is structured, in order to compare the teaching methods and promote classroom teaching and learning. Unfortunately no further progress was made.

## Postgraduate Students

Mr Mbambo registered for a PhD.

## Staff Matters

Mrs Faber received a BSc honours degree in Statistics.




### Staff

**Professor:** Dr J Schröder.
**Lecturer:** Mr P Mbambo.
**Junior Lecturer:** Mrs C Faber.
**Contract Lecturer (Part-time):** Mr N Sebastian.

## Research Outputs

### Research Articles

**Schröder, J.** 2013. The two-parameter class of Schröder inversions. *Commentationes Mathematicae Universitatis Carolinae* 54(1): 5-19.


### Contact Details

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Department of

# Physics: Qwaqwa Campus

## Overview

The Department of Physics has continued to grow as the number of postgraduate enrolment increased at all levels. The enrolment of undergraduate students towards studying Physics has gradually increased compared to previous years. Due to this increase, the Department has been awarded funding for a new building in order to accommodate research facilities, lecture halls for teaching, and extra offices for staff members. The Department also purchased a fluorescence spectrometer which was much needed for their research.

## Activities

During the Faculty Strategic Summit in November 2013, it was decided to revise the prerequisites for Physics undergraduate enrolment.

## Achievements of Students

One honours student, Mr Jatani Ungula, who attended the 5th South African Conference on Photonic Materials, Kariega Game Reserve on 29 April to 3 May 2013, won a prize for the second best honours poster presentation. Another honours student, Ms Seithati Tebele, who attended the 58th Annual Conference of South African Institute of Physics (SAIP) held at the University of Zululand, 8 to 12 July, won the best honours poster presentation prize in the field of Condensed Matter Physics and Material Sciences.

Faculty best student awards were held on the 6 September 2013 and the initiative was about recognising the best student in each module in the Faculty for Semester 1. Three students in the Physics Department were awarded with certificates as shown in the figure below.

Mr Jatani Ungula (MSc student) was nominated in the 3rd place in Honours category in the 3-Minute Thesis Competition of 2013.

The 2013 Student Practice in JINR field of Research, Dubna, Russia, was attended by two postgraduate students from the Department; Emily Foka (PhD) and Seithati Tebele (honours). The main purpose of the Practice was to allow the students to learn more about the JINR research programme and facilities. The Practice includes lecture courses on advanced research topics in the morning and laboratory research on low-energy electron-neutron scattering particles at the JINR divisions in the afternoon.

*Ms Seithati Tebele won the best honours poster presentation prize at SAIP.*

## National and International Collaboration

The Department is collaborating with the following people and institustions:

- Collaboration is ongoing with the North West University in electronics instrumentation for low-cost scientific instruments.
- Prof Vivian Alberts, PTIP innovations, Technopark, Stellenbosch.
- Dr Jürgen Pionteck, Leibniz-Institut für Polymerforschung, Dresden, Germany.
- Energy and Water sector, Education and Training Authority, Johannesburg.
- Mega Solar, Harrismith, South Africa.
- Physics department at the University of Johannesburg.
- Prof Edson Mayer at the University of Fort Hare.
- Prof Botha at the Department of Physics of the Nelson Mandela Metropolitan University (NMMU).
- ALC and NLC, Centre of Scientific Institute of Research (CSIR).
- Materials Science Faculty at the Washington State University, Washington, USA.

## Postgraduate Students

Mr TA Nhlapo obtained his MSc degree.

The following honours students obtained their degrees: TL Lotha, TD Malevu, FV Molefe, and TM Sithole.

## Research

The Department is growing slowly in terms of research in two areas, Solid State Physics in terms of luminescence materials, and Electronics. In the first area, there is a growing interest in interdisciplinary phosphor research on renewable energy. For the Electronics research there is still a need to acquire some good equipment for this division to grow.

## Staff Matters

Prof Francis Dejene was promoted to a full professor.

Dr Jappie Dolo resigned from the University on the 16 October 2013 and unfortunately died on 22 December 2013.

*Students receive the best student awards from the dean of the faculty, Prof Neil Heideman.*

*Students attending the conference in Russia*

*Students attending the conference in Russia*

# Research Outputs

## Research Articles

**Dejene, F.B. & Kebede, M.A.** 2013. Structural and Photoluminescence properties of $Dy^{3+}$ co-doped and $Eu^{2+}$ activated $MAl_2O_4$ (M = Ba, Ca, Sr) nanophosphors. *Optical Materials* 35: 1927-1931.

**Katashaya, S.R. & Ocaya, R.O.** 2013. Development of a low-cost data acquisition system for total solar insolation and temperature monitoring. *The Asian International Journal of Life Sciences (Supplement 9)*: 263-274.

**Koao, L.F., Dejene, F.B., Swart, H.C. & Botha, J.R.** 2013. The effect of $Ce^{3+}$ on structure, morphology and optical properties of flower-like ZnO synthesized using the chemical bath method. *Journal of Lumin* 143: 463-468.

**Ocaya, R.O.** 2013. A linear, wide-range absolute temperature thermometer using a novel p-n diode sensing technique, Measurement. *Journal of the International Measurement Confederation* 46(4): 1464-1469.

**Ocaya, R.O.** 2013. Circuit's RMS output is linearly proportional to temperature over wide range. *EDN Network*: 1-4.

**Ocaya, R.O. & Mbongo, M.** 2013. A small-plant PID temperature controller for thermoluminescence measurement. In *Proceedings of the IEEE AFRICON 2013*, Mauritius 9-12 September 2013: 883-886.

## Patent

**Ocaya, R.O.** 2013. *Collaborative GSM/Wireless/Ethernet data telemetry system.* RSA Registration number 2013/011/90.

### Staff

**Professor:** Prof FB Dejene.
**Senior Lecturer:** Dr JJ Dolo.
**Lecturers:** Mr RO Ocaya, Mr SV Motloung, and Mr KG Tshabalala.
**Junior Lecturer:** Mr LF Koao.
**Senior Assistant Officer:** Mr SV Motloung.
**Assistant Officer:** Ms MK Lebeko.


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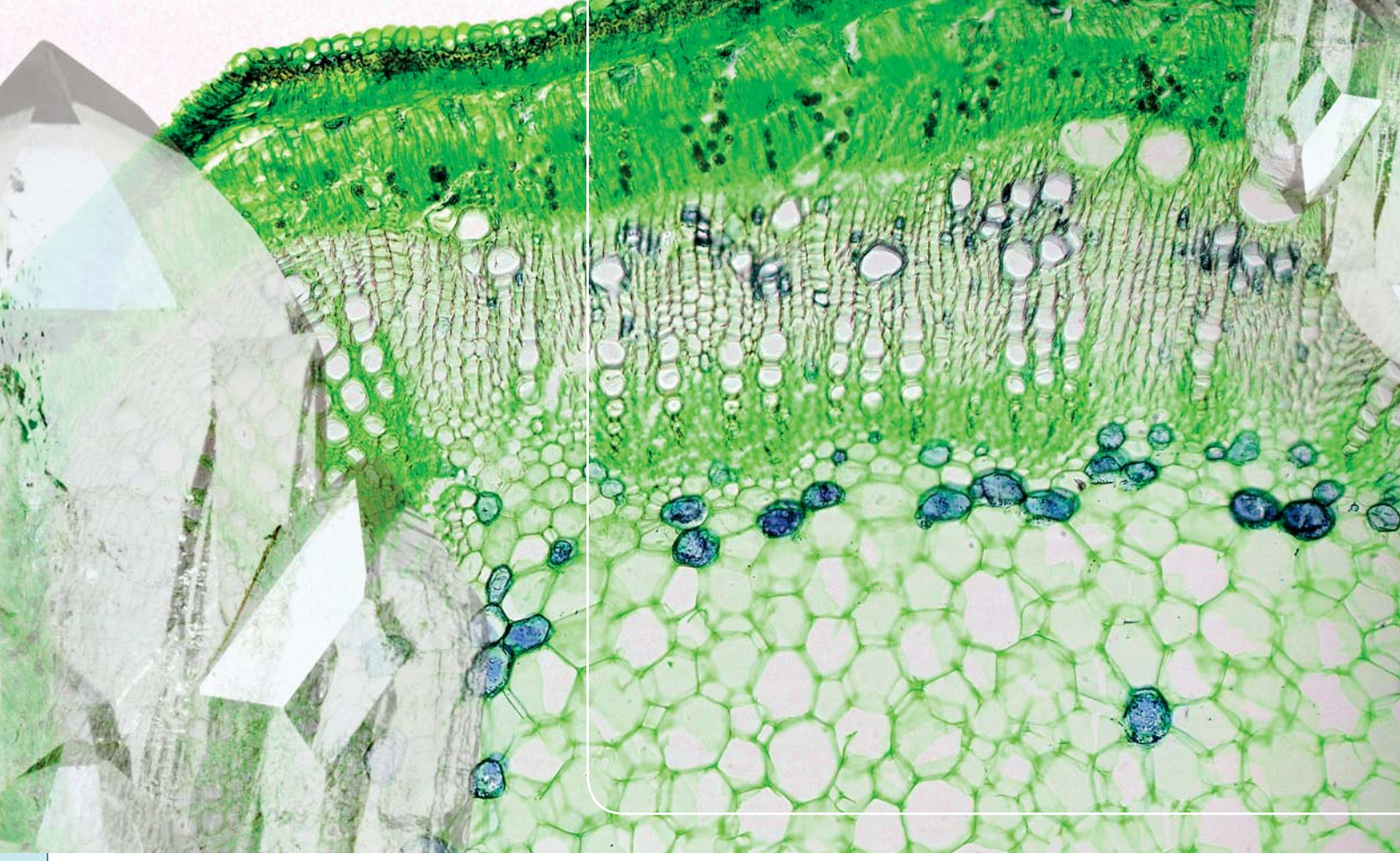

Department of

# Plant Sciences: Qwaqwa Campus

## Overview

The Department has grown from no postgraduate students in 2010 to 13 postgraduates in 2013 - comprising nine honours and four master's students. The Department also boasts four PhD holders out of five academic staff members; this had led to tremendous positive changes in our teaching and learning/lecturer-student relationship, which led to good pass and throughput rates of our students. Research activities have also grown with the addition of Dr Ngara's proteomics and Mr Pitso's conservation research on the existing wetlands and medicinal plants research in the Department. This has led to an increase in the number of research articles published in ISI accredited journals.

## Activities and Achievements

Four main research projects are running:

- WRC Project K5/1980 (Dr EJJ Sieben): Expansion and analysis of National Wetlands Vegetation Database: final analysis. Five students are involved; two honours and three master's. In the Community Assemblage Rules Project, data currently analysed were collected in 2009 and 2010 in three wetlands: Goukou (Western Cape), Wakkerstroom (Mpumalanga), and Mfabeni (KwaZulu-Natal). Issues of species association, spatial autocorrelation, functional diversity, and community aggregated traits shall be described.

*IPUF 2013: Indigenous Plant Use Conference 2013, Nelspruit, Mpamalanga. UFS Qwaqwa Phytomedicine and Phytopharmacology Resaerch Group with Profs Eloff (UP) and Ben van Wyk (UJ), as well as two other professors; one each from Sudan and DRC.*

- Phytomedicine and Phytopharmacology Research Group (Dr AOT Ashafa): six students are involved in different research projects, *viz*; medicinal potential of Basotho medicinal plants for the development of herbal antibiotics, toxicity and antidiabetic studies of Basotho medicinal plants, ecology and conservation status of six medicinal plants commonly used to treat diabetes, and comparative insecticidal properties of six aromatic plants from the Eastern Free State. The group managed to publish six articles in ISI accredited journals with cumulative 2,6 article units.
- Dr Ashafa's team to the IPUF 2013 conference won the hosting right of the 2014 edition of the conference for the UFS' Qwaqwa Campus to be held from 30 June to 3 July 2014.
- Medicinal Potential of *Scabiosa columbaria* L. and *Foeniculum vulgare* Mill (Dr LV Buwa): Two honours students are involved in looking into the biological activities of Basotho medicinal plants used in the treatment of ulcers and menstrual pain.

Dr Rudo Ngara brought a new research area (Proteomics) into the Department; dealing with the comparative analysis of stress-responsive proteins in different sorghum varieties and the molecular cloning and characterisation of sorghum secreted peroxidises.

## Achievements of Students

All the honours students finished in record time; with Ms FN Makhubu and Ms FZN Mathenjwa winning UFS academic merit awards for scoring above 70% average in their honours programme. Ms Molefe won the second-best student oral presentation at the 2013 Indigenous Plants Use (IPUF) conference in Nelspruit, 1 to 4 July 2013.

## Special Achievements

SAEON invited Dr Erwin Sieben to a workshop on database management for a future web portal to be built by SAEON. The portal shall provide shared monitoring data. Dr Sieben was further requested to lead a case study in the Mbongolweni catchment in the Isimangaliso Wetland Park in 2014.

## National and International Collaboration

- University of Lagos, Nigeria (Department of Botany and Microbiology): Dr Ashafa.
- University of Ibadan, Nigeria (Department of Botany and Microbiology): Dr Ashafa.
- University of Western Cape (Department of Biotechnology): Proteomics Research and Services Unit, ARC, Infruitec Campus, Stellenbosch: Dr Ngara.

PPRG 2013: UFS Qwaqwa Phytomedicine and Phytopharmacology Resaerch Group 2013 set. From left is Ms FN Makhubu, Ms FZN Mathenjwa, Mr SQN Lamula, Dr Ashafa (group leader), Mr SA Modise, and Ms G Mahanke.

- University of Kwazulu-Natal (Dr Sershen Naidoo and Dr Syd Ramdhani): Dr Sieben.

## Research

- Toxicity and antidiabetic activity of Basotho medicinal plants: Dr Ashafa.
- Cytotoxicity and antimicrobial activity of Basotho medicinal plants: Dr Ashafa.
- In vitro and in vivo anthelmintic activity of Basotho medicinal plants: Dr Ashafa.
- Anticancer properties of three Basotho traditional herbs: Dr Ashafa.
- Ecology and conservation status of six Basotho antidiabetic plants: Dr Ashafa.
- Comparative insecticidal activity of five medicinal plants from the Eastern Free State, South Africa: Dr Ashafa.
- Comparative analysis of drought and salinity stress responsive proteins in different sorghum varieties: Dr Ngara.
- Molecular cloning and characterisation of a sorghum-secreted peroxidise: Dr Ngara.
- Medicinal Potentials of *Scabiosa columbaria* L. and Foeniculum vulgare Mill: Dr Buwa.
- WRC Project K5/1980: Expansion and analysis of National Wetlands Vegetation Database. Final analysis: Dr Sieben.

## Awards

- Dr Rudo Ngara: Semi-finalist for the 3rd CTA Africa-wide Women in Science Competition, 2012/2013.
- Dr Erwin Sieben: Nominated for National Wetlands Award for work on South African wetlands vegetation at the National Wetlands Indaba.

## Staff Matters

The Department appointed Dr Rudo Ngara in the position of lecturer in September 2013.

# Research Outputs

## Research Articles


**Ashafa, A.O.T.** 2013. Medicinal potential of Morella seratta (Lam.) Killick (Myricaceae) root extracts: Biological and pharmacological activities. *BMC Complementary and Alternative Medicine* 13: 163-171.

**Ashafa, A.O.T., Abass, A.A., Osinaike, T. & Lewu, F.B.** 2013. Morphologica characters and ascorbic acid content of an elite genotype of Cochorus olitorius: the influence of moisture stress. *South African Journal of Plant and Soil* 30: 113-117.

**Kazeem, M.I., Abimbola, S.G. & Ashafa, A.O.T.** 2013. Inhibitory potential of Gossypium arboretum leaf extracts on diabetes key enzymes, α-amylase and α-glucosidase. *Bangladesh Journal of Pharmacology* 8: 149-155.

**Kazeem, M.I., Akanji, M.A., Yakubu, M.T. & Ashafa, A.O.T.** 2013. Protective effect of free and bound polyphenol extracts from Ginger (Zingiber officinale Roscoe) on the hepatic antioxidant and some carbohydrate metabolizing enzymes on streptozotocin-induced diabetic rats. *Evidence-Based Complementary and Alternative Medicine* 2013: 1-7.

**Kazeem, M.I., Ogunbiyi, J.V. & Ashafa, A.O.T.** 2013. In vitro studies on the inhibition of a-amylase and a-glucosidase by leaf extracts of Picralima nitida (Stapf). *Tropical Journal of Pharmaceutical Research* 12: 719-725.

**Molefe, N.I., Tsotetsi, A.M., Ashafa, A.O.T. & Thekisoe, M.M.O.** 2013. In vitro anthelmintic effects of Cotyledon orbiculata, Hermannia depressa and Nicotiana glauca against parasitic gastro-intestinal nematodes of livestock. *Journal of Medicinal Plants Research* 7: 536-542.


*SAEON Afromont workshop at Didima, KZN: Dr Sue van Rensburg (AFROMONT S/A) in the middle giving background information on the map (a 3D map carved out in the rock) of the experimental catchments that were established by Killick in the sixties in the Didima area. Listening are the UFS Qwaqwa Afromont researchers comprising Willem van Zyl, Erwin Sieben, Geofrey Mukwada, Tom Ashafa, Wiseman Chingombe, Phillips Taru, and Calvin Muzingiri. All activity is geared towards reviving these experimental catchments in order to capture long-term monitoring data.*

## Staff

**Senior Lecturer:** Dr AOT Ashafa, Dr L Buwa, and Dr EJJ Sieben.

**Lecturers:** Dr R Ngara.

**Junior Lecturer:** Mr TR Pitso.

**Senior Officers: Professional Services:** Mr NP Mzizi and Mr PJ Mojau.

**General Worker: Animal House:** Ms G Mahanke.

## Contact Details


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# Academic

# Centres

# Disaster Management Training and Education Centre for Africa

(UFS-DiMTEC)

## Overview

The Disaster Management programmes offered by DiMTEC are considered the most prominent postgraduate programmes established in Africa. Its blended learning approach and multidisciplinary syllabus enable professionals and students from all over the African continent to acquire considerable knowledge and expertise on Disaster Management. The two Disaster Management programmes offered are the Advanced Diploma and the Master's degree.

Of the nearly 300 students who applied for the 2013 Advanced Diploma, 60 were selected to enrol. Students came from several African countries including Sudan, DRC, Malawi, Zimbabwe, Zambia, Namibia, Lesotho, and Swaziland; indicating the excellent African footprint maintained by DiMTEC.

## Master's Degree Graduation

The following students graduated in June 2013: B Banda, M Sekhesa, E Mamadi, T Ngando, BM Mabela, L, Ringisai, L Sikwentu, R Seabo, B Ngonyama, T Mkansi, D Mabunda, A Niipare, BM Mapule, DM Mutele, and M van der Nest.

Two students, Ms L Mashile and Ms SC Iheadiri, graduated in Disaster Management on 5 December 2013.

## Academic Throughput

DiMTEC maintains high academic standards with an enviable throughput. The class of 2013 exceeded all expectations. Table 1 indicates the academic performance of the 2013 intake for the different modules.

| Subject | Pass Rate | Subject | Pass Rate |
|---|---|---|---|
| Dim601 | 100% | Dim608 | 93% |
| Dim602 | 90% | Dim701 | 100% |
| Dim603 | 100% | Dim703 | 100% |
| Dim604 | 87% | Dim704 | 75% |
| Dim605 | 88% | Dim705 | 93% |
| Dim606 | 98% | Dim706 | 100% |
| Dim607 | 90% | Dim707 | 93% |

## Airborne with SA Air Force Helicopters

DiMTEC staff enjoyed the privilege to participate in a yearly practical exercise of the South African Medical Services. Mss Alice Ncube and Olivia Kunguma flew with the crew to various destinations in and around Bloemfontein, and were deployed with a rope from the helicopter onto the top of one Bloemfontein's water towers.

## Experience and Training

### Field Experience and Student Support – Ekurhuleni Metropolitan Municipality (5 to 12 July 2013)

Mr Johanes Belle attended a week-long practical experience hosted by the Disaster Management Centre of the Ekurhuleni Metropolitan Municipality (EMM). The field experience started with a response to burnt-down shacks in the Alberton area. Together with the Regional Disaster Management Centre located in Alberton, blankets and food parcels were handed to the affected people. The next response was a site inspection for a proposed development to evaluate the likely risks of such a development on the local community. Accompanied by a former DiMTEC student, Mr M Sikhakhane, they visited an informal settlement built on dolomite rock with the risk of sinkholes. Mr Belle also partic ipated in the vulnerability assessment of 11 identified informal settlements in the EMM.

