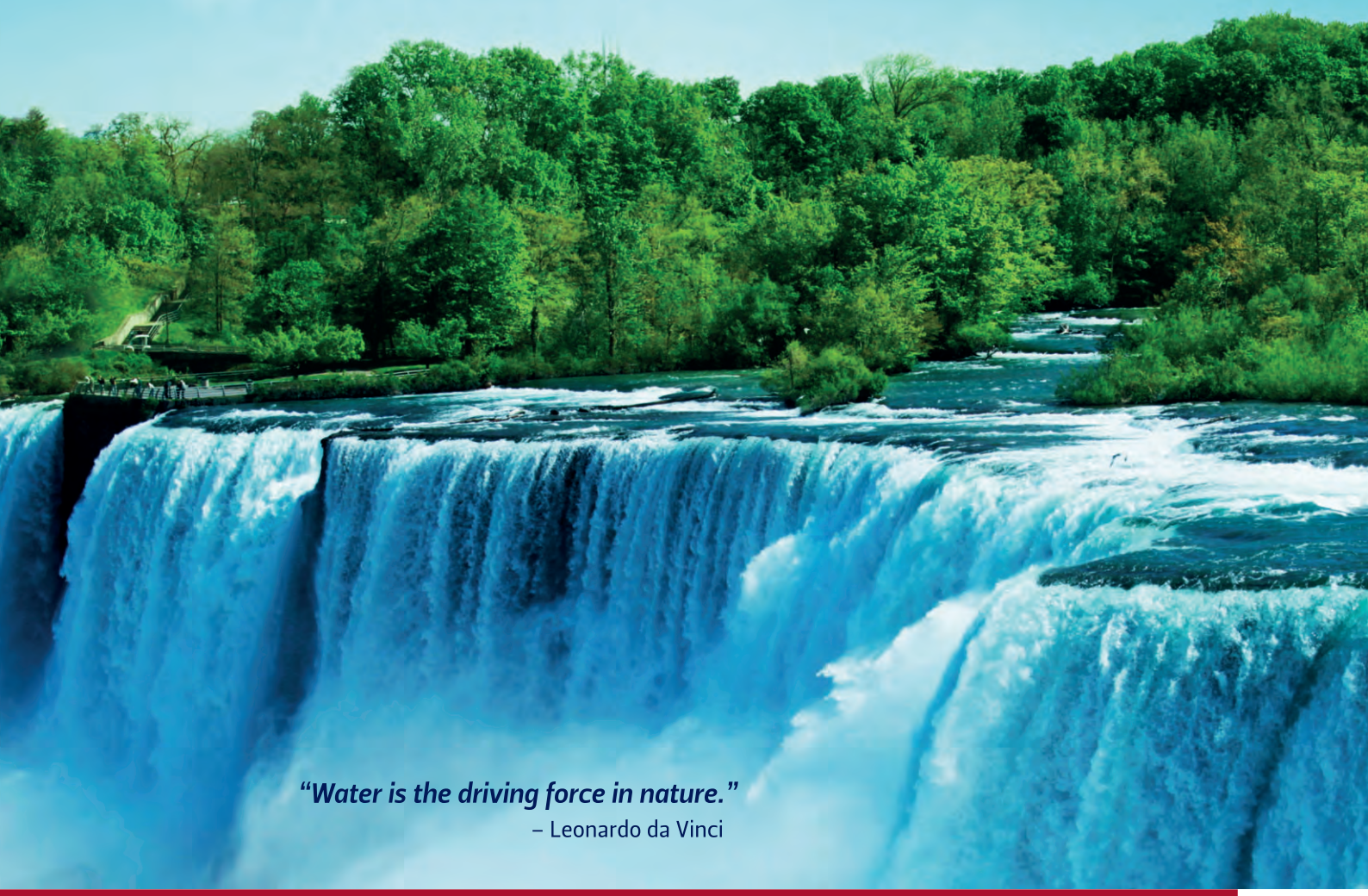
2012

Natural and Agricultural Sciences

Annual Report



"Water is the driving force in nature."
– Leonardo da Vinci

UNIVERSITY OF THE
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UNIVERSITEIT VAN DIE
VRYSTAAT
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UFS·UV
NATURAL AND
AGRICULTURAL SCIENCES
NATUUR- EN
LANDBOUWETENSKAPPE

2012

Natural and Agricultural Sciences

Annual Report

International Water Cooperation

In December 2010, the United Nations General Assembly declared ***2013 as the United Nations International Year of Water Cooperation*** *(Resolution A/RES/65/154). In reflection of this declaration, the 2013 World Water Day, which will take place on 22 March 2013, also will be dedicated to water cooperation.*

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Table of

Contents

Preface:
Message from the Dean

The past year once again saw the Faculty do justice to the academic and human projects of the university which lie at the heart of its vision and mission. Our growth in fulltime equivalents continued its upward trajectory for a third successive year as did out outputs in research units, and masters and doctoral graduates.

Prof. N.J.L. Heideman

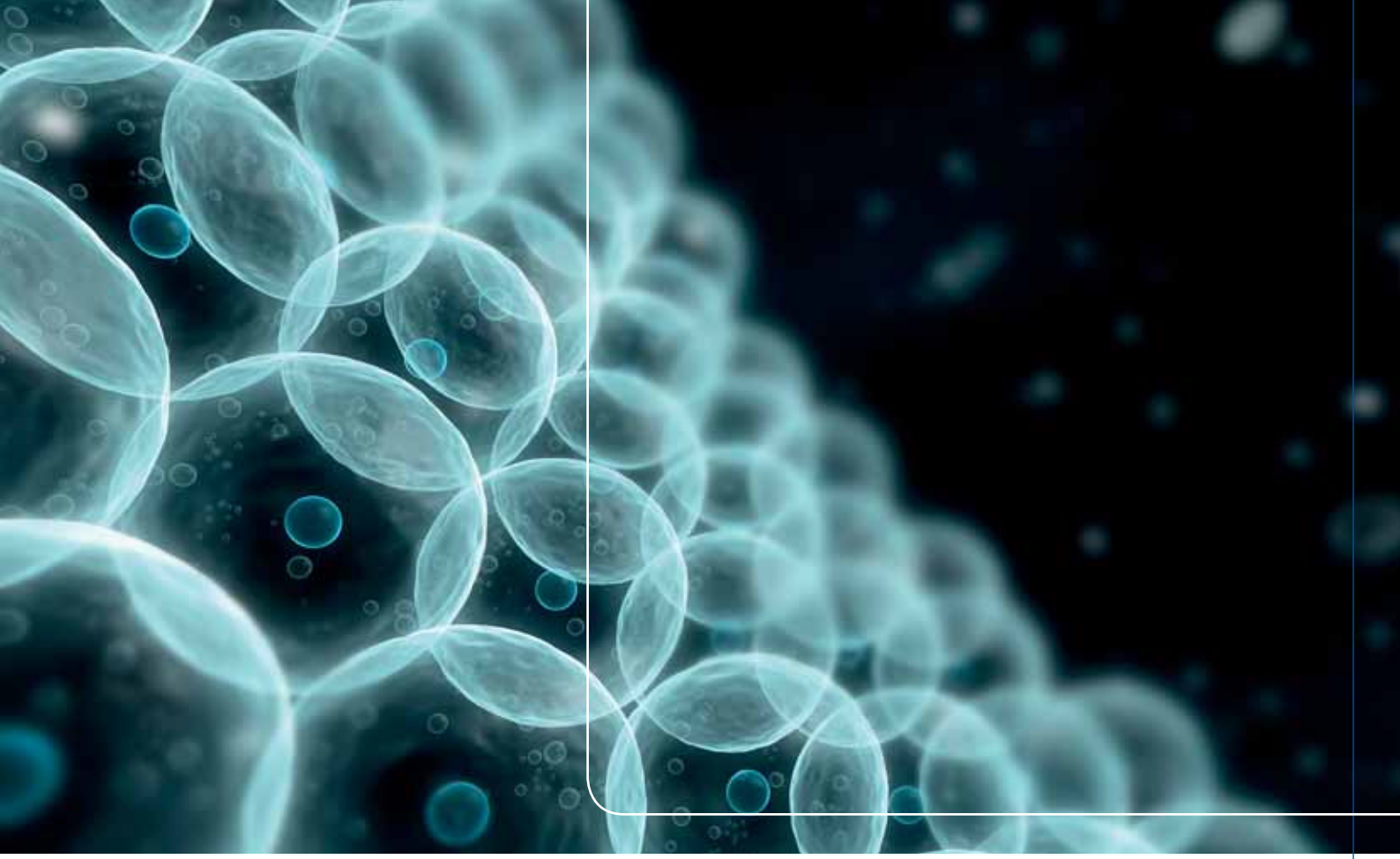
The top ten publishers of accredited journal articles for 2012 had numbers ranging from 4 to 10 units each and also included some of our emerging scholars, which is gratifying. Several scholarly books saw the light and included ones in physics, the biological sciences, grassland science and geography. Progress was also made with respect to diversifying the academic cadre of the faculty with the appointment of several black staff members.