### MSB Field Staff Induction Training Course in Sweden

Mr Johanes Belle attended the Swedish Civil Contingencies Agency (MSB) Field Staff Induction Training in Sweden from 21 to 26 February 2013. The course took place at the MSB headquarters in Karlstad, Sweden.

The Field Staff Induction Training Course equips participants with knowledge on how to handle disaster response in the field as emergency relief workers. More than 35 participants took part in the training and comprised professionals from various disciplines involved in disaster relief and disaster risk reduction.

## Support of DiMTEC Students in Namibia

Ms Alice Ncube travelled to Windhoek, Namibia, in support of students busy with research. She also met with one of DiMTEC's alumni, Ms Anna-Marie Niipare. Ms Ncube had the opportunity to meet personnel at Windhoek's Disaster Management Centre and visited the University of Namibia. She also met with Ms Anastasia Amunyela who is from the President's office in Namibia – she was instrumental in the development of disaster management structures at all levels in Namibia.

*Some of the students who graduated in June 2013.*

*Some of the students who graduated in December 2013.*

*Anna-Marie Niipare with the staff of Windhoek's Disaster Management Centre.*

*Field trip in the Mefou Catchment in Cameroon.*

*From the left are: Josephine Shields Recass (project manager, World Disasters Report 2013), Dr Andries Jordaan (director: DiMTEC), and Andreas Papp (programme director, Medecins Sans Frontieres, Austria).*

## Achievements and Activities

Olivia Kunguma (junior lecturer at DiMTEC) was invited to present a paper at the World Conference on Disaster Management (WCDM) held in Toronto, Canada, 24 to 28 June 2013. Her presentation, entitled "Public awareness campaigns, a disaster risk reduction strategy for fire and flood hazards in the Western Cape province, South Africa", was well attended as one of the sub-plenary sessions. She also had the opportunity and privilege to visit the Niagara Falls, one of the world's most magnificent wonders.

From 14 to 24 November 2013, Mr Johanes Belle attended and actively participated in the Integrated Watershed Management Research and Development Capacity Building workshop in Cameroon. Dr Andries Jordaan, director of DiMTEC, is an active member of the research team and nominated Mr Belle to attend the workshop. Mr Belle prepared a presentation on the importance of wetlands in integrated watershed management as part of his ongoing PhD research. He also utilised this opportunity to visit the University of Yaounde and the University of Buea to lay the foundation for possible future research and training collaboration. Experts in watershed management from Germany, researchers from partner universities, including the University of Cologne in Germany, Jomo Kenyatta University in Kenya, University of Western Cape in South Africa, University of Yaounde in Cameroon, and the DAAD, attended this workshop where Mr Belle represented the UFS. More than 11 local chiefs who live in the Mefou catchment, as well as local researchers, water management authorities in Cameroon, and master's and doctorate students involved in water, environment, disaster and other related fields of study, were also present at the workshops.

The Abu Dhabi Municipality Hazard and Risk Assessment project, ADSHRA, organised the third ADSHRA project workshop in Abu Dhabi, UAE, in April 2013. The conference focused on Abu Dhabi Seismic Hazard and Risk Assessment. Prof Dusan Sakulski was invited as a speaker.

The Organization for security and co-operation in Europe (OSCE) Mission to Serbia organised a thematic international conference with the focus on Disaster Risk Management in Belgrade, Serbia, during November 2013. Prof Dusan Sakulski was invited as one of the international speakers.

Dr Andries Jordaan was invited to participate in several African initiatives from the United Nations and the Government of Germany. Dr Jordaan believes that "South Africa will not remain stable – politically and economically – while it remains an island of wealth in a sea of poverty" and that "the future for a stable South Africa is through the development of the rest of Africa". In line with these philosophies, he has built networks and actively contributed towards the development efforts in Africa. The African footprint of DiMTEC is evidence that African students regard the DiMTEC postgraduate programme as their programme of choice.

The United Nations Office for Outer Space Affairs (UNOOSA) invited DiMTEC's director, Dr Andries Jordaan, as part of the UNSPIDER technical advisory mission (TAM) to advise the Government of Ghana on the use of space-based technology for disaster risk reduction. The rest of the TAM consisted of experts from China, UK, Belgium, Germany, Austria, Nigeria, and Kenia. The week-long visit took place from 25 to 29 November 2013 during which 17 different departments and institutions were interviewed and consulted, mainly in the capital of Ghana, Accra. The National Disaster Management Organisation of Ghana (NADMO) requested UNOOSA to advise the government of Ghana on the use of space-based technologies, which include remote sensing, navigation, and communication. Different departments and institutions

were evaluated in terms of their access to space-based systems and the capacity to utilise the technology. Dr Jordaan reported that the TAM also conducted a successful workshop with all line departments and some universities in Ghana. A report with recommendations was submitted to the Ghana government.

The world's largest humanitarian network, The International Federation of Red Cross and Red Crescent Societies (IFRC), launched the World Disasters Report in 2013. The report examines the impact of technological innovations on humanitarian actions. Dr Andries Jordaan attended the event at the Vienna International Centre.

Dr Andries Jordaan was invited as an international expert on water risk and water-related disasters to the third scoping workshop of the Institute for Integrated management of Material Fluxes and of Resources (UNFLORES). He also participated in the regional workshop on the establishment of the Twin Institute of UNFLORES at Eduardo Mondlane University in Maputo, Mozambique. During this workshop, Dr Jordaan was appointed as the UNFLORES African focal point to a team of scientist from seven universities in seven different African countries for drought and flood research in Africa. On invitation from UNFLORES, Dr Jordaan also participated in the International Kickoff Workshop on Advancing a Nexus Approach to the Sustainable Management of Environmental Resources held in Dresden, Germany, 10 to 12 November 2013.

On invitation, Dr Andries Jordaan visited the National Public University in Budapest, Hungary. He met with the director of the fire management programme, Dr Agoston Restas, and an agreement for joint research and exchange of students and lecturers were positive outcomes of this visit.

The Partnership for Africa Foundation, funded by the Federal Ministry for Economic Cooperation and Development (BMZ) in Germany, invited and appointed Dr Andries Jordaan as the scientific expert and representative for African universities on the German/African project "Building the Future Together".

The Partnership with Africa Foundation invited Dr Andries Jordaan as an African representative and expert to the high-level panel discussions on collaboration in business linkages between Germany and Africa in Bonn, Germany.

As an active member of the International Society for Integrated Disaster Risk Management (IDRiM), Dr Andries Jordaan was invited to the Society's annual conference in Newcastle Upon Tyne in the United Kingdom. The title of his presentation was "Drought insurance for extensive livestock farmers based on Standard Precipitation Index as a tool for drought risk reduction". The conference was jointly organised by the Dealing with Disasters Programme at Northumbria University. Due to the initiative of Dr Jordaan, the Dealing with Disasters conference will be organised in South Africa in 2014.

## National Conferences

Disaster Management Institute of Southern Africa (DMISA) Conference 2013

Through its intricate planning, organisation, and recruitment, DiMTEC proudly played a major role in hosting the 2013 DMISA, held at the President Hotel in Bloemfontein. Ms Olivia Kunguma was instrumental in most of the logistical arrangements for the conference.

As usual, DiMTEC presented important academic papers at the conference. These include: (i) Index Insurance as a Risk Transfer tool for Disasters, presented by Dr AJ Jordaan (Plenary presentation); (ii) Assessing the knowledge, attitudes and practices regarding cholera preparedness and prevention in Ga-Mampuru village, Limpopo, South Africa, presented by Ms A Ncube; and (iii) Dolomite Sinkhole Risk Awareness: A study of Zonkizizwe Extension Six Settlers in Kathlehong Area in Ekurhuleni Metropolitan Municipality, presented by Mr JA Belle.

### African Water Symposium

The First African Water Symposium on Water Conflicts together with the 5th Orange River Basin Symposium was hosted by the University of the Free State in cooperation with the State University of New York and Central University of Finance and Economics in June 2013. Prof Dusan Sakulski and Dr Andries Jordaan presented the paper "Vulnerability, adaptation and coping to drought in the Eastern Cape for the Agricultural Sector" on the second conference day. This was the first opportunity to present preliminary research results regarding rainfall (drought hazard) analysis in the Eastern Cape.

### Annual Conference for Agricultural Extension Officers

Dr Andries Jordaan's research on drought in the Northern Cape was acknowledged by the Society for Agricultural Extension Officers and his paper entitled "Drought Risk in Arid Southern Africa: Climate Change or a Challenge for Extension" was presented by Prof Dusan Sakulski.

## Short Learning Programmes and Workshops

### PhD Block course: Cape Town

In conjunction with the United Nations University, DiMTEC presented the PhD Block Course in Cape Town from 17 to 29 March. It was attended by 23 participants from South Africa, as well as a participant from China.

### World Health Organisation (WHO) Vulnerability and Risk Assessment course

The WHO requested DiMTEC to develop and present a two-week short learning programme on vulnerability and risk assessment. Dr Andries Jordaan, Prof Dusan Sakulski, and Ms Alice Ncube developed and presented the course in Cape Town during March 2013. All the senior African country representatives of the WHO attended this highly successful course.

### Peace Relief and Reconstruction course (PRR)

This course, developed on request of the South African National Defence Force's Peace Mission Training Centre, was presented at the Peace Mission Training Centre at the War College in Pretoria. In preparation for peace missions in Africa, Dr Andries Jordaan, also a Lieutenant Colonel in the SANDF Reserve Forces, developed and presented the course to senior officers in the SANDF, the South African Police Service (SAPS), and Correctional Services. The course was highly successful and attendees recommended that the course should become compulsory for all officers in the SANDF and SAPS. The Sphere Project: The Humanitarian Charter and Minimum Standards in Humanitarian Response, formed part of the PRR course.

### Workshops with Municipalities

DiMTEC facilitated two workshops on Disaster Risk Assessment for municipal councillors and officials in Fezile Dabi (Sasolburg) and Middelburg municipalities. Dr Andries Jordaan and Ms Alice Ncube were the facilitators.

## Research

Water Research Commission Research Project on Drought Risk Assessment in the Eastern Cape Province.

Dr Jordaan managed to secure a WRC project to the value of R2,95 million with him as project leader. The three-year research project provides funding and research opportunities for two PhD students and four master's students. Other researchers involved in the project are Prof Bennie Grove and Prof Dusan Sakulski.

# Research Outputs

## Research Articles

**Belle, J.A. & Ndille, R.** 2013. Managing the Limbe Floods: Considerations for Disaster Risk Reduction in Cameroon. *International Journal of Disaster Risk Science* 5: 147-156.

**Belle, J.A., Ferreira, S.B. & Jordaan, A.** 2013. Attitude of Lesotho health care workers towards HIV/AIDS and impact of HIV/AIDS on the population structure. *African Health Sciences* 13(4): 117-1125.

**Jordaan, A.J., Sakulski, D.M. & Jordaan, A.D.** 2013. Interdisciplinary drought risk assessment for agriculture: The case of communal farmers in the Northern Cape Province, South Africa. *South African Journal for Agricultural Extension* 41: 44-51.

**Kunguma, O. & Terblanche, L.** 2013. Crisis communication plan for municipalities: The case for Frances Baard district municipality. *Communitas: Journal for community communication and information impact* 18: 205-221.

**Kunguma, O., Jordaan, A.J., Bhebhe, D. & Majonga, H.** 2013. A case study of the perceived socio-environmental problems caused by illegal gold mining in Gwanda District, Zimbabwe. *Disaster Advances* 6(10): 70-76.

## Staff

**Director:** Dr AJ Jordaan.

**Professor:** Prof D Sakulski.

**External Lecturers:** Dr H Booysen and Dr E du Plessis.

**Junior Lecturers:** Mr J Belle, Ms O Kunguma, and Ms A Ncube.

**Researcher Assistants:** Mr C Mokete, Ms MM Motsumi, Mr RT Mayne, Ms R Rambau, Ms and NB Zwane.

**Secretary:** Mrs A Schroder.

**Senior Assistant Officer:** Mrs Germie van Coppenhagen.

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Centre for

# Environmental Management

## Overview

The Centre for Environmental Management (CEM) in the Faculty of Natural and Agricultural Sciences at the UFS has established a niche for itself in Southern Africa. The niche is based on three intertwined components; namely, the master's and doctoral programmes, a variety of short courses, and a research and contract component. The CEM is an established centre of expertise in aquatic ecology. It carries out projects, mainly applied, and provides services to communities in the central part of South Africa.

The master's programme developed gradually around the themes of sustainable development, project management, environmental assessment, environmental management systems, and integrated environmental management, and is now a well-established and highly sought after qualification. Of the 109 applications that had been received; 43 students were selected and 38 of them enrolled for the two-year course in January 2013. Students originate from a variety of African countries, making this a truly continental programme. Approximately 50 lecturers are involved in the programme - half of who are contracted from the private and public sector for their particular competencies.

At the 2013 winter graduation ceremony, a record number of 30 students graduated with master's degrees in Environmental Management; of which three students graduated *cum laude*. The prize for the best student and the CEM prize for the best mini-dissertation in environmental management in 2012 were both awarded to Mienie Farrell. The Limpho Letsela prize, in memory of a former CEM staff member,

*Determining EWR on the Mokolo River.*

was awarded for the first time in 2013. Mr Olavi Makuti from Namibia received this prize, awarded to the Best Foreign African Student in the previous year. At the spring graduation ceremony, Jurie du Plessis was awarded his PhD in Environmental Management. Three students received their master's degrees in Environmental Management.

Graduates are equipped with an interdisciplinary overview of the South African environment. They are in considerable demand by companies, consultants, government at various levels, and nature conservation bodies. Today, environmental management systems are required by even the smallest of businesses, and environmental assessment has become a highly sophisticated requirement for a variety of development activities. Water research is also becoming more and more important in Africa.

One of the cornerstones of CEM's approach to education and research is cooperation. In addition to the contributions made by lecturers from outside the University, colleagues at other UFS departments are also involved in CEM activities. CEM staff reciprocates by contributing to programmes in other faculties. A number of highly skilled and experienced research associates also make valuable contributions.

Lecturers from the CEM contribute to two other postgraduate programmes offered by the University of the Free State. Marinda Avenant has been contributing to the master's programme in Development Studies, coordinated by the Centre for Development Studies, since 2008. She presents a module on climate change and development in Africa.

For the honours programme in Africa Studies, coordinated by the Centre for Africa Studies, Prof Seaman and Mrs Avenant presented a course on Africa's resources and environment.

Leadership training in sustainable development: the population, environment and development nexus: This programme, aimed at practitioners at national, provincial, and municipal levels, focuses on the interrelationships of population, environment, and development and its significance for sustainable human development. Prof Seaman and Mrs Avenant have been lecturing in this initiative since 2006.

## Activities

The CEM presented the first African Water symposium in conjunction with the 5th International Conference on Conflict Management, Peace, Economics, and Peace Science, and the 5th Orange River Basin Symposium in Bloemfontein from 19 to 21 June 2013. The theme of this event was water conflict.

## GIS Facility

Mr Frank Sokolic, a recognised expert and consultant on Geographical Information Systems (GIS), continued his close collaboration with the CEM by spending a week every month in the Centre's offices. This facility has been exceptionally fruitful. By being able to discuss with him their GIS challenges at first hand, the Centre's students

*A record number of 30 students graduated with master's degrees in Environmental Management at the winter graduation ceremony of 2013.*

and staff have benefited greatly in the GIS solutions he has provided. He has also presented valuable, environmentally-oriented GIS courses to students and outsiders.

## Community Service

For the last five years, the ecological condition of the urban impoundment, Loch Logan, which is the central focus of Bloemfontein's Waterfront development, has been monitored by postgraduate students from the CEM. The information thus derived has been shared with the water body's owners (the Mangaung Metropolitan Municipality) and the owners of the Waterfront development, for use in the management of the lake.

## Careers Day

For the past 20 years, the director and staff of the CEM have been central to the organisation and presentation of the Rotary Careers Day, first at St. Andrews School, and presently at Eunice Secondary School. It is a careers information day, at which learners (who have earlier indicated their preferences) have dedicated discussions with their first, second and third career-choice professionals in successive sessions over two hours. About 40 professionals gave their time to explain what their professions involve.

## Collaboration

Exchange students from the Technische Universität Dresden (TUD), Germany: Annually, for the past three years, one or two students from the TUD, studying under Dr Dirk Jungmann, have joined the CEM for about two months to complete a practical project in aquatic ecology and ecotoxicology as part of their master's degrees. During 2013 the students were Ulrike Smallfuss and Denise Marx, whose work fitted in very well with our laboratory's research. The exchange provides excellent motivation for our own students.

The Katolieke Universiteit of Leuven (KUL), Belgium: Over a number of years there has been close research contact with the KUL, specifically between Prof Maitland Seaman and Prof Luc Brendonck, his student Dr Bram van Schoenwinkel, and KUL students, on the ecology of temporary waters. A number of theses and internationally recognised research papers have resulted from this collaboration.

## Research Projects

Development of an interactive vulnerability map and preliminary screening-level monitoring protocol for assessing the potential environmental impact of unconventional gas mining by means of hydraulic fracturing: During 2010 and 2011, various exploration applications for shale gas mining and coal-bed methane mining were lodged with the Petroleum Agency of South Africa (PASA). These applications currently cover almost 40% of the total surface area of South Africa and are located in the Karoo geological basin and sub-basins. Large-scale exploration for unconventional oil and gas in South Africa has, however, not proceeded yet, pending the development of regulations specific to unconventional gas mining and hydraulic fracturing.

Based on perceived gaps in the knowledge on unconventional gas mining in South Africa and how this activity could impact on the biophysical and socio-economic environments, researchers at CEM and the Water Research Commission compiled a background review that will provide regulators

with information about unconventional gas mining by means of hydraulic fracturing. This study includes the compilation of an interactive vulnerability map that will aid decision makers at national level and other practitioners by providing information on the vulnerability to unconventional gas mining of specific themes (surface water, groundwater, vegetation, seismicity, and socioeconomics). The monitoring protocol that is being developed can be used as a guideline for planning monitoring activities during the various phases of unconventional gas mining.

## Biomonitoring of Free State Rivers

Staff of the CEM, Marinda Avenant, Hennie Louw and Esté Prinsloo, participated in a project initiated by the Department of Water Affairs: Free State Regional Office to monitor the ecological integrity of the Free State's rivers over one year. The study, which considered various river components, such as flow, habitat, physical-chemical water quality, riparian vegetation, and aquatic biota, was done in collaboration with Blue Science Consulting and the North West University. The CEM team was responsible for assessing the health of fish communities in the province's southern rivers. The study concluded that the majority of rivers in the Free State were moderately to largely modified from their natural state.

## Projects

### DAAD Project – Alliance for Wetlands – Research and Restoration (AllWet RES)

Through the CEM, the UFS is one of the core partners of a German-South African research project on wetlands funded by DAAD (the German Academic Exchange Service). This project focuses on the improvement of knowledge about the possibilities and limitations of the restoration of degraded wetlands in the northern Maputoland area, South Africa.

For two weeks between July and August, the Technische Universität München with the Humboldt University in Berlin hosted the AllWet Summer School in Germany. Ten participants from the University of the Free State were invited, which included two UFS staff members involved with the AllWet Programme, two PhD students, one MSc student, and five undergraduate students. The Summer School was very successful; with the participants learning about peatland ecology, management and restoration. In October, German students (two each undergraduate, MSc and PhD) visited South Africa to conduct research on topics revolved around soil science (specifically peatlands), wise use of wetlands, the community's use of wetlands, and the impact of Eucalyptus trees on wetlands in the Manguzi area. Project participants reported on the progress of the AllWet project to the wetland community of South African at the National Wetland Indaba in Cape St. Francis.

### Testing a Methodology for Environmental Water Requirements in Non-Perennial Rivers: The Mokolo River Case Study (WRC project KS/1798)

This project is the third phase of an overarching project that focuses on the environmental water requirements of non-perennial rivers (Phase I: WRC K5/1414 and Phase II: WRC K5/1587). In Phase I, the existing EWRs completed on some non-perennial rivers in South Africa were evaluated and problems identified. In Phase II, the ecological functioning of a non-perennial river was investigated and a prototype EWR method (Arid-Proto) for non-perennial rivers was developed using the Seekoei River as a case study. In Phase III, the Arid-Proto EWR method was tested on the Mokolo River (a semi-permanent river) and a revised method, namely the Drift-Arid method was developed. The groundwater-surface water interaction hydrological modelling, using MIKE-SHE software, of the Mokolo River was also investigated and it was found that it was difficult to apply the model to arrive at useful management answers due to the lack of fundamental data. The MIKE-SHE model did, however, have the potential to model system changes in the Mokolo River.

This project also follows on two recently completed projects (WRC KS/1414 and WRC KS/1587); which both focused on the environmental water requirements for non-perennial rivers. A 28-member multidisciplinary project team comprised representatives from UFS (CEM, Departments of Geography, Soil, Crop and Climate Sciences, and Sociology), Rhodes University, and consultants Southern Waters and Water Matters. The main objective of the current study is to test the prototype DRIFT-Arid (DRIFT refers to Downstream Response to Imposed Flow Transformation) method on a variety of non-perennial rivers in South Africa. To do this, the team needed to identify suitable catchments, select sites in each of these catchments, collect field data, and identify suitable indicators and scenarios of change. The hydrology for each chosen scenario then needed to be simulated and the DRIFTArid DSS was used to capture specialist knowledge to predict the change in the catchment at each site selected for each scenario chosen. The prototype DRIFT-Arid method was improved and adapted as the project progressed and a revised DRIFT-Arid method was developed. The DRIFT-Arid method now needs to be tested on an episodic river. The team identified various further projects associated with the development of the method for which project proposals were presented to the WRC.

### Biomonitoring of the Ecological Status of Free State Rivers

Eleven sites on the Modder, Riet and Caledon Rivers are monitored three times a year (March, July and November) by a team from CEM. Data have been collected on these three rivers for the last 15 years. The monitoring focuses on water quality, algae, and macro-invertebrates. An end-of-the-year report (available at the CEM) is compiled;

*Marinda Avenant, Falco Buschke, and Mahlet Bekele monitoring fish in the Mokolo River.*

comparing the status of the rivers from the last three years of data.

## Agricultural Hazardous Waste: Determining/ Performing a Baseline Estimate of Volumes of Waste in the Waste Cycle/Chain

This project is based on a hazardous waste source inventory that must be developed for the Free State province through the Department of Economic Development, Tourism and Environmental Affairs (DETEA) of the Free State. The aim of the project is to identify, characterise and quantify hazardous agricultural chemical waste (pesticides, herbicides, fertilisers, lubricants, fuels, and oils) and its sources. This will lead to a clear record of the types and amounts of hazardous waste produced in the province, which will serve as a preliminary step for sound hazardous waste management in the Free State. This is important to ensure the health of people and the environment. The main questions that will be answered in this study include the following: What does the agricultural hazardous waste cycle in the maize sector look like? Does the maize sector use and dispose of agrochemicals effectively? What is the impact of these chemicals on the environment, and how can agro-chemical waste be better managed? The project is due to be completed in November 2013.

## Agricultural Hazardous Waste: Understanding the Hazardous Waste Cycle in the Maize Production Chain and Testing a Methodology to Collect Waste Information for the Development of a Waste Register

This project was based on a hazardous waste source inventory that must be developed for the Free State province through the Department of Economic Development, Tourism and Environmental Affairs (DETEA) of the Free State. The aim of the project was to understand the hazardous agricultural chemical waste cycle, focusing specifically on the maize sector, by identifying the waste types associated with this sector (including wastes such as pesticides, herbicides, fertilisers, lubricants, fuels, and oils), as well as the sources of these wastes. The project also investigated how a hazardous waste inventory could be developed, e.g. whether a voluntary registration system should be used to gather the data or whether methodologies such as personal interviews and/or telephonic surveys would suffice.

The project showed that the development of a hazardous waste register for the Free State (which should include hazardous waste generated in sectors such as the medical sector and other agricultural sectors) would be a complex task. Suitable data collection techniques should be investigated more fully. The success of such a system is heavily reliant on buy-in by the government through all its interested parties, by the agro-chemical industry, as well as by farmers.

## Biodiversity Monitoring at Kolomela Mine (Kumba Iron Ore): Postmasburg

The CEM, in collaboration with the National Museum, is conducting a biomonitoring programme at Kolomela Mine close to Postmasburg. Monitoring started in 2010 and with the renewal of the contract, will continue until 2018. The mine is situated on the Ghaap plateau, a unique area of very high plant diversity and endemic or near endemic plant species.

Aspects that are being monitored include rangeland management and bush encroachment, conducted by Prof

Nico Smit (Pasture Science, UFS), vegetation diversity and rehabilitation by Dr Ziets Zietsman (National Museum, Bloemfontein, NMB), soil water balance by Profs Leon van Rensburg and Pieter Le Roux (Soil Studies, UFS), aquatic and terrestrial invertebrates (CEM), small mammals by Dr Nico Avenant (NMB), and reptile and amphibians by Mr Hennie Butler (Zoology, UFS).

The aim of the monitoring programme is to determine the impact of dust and dewatering on the local biodiversity. During the initial phase, sensitive areas and species were identified and management recommendations are now being put in place to ensure the sustainability of the relevant species and ecosystems. Numerous gaps in our knowledge on the biodiversity of the Ghaap plateau were identified and research projects were initiated to address these.

A review and update of the Ecological Importance and Sensitivity (EIS) and Present Ecological State (PES) for rivers and tributaries in the Middle and Lower Vaal and Upper and Lower Orange Water Management Areas

Marinda Avenant (fish specialist) and Marie Watson (macro-invertebrate specialist) were included in a team tasked with an update of the 1999 PESEIS study for the Department of Water Affairs. This is a comprehensive, country-wide review using specialist knowledge from all catchments and includes hydrology, water quality, fish, invertebrates, vegetation, and habitat. Two workshops were held in Bloemfontein, where the team, using Google Maps, available data and specialist knowledge, provided a PES category for each river reach in the Orange and Vaal River water management areas.

### The Enterprise Architectures in 2012/13 of Free State Towns

Dr Daan Toerien (research associate), in collaboration with Prof Maitland Seaman, investigated the nature of enterprises that occur in Free State towns. This study has led to some very important conclusions on what drives enterprises in small towns. It is very clear that there is a very direct relationship between the amount of money entering each town and the number of enterprises in the towns. Conversely, the creation of new enterprises in a town will not succeed unless that enterprise brings more money into the town.

## Conferences

Prof Maitland Seaman served as the chairman of the programme committee of the International Association for Impact Assessment's conference, which was presented in Thaba 'Nchu in September.

Dr Nico Avenant (research associate) and Marinda Avenant (lecturer) attended the 11th International Mammalogical Congress held at Queen's University in Belfast, Northern Ireland, from 11 to 16 August 2013. Mrs Avenant presented a poster entitled "Determining the instream water requirements for South African dryland rivers: do mammals have a role to play?". Dr Avenant presented three posters on the following topics: Small mammals and Grassland integrity; Dietary interactions of damage-causing caracal in a highly impacted rangeland ecosystem, South Africa; and The impact of mesopredator release on rangeland in South Africa.

Surina Esterhuyse attended the biennial Groundwater Conference hosted by the Groundwater Division of the Geological Society of South Africa. She presented the paper "Towards the effective management of groundwater resources during unconventional gas mining" during the Water Research Dialogue session on Karoo Aquifers and Unconventional Gas Exploration, which was held in Durban, 17 to 19 September 2013.

Surina Esterhuyse also attended a US-RSA Unconventional Gas Environmental and Regulatory Workshop in 2013 that was presented by the US Department of State, the US Department of the Interior, and the South African departments of Water Affairs and Environmental Affairs under the Unconventional Gas Technical Engagement Programme. The aim of this workshop was to identify aspects related to unconventional gas that require regulation and determine a way forward for environmental regulation of unconventional gas in South Africa.

Mr Arjen Nell attended the 18th Annual Conference of the International Association for Impact Assessment South African Affiliate (IAIAsa) at Thaba 'Nchu from 16 to 18 September 2013, where he presented a poster on the development of a methodology to perform baseline estimates of volumes of hazardous waste generated in the maize production cycle.

Two researchers, Ina Ferreira and Esté Prinsloo, attended the SASAqS conference in Arniston, Western Cape, in July 2013. The Southern African Society of Aquatic Scientists is a learned society concerned with the research, management, and conservation of inland waters throughout Southern Africa. Two oral presentations, namely, the influence of hydrological phase on the community composition of Simuliidae and Baetidae species, and implications on biomonitoring in the non-perennial Seekoei River (Ina Ferreira), and the Cape Clawless Otter: a useful indicator for determining environmental water requirements in ephemeral rivers (Esté Prinsloo), focused on the ecology of non-perennial rivers.

Mr Piet-Louis Grundling, research associate, attended the South African National Wetland Indaba (NWI) from 23 to 25 October at Cape St. Francis. The theme of the congress was "Wetlands as ecological infrastructure". He presented a talk entitled "Dung, dynamite, diamonds and diatoms – the expected cumulative impacts of land-use change in the Seringveld Conservancy on its wetlands and streams".

He also attended the International Mire Conservation Group (IMCG) Fenner Peatland Forum on 6 December at Fenner School of Environment and Society, Australian National University, Canberra, Australia. The International Mire Conservation Group (IMCG) is an international network of specialists who internationally promote, encourage and, where appropriate, coordinate the conservation of mires and related ecosystems. As current chair of the IMCG he presented a talk entitled "Hot water spring mires in Kruger National Park: adaptive management and elephant realities".

Towards the end of the IMCG visit to Australia, Piet-Louis Grundling presented a talk entitled "Challenges for peatland management in South Africa: lessons learnt in Australia" (12 December) at a meeting of the Ecological Society of Australia, Peatland Forum, University of Tasmania, Hobart, Australia.

Research associate, Dr Daan Toerien, made a presentation at the launch of the South African SME Observatory in Bloemfontein on 3 December. His paper was entitled "Enterprise dynamics in Free State towns".

*Prof Seaman mending a fishing net.*

# Research Outputs

## Research articles

**Buschke, F.T., Esterhuyse, S., Kemp, M.E., Seaman, M.T., Brendonck, L. & Vanschoenwinkel, B.** 2013. The dynamics of mountain rock pools – are aquatic and terrestrial habitats alternative stable states? *Acta Oecologica* 47: 24-29.

**Esterhuyse, S., Kemp, M. & Redelinghuys, N.** 2013. Assessing the existing knowledge base and opinions of decision makers on the regulation and monitoring of unconventional gas mining in South Africa. *Water International* 38(6): 687-700.

**Grundling, P., Grootjans, A.P., Price, J.S. & Ellery, W.N.** 2013. Development and Persistence of an African mire: How the oldest South African fen has survived in a marginal climate. *Catena* 110: 176-183.

**Hauptfleisch, M.L., Avenant, N.L. & Tsowaseb, A.** 2013. Aircraft-wildlife collisions at two major Namibian airports from 2006-2010. *South Africa Journal of Wildlife Research* 43(2): 177-184.

**Junk, W.J., An, S., Finlayson, C.M., Gopal, B., Květ, J., Mitchell, S.A., Mitsch, W.J. & Robarts, R.D.** 2013. Current state of knowledge regarding the world's wetlands and their future under global climate change: a synthesis. *Aquatic Sciences* 75: 151-167.

**Mitchell, S.A.** 2013. The status of wetlands, treats and the predicted effect of global climate change: The situation in Sub-Saharan Africa. *Aquatic Sciences* 75: 95-112.

**Potgieter, G.C., Marker, L.L., Avenant, N.L. & Kerley, G.I.H.** 2013. Why Namibian farmers are satisfied with the performance of their livestock guarding dogs. *Human Dimensions of Wildlife* 18(6): 403-415.

**Turton, A.R.** 2013. Can water governance deepen democracy in South Africa? Toward a new social charter for mining. *International Journal of Water Governance* 1: 65-87.

**Turton, A.R.** 2013. Water wars in the Anthropocene: A South African perspective. *Global Dialogue* 15(2): 1-11.

**Watson, M. & Dallas, H.F.** 2013. Bio-assessment in ephemeral rivers: Constraints and challenges in applying macro-invertebrate sampling protocols. *African Journal of Aquatic Science* 38(1): 35-51.

**Zietsman, P.C.** 2013. Reproductive biology of *Stomatium bolusiae* (Aizoaceae: Ruschioideae). *Bothalia* 43(1): 23-27.

## Chapters in Books

**Avenant, N.L.** 2013. *Pelea capreolus*. In: *The Mammals of Africa: Pigs, Deer, Giraffe, Bovids, and Hippos*, edited by J.S. Kingdon and M. Hoffmann. London: Bloomsbury Publishing. pp. 417-420.

**Avenant, N.L.** 2013. *Redunca fulvorufula*. In: *The Mammals of Africa: Pigs, Deer, Giraffe, Bovids, and Hippos*, edited by J.S. Kingdon and M. Hoffmann. London: Bloomsbury Publishing. pp. 422-426.

## Research Reports

**Avenant, M.F.** 2013. A review and update of the Ecological Importance and Sensitivity (EIS) and Present Ecological State (PES) spreadsheets, based on fish community integrity, for rivers and tributaries in the Upper and Lower Orange Water Management Areas. In: *A desktop assessment of the Present Ecological State, Ecological Importance and Ecological Sensitivity per sub quaternary reaches for secondary catchments in South Africa*, compiled by RQS-RDM. Report to the Department of Water Affairs, Pretoria, South Africa by the Centre for Environmental Management, UFS, Bloemfontein, South Africa.

**Avenant, M.F.** 2013. *Fish specialist report: Environmental impact assessment for the proposed construction of a gauging weir in the Caledon River*. Report to Department of Water Affairs, Pretoria, South Africa by the Centre for Environmental Management, UFS, Bloemfontein, South Africa and H2O Environmental Specialists.

**Avenant, M.F.** 2013. Fish survey of biomonitoring sites in the *Upper Orange Water Management Area (Orange, Caledon, Riet and Modder Rivers)*. Implementation of the River Health Programme in the Free State, Project no. WP10405. Report to the Department of Water Affairs, Bloemfontein, South Africa by the Centre for Environmental Management, UFS, Bloemfontein, South Africa.

**Avenant, M.F., Esterhuyse, S., Glazewski, J., Kemp, M., Kijko, A., Redelinghuys, N., Smit, A., Vos, A.T. & Watson, M.** 2013. *Development of an interactive vulnerability map and preliminary screening level monitoring protocol to assess the potential environmental impact of unconventional gas mining by means of hydraulic fracturing: Monitoring protocol*. WRC project deliverable. Report to the Water Research Commission, Pretoria, South Africa by the Centre for Environmental Management, UFS, Bloemfontein, South Africa.

**Avenant, M.F., Esterhuyse, S., Kemp, M., Kijko, A., Redelinghuys, N., Smit, A., Von Maltitz, M., Vos, T. & Watson, M.** 2013. *Development of an interactive vulnerability map and preliminary screening level monitoring protocol to assess the potential environmental impact of unconventional gas mining by means of hydraulic fracturing: Vulnerability map.* WRC project deliverable. Report to the Water Research Commission, Pretoria, South Africa by the Centre for Environmental Management, UFS, Bloemfontein, South Africa.

**Avenant, N.L.** 2013. *Small mammal monitoring on Kolomela mine properties, Postmasburg – 2012 season.* Report by the Centre for Environmental Management, UFS, Bloemfontein, South Africa.

**Esterhuyse, S.** (ed.). 2013. *Development of an interactive vulnerability map and preliminary screening level monitoring protocol to assess the potential environmental impact of unconventional gas mining by means of hydraulic fracturing: Report on the workshop for the consolidation of the monitoring concept.* WRC project deliverable. Report to the Water Research Commission, Pretoria, South Africa by the Centre for Environmental Management, UFS, Bloemfontein, South Africa.

**Hartnady, C., Mlisa, A., Turton, A.R., Blake, D., Goyns, A., Simpson, G., Von Scherenberg, L., Khudzai, A., Burgher, K. & Seyler, H.** 2013. *Research project to investigate acid water plumes, decants and intersects with Rand Water's potable water pipelines: Phase 1.* Report No. 810-04/01/2013. Report to Rand Water, Johannesburg, South Africa by the Centre for Environmental Management, UFS, Bloemfontein, South Africa.

**Seaman, M.T., Watson, M. & Vos. A.T.** 2013. *State of the Modder River 2011 to 2013 – a biomonitoring report.* Internal Report for the Centre for Environmental Management, University of the Free State, Bloemfontein. South Africa.

**Seaman, M.T., Watson, M., Avenant, M.F., Joubert, A.R., King, J.M., Barker, C.H., Esterhuyse, S., Graham, D., Kemp, M.E., Le Roux, P.A., Prucha, B., Redelinghuys, N., Rossouw, L., Rowntree, K., Sokolic, F., Van Rensburg, L., Van der Waal, B., Van Tol, J. & Vos, A.T.** 2013. *Testing a methodology for Environmental Water Requirements in non-perennial rivers. The Mokolo River Case Study.* WRC Report No. TT 579/13. Report to the Water Research Commission, Pretoria, South Africa by the Centre for Environmental Management, UFS, Bloemfontein, South Africa.

**Turton, A.R.** 2013. *Debunking persistent myths about AMD in the quest for a sustainable solution.* SAWEF Paradigm Shifter No.1. Johannesburg: South African Water, Energy and Food Forum (SAWEF). Report by the Centre for Environmental Management, UFS, Bloemfontein, South Africa.

**Watson, M.** 2013. A review and update of the Ecological Importance and Sensitivity (EIS) and Present Ecological State (PES) spreadsheets, based on macro-invertebrate community integrity, for rivers and tributaries in the Middle and Lower Vaal and the Upper and Lower Orange Water Management Areas. In: *A desktop assessment of the Present Ecological State, Ecological Importance and Ecological Sensitivity per sub quaternary reaches for secondary catchments in South Africa*, compiled by RQS-RDM. Report to the Department of Water Affairs, Pretoria, South Africa by the Centre for Environmental Management, UFS, Bloemfontein, South Africa.

## Staff

**Professor and Director:** Prof Maitland Seaman.

**Lecturer and Acting Director:** Ms Marinda Avenant.

**Affiliate Professor:** Prof Tony Turton.

**Research Associates:** Drs Nico Avenant, Hugo Bezuidenhout, James Brink, Nacelle Collins, Fred Kruger, Steve Mitchell, Daan Toerien, Ziets Zietsman, and Mr Piet-Louis Grundling.

**Course Coordinator:** Mss Marthie Kemp (until April 2013) and Hanri van Jaarsveld.

**Senior Professional Officer:** Ms Marie Watson (Macro-invertebrates).

**Professional Officers:** Mss Surina Esterhuyse (Hydrology), Marthie Kemp (Riparian vegetation), Sanet Neethling (Marketing), Donné Kolesky (Course administration), and Betty Phillips (Finance).

**Senior Assistant Professional Officer:** Ms Tascha Vos (Water quality and algae).

**Assistant Researchers:** Ms Ina Ferreira (Invertebrate), Mr Hennie Louw (Fish ecology, until March 2013), Ms Willene Naudé (Unconventional gas mining), Mr Arjen Nell (Research ecology), Mr Christiaan Odendaal (Water quality), Ms Lulu Pretorius (DAAD All-Wet Project), and Ms Esté Prinsloo (Mammal ecology).

**Messenger:** Mr Pule Thibiri.

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# Lengau Agricultural Development Centre

## Overview

The Lengau Agricultural Development Centre's Agricultural Skills Development, Training and Mentorship programme is an initiative aimed at being an engaged faculty of the UFS by utilising its academic capacity and facilities to face the challenges of sustainable agriculture in the region, country, and continent.

## Agricultural Transformation

Human resource development is being realised in all sectors of the economy but a particular need exists within the agricultural sector, since black farmers were excluded from participating in mainstream agriculture for many decades. Black farmers engaged in subsistence farming on communal land had limited access to the commercial sector. The development and growth from subsistence to commercial farming is difficult in a highly competitive sector. It requires innovative skills, knowledge, and diverse inputs to be successful.

One of the three experimental farms of the UFS is earmarked for agricultural skills development and training of emerging farmers, farm workers, and entrepreneurs in agricultural business. The buildings, facilities, and a portion of the land of the Sydenham Experimental Farm are used for animal and crop production, and alternative natural and agricultural skills development opportunities in value adding and marketing.