Both emerging and experienced scholars excelled in various ways elevating the stature of the university in the national and international academic arenas. Dr Marieka Gryzenhout (Plant Sciences) was elected to the South African Young Academy of Science and was also the first recipient of the International Mycological Association Young Mycologist Award for Africa in the form of the Ethel Mary Doidge Medal. Prof. Maryke Labuschagne (Plant Sciences) was Grain SA's Scientist of the Year. Prof. Liezel Herselman was re-elected President of the South African Plant Breeders' Association with Dr Adré Minnaar-Ontong as a member of its executive, both also being from Plant Sciences. Dr. Jana Vermaas (Consumer Science) received a certificate as one of the five best presenters during their conference in Melbourne, Australia. Prof. Martin Ntwaeaborwa (Physics) was elected the new Chairperson of the South African Nano Initiative while Dr Johan van Niekerk (Sustainable Agriculture, Rural Development & Extension) was elected to the South African Society for Agricultural Extension's National Executive Committee. The *Mail & Guardian* included Dr Olihile Sebolai (Microbial, Biochemical and Food biotechnology) in its list of 200 young South Africans (35 years and younger) who were the most influential achievers in various fields, in his case in the Health category.

In the Dean's Office Ms Elzmarie Oosthuizen received the Patricia K. Elder Award for Extraordinary Commitment and Dedication to the Advancement of International Economic Education from the National Association of Economic Educators together with The Council for Economic Education in the USA. Profs. Lodewyk Kock (Microbial, Biochemical and Food biotechnology), Hugh Patterton (Advanced Biomolecular Strategic Cluster) and Martin Ntwaeaborwa were elected members of the South African Academy of Science. A yeast genus was named *Kockiozyma* in honour of Prof. Lodewyk Kock for his contributions to yeast systematics while Prof. James du Preez from the same department was elected joint Editor-in-Chief for the journal *Biotechnology for Biofuels*. Prof. André Roodt (Chemistry) became the first person from outside Europe to be elected President of the European Crystallographic Society. The awarding of two research chairs to the faculty under the SARCHi initiative of the DST and NRF was also a notable highlight.

These are but some of the outstanding achievements by staff of the faculty in 2012 for which I gratefully acknowledge them. I also thank our support staff and general workers for their commitment and contributions to the success of the faculty.

Prof. Neil Heideman
Dean, Faculty of Natural and Agricultural Sciences



Strategic Academic Cluster:

Advanced Biomolecular Research

Overview

The Advanced Biomolecular Research Cluster brings together expertise from various disciplines to synergise in the study of biological systems in a high throughput manner, often at the level of the whole genome or proteome. Disciplines that are directly involved in the research activities include biochemistry, molecular biology, microbiology, virology, statistics, mathematics and computer science. The Cluster does not limit the scope of research questions that can be asked within the Cluster, but rather provides an opportunity to address biological questions in a manner that provides a far more definitive answer than that of a classic biological approach. Although the Cluster incorporates several focus areas, these areas are interdependent, and activities in the one focus area will require support from one or more of the other focus areas.

Focus Areas

High Throughput Biology: In this focus area all aspects of genomes and proteomes, including genome function, regulation, and evolution are addressed. Activities include genome sequencing, transcriptomics and other genome-related microarray endeavours such as chip-on-chip. The focus area also involves the high-throughput analysis of proteins, including directed evolution, proteome analysis, and high-throughput enzyme assays, including the screening of archae for activities of biotechnological value, and the screening of plant extracts for inhibitory/activating activities for specific enzymes.

Bioinformatics/Computational Biology: Activities in this focus area include all bioinformatics related research, bioinformatics collaborations with projects in the other focus areas that require bioinformatics sup-

port such as genome annotation, gene identification, database design and the development of specialised analysis software. A significant degree of molecular modeling and molecular dynamics research is also undertaken in this Focus Area.

Novel Drug Discovery: The novel drug discovery programme focuses on activity guided isolation and structure elucidation of bioactive compounds from natural sources with high throughput screening. The programme includes synthesis of bioactive compounds, analogues and internal standards for further drug development and bioavailability studies. The team collaborates with national and international experts.

Advanced Cloning Systems: In this focus area the cloning and/or characterisation and/or expression of any product is the central theme. A major focus is the development and/or improvement of expression systems for the use of heterologous expression of proteins in a number of non-conventional yeast species or bacterial strains. This focus area also involves the use of DNA and/or specific genes or gene products for the production of live, DNA or subunit vaccines.

Commercial Activities

LiquidTech is a commercial enterprise that is being incubated in the Advanced Biomolecular Research Cluster with the aim of becoming an independent company under Kovsie Holdings Ltd. LiquidTech specializes in the analysis of water samples from rivers, dams, reservoirs, treatments plants, bottled water and ground water for complex organic pollutants such as pesticides, cyanotoxins, pharmaceuticals and personal care products (PPCPs) as well as endocrine disruptors. The LiquidTech laboratory utilizes exquisitely sensitive hyphenated techniques such as liquid chromatography/tandem mass spectrometry (LC/MS/MS) capable of detecting compounds at ng/L concentrations.

Prestige Bursaries/Fellowships

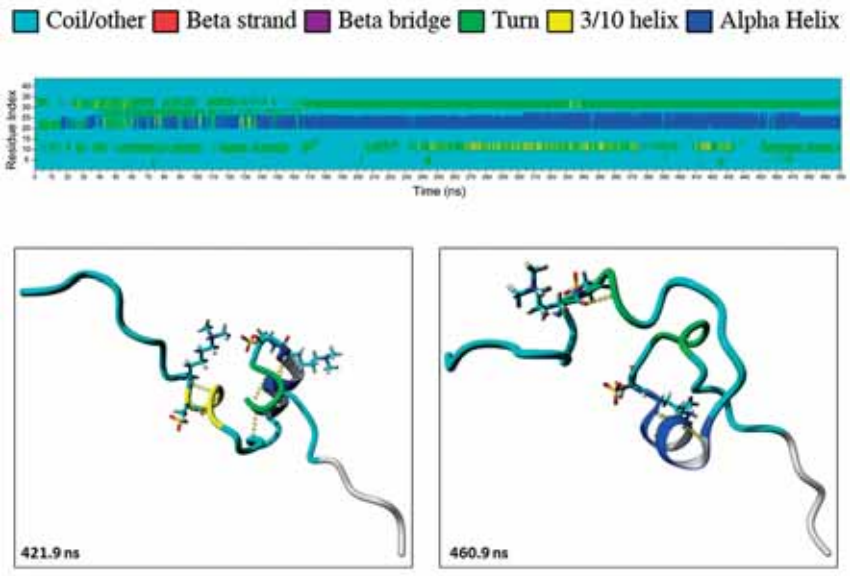
Prestige bursaries and fellowships are available to outstanding candidates to complete research in any of the Focus Areas of the Cluster. Projects that will be available in 2013 are:

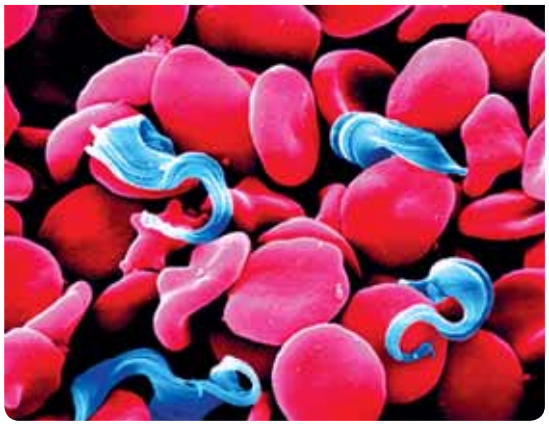
Identification of the epigenetic modifications of *Trypanosoma brucei* histone H3 that allows evasion of the human immune response. *Trypanosoma brucei* is responsible for thousands of annual deaths in sub-Saharan Africa. Infection of humans with *T. brucei*, transmitted by the Tsetse fly, results in African Sleeping Sickness or trypanosomiasis. Several hundreds of thousands of individuals suffer from this tropical disease, and there is clear evidence that the trypanosome is developing resistance to drugs currently used in treatment. If left untreated, trypanosomiasis is lethal.