The UFS, Mangaung Metropolitan Municipality, Free State Provincial Department of Agriculture, and the National African Farmers Union embraced the programme as

*Production of vegetables by Mr Thipe at the Lengau Agri Centre.*

*Piglets of Mr Klaas at the Lengau Agri Centre.*

partners in agricultural transformation. A Memorandum of Understanding was signed by the Mangaung Metropolitan Municipality, the National African Farmers Union, and the University of the Free State in December 2004 agreed to compile a Cooperate Agreement for local and provincial governance and funding of the initiative. The council of the Mangaung Metropolitan Municipality approved a contribution of R5 million or R750 000 annually in 2005 to establish and upgrade the training facilities at the Lengau Agricultural Development Centre. The estimated duration of the cooperation was set on 30 years. Unfortunately due to no financial deliveries until 2011 by the Mangaung Metropolitan Municipality, the cooperate agreement between the parties was cancelled in 2011.

An audit of sustainability of the projects at the Centre was done early in 2010. Afterwards a decision was made to change the service fee of the beneficiaries from a previous 100% subsidy and zero cost to a minimal service fee for electricity and water supply to the projects. Since a number of beneficiaries reflected an opinion of no sustainability, it was also decided that the beneficiaries will sign a contract with the University in 2011 and their retraining and weekly reports of each project would be compulsory. The new dispensation was implemented from 1 January 2011. Retraining in production and marketing skills of the vegetable and pig producers were intensified in 2011 and highly significant progress in production and financial turnover was achieved by these trainee famers. The vegetable farmers increased their production fourfold and established a weekly fresh market at the South Campus of the UFS. The successful weaning of piglets increased from approximately 3,5 weaners per sow to 6,7. The number of farrowing cycles per annum increased from less than one to 1,8 annually of 28 reproductive sows.

## Facilities

The facilities at Lengau Development Centre were upgraded and utilised in an extensive manner to address the needs of newly settled and prospective emerging and commercial black farmers. Services range from livestock auctioneering, herd improvement, branding, dehorning, castration, primary herd, and ordinary and advanced food gardening. The Centre also serves as a centre for education of undergraduates and postgraduates, mentors, farmers,

*Emerging farmers and students of the Agricultural Extension Internship at Lengau Agri Centre.*

and black entrepreneurs in many aspects of livestock, crop farming, and agribusiness. Almost R6,5 million was invested by the University of the Free State over the past seven years to upgrade and manage the facility.

A rental agreement was entered into with BKB Louwid Auctioneers during 2008 to conduct weekly livestock auctions for the Bloemfontein area at the Lengau Development Centre. This agreement was terminated in the beginning of 2011 and another rental contract was negotiated with Maluka Auctioneers. Unfortunately, Maluka Auctioneers did not adhere to the original agreement and the contract was cancelled in August 2011.

Six hydroponic units were erected at the Centre. The hydroponic units and approximately half a hectare of open garden space are used to train six trainees in vegetable production skills at the centre.

## Training

The Lengau Agricultural Development Centre, being part of the University of the Free State, was not allowed earlier to operate as an accredited training centre on educational levels lower than grade 12. The Centre entered into a cooperate agreement with Umnga Farmers Training Group during 2011 and is now regarded as an accredited training centre for any training on levels lower than grade 12. The Centre, in collaboration with Umnga Farmers Training Group, applied at Agri-SETA for two learnerships and 240 skills development short learning programmes. Funding for the two learnerships in crop and animal production on NQF level 4 and 20 skills development programmes were granted. The training was offered during 2012 and 2013.

The Centre aims to undertake systematic small farmer training, tackle local development issues, and enrich the curriculum in terms of research and training at the UFS on a simultaneous basis. Some of the agricultural know-how and skills training are in the form of:

Using the facilities as an apprenticeship for prospective farmers, with a mentorship and support system in place to facilitate "learning by doing" before moving on to a commercial farm. Prospective trainee farmers can select a programme in beef cattle farming, dairy farming, small stock farming, pig farming, poultry farming, or vegetable production.

Providing skills training for agricultural entrepreneurs, farm workers, young people wanting to make a livelihood in the agricultural sector, farmers in the farmer trainee programme, and recently settled farmers. This is done by short courses at the Centre, a mobile training capacity to serve municipalities in the Free State province, educational tours to key centres relevant to ongoing projects, and designing and soliciting accreditation of appropriate learnership courses.

Supporting emergent farmers/entrepreneurs through livestock auctions at the Centre, linkages to input suppliers and markets, aftercare of newly settled farmers and start-up entrepreneurs. The Centre provides appropriate infrastructure on municipal land for small-scale farming entrepreneurs. The Centre enhances lobbying capacity by establishing commodity groups with linkages to regional and national farmer organisations. Assistance is also given to process applications to the Land Redistribution for Agricultural Development (LRAD) programme.

An outreach programme through partnerships to extend the clientele through a "hub-and-spokes" framework to different parts of the country.

In conjunction with the Free State Provincial Department of Agriculture, two farmers' days were held at the centre and four farmers' days in the country where farmers were skilled in vaccination, branding, dehorning, castration, and tick control. They also received training and advice in breeding and bull selection for the improvement of livestock. More than 1 000 head of cattle were handled and an average of 11 farmers attended the sessions.

Two people were trained in broiler production skills at the Centre. These trainees made a success of the trials in broiler production of 250 birds per cycle achieving a mortality rate of less than 5% and a slaughter mass of more than 2 kg per bird at average. The production cost per dressed broiler was at average R11,52 per kg.

Two trainee stock farmers were successfully allocated land and another two were granted funding for land. These farmers are mentored on a regular basis in collaboration with the Free State Department of Agriculture.

Furthermore, two entrepreneurs are utilising the eucalyptus (*bloekom*) trees at the Lengau Development Centre as an opportunity for fire wood in the local community. The first samples of fire bricks were produced from wastepaper and the marketing of the products is currently investigated by the Students in Free Enterprise (SIFE) of the Faculty of Economic and Management Sciences.

Thirty-eight pest control operators wrote their qualifying examination papers of the South African Crop Life and Animal Health Association at eight sessions at the Centre.

Doretha Jacobs of the Department of Microbial, Biochemistry and Food Biotechnology trained 11 beneficiaries in sewing skills. A variety of products were produced and either taken home or marketed in the community. Thirty-two Consumer Science students applied their knowledge and skills in this project for community service learning purposes.

## Internship Programme

In an attempt to enhance agricultural extension skills development of undergraduates, an internship was implemented during 2012 at the Lengau Agri Centre. The students were collected on the Main Campus on Saturday mornings and allowed to utilise the trainee farmers and agricultural enterprises to collect production and marketing data, analyse and reflect amongst students and farmers. Accommodation facilities on the premises were utilised to house the eight students during weekends for this purpose. Eight sessions were implemented in the second semester during weekends and both students and farmers reflected positively and requested a continuation of the intervention. The internship was temporarily extended in 2013 due to the full-scale implementation of the two learnership programmes by Umga Farmers Training Group. Sixteen students and the two instructors utilised the accommodation facilities at Lengau ADC and one of the houses at the Paradys experimental farm.

## E-Learning Programme

Seed funding for the first phase of developing an encyclopaedia and e-learning programme in agricultural skills development of farmers and extension officers was granted by AgriSETA to the University. Mr Johan Stassen was contracted by the University to develop the programme.

### Staff

**Senior Lecturer:** Dr Léan van der Westhuizen.

**Farm Assistant:** Mr Albert Khumalo.

**Farm guards:** Messrs Alfred Mxhaka and Esau Selepe.


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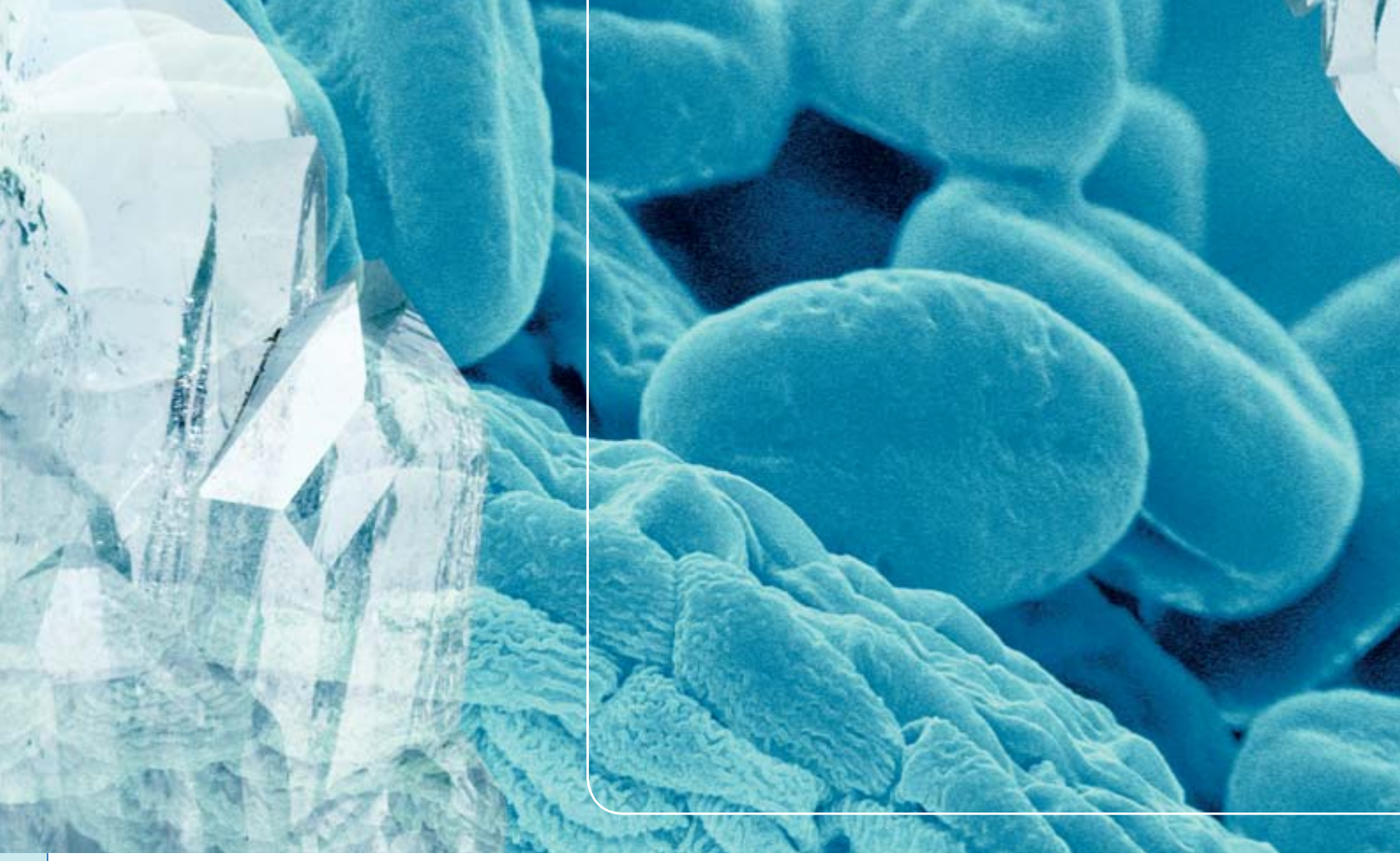

Centre for

# Microscopy

## Overview

The core users carrying out microscopy research at the Centre comprise internal researchers and students from the faculty. The number of users for the past four years is indicated below:

| 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|
| 53 | 48 | 64 | 72 |

The next table indicates the duration of microscope usage by staff and students from various departments. Preparation time amounts to almost 835 hours in the laboratory before microscope analysis actually commences.

Projects from external institutions were facilitated by the Directorate for Research Development. Gotha Pharmaceuticals investigated the efficiency of a product in treatment of skin injuries. For this investigation, the scanning electron microscope was used to analyse skin biopsies obtained from laboratory animals. Further analysis on the product was also performed with transmission and confocal laser scanning microscopes. Meyer Zall Pharmaceuticals analysed a product to determine the size and distribution of oil droplets in emulsions using fluorescence and confocal laser scanning microscopy.

## Research and Training Activities

Honours students from the departments of Zoology and Entomology (DRK/ENT614) and Microbial, Biochemical and Food Biotechnology (MKB/BOC614) attended practical

*The Centre is often visited by school groups. Here is such a group of learners standing in awe looking at the scanning electron microscope magnifying images to incomprehensible sizes.*

| Department | Usage hours | | |
|---|---|---|---|
| | CLSM | SEM | TEM |
| Cardiothoracic Surgery | - | 7 | - |
| Centre (Image processing, support, training) | 15 | 213 | 33 |
| Chemistry | 4 | - | 35 |
| Genetics | 5 | - | - |
| Microbial, Biochemical and Food Biotechnology | 2 | 100 | 21 |
| Physics | - | 182 | 21 |
| Plant Sciences | 10 | 11 | 8 |
| Zoology and Entomology | 4 | 17 | 4 |
| **External researchers/projects:** | | | |
| Central University of Technology | - | 18 | - |
| Gotha Pharmaceuticals | 5 | 43 | 1 |
| Meyer Zall Pharmaceuticals | 4 | - | - |
| **Total Usage** | **49** | **584** | **123** |

presentations concerning the preparation of material and handling of equipment. Undergraduate students (second-year) from the departments of Zoology and Entomology and Plant Sciences attended demonstrations regarding microscopy research.

A local researcher from the Central University of Technology, Dr Ntsoaki J Malebo (postdoctoral fellow, Unit of Applied Food Science and Biotechnology), performed ultrastructural research using scanning electron microscopy. This researcher plans to visit the Centre on a regular basis for a continuous research project. By broader marketing at the Central University of Technology in 2013, another researcher, Mr JA Bothma (Mechanical and Mechatronic Engineering, Faculty of Engineering and Information Technology), indicated that a group of engineers (including visiting researchers from Russia) are interested in performing research at the Centre.

## Maintenance Aspects

The problematic state of the Shimadzu SEM remains unresolved since there is no longer a company available in South Africa that can attend to electronic problems on this type of microscope. Internal maintenance on the microscopes for 2013 was attended to by Prof Van Wyk and involved approximately 37 hours with an estimated cost saving of R15 900 (based on rates that external companies charge for similar maintenance on microscopes).

## Extending the Facilities

The acquisition of a new SEM was finalised in 2013 in collaboration with Prof Martin Ntwaeaborwa from the Department of Physics. An amount of R10 million was competed for from the NRF and allocated from the NRF NNEP programme (National Nanotechnology Equipment Programme).

The necessity for support of histological and other light microscopy-related preparation techniques at the Centre was determined among interested researchers. Positive feedback was received which led to the acquisition of a microtome and steel knife sharpener (bought in 1970) from Plant Sciences. Maintenance was performed on this equipment by Prof Van Wyk and is now in full working order. A preparation laboratory for this microtechnique was furnished and equipped with a paraffin wax embedding oven and a water bath for mounting thin sections on glass slides. Prof Van Wyk donated R40 000 via his NRF incentive allocation towards this initiative.

## Research Outputs

### Research Articles


**Božanić, D.K., Luyt, A.S., Trandafilović, L.V. & Djoković, V.** 2013. Glycogen and gold nanoparticle bioconjugates: Controlled plasmon resonance via glycogen-induced nanoparticle aggregation. *RSC Advances* 3(23): 8705-8713.

**Eassa, N., Betz, R., Coetsee, E., Swart, H.C., Venter, A. & Botha, J.R.** 2013. Surface modification of bulk n-InAs (111): A etched in bromine-methanol. *Current Applied Physics* 13(2): 366-370.

**Koao, L.F., Dejene, F.B., Swart, H.C. & Botha, J.R.** 2013. The effect of Ce3+ on structure, morphology and optical properties of flower-like ZnO synthesized using the chemical bath method. *Journal of Luminescence* 143: 463-468.

**Kumar, V., Bedyal, A.K., Pitale, S.S., Ntwaeaborwa, O.M. & Swart, H.C.** 2013. Synthesis, spectral and surface investigation of NaSrBO3: Sm3+ phosphor for full color down conversion in LEDs. *Journal of Alloys and Compounds* 554: 214-220.

**Noto, L.L., Chitambo, M.L., Ntwaeaborwa, O.M. & Swart, H.C.** 2013. Photoluminescence and thermoluminescence properties of Pr3+ doped ZnTa2O6 phosphor. *Powder Technology* 247: 147-150.

**Noto, L.L., Pitale, S.S., Gusowki, M.A., Terblans, J.J., Ntwaeaborwa, O.M. & Swart, H.C.** 2013. Afterglow enhancement with In3+ codoping in CaTiO3: Pr3+ red phosphor. *Powder Technology* 237: 141-146.

**Olivier, A.P.S., Swart, C.W., Pohl, C.H., Van Wyk, P.W.J., Swart, H.C., Coetsee, E., Schoombie, S.W., Smit, J. & Kock, J.L.F.** 2013. The "firing cannons" of *Dipodascopsis uninucleata* var. *uninucleata*. *Canadian Journal of Microbiology* 59(6): 413-416.

**Sharma, K., Kaith, B.S., Kumar, V., Som, S., Kalia, S. & Swart, H.C.** 2013. Synthesis and properties of poly (acrylamide-aniline)-grafted gum ghatti based nanospikes. *RSC Advances* 3(48): 25830-25839.

**Sibeko, M.A. & Luyt, A.S.** 2013. Preparation and characterization of vinylsilane crosslinked high-density polyethylene composites filled with nanoclays. *Polymer Composites* 34(10): 1720-1727.

**Swart, C.W., Dithebe, K., Van Wyk, P.W.J., Pohl, C.H., Swart, H.C., Coetsee, E., Lodolo, E. & Kock, J.L.F.** 2013. Intracellular gas bubbles deform organelles in fermenting brewing yeasts. *Journal of the Institute of Brewing* 119(1-2): 15-16.

**Zanotto, A., Luyt, A.S., Spinella, A. & Caponetti, E.** 2013. Improvement of interaction in and properties of PMMA-MWNT nanocomposites through microwave assisted acid treatment of MWNT. *European Polymer Journal* 49(1): 61-69.


### Staff

**Professor:** Prof PWJ van Wyk.

**Lecturer:** Dr CW Swart-Pistor.

**Assistant Officer:** Ms H Grobler.

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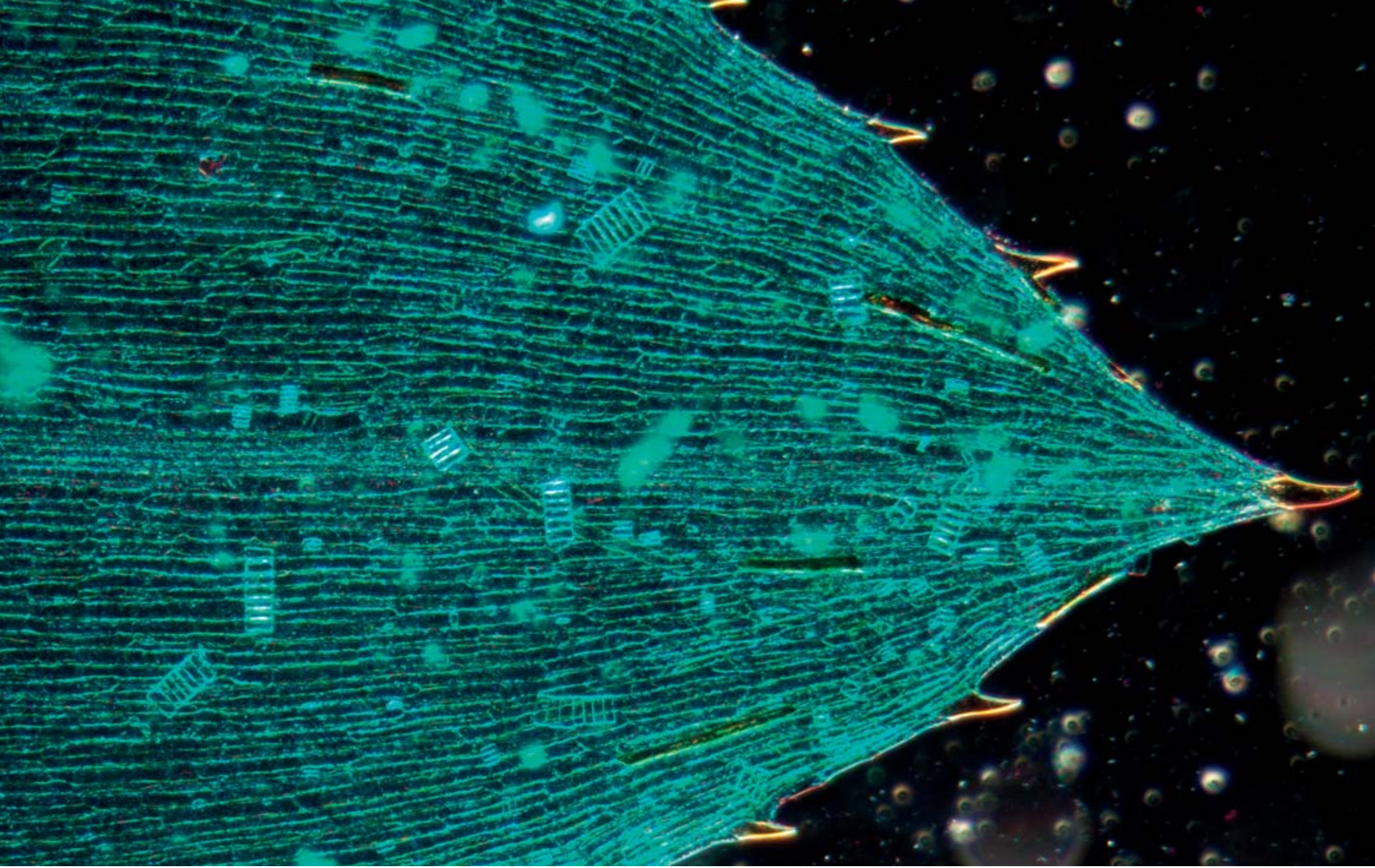

Centre for

# Sustainable Agriculture, Rural Development and Extension

## Overview

The Centre for Sustainable Agriculture, Rural Development and Extension (CENSARDE) at the University of the Free State (UFS) is designed to accommodate pre and postgraduate students who are working full-time, while furthering their studies by means of distance education. The courses on offer afford students the opportunity to acquire multidisciplinary skills and knowledge in sustainable agricultural practices. The Centre is proud of its students and their achievements.

Prof Izak Groenewald is the director of CENSARDE. The contributions from Dr Johan van Niekerk, senior lecturer at the Centre, internal lecturers, and a cohort of 18 external distinguish academia in guiding the students in their research efforts, is one of the reasons for the Centre's success in terms of the increased student throughput rate. The Centre also has several professors extraordinary and research fellows.

CENSARDE's research is focused on the value-adding chain, agribusiness management, rural development, as well as crop and livestock management. It aims to contribute towards the development and maintenance of sustainable production systems.

Students who enter this programme come from all spheres of life, although they all share the common goal of learning more about the science of sustainability in agricultural production, rural devolvement, and extension. Most of the students are in the full-time employment of the Department of Agriculture (DoA) and the Agricultural Research Council (ARC). Some are commercial, part-time or small-scale farmers, while others

*The group of 43 MSA graduates during the winter graduation ceremony.*

*Drs E Zwane and D Nkosi assessing scripts.*

are employed by banks, agribusinesses, and consultancies. International students account for about 25% of the students.

The course content is scrutinised annually by local and international partners to ensure local applicability, relevancy, and also to remain internationally sound.

## Activities and Achievements

In 2013, 40 students enrolled for the first year of the master's programme. In the same academic year, 43 students graduated with a master's degree in Sustainable Agriculture (MSA) - three with distinction. An audit team comprising Drs D Nkosi (ARC) and E Zwane (SASE) was commissioned to ensure the quality of the research reports

This was the culmination of many months of hard work for these graduates who study part-time while working full-time. This brings the total number of MSA degrees awarded to 368 since the Centre's inception in 1994. CENSARDE has a proud track record of graduates who leave the programme well-equipped to address the challenges of the workplace. This is an important contribution since modern-day agriculture is practiced in a constantly-changing environment with many constraints and challenges. Students develop technological, managerial, and thinking skills that are embedded in the programme.

Locally, CENSARDE's personnel continued to train extensionists from the Eastern Cape Department of Agriculture for the Advanced Diploma in Sustainable Agriculture and Rural Development (ADSARD). This qualification aims to meet the needs of the Agricultural Extension and Advisory Service to assist their workforce in attaining further qualifications. A part of the plan is for extension officers with diplomas (NQF level 6) to be able to achieve an advanced diploma (NQF level 7) and facilitate mobility for advanced qualifications. This is driven by the National Extension Recovery Plan of the Government and supported by the Norms and Standards Requirement pertaining to Extensionists.

Staff from the Centre were also involved in various conferences around the country. Dr Johan van Niekerk was re-elected as a member of the board of the South African Society of Agricultural Extensionists (SASAE), elected as chairperson of the Free State branch, and hosted the annual conference of 2013 on the Main Campus of the University of the Free State. This was a great success. Prof Izak Groenewald still serves on the National Reference Group to develop and formalise a New Extension Policy for South Africa. The final draft policy document was submitted for final comments. A workshop was held in Pretoria; facilitated by Dr Kristin Davis of GFRAS, and attended by various dignitaries.

Simultaneously, GFRAS facilitated an international workshop on agricultural education and training; focusing on curricula development and policy support. This was

*Advanced Diploma class at Dohne Research Station.*

*Advanced Diploma class at Dohne Research Station.*

*Drs T Ngomkane (Presidency), T Lukhalo, and L Botsheleng (National DAFF), K Davis (GFRAS) and Dr J van Niekerk.*

*Dr M Blum addressing a group of master's degree students at Bloemfontein.*

held at Roodevallei, Pretoria. An important outcome of that meeting was the establishment of a Consortium of Universities teaching Agriculture and more specific extension.

CENSARDE decided to place more focus on its PhD programme; in line with the UFS' strategic goal to increase postgraduate students and publication. To this end, 15 PhD applicants were evaluated and invited to a three-day PhD workshop held in Pretoria. Additionally, 12 possible PhD promoters were also invited. The programme focused on project definition, description, and proposals. Promoters were assigned to students and these smaller groups engaged in meaningful discussions. This workshop was repeated six months later at the same venue and for now, CENSARDE has an effective, running PhD programme - supporting students and engaging study leaders.

Five of the study leaders were appointed as research fellows at this centre. One such research follow, Dr Elliott Zane, was invited by the UFS to address a selected group of agriculturalists in the Free State.

During October 2013, Prof Groenewald attended a dialogue in Cape Town with delegates from all over Africa, addressing the issues of family farming. This was as a preliminary to 2014 being proclaimed by the UN as the Year of Family Farming, which culminates in a convention at the FAO in Rome towards end of 2014.

Whilst Prof Groenewald remains on the editorial board of the internationally accredited scientific *Journal for Sustainable Agriculture*, he is also regularly invited to workshops and study groups because of his expertise in phosphate supplementation for free-grazing ruminants.

## International Activities

CENSARDE was involved in several international linkages:

Prof Groenewald is still coordinating a student exchange programme between the University of the Free State, Virginia Polytechnic, and State University in Virginia, USA. This exchange started in 1998 and is the longest-running and most influential programme of its kind at the UFS. Students

study at Virginia Polytechnic for the full second semester of their third study year and do so without prolonging their total study period of the degree.

Magdalene Blum from the FAO in Rome was invited as a guest speaker at the mentioned SASAE conference. At the same time, she addressed master's students on recent advances on agricultural and rural extension: a world perspective. Discussions with her were finalised to assist in curricula development and to become a joint presenter of a module of the Centre, which she will deliver via Skype in 2014.

Prof Groenewald presented a poster at the European Association of Animal Production (EAAP) in Nantes, France. Animal scientists from all over Europe gather annually to share new research results and share ideas.

Prof Groenewald and Dr Johan van Niekerk attended the 2013 GFRAS meeting held in Berlin, Germany. Valuable contacts were made amongst others with academia at Minnesota University, Illinois University, and European counterparts.

Regionally, master's students of the Centre were visited by Prof Groenewald in Oshikati, in the north of Namibia, where research projects were evaluated. During the same visit, discussions were held with PhD students at Katima Molimu.

## Research

CENSARDE is set to increase the number of publications from its personnel and students in the coming year. To this end, the Centre's training programmes were aligned with a needs assessment from the agricultural environment. Innovative thoughts were required to plan a whole new approach to the Centre's teaching and learning curricula. This is illustrated as the new vision for the Centre for the next decade. Registrations of new qualifications are being processed.

The Centre gives thanks and recognition to the management of the UFS and faculty, the professors extraordinary and research fellows, and its own staff members for their continued support and commitment to CENSARDE.

## Research Outputs

### Research Articles

**Groenewald, I.B., Nesamvuni, A.E., Stroebel, A., Tshikolomo, K.A. & Walker, S.** 2013. Development of a water management decision model for Limpopo Province of South Africa based on congruence between sector challenge and service organization capacity. *American International Journal of Contemporary Research* 16: 126-141.

**Mnisi, M.** 2013. Towards sustainable sugar cane production in South Africa: A case study of the Low veld area, Mpumalanga province. *Asian Journal of Science and Technology* 8: 31-38.

**Mthembu, M.T. & Nkambule, B.L.** 2013. The sustainability of cotton production using genetically modified seeds by emerging smallholder farmers in South Africa: A global and African perspective. *African Journal of Agricultural Research* 6: 4293-4298.

**Nesamvuni, A.E., Tshikolomo, K.A. & Walker, S.** 2013. Prospect for developing water storage through analysis of runoff and storage capacity of Limpopo and Luvuvhu-Letaba water management areas of South Africa. *International Journal of Applied Science and Technology* 10: 70-79.

**Nkambule, B.L.** 2013. Towards sustainable smallholder irrigation development projects: A case study of the Maplotini irrigation scheme, Swaziland. *Journal of Agricultural Extension and Rural Development* 3: 143-145.

### Staff

**Professor:** Prof Izak Groenewald.

**Professors Extraordinary:** Profs Edward Nesamuvuni and Alice Pell.

**Senior Lecturer:** Dr Johan van Niekerk.

**Research Associates:** Drs Clifford Dlamini, Doughlas Nkosi, Fanie Terblanche, Elliot Zwane, and Kristin Davis.

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# Paradys Experimental Farm

## Overview

The Paradys experimental farm, located 14 km from the Main Campus of the University of the Free State, downscaled last year to four branches. The dairy was temporarily halted and the focus was moved from the agricultural branch to the production of feed and grazing. The core function of Paradys Experimental Farm is to serve as extension of the Department of Animal, Wildlife and Grassland Sciences for the purpose of research and practical implementation of theoretical knowledge in practice by undergraduate and postgraduate students. The experimental farm is also used for the empowerment of commercial and upcoming farmers in animal and crop cultivation.

## Training

Every year is kicked off by welcoming the prospective Agriculture students and their parents to the experimental farm, after which they go on tours to every branch. This brings about good cooperation between fellow students from early on and a foundation is laid for parents and students to feel at home at the University of the Free State. At the beginning of the year 150 parents and students attended the prestigious event. The day showed the faculty's zeal for agricultural training and the workshops gave the parents the opportunity to meet lecturers in the faculty and to address critical questions.

*Student practical sessions.*

*Training sessions for students and farm workers.*

In 2013, Paradys Experimental Farm accommodated three students in the internship programmes to form part of farm management branches, thus applying theory in various subject fields. Students come in immediate contact with the practice and the challenges existing in the agricultural sector on farm level. The internship system is designed in such a way as to give continuity to the management system, and senior students are continuously tasked with mentoring junior students in the respective branches of the practice.

In 2013, the experimental farm especially set about establishing sustainable farming practices on the experimental farm. The aim is first of all to simulate the agricultural industry and to bring the respective students in touch with all the trends in the agricultural sector. Structural changes were brought about in all branches in order to succeed in this goal and the development of certain non-sustainable branches is currently in the spotlight since economy of scale is also discussed and also applies to the experimental farm. The developments attempt to significantly influence the contributions to the surrounding communities, as well as enhancing opportunities for student training. Therefore, the vision is to establish a modified experimental farm with the best technology in the world that can be managed commercially and that adheres to all sustainability guidelines. The processes are already in a very advanced stage and are supposed to be completed by 2015. Provision

*Top Pig farmers' day.*

is also made for further growth after reasonable targets have been met by the farm and its management team.

In 2013, about 400 of our students had the opportunity to attend practical sessions that were presented on the experimental farm. The experimental farm especially offers students that do not originate from farms the opportunity to better understand the workings of an agricultural business and to relevantly apply their studies from there. Many students that come here for training are glad to come into contact with the animals, as well as the soil during cultivation excursions. The methods established specifically stimulate their interest in and insight into the industry.

We also had learners and staff from Lesotho visiting the farm, where programmes were offered to stimulate their interest in agriculture.

The contribution the experimental farm made to the agricultural industry and communities significantly improved in the past year. Various products were introduced to the market and demonstrated by means of a workshop and congresses.

John Deere also presented a successful farmers' day to introduce a new range of tractors that entered the South African market by means of practical demonstrations. Prospective farmers expanded the information they obtained and interaction was stimulated to bring the prospective farmers in contact with commercial farmers in order to transfer experience.

The management of the experimental farm agree that staff development is a very important part of any business or institution and therefore the training of unschooled labourers on the farm is being attended to. Grain SA presented courses to the staff in various facets of maintenance and calibrating of planters and pesticides. The progress ensures that there is positive development on all levels of the farm and management.

## Farmlands

In 2013, Paradys Experimental Farm planted about 14 hectares of feed sorghum and 80 hectares of teff. The teff was planted with the primary purpose of cutting it in January to March 2014 and baling it for the 2014 winter feed supplement. The first phase of two hectares of prickly pears was planted to eventually serve as a feed supplement for the cattle over three to four years.

## Sheep Branch

The sheep branch showed dramatic growth over the period with the implementation of the accelerated mating frequency technique. This implies that three lambing seasons are possible in two years. Conception in the flock of 64 ewes was 94% and the lamb percentage was 167%. The latter is thanks to 85% of the ewes having multiple births. Synchronisation and AI were used to inseminate ewes. From all the lambs that were born, there was only a mortality of 3% - due to weather circumstances. Various practical sessions on sheep physiology and the management of sheep were presented to students from the Main Campus and schools from as far as Lesotho. There are currently two running studies on the flock. The studies deal with the fertility and hormonal working during heat and synchronisation. These studies form part of honours and master's dissertations. The flock currently consists of 93 ewes and 48 replacement ewes. The day management of the flock is handled by Mr J Barnard.

## Beef Cattle Branch

Conception in the Afrikaner herd was 80% in cows. The stud animals are currently on 105 breeding cows. Furthermore, a cross system was implemented with Simmentaler, of which there are 45 Afrikaner cows crossed with a Simmentaler bull. The cross system will be taken to a three-point cross, resulting in an Afrisim. Various practical examinations were bound to the management and handling of the cattle. The practical examination was attended by students of both the Main Campus and schools. There was also a close collaboration between the staff and the SAPD stock theft unit and a course was presented on branding and tattooing of animals to prevent theft. The Afrikaner herd helped in the training of the SAPD stock theft unit by the identification of animals by means of brands and ear tags, as well as the correct procedures that have to be followed when animals are branded and tagged with ear tags. The day management of the herd is handled by Mr J Barnard.

## Lapa Branch

The lapa is a popular place for weddings, farmers' days, fund raising projects, and general functions. The lapa can accommodate 120 guests for weddings. The weddings can also occur in the garden. The garden and the surrounding area is a dream paradise for wedding photos. During farmers' days and workshops, the lapa can accommodate 180 people. We presented many of the university departments' workshops and year-end functions in the lapa. We also attempted to involve the community and reach out to less privileged people.

*The lapa at Paradys Experimenal farm is ideal for functions and garden weddings.*

The lapa was used for the following functions and meetings:

- A Dutch reformed church in the city spoiled an old age home on the farm with a programme that included light exercise, refreshments, and singing together.
- The Free State Psychiatric Complex (Oranje Hospital) held a fund raising project in the form of a dance in the lapa.
- JB Mokora Primary School holds their annual prize-giving function in the lapa for grade 7 learners who will attend high school the following year.
- Medical students who completed their studies held their post-graduation function in the lapa.
- During the year Senwes held two farmers' days; one with the latest technology for tillage and the other one with the latest animal medicine for internal parasites in sheep.
- Free State Agriculture presented their two congresses for farmers and prospective farmers.
- The Coopers' farmers' day.
- Grain SA presented training for 40 students and farm workers where they taught them more about the working of engines, welding, and planting methods. Certificates were presented to the participants.
- Top Pig held a pig information day for students and farmers.
- Student practical sessions were presented during the year in all branches on the working of the dairy, beef cattle, sheep, and farmlands.
- School training days were presented where learners from primary and secondary schools in Lesotho received training.
- The SAPD stock theft unit attended a practical course with demonstrations on branding and tattooing of animals. A team-building session was presented by the SAPD for their members.
- Various churches held their year-end functions in the lapa and garden with picnics for their members.
- Country sports and public worship were presented in the lapa.

## Staff

**Farm Manager:** Dr Léan van der Westhuizen.

**Administrative Manager:** Ms Amanda Smith.

**Student Assistants:** Manie Smit, Johan Barnard, and Johnny Molomo.

**Farm Workers:** Ms Anna Sebonyane, Ms Elisa Sebonyane, Mr Thabo Khubeka, Mr Isaac Nkotshane, Mr Daniel Somi, Mr Paulus Somi, Mr Samuel Motswari, Mr Samuel Kheswa, Mr Petrus Ramatekoane, Mr Petrus Moriribela, Mr Stephen Bavuma, Mr Richard Mxhaka, and Mr Johannes Sebonyane.

**Security:** Azael Khoele, Ernst Maqala.

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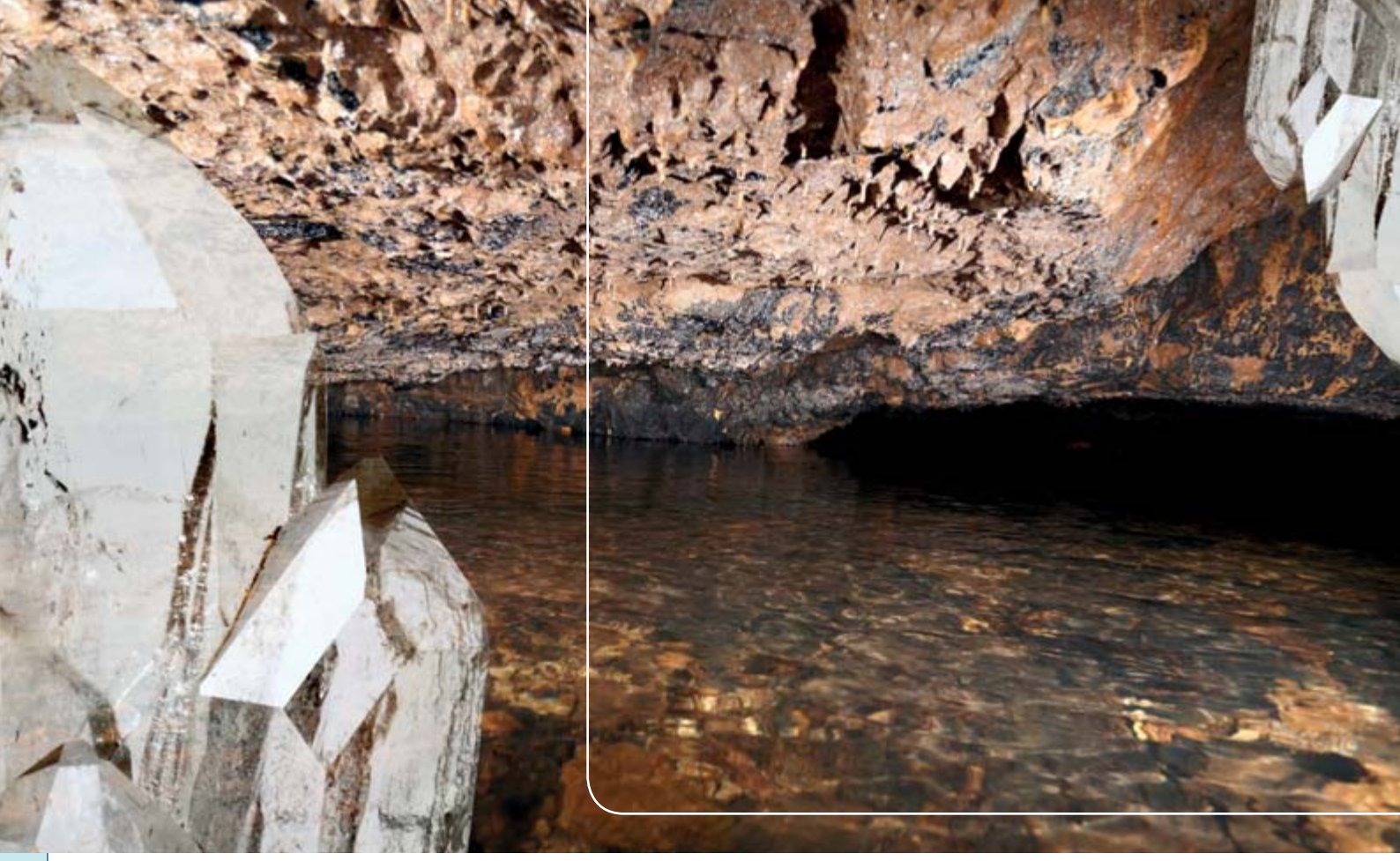

Institute for

# Groundwater Studies (IGS)

## Overview

The IGS is the leading groundwater research group in Africa on aspects related to fractured rock aquifers, industrial and mining contamination, groundwater governance, groundwater resources, and lately, on shale gas and hydraulic fracturing (fracking) in the Karoo.