Isolation and characterisation of compounds from plants that are pharmacologically active against the HIV virus. The AIDS endemic has stimulated research into anti-HIV drugs. This includes phytochemical investigations into pharmacognostically interesting plant material that has, according to anecdotal evidence, the potential to treat AIDS. The Chemistry Department has initiated a project to identify the active ingredients in some of these plant materials and to determine the toxicity, bioavailability and *in vivo* efficacy of these molecules against HIV and other commercially-important viral infections. The project involves advanced chromatography and structure elucidation.

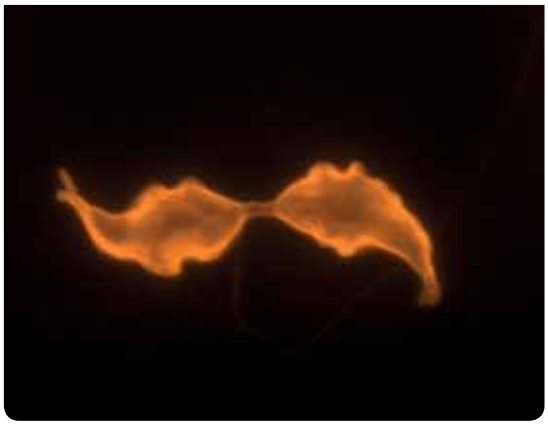
Old Yellow Enzymes (OYEs) and cytochrome P450 (CYP450s) enzymes from *Crytococcus neoformans.* Eicosanoid production is seen as an important virulence factor in the pathogenic yeasts *Cryptococcus neoformans* and *Candida albicans* and is therefore a possible drug target against these pathogens. It is also speculated that one or more Old Yellow Enzymes (OYEs) play a role in prostaglandin F2α production from prostaglandin E2. This study is focused to identify and investigate enzymes involved in prostaglandin synthesis in the pathogenic yeast *Cryptococcus neoformans* for possible drug targeting. Therefore, a better understanding of fungal eicosanoid production will result in the identification of useful targets for pharmacological development. The importance of this study is emphasised by the high mortality rates associated with *Cryptococcal* infections, especially in HIV infected patients, and the ability to gain resistance to known antifungal treatments.

Whole genome consensus sequence determination of African rotavirus strains. It is estimated that in 2008 diarrhoea was responsible for the second-most child mortalities among infectious diseases globally, after pneumonia. Although several infectious agents cause diarrhoea, rotavirus is the major aetiological agent of severe dehydrating diarrhoea, causing approximately 453 000 deaths annually among under five year-olds worldwide. Almost half of these deaths occur in sub-Sahara Africa. Unlike infections in developed countries, where G1P[8] strains cause almost 70% of the rotavirus cases, wide strain diversity is associated with infections in African countries. Recent advances made with the improvement of sequence-independent cDNA synthesis and genome amplification of dsRNA coupled with pyrosequencing, allows cDNA synthesis, amplification and complete nucleotide sequencing of the 11 genome segments without prior knowledge of the viral dsRNA sequence. These technologies allow for the whole genome characterisation of the 11-segmented dsRNA genome of rotavirus and therefore establish the true viral diversity. Using these approaches it is anticipated to determine the consensus genome sequence of African rotaviruses in order to elucidate the evolutionary mechanisms behind the wide strain diversity present on the African continent.





Trypanosoma brucei (blue), the causative agent of African sleeping sickness, seen here in the infective bloodstream form among red blood cells.



Kissing aliens: T. brucei parasites dividing by binary fission.

Staff

Director: Prof. Hugh Patterton.

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

Secretary: Mrs. Charlene Van Der Vyver.

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Strategic Academic Cluster:

Materials and Nanosciences (MNS)

Overview

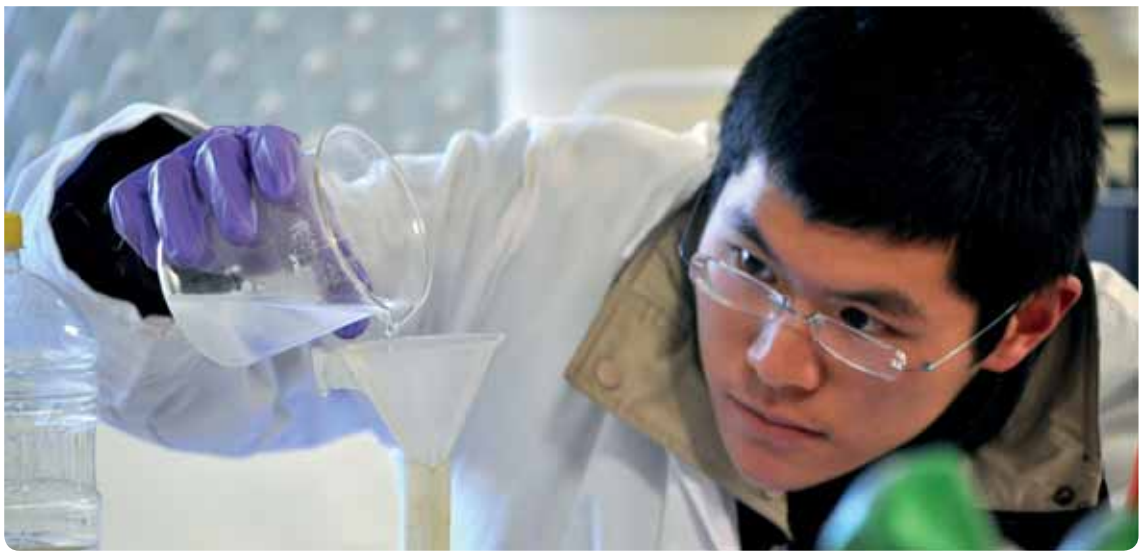
The UFS Materials and Nanosciences (MNS) Strategic Academic Cluster is a narrow-focused research entity comprising three focus areas, i.e. Nano Solid State Materials, Green Petrochemicals, and Polymers.

The MNS Cluster has, as defined in the UFS cluster initiative drive, the following characteristics:

- It has a central focus.
- It is multidisciplinary by nature with a critical mass of people working around a theme.
- It comprises a number of focus areas.
- It provides a framework for the academic training of particularly postgraduate students, research and community engagement.
- It is based on recognised institutional competence and national, regional and institutional priorities.

It has its origin in the fascinating "nanoworld" of many chemical and physical processes. Research is focused on aspects of these processes and the materials required to perform these, and can and will have different impacts on society. The principal objective of the MNS Cluster is the development of new materials and chemicals in the nanometre-sized regime, exhibiting pre-designed physical and chemical characteristics. It is divided into three focus areas exploring concepts from molecular level to the tens of nanometre scale in the fields of nano solid-state materials, (green) petrochemicals, and polymers.

Although the overarching focus is natural scientific, it also strives to address relevant environmental, social, ethical and even judicial issues which can benefit from the activities of the MNS Cluster. It is managed by a part-time cluster director (Prof. A. Roodt) and a Management Committee consisting of the Focus Area leaders.



Research

The research in the MNS Cluster for 2012 involved more than 25 different detailed projects, of which 25% are intra-cluster collaborations. With these focused projects, the MNS Clusters 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** is Prof. Hendrik Swart, Department of Physics, NRF B2-rated researcher and NRF SARChi chair, supported by Profs. Koos Terblanche, Martin Ntwaeborwa, Francis Dejene (QwaQwa Campus) and Dr. Ted Kroon.

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

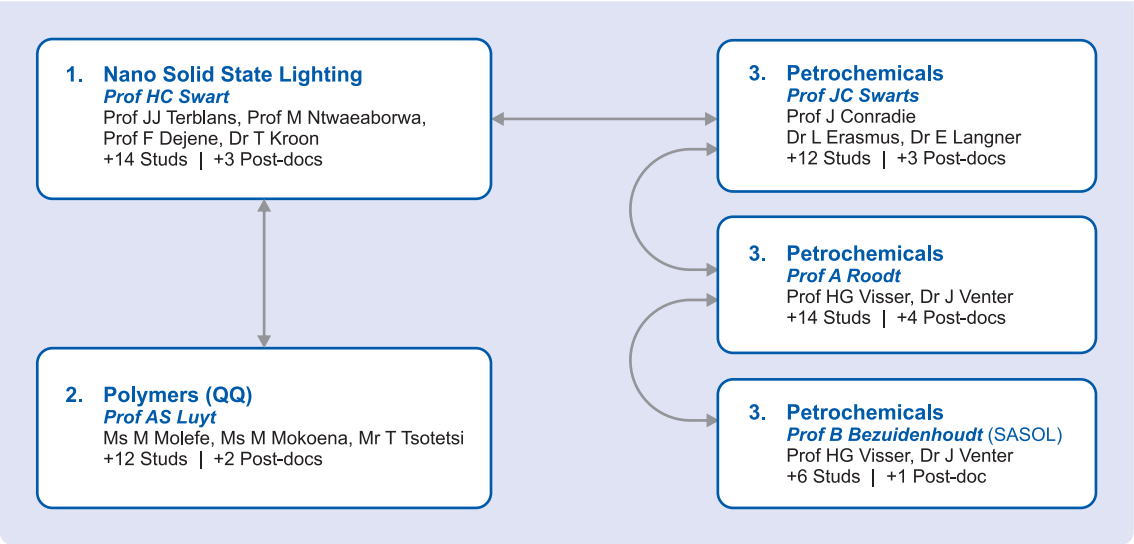
During 2012, the Nano Solid-state Materials Group focused on the establishment of research capacity in luminescent nanoparticles through basic and applied research initiatives, and it involved multiple projects connected by the experimental and theoretical skills of the researchers involved and also includes links with other institutions. The focus area addressed both fundamental and industrial research through the development of technical knowledge when determining physical and chemical surface properties.