A very exciting development is the discussions on the foundation of a SADC Groundwater Management Institute (funded by the World Bank) which will be hosted at IGS. The discussions are in an advanced stage and will be established during 2014. The University will act as the implementing agent and will be responsible for the management of the finances. IGS will provide all the academic and technical expertise.

## Activities and Achievements

The year 2013 was a very good academic year for IGS with five PhD students obtaining their degrees.

IGS was further honoured when the Protea cricket player, Hashim Amla, visited IGS with his friend, Muhammed Goga. Muhammed was enrolled for an honours degree in Geohydrology in 2013.

The Institute conducts contract research on a wide variety of water-related topics. Of special interest is its contribution to the mining and industrial sectors in terms of water management, minimisation of pollution, as well as understanding the nature and behaviour of South Africa's

*From the left: Amy Allwright, Nequita MacDonald, André van Coller (former MSc student at IGS), and Dr Francois Fourie (far right).*

aquifers. The Institute provides a complete service to these industries through field investigations, the development of specialised field equipment, a well-equipped commercial and water research laboratory, and a number of computer programs and models for the management of aquifers, to protect them from pollution. These technologies have already been applied with excellent results in South Africa and neighbouring countries.

The Institute also participates in research projects for the Water Research Commission (WRC), Coaltech, and the Government. We are proud of the fact that technologies developed through these projects are now in use worldwide.

IGS employed two postdoctorates in 2013, namely Dr Modreck Gomo and Dr Abdon Atangana.

Abdon Atangana, postdoctorate researcher at IGS, brought a new dimension to the word "productive". Since the beginning of 2013, he had published 23 articles in accredited journals and a few have already been accepted for publication in 2014. This extraordinary academic has already presented papers on international conferences in America, Turkey, and Thailand. Atangana is truly the embodiment of the UFS' core value of inspiring excellence.

Dr Abdon Atangana has been appointed as lead guest editor for the special issue on "Theory, methods, and applications on fractional calculus" for *The Scientific World Journal*. He is also a guest editor for the special issue on "Analytical and numerical approaches for complicated nonlinear equations" for *Abstract and Applied Analysis*, as well as lead guest editor for the special issue on "Fractional calculus and its applications in applied Mathematics and other sciences" in *Mathematical Problems in Engineering*. He has been appointed to the editorial board of *New Trends in Mathematical Sciences*, and is a reviewer for nine international accredited journals in Applied Mathematics.

## Radio Talks and Television Appearances

IGS staff received various invitations to speak on radio and television programmes about the impact of fracking in the Karoo. Prof Gerrit van Tonder appeared in a fracking debate on the programme *South2North* in August 2013. The other role players in the fracking game were Bonang Mohale of Shell South Africa and Saliem Fakier from the World Wildlife Fund. The question was: "Is fracking for shale gas an environmental and social risk or the golden ticket to energy freedom that could lift Africa out of centuries of energy dependence?". Prof Gerrit van Tonder and Dr Fanie de Lange appeared in the programme *Fokus* on SABC2 on Sunday 13 October 2013.

## Achievements of Students

One of the social events planned for the delegates of the Groundwater Division Conference is a groundwater knowledge quiz. At this quiz at the 13th Biennial Groundwater Division Conference hosted in Durban, the winning team would be treated to a boat cruise along the Durban harbour. It was no surprise that the winning team contained three members from the Institute for Groundwater Studies, the leading groundwater research institute in South Africa. Questions answered by the team included the authors of the book *Groundwater*, and listing sources of methane. The contributing members from IGS included Dr Francois Fourie, Ms Amy Allwright, and Ms Nequita MacDonald.

Amy Allwright (previously Matthews) had the great privilege to represent IGS at a groundwater modelling training course in Berlin, Germany, during October 2013. It is an advanced training course using the groundwater modelling software, FeFlow, developed by DHI-WASY. The course was held at the headquarters of DHI-WASY in Berlin, where Amy

*Dr Abdon Atangana.*

was exposed to expert guidance from the developers of the software.

Mr Eelco Lukas received his MSc (Geohydrology) *cum laude* in 2013. He is now registered for a PhD in Geohydrology.

Dr Abdon Atangana's speciality is Applied Mathematics. He does research on methods and applications of partial and ordinary differential equations; fractional differential equations; perturbations methods; asymptotics methods and iterative methods. Abdon, who is originally from Cameroon, enrolled at the UFS in 2009, finishing his BSc Honours in Applied Mathematics in one year. By the end of 2010, he completed his MSc in Applied Mathematics. He passed both degrees *cum laude*. In 2011, he tackled his PhD in Geohydrology and submitted his final thesis in January 2013 – and was the youngest PhD graduate at the winter graduation.

## Community Service

A free pumping test program called *Flow Characteristic (FC) Program for Aquifer Test Analysis* was developed by Prof Gerrit van Tonder, Dr Fanie de Lange and Dr Modreck Gomo and was made available on the IGS website for public use. They called it the FC-program (Flow characteristic program), but one can also analyse step drawdown tests, slug tests, etc. with this program.

## National and International Collaboration

Dr Edgardo Alarcon Leon, Environmental Geoscientist/ Hydrogeochemist at Pendragon Environmental Solutions in Australia, visited IGS during February to help set groundwater/ hydrogeochemical model for a project for a mining company that will recover iron ore resources via a series of open pits. Dr Fanie de Lange will be doing the bulk of the groundwater modelling portion of the project.

*From left: Mr Carel van der Westhuizen, Dr Edgardo Alarcon Leon, and Prof Frank Hodgson.*

*Dr Danie Vermeulen and Mr Eelco Lukas during their visit to Scotland.*

*Prof Gerrit van Tonder presenting a lecture on fracking at the University of Garmisch-Partenkirchen. Prof Harald Kunstmann is the other person standing.*

Dr Danie Vermeulen was invited by Shell International Exploration and Production to attend a workshop on fracking in the Netherlands during May 2013.

Prof Gerrit van Tonder was invited to visit Dr Stefan Cramer in Berlin on 22 and 23 September 2013. Dr Cramer is doing research on fracking in the Karoo. He also had the opportunity to visit the Helmholtz Centre in Potsdam/ Brandenburg where Prof Dr Michael Kühn and Prof Dr Georg Dresen, are doing research on the Karoo. He was also invited to do a presentation at the large German faith-based development agency, Bread for the World, and at the Heinrich Böll Foundation, the political foundation associated to the German Green Party, on the potential impacts of hydraulic fracturing in the Karoo on its groundwater resources.

On invitation from Prof Dr Harald Kunstmann at the Augsburg University, Germany, Prof Gerrit van Tonder also visited the Institute of Geography at the University of Augsburg on 24 September 2013. He was invited to give a presentation at the University of Garmisch-Partenkirchen on the currents status and problems of fracking technology and its impact on groundwater resources. The purpose was to discuss new aspects and methods for regional climate change impact studies and the possibility for future cooperation in this field.

## Conferences

Dr Danie Vermeulen and Mr Eelco Lukas attended the International Mine Water Association's 2013 Annual Conference at the Colorado School of Mines, Golden, Colorado, USA, 4 to 9 August 2013. The theme of the conference was "Reliable Mine Water Technology", which directly addresses the most serious challenge in mine water today: how to prove that mining can be undertaken while reliably protecting water resources.

The Groundwater Division conference on "Groundwater: A new paradigm" which took place in Durban from 17 to 19 September 2013 was attended by five of our students and six of our staff. Eight papers and one poster were presented by IGS.

Dr Abdon Atangana was invited to present a paper entitled "On the solution of a system of fractional nonlinear predator-prey population model via Homotopy Decomposition Method" at the minisymposium named "Implementation

*The PhD students are, from left, front: Vierah Hulley, Ferdi Linde and Jacob Nyende; middle: Chris Moseki and Abdon Atangana; their supervisors are from left, back: Prof Jopie Botha, Prof Gerrit van Tonder, and Dr Danie Vermeulen.*

of the different types of the numerical methods for Caputo's Rieman Liouville and Grünwald Letnikov sense fractional order differential equations". This minisymposium formed part of the 11th International Conference of Numerical and Applied Mathematics Analysis (ICNAAM 2013), which was held in Greece, 21 to 27 September 2013.

Dr Danie Vermeulen was invited by Dr Francesco Sindico, director of Strathclyde Centre for Environmental Law and Governance at the University of Strathclyde, Glasgow, to participate in an International Roundtable Conference on "International Water Cooperation and Transboundary Aquifers" scheduled for 15 and 16 October 2013 in Glasgow, Scotland. He was accompanied by Eelco Lukas and Glen Taylor. The conference would contribute to the UNESCO ISARM (Internationally Shared Aquifers Resource Management) Programme and to the Scottish government Hydro Nation initiative, and constitutes the University of Strathclyde's contribution to the UN International Year of Water Cooperation. It was supported by the International Atomic Energy Agency, the UK Department for International Development, and the International Association of Hydrogeologists. The main goal of the conference was to underpin the role of science in decision-making in the context of transboundary aquifer cooperation, to discuss the role of emerging legal instruments in the management of transboundary aquifers, and to explore the value of water and the role it plays in transboundary aquifer cooperation.

The conference was preceded by a one-day meeting amongst key stakeholders and policy-makers from the SADC region (or interested therein) to discuss past, existing and future projects and initiatives in the field of groundwater and transboundary aquifer management in the SADC in order to explore future challenges and opportunities. The following organisations were present at this meeting: the SADC Secretariat, the government of Malawi, the World Bank, International Groundwater Resources Assessment Centre (IGRAC), and UNESCO-IHP; amongst others.

## Postgraduate Students

The Institute had 27 enrolments for the BSc Honours in Geohydrology, 29 for the MSc and nine who registered for the PhD. Five students received their PhD degrees in Geohydrology at the June 2013 graduation ceremony.

It is important that the students at IGS are exposed to the practical issues of groundwater. A field trip is organised annually for the new honours students to at least two different locations. Students spend the first two days in the field, studying the interaction between geology and groundwater flow. This normally occurs in the Drakensberg mountains where the origin of rivers, interflow, baseflow, and numerous other issues are addressed. Groundwater plays an important role in the industry, especially regarding water volumes, and the availability and the contamination thereof. The second part of the field trip is industry related and may include a mine, a power station, or a petrochemical site.

## Research Outputs

### Research Articles


**Atangana, A.** 2013. A note on the triple Laplace transform and its applications to some kind of third-order differential equation. *Abstract and Applied Analysis* 32(1): 1-8.

**Atangana, A.** 2013. On the solution of an acoustic wave euqation with variable-order derivative loss operator. *Advances in Difference Equations* 167: 1-12.

**Atangana, A. & Alabaraoye, E.** 2013. Exact solutions fractional heat-like and wave-like equations with variable coefficients. *Open Access Scientific Reports* 2(2): 1-5.

**Atangana, A. & Alabaraoye, E.** 2013. Solving a system of fractional partial differential equations arising in the model of HIV infection of CD4+ cells and attractor one-dimensional Keller-Segel equations. *Advances in Difference Equations* 2013(1): 1-14.

**Atangana, A. & Baleanu, D.** 2013. Numerical solution of a kind of fractional parabolic equations via two difference schemes. *Abstract and Applied Analysis* 378: 1-8.

**Atangana, A. & Baleanu, D.** 2013. Nonlinear fractional Jaulent-Miodek and Whitham-Broer-Kaup equations within Sumudu transform. *Abstract and Applied Analysis* 5(2): 1-8.

**Atangana, A. & Belhaouari, S.B.** 2013. Solving partial differential equation with space- and time-fractional derivatives via homotopy decomposition method. *Mathematical Problems in Engineering* 102(1): 1-9.

**Atangana, A. & Bildik, N.** 2013. Approximate solution of tuberculosis disease population dynamics model. *Abstract and Applied Analysis* 2013(3): 1-8.

**Atangana, A. & Bildik, N.** 2013. Existence and numerical solution of the Volterra fractional integral

equations of the second kind. *Mathematical Problems in Engineering* 151: 1-11.

**Atangana, A. & Bildik, N.** 2013. The use of fractional order derivative to predict the groundwater flow. *Mathematical Problems in Engineering* 28(1): 1-9.

**Atangana, A. & Botha, J.F.** 2013. A generalized groundwater flow equation using the concept of variable-order derivative. *Boundary Value Problems* 53: 1-11.

**Atangana, A. & Bulut, H.** 2013. Extension of homotopy decomposition method (HDM) to coupled nonlinear Van der Pol type's equation. *Scientific Bulletin of the 'Petru Maior' University of Tirgu Mures* 10(XXVII): 54-62.

**Atangana, A. & Cloot, A.H.** 2013. Stability and convergence of the space fractional variable-order Schrödinger equation. *Advances in Difference Equations* 2013(1): 80.

**Atangana, A. & Kilicman, A.** 2013. A novel integral operator transform and its application to some FODE and FPDE with some kind of singularities. *Mathematical Problems in Engineering* 198: 1-7.

**Atangana, A. & Kilicman, A.** 2013. A possible generalization of acoustic wave equation using the condept of perturbed derivative order. *Mathematical Problems in Engineering* 1(2): 1-6.

**Atangana, A. & Kilicman, A.** 2013. Analytical solutions of boundary values problem of 2D and 3D poisson and biharmonic equations by homotopy decomposition method. *Abstract and Applied Analysis* 2: 1-9.

**Atangana, A. & Kilicman, A.** 2013. Analytical solutions of the space-time fractional derivative of advection dispersion equation. *Mathematical Problems in Engineering* 2013: 1-9.

**Atangana, A. & Kilicman, A.** 2013. The use of Sumudu transform for solving certain nonlinear fractional heat-like equations. *Abstract and Applied Analysis* 4(9-12): 1-12.

**Atangana, A. & Noutchie, O.** 2013. Stability and convergence of a time-fractional variable order Hantush equation for a deformable aquifer. *Abstract and Applied Analysis* 2013(1): 1-10.

**Atangana, A. & Noutchie, S.C.O.** 2013. On the exact solution of high even-order differential equation. *Life Science Journal* 10(3): 246-252.

**Atangana, A. & Noutchie, S.C.O.** 2013. Two-dimension hydrodynamic dispersion equation with seepage velocity and dispersion coefficient as function of space and time. *Abstract and Applied Analysis* 3(1): 1-7.

**Atangana, A. & Secer, A.** 2013. A note on fractional order derivatives and table of fractional derivatives of some special functions. *Abstract and Applied Analysis* 32(1): 1-8.

**Atangana, A. & Secer, A.** 2013. The time-fractional coupled-Korteweg-de-Vries equations. *Abstract and Applied Analysis* 2013: 1-8.

**Gomo, M. & Vermeulen, D.** 2013. Investigation of hydrogeochemical processes in groundwater resources located in the vicinity of a mine process water dam. *Journal of African Earth Sciences* 86: 119-128.

**Gomo, M., Van Tonder, G.J. & Steyl, G.** 2013. Investigation of the hydrogeochemical processes in an alluvial channel aquifer located in a typical Karoo basin of Southern Africa. *Environmental Earth Sciences* 70(1): 227-238.

**Nyende, J., Van Tonder, G. & Vermeulen, D.** 2013. Application of isotopes and recharge analysis in investigating surface water and groundwater in fractured aquifer under influence of climate variability. *Earth Science & Climate Change* 4(4): 1-14.

**Nyende, J., Van Tonder, G. & Vermeulen, D.** 2013. Conceptual and numerical model development for groundwater resources management in a Regolith-fractured-basement aquifer system. *Earth Science and Climate Change* 4(5): 1-11.

## Staff

**Director:** Dr PD Vermeulen.

**Professor:** Prof GJ van Tonder.

**Affiliate Associate Professor:** Prof KT Witthüser.

**Affiliated Researchers:** Prof JF Botha and Dr J van der Merwe.

**Researchers/Geohydrologists:** Dr FD Fourie, Dr PD Vermeulen, Mr SS de Lange, and Mr E Lukas.

**Postdoctorate Researchers:** Dr A Atangana and Dr M Gomo.

**Research Assistant:** Mr PJH Lourens.

**Head Chemist:** Mrs L-M Deysel.

**Chief Officer: Professional Services:** Mrs E de Necker.

**Assistant Analyst:** Mrs H Human.

**Senior Officer: Financial Manager:** Mrs L Rust.

**Officer:** Mrs WC Geyer.

**Assistant Officer:** Mrs DM du Plessis.

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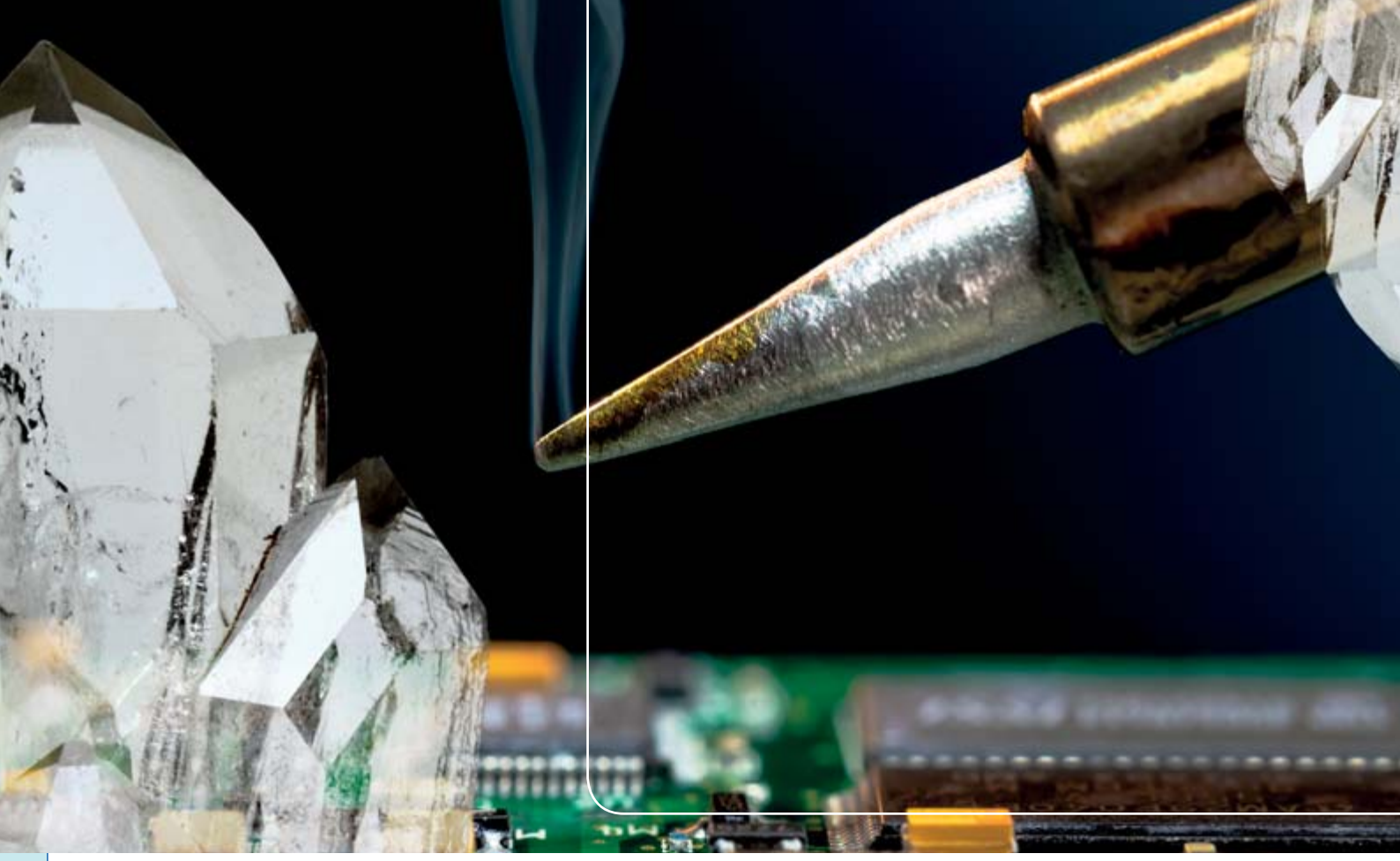
# Academic Support

# Units



Workshop:

# Electronics Division

## Overview

The Electronics Division yet again experienced a very busy year and we had to work hard not to fall behind schedule. During 2013 we built and repaired more than 800 instruments.

The estimated saving for the Faculty of Natural Sciences for the past year is R3 681 600.00. This amount is calculated by taking the actual amount of working hours multiplied by R600.00. We repaired the following expensive apparatus: Leco, ICPMS, ICP, BASS, XRD, SAM700, and numerous other instruments. An estimated amount of R1 500 000.00 was saved while repairing the above apparatus. The total savings amount is in the region of R5 181 600.00.

## Work Activities

A total of 486 work requisitions were received; representing 816 apparatus. Of these, 38 were for development projects. Some were new and others were extensions of existing systems, as well as the upgrading of older systems, as shown in Table 2 and 3.

Of a possible 6 221 working hours, 6 136 were actively used. Percentagewise the active usage is calculated at 98.6%. The possible hours were calculated at 7,25 hours per day per person present.

Table 1 lists the 31 departments and divisions which made use of the services of the Electronics Division with the total time needed for each project, the total time needed for each project, and the percentage of the total time it took to complete the project.

**Table 1:**

| Department | Total time spent | Percentage |
|---|---|---|
| Physics | 1101,00 | 17,94% |
| Chemistry | 1004,00 | 16,36% |
| Biotechnology | 767,00 | 12,50% |
| Internal Administration | 510,00 | 8,27% |
| Soil, Crop and Climate Sciences | 489,00 | 7,97% |
| Plant Sciences | 430,00 | 7,01% |
| Institute for Groundwater Studies | 246,00 | 4,01% |
| Animal, Wildlife and Grassland Sciences | 244,00 | 3,98% |
| Zoology and Entomology | 240,00 | 3,91% |
| Computer Sciences and Informatics | 171,00 | 2,79% |
| Urban and Regional Planning | 162,00 | 2,64% |
| Electronics | 150,00 | 2,44% |
| Geology | 126,00 | 2,05% |
| Medical Microbiology | 95,00 | 1,55% |
| External Work | 84,00 | 1,37% |
| Genetics | 65,00 | 1,06% |
| Physical Recourses | 45,00 | 0,73% |
| Architecture | 36,00 | 0,60% |
| National Control Laboratory | 36,00 | 0,60% |
| Pharmacology | 30,00 | 0,49% |
| Geography | 20,00 | 0,33% |
| Centre for Environmental Management | 14,00 | 0,23% |
| Fine Arts | 13,00 | 0,21% |
| Experimental Farms | 12,00 | 0,20% |
| Centre for Microscopy | 12,00 | 0,20% |
| Dean's Office | 11,00 | 0,18% |
| Haematology | 9,00 | 0,15% |
| Exercise and Sport Science | 8,00 | 0,13% |
| Medical Physics | 3,00 | 0,05% |
| School for Open Learning | 2,00 | 0,03% |
| Centre for Sustainable Agriculture | 1,00 | 0,02% |
| **Total** | **6136,00** | **100,00%** |

Table 2 lists completed projects of different departments.

**Table 2:**

| Department | Apparatus |
|---|---|
| Physics | 26 x Camera System<br>2 x Access Control<br>2 x 12V Power Supply<br>1 x 30V Power Supply<br>1 x Pressure SMS Warning System<br>1 x Fine Focus Control for SAM 700 |
| Biotechnology | 1 x 6 Chanel Fridge/Freezer Alarm System<br>6 x Camera System<br>2 x Sand Oven Controls<br>1 x 2 Channel Fridge Alarm System<br>1 x Incubator with Humidity Control |
| Institute for Groundwater Studies | 6 x Access Control<br>1 x Fraction Collector<br>1 x Access Control/Upgrade |
| Chemistry | 3 x Fraction Collectors<br>1 x Light Box<br>1 x Nano Amp Amplifier |
| Urban and Regional Planning | 3 x Camera System<br>3 x Video Intercom System |
| Plant Sciences | 2 x SMS - 80 Freezer Warning System<br>1 x Video Intercom System |
| Computer Sciences and Informatics | 4 x Access Control |
| Genetics | 1 x Video Intercom System |
| Soil, Crop and Climate Sciences | 2 x Upgrade Climate Units |
| Geology | 1 x Access Control/Upgrade |
| Medical Microbiology | 10 x Fridge/Freezer Temperature Monitor System |

*Mark Jackson and Innes Basson repairing equipment for the Physics Department.*

*Table 3 lists projects that are still in progress.*

**Table 3:**

| | |
|---|---|
| Chemistry | 3 x Mantel Temperature Control<br>2 x 30V Power Supply<br>1 x Hand Stirrer |
| Animal, Wildlife and Grassland Sciences | 2 x Access Control |
| Zoology and Entomology | 1 x VHF Transmitter |
| Institute for Groundwater Studies | 1 x Safety Control for ICP |
| Physics | 1 x Pressure Control Unit |
| Electronic Division | 1 x Study of the USB Port |

*Table 4 shows the time spent on the different faculties.*

**Table 4:**

| | | |
|---|---|---|
| Natural and Agricultural Sciences | 5780,00 | 94,20% |
| Other | 356,00 | 5,80% |

A total of 1680 hours (64,31%) were spent on development, 3946 hours (27,38%) on maintenance, and 510 hours (8,31%) on administration.

*Adriaan Hugo and Mark Jackson busy with software development.*

**Staff**

**Head of Department:** Mr AB Hugo.

**Control Technicians:** Mr I Basson, Mr HJ Roodt, and MH Jackson.


## Contact details

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Workshop:

# Instrumentation Division

## Overview

As a year that can only described as an exacting one for Instrumentation, 2013 eventually succumbed to the promise of the New Year. It was a year with many developments; some positive, some negative – some choices made, others more forcibly and not always positively enforced, but everything contributed to the changes that had great impact on the workings of the Division.

Mr Japie Myburg was on sabbatical from the end of June until December; inclusive of his retirement as head of department at the end of December 2013. After 31 years of service, the most of those as head of department, he will be greatly missed. The staff of Instrumentation wishes to thank Mr Myburg for his selfless duty and wish him a happy and prosperous retirement.

Mr Johann Erasmus, assistant head of Instrumentation, experienced a difficult year due to illness. As a result of this he was forced to take a long leave of recuperation from work. This had a substantively negative effect on the productiveness of the Division.

Mr Kobus Kruger, who, in October 2012, was employed on a year-long probationary period, joined the ranks of the full-time employees in 2013.

Mr Pieter Botes was appointed as acting HOD until the end of December 2013. Further evaluation of prerequisites and other factors with regards to appointing a person to the position of line manager: Instrumentation will be done by the dean, Prof Neil Heideman, in 2014.

In 2013, the Division therefore had to cope with only 60% of its staff. Taking that into consideration and all the other challenges the Division had to face, it is a great tribute to the remaining staff that they not only coped with the situation, but that their outputs to other departments in the faculty, albeit with a slight delay in delivery time, continued.

Given the situation and circumstances in the Division, decisions were made regarding the strategy of service delivery that is currently being followed in the Division. This strategy will have to be re-evaluated in terms of the governing strategy relating to service delivery, delivery time, new products and requests relating to service delivery.

## Work Overview

The outline below will show the work and number of orders, as well as the time taken to complete these orders, for the various departments both in and outside the Faculty of Natural and Agricultural Sciences. Annual and sick leave will also be indicated. The overview will also show the real time, as well as the time spent on projects in the Division. Only the large projects which were done for the various departments are indicated.

Table 1 shows the working hours spent on each of the departments inside the Faculty of Natural and Agricultural Science (internal departments).

**Table 1:**

| Internal Departments | Number of work orders | Number of hours spent on the orders |
|---|---|---|
| Chemistry | 34 | 681 |
| Physics | 30 | 749 |
| Zoology and Entomology | 13 | 98 |
| Electronics | 28 | 241 |
| Geology | 7 | 48 |
| IGS | 9 | 490 |
| Plant Sciences /Genetics / Plant Cultivation | 14 | 822 |
| Soil and Harvest Sciences/ Climatology | 17 | 495 |
| Zoology and Entomology | 3 | 50 |
| Animal, Wildlife and Grassland Sciences | 3 | 53 |
| Food Science | 8 | 106 |
| Pharmacology | 2 | 18 |
| Haematology | 1 | 6 |
| Biotechnology/Microbiology | 39 | 2362 |
| Medical Virology | 3 | 24 |
| Medical Microbiology | 3 | 28 |
| Computer Science and Information Technology | 3 | 24 |
| Geography | 1 | 4 |
| Office (work done by line manager) | - | 980 |
| **Total: Internal Departments** | **218** | **7 279** |

Table 2 shows the working hours spent on departments outside the Faculty of Natural and Agricultural Science (external departments).

**Table 2:**

| External Departments | Number of work orders | Number of hours spent on the orders |
|---|---|---|
| Environmental Management | 2 | 161 |
| National Control Labs | 9 | 101 |
| Human Movement Science/ Biokinetics | 6 | 22 |
| Paraxell | 3 | 20 |
| **Total: External Departments** | **20** | **304** |

The project under the leadership of Prof Esta van Heerden, was the largest project undertaken by Instrumentation in 2013. It already started in 2012 and only reached completion in 2013. The design and building of high-pressure units that could mimic deep-mine environments was undertaken in order to recreate, in a laboratory environment, the possibility to consistently study and monitor the samples retrieved from deep within South African mines. The continuous evaluation of the project was also of critical importance. This project resulted in the award for best technical staff member in the Faculty of Natural and Agricultural Sciences to be awarded to Mr Pieter Botes from the Division of Instrumentation.

## Problem Overview

The shrinking staff number in this Division is a matter of great concern. The problem is that technical artisans are no longer trained. Mary-Ann O'Donnel, well known journalist

from *Engineering News*, stated that in 2010 a shortage of 80 000 artisans was experienced in South Africa, and that the average age of these craftsmen in 2010 was a disconcertingly high 53.

To neutralise the situation, or to handle the problem in the Division, another strategy should be considered: a modernisation of mechanical machines, which would include the possibility of purchasing a modern CNC machine. This machine would be able to assist the technicians to work faster and more cost efficiently. It must never be considered that the CNC machine could replace a technician, as continuous hand work and crafting cannot be eliminated.

### Staff

**Line Head:** Mr PDS Botes.
**Assistant Head:** Mr J Erasmus.
**Control Technicians:** Mr JPW Rautenbach and Mr NJ Kruger.
**Technical Assistants:** Mr E Hlazo and Mr Gtswene.

### Contact Details

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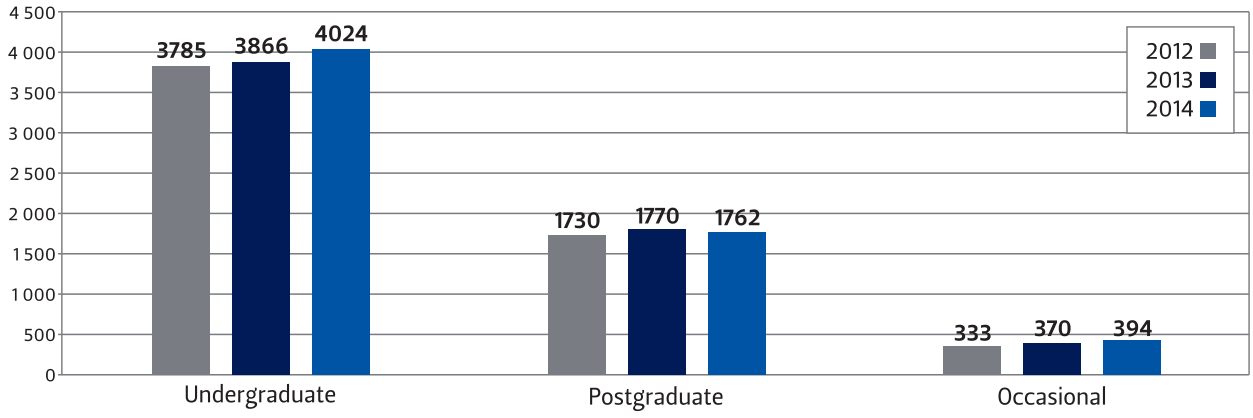
# Statistical Data

## UFS registrations by education level



## Student Figures: 2010 – 2012

| | Female | | | | | Male | | | | | Total | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Black | Coloured | Asian | White | **Total** | Black | Coloured | Asian | White | **Total** | Black | Coloured | Asian | White | **Total** |
| **2011** | | | | | | | | | | | | | | | |
| **Undergraduate** | 1164 | 36 | 15 | 492 | **1707** | 1014 | 41 | 22 | 761 | **1838** | 2178 | 77 | 37 | 1253 | **3545** |
| **Postgraduate** | 376 | 19 | 15 | 312 | **722** | 502 | 24 | 17 | 497 | **1040** | 878 | 43 | 32 | 809 | **1762** |
| **Occassional** | 132 | 1 | 1 | 15 | **149** | 127 | 3 | 4 | 32 | **166** | 259 | 4 | 5 | 47 | **315** |
| **Total** | 1672 | 56 | 31 | 819 | **2578** | 1643 | 68 | 43 | 1290 | **3044** | 3315 | 124 | 74 | 2109 | **5622** |
| **2012** | | | | | | | | | | | | | | | |
| **Undergraduate** | 1217 | 35 | 11 | 506 | **1769** | 1068 | 47 | 19 | 774 | **1908** | 2285 | 82 | 30 | 1280 | **3677** |
| **Postgraduate** | 358 | 21 | 12 | 302 | **693** | 501 | 22 | 16 | 454 | **993** | 859 | 43 | 28 | 756 | **1686** |
| **Occassional** | 130 | 1 | - | 17 | **148** | 116 | 4 | 4 | 51 | **124** | 246 | 5 | 4 | 68 | **323** |
| **Total** | 1705 | 57 | 23 | 825 | **2610** | 1685 | 73 | 39 | 1279 | **3076** | 3390 | 130 | 62 | 2104 | **5686** |
| **2013** | | | | | | | | | | | | | | | |
| **Undergraduate** | 1251 | 36 | 11 | 519 | **1817** | 1102 | 50 | 20 | 796 | **1968** | 2353 | 86 | 31 | 1315 | **3785** |
| **Postgraduate** | 366 | 21 | 12 | 303 | **702** | 523 | 22 | 16 | 467 | **1028** | 889 | 43 | 28 | 770 | **1730** |
| **Occassional** | 132 | 1 | 0 | 18 | **151** | 121 | 4 | 4 | 53 | **182** | 253 | 5 | 4 | 71 | **333** |
| **Total** | 1749 | 58 | 23 | 840 | **2670** | 1746 | 76 | 40 | 1316 | **3178** | 3495 | 134 | 63 | 2156 | **5848** |

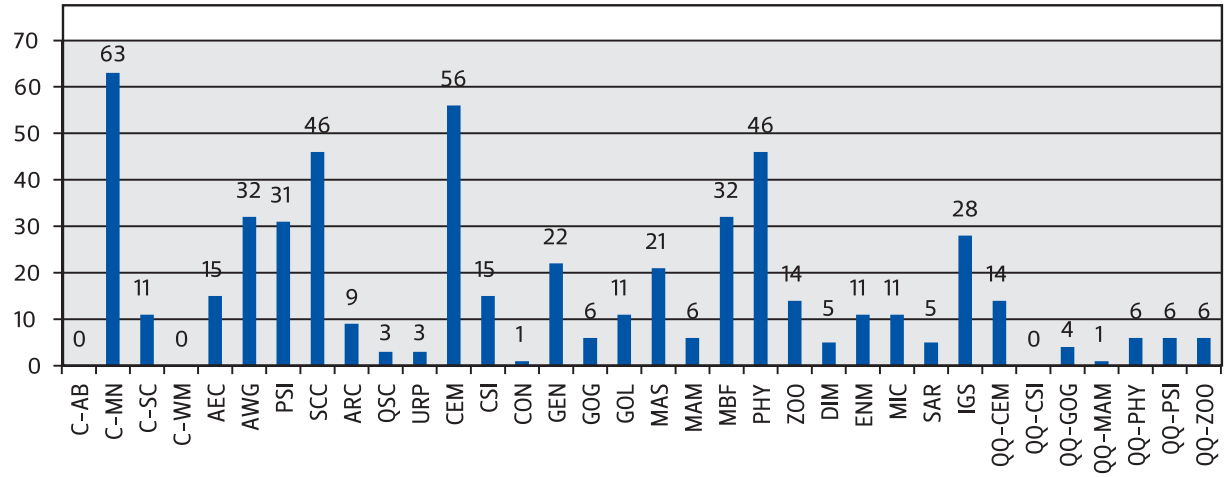
## International Students

| Qualification Level | Number of Students |
|---|---|
| Undergraduate | 182 |
| Postgraduate | 289 |
| Occasional Studies | 29 |
| Grand Total | 500 |

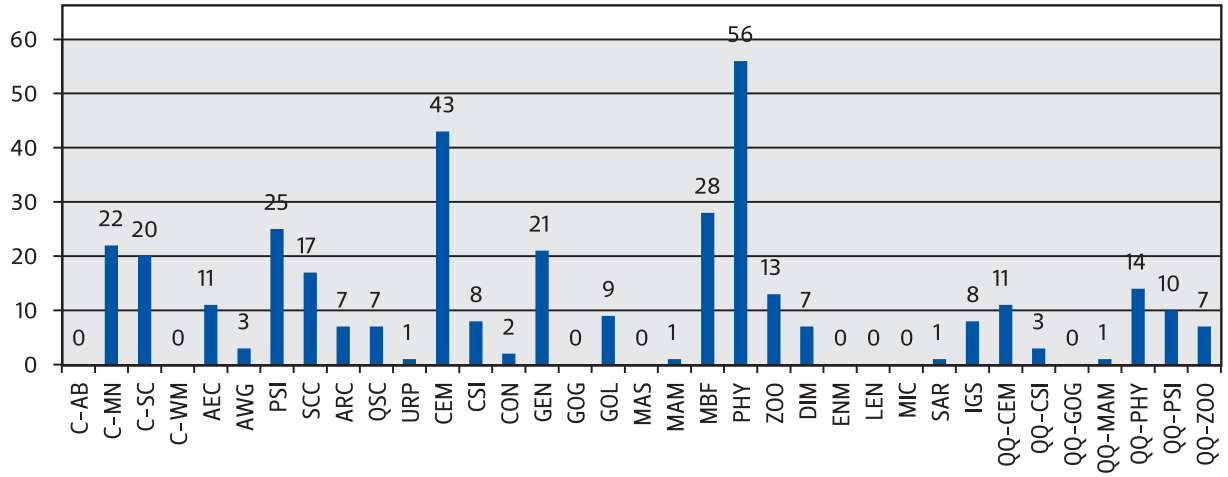
## Abbreviations

| | |
|---|---|
| AEC: | Agricultural Economics |
| ARC: | Architecture |
| AWG: | Animal, Wildlife and Grassland Sciences |
| C-AB: | Cluster: Advanced Biomelucular Research |
| CEM: | Chemistry |
| C-MN: | Cluster: Materials and Nanosciences |
| CON: | Consumer Science |
| C-SC: | Cluster: New technologies for sustainable crop development in semi-arid regions |
| CSI: | Computer Science and Informatics |
| C-WM: | Cluster: Water Management in Water scarce areas |
| DIM: | Dimtec |
| ELC: | Electronics |
| ENM: | Environmental Management |
| GEN: | Genetics |
| GOG: | Geography |
| GOL: | Geology |
| IGS: | Institute for Groundwater Studies |
| INS: | Instrumentation |
| LEN: | Lengau Agricultural Development Centre |
| MAM: | Mathematics and Applied Mathematics |
| MAS: | Mathemetical Statistics |
| MBF: | Microbial, Biochemical and Food Biotechnology |
| MIC: | Center for Microscopy |
| PAR: | Paradys Experimental farm |
| PHY: | Physics |
| PSI: | Plant Sciences |
| QQ-CEM: | Chemistry (Qwaqwa) |
| QQ-CSI: | Computer Science and Informatics (Qwaqwa) |
| QQ-GOG: | Geography (Qwaqwa) |
| QQ-MAM: | Mathematics and Applied Mathematics (Qwaqwa) |
| QQ-PHY: | Physics (Qwaqwa) |
| QQ-PSI: | Plant Sciences (Qwaqwa) |
| QQ-ZOO: | Zoology and Entomology (Qwaqwa) |
| QSC: | Quantity Surveying and Construction |
| SAR: | Sustainable Agriculture, Rural Development and Extension |
| SCC: | Soil, Crop and Climate Sciences |
| URP: | Urban and Regional Planning |
| ZOO: | Zoology and Entomology |