The focus-area leader of the **Polymers thrust** is Prof. Riaan Luyt, Department of Chemistry at the QwaQwa campus, an NRF C1-rated researcher, who is supported by Mr. Tsietsi Tsotetsi, Mss. Mpondi Molefe and Moipone Mokoena. This focus area covers 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 explores 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 focus 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.

The focus-area leaders in the (green) **Petrochemicals thrust** are Prof. André Roodt (Homogeneous catalysis, supported by Prof. Deon Visser and Drs. Johan Venter, Alice Brink and Marietjie Schutte-Smith), and Prof. Jannie Swarts (Heterogeneous catalysis, supported by Prof. Jeanet Conradie and Drs. Ernie Langner, Lizette Erasmus and Eleanor Fourie), both NRF C1-rated researchers in the Department of Chemistry at the Main campus. These two thrusts are further supported by the Synthesis Group of Prof. Ben Bezuidenhoudt, SASOL professor in Process Chemistry.

The (green) Petrochemicals focus on homogeneous and heterogeneous catalysis and synthesis, which aim 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 focuses 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.



Flow chart: Simplified illustration of MNS Cluster Group structure.

Moreover, it pursues clean operating systems, from both economic and environmental considerations, to yield pure products with higher yields and minimising waste, which ensures 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 Group focused 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.

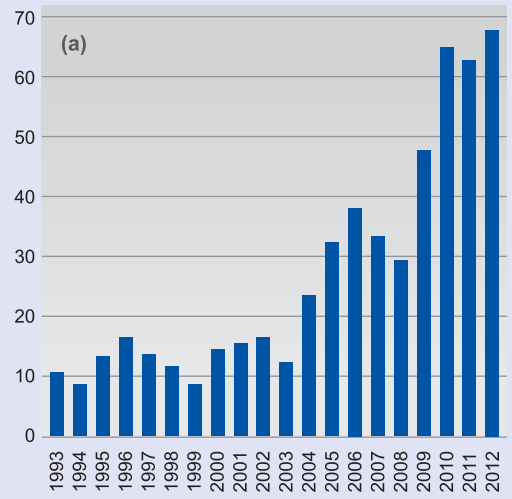
The Heterogeneous Catalysis Group, on the other hand, further focused on synthetic and physical chemistry aspects of multinuclear metallocenes, which included industrial studies on carboxylato complexes and heterogeneous catalysis of systems supported on two-dimensional supports in collaboration with SASOL. These included also 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.

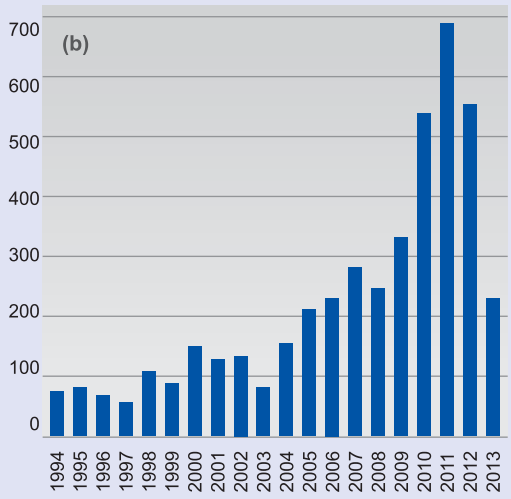
The MNS Cluster currently operates as illustrated by the above flow chart.

Special Achievements

Special achievements by the MNS Cluster over the past year are 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.
- Prof. Hendrik Swart was awarded a SARChi Research Chair in Nano Solid-State Lighting (worth R2.5 million per annum for 10 years).
- A large number of new hybrid materials that are polymer and nanomaterial-based and which exhibit interesting new properties have been produced.
- Research from the MNS Cluster was presented locally and internationally on more than 30 occasions during the past year.
- More than thirty students received bursaries under the MNS Cluster for 2010 – 2012 (including two prestige scholarships), which resulted in more than 40 papers published in the international scientific literature.
- The MNS Cluster is also indirectly associated with more than 60 students via the focus area leaders' research groups.
- The MNS Cluster expanded its unique facilities, and a particular strength of the research group is the ability to do surface-characterisation studies on phosphor nanomaterials and industrial steel and alloy samples.
- The total funding raised by the Cluster in 2012 exceeded R15 million; including R3 million from SASOL, R2 million from the NRF and R8 million for the new nano-TOF equipment.
- The infrastructure in the petrochemicals focus area was expanded in terms of heterogeneous catalysis, a Micromeritics ASAP 2020 gas-adsorption apparatus, a Seteram Scanning Differential Calorimeter and a reduction oven. Included is a special oven with fine temperature control up to 300 C° and a bomb reactor for the syntheses of Metal Organic Framework (MOF) nanoparticles.
- The setup available for homogeneous, heterogeneous and process chemistry now boasts an in-





Search Items	Number
Number of papers found	593
Sum of the papers Cited	5498
Cites without self citations	3900
Citing Articles	3236

Search Items	Number
Citing Articles without self-citations	2826
Average Citations per Item	9.27
Cumulative h-index	33

(c)

ISI Web of Knowledge search results for Profs. Hendrik Swart, Riaan Luyt, Jannie Swarts, Ben Bezuidenhoudt and Andreas Roodt by end 2012, with (a) number of papers per annum, (b) number of citations per annum and (c) summary table with specific numbers.

ternationally-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 (Figure 1) in the MNS Cluster. It is clear that in particular over the last 3 years, significant growth took place. In fact, these five senior researchers in the MNS Cluster has co-authored around one-third of the total papers produced by the complete UFS Faculty of Natural and Agricultural Sciences. The activity regarding papers has virtually doubled, as illustrated for 2012 by the 67 papers and 654 citations per annum received, respectively.
- The overarching conclusion is that the MNS Cluster is a viable entity which produces significant outputs under a flagship research theme of the UFS.
- ISI Web of Knowledge search results for Profs. Hendrik Swart, Riaan Luyt, Jannie Swarts, Ben Bezuidenhoudt and Andreas Roodt by end 2012, with (a) number of papers per annum, (b) number of citations per annum and (c) summary table with specific numbers.

Research Outputs

Strategic Academic Cluster: Materials and Nanosciences (MNS)

Research Artikels

Ahmad, E.E.M. & Luyt, A.S. 2012. Effects of organic peroxide and polymer chain structure on mechanical and dynamic mechanical properties of sisal fiber reinforced polyethylene composites. *Journal of Applied Polymer Science* 125: 2216-2222.

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Strategic Academic Cluster:

Technologies for Sustainable Crop Industries in Semi-arid Regions

Overview

The cluster investigates environmental and agro-ecological factors that impact sustainable crop-related industries in semi-arid regions of South Africa. The overall approach is to identify constraints to sustainable supply chains and to address them by means of biotechnological interventions and applications, as well as organisational innovations.

The cluster strives toward a holistic and multidisciplinary approach to agro-ecosystem analysis, which is supported by the innovative application of traditional technologies and the development of new green technologies for improving farming practices and plant traits required for optimal yields in water-scarce environments.

The cluster seeks to provide South Africa with new information that will improve the country's transition towards a Green Economy where the system of economic activities for relevant sectors will result in sustainable improvements in human well-being and development. Technologies are based on sound research and development, and on innovation systems that cater to the needs of poor and rich alike and are integrated within the context of a holistic "food systems approach".

Research Activities

Research conducted during 2012 is grouped into three focus areas:

Focus Area 1: Production Technologies for Managing Crop Environments

The Cereal Rust Research Programme (CRRP) in Focus Area 1 once again yielded significant new discoveries with regard to the identification of wheat genotypes that have genetic resistance to leaf and stem rust. The Focus Area leader, Prof. Zakkie Pretorius, was

nominated by the South African Research Chairs Initiative (SARChI) for a SARChI Research Chair in Disease Resistance in Field Crops in 2011 and final endorsement of the Chair occurred in 2012. The Chair will provide Prof. Pretorius with the means to extend his research capacity and will consequently strengthen the resource base of the cluster significantly.

Dr. N.T. Gebeyehu, a postdoctoral fellow from Ethiopia, made significant progress in determining the histological mechanism(s) involved in adult-plant stripe rust resistance of wheat. This is the first project of its kind where histological observations of stripe rust adult plant resistance (APR) was carried out on field samples of diseased wheat.

Another full-time researcher in the CRRP, Dr. Botma Visser, implemented a detection protocol for the rapid and accurate identification of different South African members of the Ug99 stem rust lineage.

Dr. P.A.L. le Roux made great strides in developing digital soil mapping (DSM) as a soil survey tool to optimise the use of soil resources in Southern Africa. In 2012, the highlight of this project was a presentation of his work at the 5th Global Workshop on DSM, where the work done in South Africa was extremely well-accepted. It illustrated that South Africa is on track with global initiatives in this field. Another breakthrough was made at the 16th SANCIAHS National Hydrology Symposium in Pretoria, where the value that DSM can add to hydrology, was clearly shown.

Dr. Marieta Cawood studied the biochemistry of resistance in wheat to biotic stresses and made significant discoveries in this regard. She confirmed that firstly, chitosan oligomers can act as elicitors in the Russian wheat aphid resistance response of wheat, and secondly, that polyphenol oxidase plays a role in the defence response of wheat against the Russian wheat aphid. She also convincingly showed that the plant, African wormwood (*Artemesia afra*), may have a dual effect against the Russian wheat aphid by acting as a repellent as well as an elicitor that triggers defence responses in wheat.

Dr. Marieka Gryzenhout is developing DNA barcodes for rapid identification of pathogens and latent pathogens of agricultural crops in semi-arid regions. This technology has great potential for improving crop production and will become crucial in terms of attaining food security in Southern Africa. A very interesting and unique facet of her work is the synergy it has brought about between various disciplines in the cluster, namely plant pathology, mycology, agronomy, biochemistry and entomology. This is aptly reflected in a project to evaluate and elucidate the allelopathic potential of the important food crop, amaranth (*Amaranthus cruentus*), to crop and weed species which is managed by Dr. James Allemann. This collaboration forms a crucial part of a consortium (SA-NuGrain), established with the North-West University and the ARC-Roodeplaat, which has considerable commercial potential.

Wheat seedlings artificially inoculated with leaf rust.

Focus Area 2: Genetic Technologies for Crop Improvement

The leader of Focus Area 2, Prof. Maryke Labuschagne, made significant progress in improving and stabilising wheat quality for a changing climate by selecting appropriate polymeric and monomeric protein fractions in South African wheat cultivars using Size Exclusion High Performance Liquid Chromatography (SE-HPLC).

Dr. Angeline van Biljon studied the genetic diversity and quality characteristics of sweet potato breeding lines developed for the needs of resource-poor farmers. Her research represents the first report on simple sequence repeat (SSR) markers in South African sweet potato breeding lines and is essential for the usage of these lines in breeding programmes for improving quality.

Prof. Neal McLaren's research to determine the epidemiological value of resistance or tolerance to principle soil-borne sorghum and soybean diseases in South Africa continued to yield important breakthroughs. Analyses for ergosterol (as a measure of active fungal colonisation) and mycotoxin concentrations indicated a distinct relationship between sorghum grain characteristics and grain mould severity. Ergosterol, extracted as an indicator of fungal colonisation of roots, proved a useful indicator of root colonisation by root rot fungi. Genotype response to changing environments was also found to be variable and sorghum lines with stable resistance over seasons were identified.

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

Focus Area leader, Prof. Arno Hugo, made several significant contributions towards developing stable animal feed for safe human food. Chemical preserva-

Dr. Gert Marais and a Namibian Master's student next to a container used to store sorghum and millet.

tives and antioxidants are used extensively in animal feed and human food globally and are constantly under scrutiny. The use of natural preservatives and lipid antioxidants are therefore encouraged. In an interdisciplinary and collaborative research project with Prof. Celia Hugo and Dr. Okert Einkamerer, plant-derived preservatives and antioxidants were evaluated for their application as preservatives and antioxidants in animal feed and human food. Four students working in Focus Area 3 graduated during 2012 and four articles were published from this research project.

Dr. Maryna de Witt continued to evaluate cactus pear (*Opuntia ficus-indica*) for its functional food ingredients. Her project focused on using mucilage and cladode flour as functional ingredients in various foodstuffs and drinks. She also studies the antioxidant content as well as antioxidant potential of cactus pear fruit, cladodes and processed products. This groundbreaking research had very positive outcomes, which resulted in her undertaking a trip to Mexico in 2012 to impart this knowledge to local food scientists.

Visit to the Okinawa Institute of Science and Technology (OIST) in Japan

Prof. Wijnand Swart formed part of a delegation led by Prof. Driekie Hay, Vice-Rector, Academic and Research of the UFS, to Japan in October 2012. The delegation included Profs. Aldo Stroebel, Corli Witthuhn, André Roodt, Hendrik Swart, Hugh Patterton, Maitland Seaman, and Dr. Glen Taylor. Other universities in Tokyo, namely Meiji, Chiba and Tokai Universities were also visited. The aim of the visit was to establish cooperation between UFS and OIST.

The delegation at Chiba University, 11 October 2012. Prof. Wijnand Swart was indicated as representative to take contact with the Chiba University further.

Research Outputs

Strategic Academic Cluster: Technologies for Sustainable Crop Industries in Semi-Arid Regions

The delegation at Tokai University, 12 October 2012.

Research Articles

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Chapter in Book

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Strategic Academic Cluster:

Water Management in Water-scarce Areas

Overview

The Research Strategy of the University of the Free State (UFS) has as primary goal; the need to contribute increasingly to national and regional development and growth through the delivery of people, knowledge, innovation and solutions in selected areas that can serve the interests of the country and the continent. This can only be done if it is also in a position to contribute to global excellence in research.

At the core of the strategy is the concept of Strategic Academic Clusters in priority areas where the University has particular strengths, or where the leadership wishes to develop globally-recognised expertise as part of the strategic positioning of the institution in the systems within which it operates. The clusters have an outward-looking focus, with trans-, multi- and interdisciplinary partnerships and alliances with other universities, funding agencies, government and non-government agencies and the private sector; searching for unique opportunities in South Africa, Africa, and beyond.

The Water Management in Water-scarce Areas Research Cluster carries out research and develops associated teaching in the management of the scarce water resource in its physical, ecological, social and economic aspects. In essence, the Cluster will give attention to the risks associated with the availability of the water resource in its natural and utilisable states.

Entrepreneurship is being developed in the fields of routine water quality analysis, in the description of the minimum requirements for the maintenance of individual ecosystems (groundwater, rivers and other wetlands), in the optimal utilisation of water for agriculture and other socio-economic needs, in the prediction of water availability and in the assessment of the risks associated with water scarcity in numerous

The rapid at site EWR3 in the Seekoei River during a field visit, when the river was in the flow phase.

fields of use. The latter risks would include loss of quality and competitive usage.

There are strong indications that as populations increase to global human carrying capacity, water is becoming a critical resource. As large parts of Southern Africa and the developing world are water-scarce, the need exists for developing this particular strategic research cluster. The UFS has a strong water-related research base, much of it in water-scarce areas. Therefore it would seem appropriate and strategic that the UFS develops this niche.

The Water Management in Water-scarce Areas Research Cluster's ultimate goal is the establishment of an academic cluster that leads this field in South Africa and acts as a magnet for research and teaching at a very high level.

Water management in water-scarce areas is essentially different from that where water is abundant. Unfortunately most of Southern Africa is water-scarce. Therefore, this Cluster is structured to create a powerful intellectual cohesion among researchers with the potential to develop self-sustaining critical mass in key areas of national, regional and/or international relevance to water management in water-scarce areas.

Flagship Projects

Research under the auspices of the cluster is grouped into four focus areas:

Focus Area 1: Management of aquatic ecosystems in water-scarce areas

(Leader: Prof. Johann du Preez, Department of Plant Sciences):
As the water supply becomes critical in water-scarce areas, it becomes imperative to safeguard water bodies, above and below ground. These water bodies are sustained by their ecosystems, and the development of management tools will aid in the protection and use of water in water-scarce areas.

Focus Area 2: Climate change and variability in water-scarce areas

(Leader: Prof. Sue Walker, Department of Soil, Crop and Climate Sciences):
This focus area enables research into planning for water use and operational early warning systems developed for application to benefit the people of Africa. Water-scarce areas also show large variability in climatic conditions and all sectors of the country need to be prepared to expect weather extremes over the next few decades.