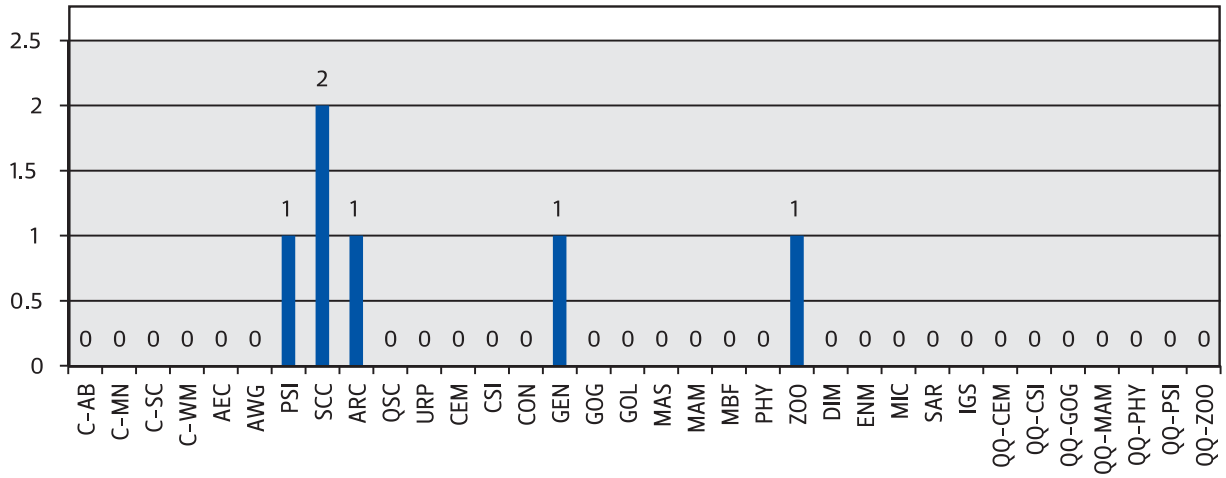
## Articles published



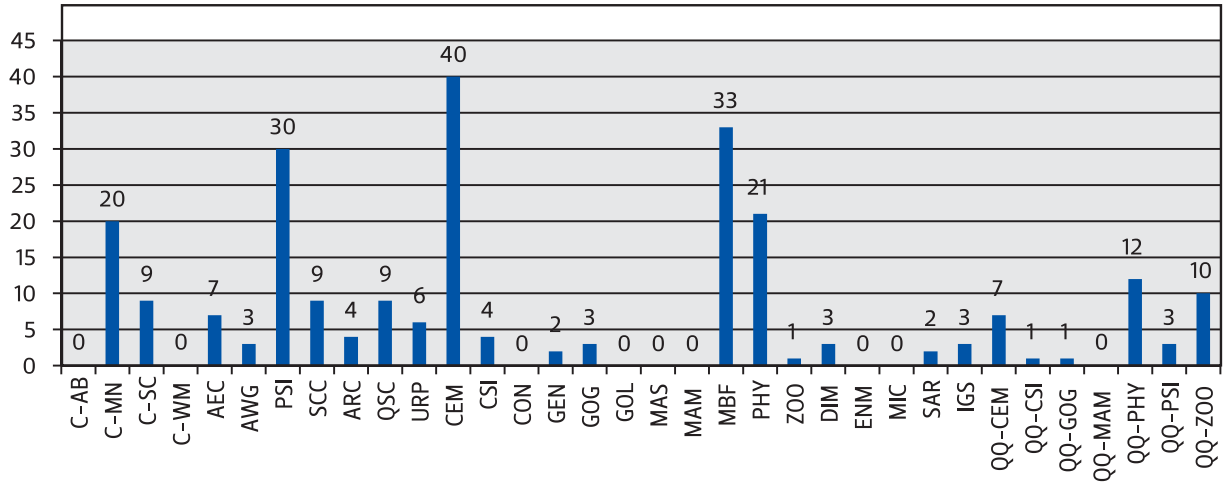

## Local Conferences



## Books Published




## International Conferences



# Glossary

## A

| | |
|---|---|
| AACE | Association for the Advancement of Cost Engineering |
| AAPS | Association of African Planning Schools |
| ADF | Amsterdam Density Functional Theory |
| ADH | Alcohol Dehydrogenase |
| ADSARD | Advanced Diploma in Sustainable Agriculture and Rural Development |
| ADSHRA | Abu Dhabi Municipality Hazard and Risk Assessment |
| Agbiz | Agricultural Business Chamber |
| AgMIP | Agricultural Modelling Intercomparison and Improvement Project in Sub-Saharan Africa and South Asia |
| AgriSETA | The Agricultural Sector Education Training Authority |
| AI | Artificial Insemination |
| AllWet RES | Alliance for Wetlands / Research and Restoration |
| AMD | Acid Mine Drainage |
| AMI | Advanced Metals Initiative |
| AMWC | Advanced Materials World Congress |
| ARC | Agricultural Research Council |
| ARC-API | ARC Animal Production Institute |
| ARC-SGI | ARC Small Grain Institute |
| ARNTD | African Research Network for Neglected Tropical Diseases |
| ASOCSA | Association of Schools of Construction of southern Africa |
| AZEF | Arid Zone Ecology Forum |

## B

| | |
|---|---|
| BCI | Brain-Computer Interface |
| BeCA | Biosciences eastern and central Africa |
| BGRI | Borlaug Global Rust Initiative |
| BI | Business Intelligence |
| BKB | Boeremakelaars (Koöperatief) Beperk |
| BMZ | Federal Ministry for Economic Cooperation and Development, Germany |
| BRAHMS Database | Botanical Research and Herbarium Management System |

## C

| | |
|---|---|
| CACTUSNET | International Technical Cooperation Network on Cactus |
| CATSA | Catalysis Society of South Africa |
| CBS | Centraalbureau voor Schimmelcultures (Netherlands) |
| CEM | Centre for Environmental Management |
| CENSARDE | Centre for Sustainable Agriculture, Rural Development and Extension |
| CIAV2013/7$^{0}$ATP/VerSUS | International Conference on Vernacular Heritage and Earthen Architecture 2013 |
| CIMMYT | International Maize and Wheat Improvement Centre |
| CIOB | Chartered Institute of Building |
| CLA | Conjugated Linoleic Acid |
| CLSM | Confocal Laser Scanning Microscope |
| CMV | Cytomegalovirus |
| CNC | Computer Numerical Control |
| CNR | National Research Council, Italy |
| COBRA | Construction and Building Research Association |
| CSIR | Centre of Scientific Institute of Research |
| CTA | Cerenkov Telescope Array |
| CTHB | Centre for Tree Health Biotechnology |
| CTL | Centre for Teaching and Learning, UFS |
| CU | Columbia University |

## D

| | |
|---|---|
| DAAD | German Academic Exchange Service |
| DETEA | Department of Economic Development, Tourism and Environmental Affairs |
| DFID | Department of International Development, UK |
| DHE | Department of Higher Education |
| DiMTEC | Disaster Management Training and Education Centre for Africa |
| DNA | Deoxyribonucleic Acid |
| DoA | Department of Agriculture |
| DRIFT | Downstream Response to Imposed Flow Transformation |
| DSC | Differential Scanning Calorimetry |
| DSS | Decision Support System |
| DST | Department of Science and Technology |
| DST-NRF | Department of Science and Technology National Research Foundation |
| DTI | Department of Trade and Industry |

## E

| | |
|---|---|
| EAAP | European Association of Animal Production |
| ECA | European Crystallographic Association |
| ECEL | European Conference on E-Learning |
| ECM | European Crystallographic Meeting |
| EFI | European Federation for Immunogenetics |
| EFINTD | European Foundation Initiative into Neglected Tropical Diseases |
| EGCG | Epigallocatechin-3-gallate |
| EIS | Ecological Importance and Sensitivity |
| EL | Lectroluminescence |
| EMBO | Excellence in the Life Sciences |
| EMM | Ekurhuleni Metropolitan Municipality |

| | |
|---|---|
| ETSA | Eye Tracking South Africa |
| ETSA2013 | Eye Tracking South Africa Conference 2013 |
| EuCheMS | European Association for Chemical and Molecular Sciences |
| EWR | Environmental Water Requirements |

## F

| | |
|---|---|
| FAO | Food and Agricultural Organisation |
| FAO-ICARDA | FAO's International Center for Agricultural Research in the Dry Areas |
| FAO-ICARDA CACTUSNET | FAO-ICARDA's International Technical Cooperation Network on Cactus |
| FC | Flow Characteristic |
| FCM | False codling moth |
| FEBS | Federation of European Biochemical Societies |
| FEI | *Field Emission Inc* |
| FET | Further Education and Training |
| FHB | Fusariumhead blight |
| FMP | Facilities Management Programme |
| FSIA | Free State Institute of Architects |
| FTE | Full-time Equivalent |

## G

| | |
|---|---|
| GFAAS | Graphite Furnace Atomic Absorption Spectroscopy |
| GFRAS | Global Forum for Rural Advisory Services |
| GFZ | GeoForschungsZentrums |
| GIS | Geographical Information Systems |
| GISC | Gestalt International Study Center |
| GLYAT | Glycine N-acyltransferase |
| GRF | German Research Foundation |
| GWK | Griekwaland-Wes-korporasie |

## H

| | |
|---|---|
| H Index | Hirsch index or Hirsch number |
| H.E.S.S. | High Energy Stereoscopic System |
| H3ABioNet | Pan African Bioinformatics Network for H3Africa |
| H3Africa | Human Heredity and Health in Africa |
| HEC | Human-Elephant Conflict |
| hERGscreen | human Ether-à-go-go Related Gene |
| HIV | Human Immunodeficiency Virus |
| HPC | High Performance Computing |
| HPLC | High Performance Liquid Chromatography |

## I

| | |
|---|---|
| IAAM | International Association of Advanced Materials |
| IAIA | International Association for Impact Assessment |
| IAIAsa | International Association for Impact Assessment, South African Affiliate |
| ICARDA | International Center for Agricultural Research in the Dry Areas |
| ICDP | International Continental Drilling Programme |
| ICNAAM | International Conference of Numerical and Applied Mathematics Analysis |
| ICP | Integrated Circuit Piezoelectric |
| ICPMS | Inductively Coupled Plasma Mass Spectrometry |
| ICT | Immunochromatographic Test |
| IDC | Industrial Development Corporation |
| IDP | Integrated Development Plan |
| IDRiM | the International Society for Integrated Disaster Risk Management |
| IEC | the Independent Electoral Commission |
| IFHE | International Federation for Home Economics |
| IFMA | International Farm Management Association |
| IFRC | International Federation of Red Cross |
| IFS | International Foundation of Science |
| IGRAC | International Groundwater Resources Assessment Centre |
| IGS | Institute for Groundwater Studies |
| IHP | International Hydrological Programme |
| IIASA | International Institute for Applied Systems Analysis |
| IIWM | Integrated Water Management |
| ILRI | International Livestock Research Institute |
| IMCG | International Mire Conservation Group |
| INORG2013 | Inorganic Conference of the South African Chemical Institute |
| INQS | Institute of Namibian Quantity Surveyors |
| *INRA* | National Institute for Agricultural Research |
| IOM | Institute of Medicine |
| IPF | Institute of Polymer Research |
| IPMA | International Project Management Association |
| IPMP | Intensive Project Management Programme |
| IPUF | Indigenous Plant Uses Forum |
| IRIS | Indicator of Reduction in Soil |
| IRSES | International Research Staff Exchange Scheme |
| ISARM | Internationally Shared Aquifers Resource Management |
| ISI | International Statistical Institute |
| ISPA | Institute of Sciences of Food Production |
| ISPM | Instituto Superior Politécnico de Manica |
| IUPAC | International Union of Pure and Applied Chemistry |

## J

| | |
|---|---|
| JEOL | Japan Electro-Optics Laboratory |
| JINR | Joint Institute for Nuclear Research |

## K

| | |
|---|---|
| KIFI | Kumutjonga Inland Fisheries Institute |
| KUL | Katolieke Universiteit of Leuven |
| KZNIA | KwaZulu-Natal Institute for Architecture |

## L

| | |
|---|---|
| LC-MS | Liquid chromatography–mass spectrometry |
| LED | Light Emitting Diode |

| | |
|---|---|
| LRAD | Land Redistribution for Agricultural Development |

## M

| | |
|---|---|
| METF | Minerals Education Trust Fund |
| MNRAS | Monthly Notices of the Royal Astronomical Society |
| MNS | Material and Nanosciences |
| MOF | Metal Organic Framework |
| MRC | Medical Research Council |
| MRTM | Mineral Resource Throughput Management |
| MS | Mass Spectroscopy |
| MSB | Swedish Civil Contingencies Agency |
| MUTHI | Multidisciplinary University Traditional Health Initiative |

## N

| | |
|---|---|
| NADMO | National Disaster Management Organisation of Ghana |
| NanoSAM | Nano Scanning Auger Microscopy |
| NASSP | National Astrophysics and Space Science Programme |
| NECSA | Nuclear Energy Corporation of South Africa |
| NELSAM | National Earthquakes in South African Mines |
| NIH | National Institutes of Health |
| NLC | National Laser Centre |
| NMB | National Museum, Bloemfontein |
| NMMU | Nelson Mandela Metropolitan University |
| NMR | Nuclear Magnetic Resonance |
| NNEP | National Nanotechnology Equipment Programme |
| NNPTP | National Nanoscience Postgraduate Teaching Platform |
| NPS | Non-profit Source |
| NRCPD | National Research Centre for Protozoan Diseases |
| NRF | National Research Foundation |
| NSF | National Science Foundation |
| NSPCA | National Society for the Prevention of Cruelty to Animals |
| NSTF | National Science and Technology Forum |
| NTeMBi | Nuclear Technologies in Medicine and the Biosciences |
| NTeMBi | Nuclear Technologies in Medicine and the Biosciences programme |
| NWI | National Wetland Indaba |
| NWU | North-West University |
| NZG | National Zoological Gardens |

## O

| | |
|---|---|
| OES | Optical Electronic and Mass Spectroscopy |
| OIE | International Office of Epizootics |
| OLED | Organic Light-emitting Diode |
| OLF | Occasional Lecturer Fund |
| OSCE | Organisation for Security and Cooperation in Europe |
| OVK | Oos Vrystaat Kaap Operations Limited |

## P

| | |
|---|---|
| PAQS | Pacific Association of Quantity Surveyors |
| PARI | Public Affairs Research Institute |
| PARSA | Parasitological Society of Southern Africa |
| PASA | Petroleum Agency of South Africa |
| PCR | Polymerase Chain Reaction |
| PES | Present Ecological State |
| PGE | Platinum-Group Elements |
| PHP | People's Housing Programme |
| PLPR | International Academic Association on Planning, Law and Property Rights |
| POU | Publication Output Unit |
| PPAR | Peroxisome Proliferator-activated Receptors |
| PRECIS | Providing Regional Climates for Impacts Studies |
| PRR | Peace Relief and Reconstruction |
| PRT | Protein Research Trust |
| PRTF | The Pesticide Resistance Testing and Research Facility |
| PSP | Prestige Scholar Programme |

## Q

| | |
|---|---|
| QCP | Quantity surveying, construction and project management |
| QTL | Quantitative Trait Loci |

## R

| | |
|---|---|
| RFG | Research Foundation of Germany |
| RICS | Royal Institutions of Chartered Surveyors |
| RISE | Research Internship in Science and Engineering |
| RLB | Reverse Line Blot |
| RPO | Red Meat Producers Association / Rooivleisprodusente Organisasie |
| RQS | Resource Quality Services |

## S

| | |
|---|---|
| SAAFECS | South African Association of Family Ecology and Consumer Science |
| SAAFoST | South African Association for Food and Science Technology |
| SAARC | The South Asian Association for Regional Cooperation |
| SAASTA | South African Agency for Science and Technology Advancement |
| SAB | South African Breweries |
| SACCCS | South African Centre for Carbon Capture and Storage |
| SACI | South African Chemical Institute |
| SACPCMP | South African Council for Project and Construction Management Professions |

| | |
|---|---|
| SACPLAN | South African Council for Planners |
| SACPVP | South African Council for Property Valuers Profession |
| SACQSP | South African Council for Quantity Surveying Profession |
| SADC | Southern African Development Communities |
| SAENSE | Screening Applications and Novelty in Specialised Environments |
| SAEON | South African Environmental Observation Network |
| SAFEX | South African Futures Exchange |
| SAFOI | South African Fryer Oil Initiative |
| SAHF | South African Housing Foundation |
| SAICSIT | South African Institute for Computer Scientists and Information Technologists |
| SAIFM | South African Institute of Financial Markets |
| SAIP | South African Institute of Physics |
| SANBI | South African National Biodiversity Institute |
| SANDF | South African National Defence Force |
| SAPI | South African Planning Institute |
| SAPOA | South African Property Owners Association |
| SAPPA | South African Pecan Producers Association |
| SAPS | South African Police Service |
| SARChI | South African Research Chairs Initiative |
| SASAE | South African Society of Agricultural Extensionists |
| SASAqS | Southern African Society of Aquatic Scientists |
| SASAS | South African Society for Animal Science |
| SASBMB | South African Society of Biochemistry and Molecular Biology |
| SASM | South African Society for Microbiology |
| SASRI | South African Sugarcane Research Institute |
| SASS | South African Spectroscopy Society |
| SASSDA | South African Stainless Steel Development Association |
| SA-YSSP | South African Young Scientist Summer School Programme |
| SDI | Shack/Slum Dwellers International |
| SEM | Scanning Electron Microscope |
| SETI | Science, engineering, technology and innovation |
| SIFE | Students in Free Enterprise |
| SKA | Square Kilometre Array |
| SME | Small and Medium Enterprises |
| SNP | Single Nucleotide Polymorphisms |
| SSAG | Society of South African Geographers |

## T

| | |
|---|---|
| TAM | Technical Advisory Mission |
| TEM | Transmission Electron Microscopy |
| TGA | Thermal Gravimetric Analysis |
| THRIP | Technology and Human Resources for Industry Programme |
| TIA | Technology Innovation Agency |
| TLR-7 | Toll-like Receptor 7 |
| TUD | Technische Universität, Dresden |

## U

| | |
|---|---|
| UAE | United Arab Emirates Embassy, in |
| UGCG | Underground Coal Gasification |
| UNFLORES | Institute for Integrated Management of Material Fluxes and of Resources |
| UNISA | University of South Africa |
| UNOOSA | The United Nations Office for Outer Space Affairs |
| UNSPIDER | United Nations Platform for Space-Based Information for Disaster Management and Emergency Response |
| USA | United State of America |
| USDA-ARS | United States Department of Agriculture-Agricultural Research Service |

## W

| | |
|---|---|
| WCDM | World Conference on Disaster Management |
| WETREST | Wetland Research and Training |
| WGT | Winter Grain Trust |
| WHO | World Health Organisation |
| WRC | Water Research Commission |
| WSU | Washington State University |
| WVPA | World Veterinary Poultry Association |

## X

| | |
|---|---|
| XRD | X-Ray Diffraction |
| XRF | X-Ray Fluorescence |

# 1913–2013

*Celebrating 100 years of Crystallography*