Focus Area 3: Managing water scarcity in agriculture

(Leader: Prof. Leon van Rensburg, Department of Soil, Crop and Climate Sciences):
Both natural and man-made water scarcity is facing one-third of the developing world. Arid and semi-arid climatic zones are regarded as naturally water-scarce due to the erratic, spatial and temporal distribution of rainfall. These areas are also highly sensitive to soil erosion. Rural farmers are the most vulnerable as they depend on the natural resources (veld, soil and water) to provide food, fibre and shelter for their families.

Focus Area 4: Optimal water-use for development in water-scarce areas

(Leader: Prof. Bennie Grové, Department of Agricultural Economics):

The supply of water to communities established inappropriately, unavoidably or strategically (in the

Esté Prinsloo doing water depth measurements.

case of mines) has, in many cases, led to extensive damage of ecosystems as those communities became established. Planning for the wise use of the available water can lead to huge benefits for water-scarce areas, not only in South Africa, but also in large parts of Southern Africa and the developing world.

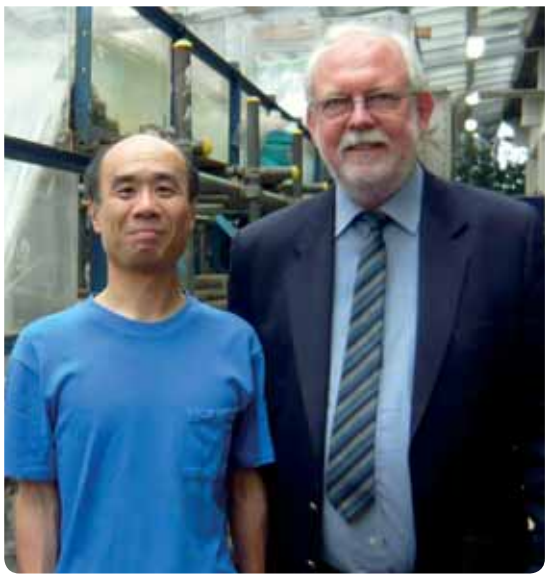
Projects and Research Activities

The following studies were undertaken by the Water Cluster during 2012:

1. Zooplankton and their symbionts in the Okavango Delta and its associated basins, Botswana – Deidré West (Ph.D. Student – Department of Zoology and Entomology).
2. Management of water resources in non-perennial rivers – Joan Adendorff (Ph.D. student – Centre for Environmental Management).
3. An investigation into the fish community structure of three pools in the Seekoei River, Northern Cape, South Africa – Hennie Louw (Masters' student – Centre for Environmental Management).
4. A vegetation and environmental analysis of the Palaeo-Kimberley, Palaeo-Modder rivers and the surrounding area – Andri van Aardt (Ph.D. student – Department of Plant Sciences).
5. The integration of Disaster Risk Reduction and Climate Change Adaptation principles into wetlands management in the Free State – Johannes Belle (Ph.D. Student – Centre for Disaster Management).

Preparing the soil to install DFM soil water sensor in the field at the Kolomela Mine near Postmasburg.

6. The implications of hydrological phases in non-perennial rivers on macro-invertebrate species composition – Ina Ferreira (Masters' Student – Centre for Environmental Management).



Dr. Michi Kojima and Prof. Seaman during a visit to Meiji University in Japan where Dr. Kojima demonstrated his river-flow dynamics model.

Visit to Japanese Universities:
8 – 18 October 2012

Following a visit by the Rector, Prof. Jansen, early in 2012 to the Okinawa Institute of Science and Technology (OIST) in Japan, he suggested to the Directors of the Strategic Academic Clusters that the UFS had much to gain from cooperation with OIST, and that the Cluster Directors associated with science and technology should visit OIST, but also three other universities in Tokyo, namely Meiji, Chiba and Tokai. A team, led by Prof. Driekie Hay, visited Japan in October 2012. The team included Profs. Aldo Stroebel, Corli Witthuhn, André Roodt, Hendrik Swart, Wijnand Swart, Hugh Patterton, Maitland Seaman, and Dr. Glen Taylor.

Research Outputs

Strategic Academic Cluster: Water Management in Water-Scarce Areas

Research Articles

Mavimbela, S.W. & Van Rensburg, L.D. 2012. In-Situ Evaluation of evaporation in layered soils (Tukulu, Sepane and Swartland). *Journal of Agricultural Science and Technology* 5 (suppl. 2): 577-590.

Mavimbela, S.W. & Van Rensburg, L.D. 2012. Integrating micro-flood irrigation with in-field rainwater harvesting: Maize yield and water use efficiency. *Irrigation and Drainage* 61(suppl. 2):70-81.

Zerizghy, M.G., Van Rensburg, L.D. & Stigter, K. 2012. Characterization of rainfall in the Central South African Highveld for application in water harvesting. *Irrigation and Drainage* 61(2): 24-33.

Staff

Director: Prof. Maitland Seaman.

Focus Area Leaders: Profs. Johann du Preez, Sue Walker, Leon van Rensburg, and Bennie Grové.

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Department of

Agricultural Economics

Overview

The Department of Agricultural Economics understands the social, environmental and economic challenges facing the agricultural sector in Sub-Sahara Africa. The growth in the department reflects on the capacity to capitalises on incentives to build partnerships with Agri Business and Agricultural specialists in the banking sector to combine an entrepreneurial approach with the multi-disciplinary nature of tuition, research and community service. The focus of the Department is on training agricultural economist that specialises in Agricultural management and working with farmers and agri Business.

The Department of Agricultural Economics provides students in Agricultural Economics with theoretical training linked to current agricultural economics and marketing issues internationally and in Southern Africa. Emphasis on management, strategic planning and analysis of markets is synonymous with forging a strong relationship with the industry.

Special Achievements

The 2012 annual Conference of the Agricultural Economic Association of South Africa (AEASA) was hosted by the Department of Agricultural Economics under the leadership of Prof. Bennie Grové. The conference was held on the campus of the University of the Free State, 30 September – 3 October 2012, with 250 national and international delegates.

The conference topic was "Challenges beyond 50 years of Agricultural Economics in South Africa". Guest speakers included Prof. Kent Olson from the University of Minnesota, USA. Prof. Olson presented the Simon Brand Memorial address on "Trends, Issues, Threats and Opportunities Affecting Farmers". Other invited guest speakers included Dr. Ward Anseeuw, who is a development economist and policy analyst from CIRAD (the Agricultural Research Centre for International Development in France). His presentation was on "The global land rush, new investment models and agrarian change". Dr.

The AEASA conference was hosted by the Department of Agricultural Economics. From left to right: Prof. Bennie Grové, Prof. Giel Viljoen, Prof. Sheryl Hendriks, Prof. Kent Olson, Prof. Johan Willemse, and Dr. Jack Armour.

Hans Balyamujura, General Manager of ABSA Agri Business-Africa, presented his guest lecture on "Turning Africa's massive agricultural potential into opportunities and benefits to the local populations".

A Strategic AgriBusiness Session was held on the last day of the three-day conference and distinguished guest speakers included Mr. Frank Lawrence, Chairman of GWK, and Mr. Francois Strydom, the Managing Director of SENWES, as well as Prof. Hamish Gow from the Massey University of New Zealand. Prof. Gow presented a workshop on "How to practically implement strategic tools to face the challenges of the future".

During the gala dinner and prize-giving, Esté van der Merwe, a research assistant in the Department of Agricultural Economics, received the award for the second-best paper presented at the conference and she also won the second prize for the best Masters' thesis in Agricultural Economics for 2012.

Mr. W.A. Lombard is a research assistant in the Department of Agricultural Economics. He won the prize for the best fourth-year B.Sc. Agricultural Economics student, as well as the best B.Sc. Agricultural Economics Honours' student for 2012.

The Department presented eight papers and three posters at the AEASA conference.

The AEASA conference was hosted by the Department of Agricultural Economics.

Activities

Lecturers, Prof. Johan Willemse, Dr. Antonie Geyer, Mr. Frikkie Maré and Mr. Dirk Strydom, presented workshops on agricultural markets at the regional meetings of the Red Meat Producers' Organisation and the National Wool Growers' Association at Senekal, Smithfield, Bothaville, Brandfort, Edenburg and Reitz. 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 from Santam Agri, Nicky Weimar, senior economist of Nedbank, and Mr. Jaco Kirstein from KG Auditors, who discussed capital gains tax and estate planning. These workshops are attended by 150 guests each quarter on the campus of the University of the Free State. The workshops are sponsored by the banking sector and other agribusinesses and form part of the network which in turn helps to fund the Department's bursary scheme.

The Agricultural Economic Department Bursary Project had 13 students who received bursaries from the Agri Business Industry for 2012. Industries who sponsored students were GWK, OVK, Silostrat, ABSA, Senwes, BKB, Veeplaas, RPO, Suidwes Investments, John Deere and the Protein Research Foundation.

Prof. Bennie Grové, Dr. Henry Jordaan and research assistant, Marcil Venter, attended the biannual conference of SANCID (The South African National Committee on Irrigation and Drainage), 21 – 23 November 2012, in the Drakensberg, where they presented three papers.

The 63th ICID (International Commission on Irrigation and Drainage) conference held in Adelaide, Australia, 24 – 30 June 2012, was attended by Prof. Bennie Grové, where he presented a paper on Economic Impacts of Environmental Flow Requirements.

Dr. Antonie Geyer visited the Johann Heinrich von Thunen Institute in Braunschweig, Germany, 20 No-

vember – 07 December 2012. He received training in the AgriBenchmark for Beef and Sheep programmes.

During September 2012, Henry Jordaan attended an international course on optimising the performance of producers' organisations that was presented by the Centre for Development Innovation (CDI) and Wageningen University and Research Centre. The course was presented at CDI in Wageningen, The Netherlands.

The 2012 graduates from the Department of Agricultural Economics were nine Ph.D. students, 18 B.Sc. Agric. students, 13 B. Agric. Honours students, and 51 B.Com. Honours' Agricultural Economics students.

Community Service

At national level, SAFEFE (South African Foundation for Economic and Financial Education) facilitated the training of teachers in the Free State, KwaZulu-Natal, Eastern Cape, and the Western Cape for 2012.

SAFEFE was also involved in two international programmes with the USA:

- University of Minnesota student exchange programme (Ph.D. and Masters' degree) in the Free State and North West Province.
- Northern Illinois University fact-finding trip for Entrepreneurship in the Western Cape.

In the student exchange programme, five Ph.D. and Masters' students from the Department of Applied Economics of Minnesota University, together with three faculty members, visited the University of the Free State in May 2012. Ph.D. and Masters' students from the Department of Agricultural Economics of the University of the Free State and the visitors from Minnesota University visited different institutions and farms in the Free State and North West.

Other places visited by the students included a visit to Allem Brothers, a milling factory, and a visit to Senwes Grainlink, both in Viljoenskroon. A visit to a carrot farm, which is a Senwes producer, was very informative. This was followed up with a visit to the NAMPO agricultural show in Bothaville and a meeting with a facilitator from Grain SA who accompanied the group to a fertiliser-producing company, Seneca, which serves the local farming community. Two emerging famers were visited under the supervision of Grain SA and the Minnesota visitors found their success stories very informative.

Achievements

At the Faculty year-end prize-giving, Dirk Strydom received the Faculty Award for Community Service with the SAFEX workshops he held for 356 farmers during 2012.

Mrs. Lize Morris received the Faculty Award for the best junior lecturer for 2012.

Mr. Theo Potgieter and Prof. Sheryl Hendriks, President of AEASA, with the F.R. Tomlinson Commemorative Medal.

Every year an outstanding agricultural economist is nominated to present the prestigious F.R. Tomlinson Commemorative Lecture, which was hosted by the Department of Agricultural Economics on the campus of the University of the Free State on 16 February 2012. Mr. Theo Potgieter, the director of JTP Consulting, was nominated as the guest lecturer for the 2012 lecture. He is an Agricultural Economist by training with experience in agricultural development, project management, 25 years' experience in commercial banking and consulting on Broad-Based Black Economic Empowerment, and is currently a Non-Executive Director of the Land Bank.

The Unit in Livestock Economics was established in the Department of Agricultural Economics during 2012 with the focus of nationally and internationally marketing the University of the Free State, and in particular the Department of Agricultural Economics. The coordinator of the Unit is Dr. A.C. Geyer, senior lecturer in the Department of Agricultural Economics. Other key staff members involved are Prof. B.J. Willemse, Mr. F.A. Maré, Mr. H.N. van Niekerk and Mr. J.I.F. Henning.

The Unit will specialise in economic research for livestock, support training and development in the livestock industry, provide economic information for livestock extension, promote sustainable livestock agribusiness, enhance collaboration with livestock industries, and improve the welfare of communities by impartially-applied economic problem solving. The purpose and mission is to link directly with the livestock industries regarding research, training, development and extension. The Unit in Livestock Economics consists of divisions for large stock, small stock, game, poultry and related matters (predators, theft, market, etc.)

Research Outputs

Department of Agricultural Economics

Research Articles

Baiphethi, M.N., Kundhlande, G., Viljoen, M.F. & Manona, S. 2012. 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(2): 119-128.

Botha, C.F., Taljaard, P.R., Alemu, Z.G., Jooste, A. & Pelser, A.J. 2012. Segmenting food consumption in the Free State Province of South Africa. *Agrekon* 51(3): 52-77.

Botha, J., Van Rensburg, L.D., Anderson, J., Hensley, M. & Baiphethi, M.N. 2012. Alleviating household food insecurity through in-field rainwater harvesting. *Irrigation and Drainage* 61: 82-94.

Dlamini, T., Fraser, G. & Grove, B. 2012. Economics of meat production from springbuck in the Eastern Cape Karoo. *Agrekon* 51(1): 1-20.

Shiimi, T., Taljaard, P.R. & Jordaan, H. 2012. Transaction costs and cattle farmers' choice of marketing channel in North-central Namibia. *Agrekon* 51(1): 42-58.

Strydom, D.B., Morris, L., Van Zyl, H. & Willemse, B.J. 2012. Reduction of transaction cost within the processing industry. *African Journal of Agricultural Research* 7(47): 6265-6273.

Strydom, D.B., Willemse, B.J. & Van Zyl, H. 2012. Factors effecting longer term farm contracts in the frozen fries processing industry. *African Journal of Agricultural Research* 7(37): 5181-5190.

Toure, A.A., Grove, B., Groenewald, J.A., Seck, P. & Diagne, A. 2012. Economics in West African irrigated-rice production. *Agronomie Africaine* 24(2): 151-160.

Staff

Professors: Prof. Johan Willemse, and Prof. Bennie Grové.

Lecturers: Dr. A.C. Geyer, Dr. Henry Jordaan, Dr. L. Terblanche, Mr. Kobus van Staden, Mr. Dirk Strydom, Mr. Frikkie Maré, Mr. Janus Henning, Mr. Abiodun Ogundeji, Mr. Petso Mokhatla, Ms. Nicky Matthews, and Mr. Walter van Niekerk.

Departmental Secretary: Mrs. Louise Hoffman.

Officers: Mrs. Chrizna van der Merwe, and Ms. Ina Combrinck.

Research Assistants: Coenraad Badenhorst, Nompilo Mgabi, Kobus Bruwer, Mbali Nyembe, Nomalanga Mdungela, Herman Lombard, W.A. Lombard, Olebogeng Mojanaga, Lerato Mofolo, Nompilo Majosi Phoka Nkhuoa, Rechtus Steyn, Manfred Venter, Gunther Griessel, Primrose Madende, Yondela Mahlathi, Marcil Venter, Lerato Bogacwi, Toba Fadeyi, Berhane Haile, Julie Hayward, Francois Human, Philip Oosthuizen, Anchen Scheepers, and Rechtus Steyn.

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Department of

Animal, Wildlife and Grassland Sciences

Overview

The mission of the Department of Animal, Wildlife and Grassland Sciences remains focused on the transfer of current knowledge and the creation of new knowledge through relevant innovative, scientific research. The interaction and cooperation of the different disciplines (Animal Breeding, Animal Nutrition, Animal Physiology, Wildlife, and Grassland Science) have helped to strengthen the objective of sustainable, more efficient livestock and wildlife production systems in South Africa. These production systems range from intensive to extensive and also from small-scale farming to large, highly scientific operations. To address the production needs in the community and industry requires a high standard of expertise and involvement in the different disciplines being generated by the Department. The most important product of the Department remains its students and therefore it is crucial that the training provided reflects a high standard of academic excellence, applied knowledge and insight. There is thus a continuous interaction with the industry and farming community to address the needs for optimal production.

In 2012, a total of 19 postgraduate students attained their degrees (ten B.Sc. Honours' students, five M.Sc. students and five Ph.D. students) in their respective disciplines; an indication of the productivity of the Department of Animal, Wildlife and Grassland Sciences. The structuring of the Department into the various disciplines has thus created Centres of Excellence which facilitates the aspects of teaching, research and community service. The extensive research programme has also been complemented by interdisciplinary actions within the Department, between the Department and other departments at the University of the Free State, and with other national institutions.

Limited research funds remain a big challenge for the research endeavours and postgraduate programme. The main source of funding for research remains the National Research Foundation (NRF); with contributions being made by the industry (e.g. Voermol Feeds, Nutrifeeds, Supreme Chickens, Cape Mohair and Wool, National Lucerne Organisation, Pfizer, Meadow Feeds, the National Wool Growers Association, and Rhine Ruhr – Foss Instruments).

Special Achievements

In 2012, 87% of the Department's academic staff made scientific contributions, both locally and abroad, at conferences and discipline-related meetings. The ground-breaking research by Mr. Francois Deacon on the giraffe (Ph.D. project) in monitoring their seasonal migration routes and behavioural patterns continues. In the field of Animal Production, Prof. Hennie Snyman received recognition for his research on the intruder plant known in the farming community as "slangbos" or "bankrotbos". In the last 18 months, four manuscripts in accredited journals and 21 articles in the popular press were published, while the subject was addressed at 11 farmers' and information days. Progress was made in eradicating this plant and increasing the productivity and carrying capacity of the natural pastures. A definite highlight for 2012 was the publication of a book on pastures edited by Prof. Hennie Snyman for Landbouweekblad and Landbou.com, published by Media24. Over 1 500 copies of the book were sold nationally in a period of three months. A doctoral student in Soil Science and Grassland Science, Pieter Swanepoel, received an award at the annual Congress of the Grassland Society of Southern Africa 2012 for the best theatre presentation by a young scientist. His co-promoters were Prof. Chris du Preez and Prof. Hennie Snyman.

National and International Collaboration

The Department of Animal, Wildlife and Grassland Sciences remains deeply involved in the industry, the National Department of Agriculture, and the Agricultural Research Council (ARC). Examples of members formally involved with certain institutions include Breed Plan and several Breed Societies: Prof. Frikkie Neser; Voermol Feeds: Prof. Johan Greyling and Prof. Hennie Snyman; Red Meat Producers' Organisation: Prof. H.O. de Waal; National Lucerne Organisation: Dr. Gerrie Scholtz; Free State Game Association: Prof. H.O. de Waal and Prof. Nico Smit; South African Society for Animal Science: Prof. Frikkie Neser; National Wool Growers' Association: Prof. H.O. de Waal; South African Wildlife Management Association: Prof. Nico Smit; the Industrial Development Corporation: Prof. H.O. de Waal and Mr. Willie Combrinck; Supreme Chickens: Mr. Foch de Witt; Veeplaas: Mr. Ockert Einkamerer; Nutrifeeds: Mr. Foch de Witt; Ramsem Artificial Insemination Station:

Prof. Hennie Snyman edited a book on pastures.

Prof. Johan Greyling and Dr. Alarik Jooste; and Pfizer Veterinary Supplies: Prof. Johan Greyling and Dr. Alarik Jooste. This collaboration and cooperation between the Department and the industry illustrates the Department's involvement and is also reflected in the Department's focus on market-orientated research. There are currently five Professors Extraordinary (local and abroad) affiliated in the Department. They are Prof. Amie Aucamp (Grassland Science), Prof. Gert Erasmus (Animal Breeding), Prof. Michiel Scholtz (Animal Breeding), Prof. Lucky Nedambale (Reproduction Physiology), and Prof. Akke van der Zijpp (Production Systems); indicative of the status that the Department enjoys nationally and internationally.

During September 2012, a group of five specialists from South Africa, including Prof. H.O. de Waal, Dr. Herman Fouché, Dr. Maryna de Wit, Mr. Willie Combrinck and Mr. Coenie Erasmus was invited to visit South and Central America for an Opuntia study tour. The countries visited included Argentina, Chile and Mexico. This research programme at the University of the Free State on the production and uses of spineless cactus pear (*Opuntia ficus-indica*) is augmented by information obtained from different sources. The information and knowledge are applied in implementing and developing the Cactus Pear Project at Oppermansgronde in the Free State Province and elsewhere in the country.

The group visited Mexico, Chile and Argentina from 2 – 20 September 2012 to gain first-hand knowledge on the production and uses of cactus pear. All the objectives of the tour were met successfully:

A dairy that can milk 64 cows simultaneously.

The cow-housing of a mega dairy visited by Prof. Johan Greyling in Israel.

- The knowledge gained on the entrepreneurial potential and possibilities of cactus pear cultivation, processing and uses can be widely applied.
- The cactus pear gene pool in Mexico, Chile, Argentina, and the USA can contribute to the gene pool in South Africa.
- A range of applications are available for cactus pears as human food, including traditional and commercial uses.
- Cactus pears and specifically natural colourants obtained from cochineal form the basis for several pharmaceutical applications.
- A range of applications are available for processing cactus pear cladodes into animal feed. Being its country of origin, cactus pears grow wild in Mexico where farmers feed them to livestock, mostly freshly-chopped cladodes; cactus pear cladodes also supplement the water requirements of livestock in the dry regions.
- The cactus pear production systems on small-holdings are mostly traditional but several new initiatives are being developed and implemented.
- Special attention was given to empowering women in development projects based on the cactus pear.
- The foundations were laid to exchange scientists, specialists and students to assist in various activities and topics, among others training, research and development, and education.

The Binational Seminar (Antonio Narro Agrarian Autonomous University (UAAAN), Saltillo, Mexico), Mini-Symposium (University of Chile, Santiago, Chile) and CACTUSNET FAO-ICARDA Meetings (Termas de Rio Hondo, Santiago del Estero, Argentina) provided excellent opportunities for scientific presentations and the exchange of knowledge by three South African speakers with Mexican, Chilean, Argentinean, Peruvian, Brazilian and American colleagues and were greatly appreciated by all participants.

In September, the International Goat Congress (500 delegates) was attended in Gran Canaria (Canary Islands) and contributions were made by Prof. Johan Greyling. He was also elected to the Board of the IGA (International Goat Association) at this meeting for a term of five years. To further demonstrate international collaboration, it can be mentioned that the Animal Breeding Group (Prof. Japie van Wyk, Prof. Frikkie Neser and Dr. Mike Fair) attended and presented at the 63rd Annual Meeting of the European Association of Animal Production (EAAP) held in Bratislava, Slovakia, during August 2012.

Slovakia is a small landlocked country in the centre of Europe with a population of over five million inhabitants. The country is divided into eight self-governing regions. Its capital is Bratislava which has about half a million inhabitants. One of the main objectives of the meeting was to focus on sustainability and efficiency of the livestock sector. The programme covered all aspects of scientific achievements within Animal Science dealing with Genetics, Animal Breeding, Farm Management and Technology, Product Quality, Nutrition, Physiology, Health and Animal Welfare, as well as other related topics. During the meeting, scientists debated effective solutions and long-term perspectives needed for a world with resource constraints and environmental limitations. More than 1 000 delegates participated in discussions on nearly 800 scientific contributions.

Research

Some of the research highlights in the Department of Animal, Wildlife and Grassland Sciences included the following:

- In the Animal Nutrition discipline the ongoing research on the production and uses of cactus pears (*Opuntia ficus-indica*) was expanded to

Prof. Nico Smit and students busy at the Kolomela Project.

other countries. This research team was led by Prof. H.O. de Waal. Concurrently, Prof. H.O. de Waal also conducted research into the control of predators. Furthermore, Mr. Foch de Witt and Mr. Ockert Einkamerer evaluated the effect of dietary fatty acid supplementation on the performance of broilers and layers. Research focused on egg and broiler meat production when utilising the different lipid sources. A very successful study was also completed (Mr. Ockert Einkamerer – study leader) on the supplementation of an anti-oxidant and different fat sources and the effect on the oxidative characteristics of the lamb carcass.

- In the discipline of Animal Breeding, the focus remains on the determination of breeding value (EBVs) and Prof. Frikkie Neser and Prof. Japie van Wyk were involved in assessing genotype x environment (G x E) interactions and performance testing in sheep and cattle. Most research is performed in close collaboration with different stud breed societies.
- In Animal Physiology, assisted-reproductive techniques were researched in cattle, sheep, poultry and goats (Mr. Benedict Raito, Dr. Alarik Jooste, and Prof. Johan Greyling). The applied techniques include *in vitro* embryo production, artificial insemination (AI), embryo transfer (ET), synchronisation of oestrus, and the cryopreservation of gametes. Controlled breeding efforts are being made to increase the efficiency of synchronisation and conception rates, especially following fixed time AI. The seasonality of sexual activity in small stock is being studied in a quest to also ultimately optimise lambing percentages. The seasonal characterisation of cockerel semen is the latest aspect receiving attention.
- In the Wildlife discipline, barring the unique work being done on the giraffe (Mr. Francois Deacon), a joint research project in the Northern Cape, the rehabilitation of the ecology (Sishen), is ongoing (Prof. Nico Smit). Problem areas that arise from the open-cast mining include, amongst others, soil removal and the dewatering of the underground water reservoirs. The grassland researchers are thus involved with the vegetation survey.
- Dr. Beanelri Janecke researches the nitrogen content in the faeces of different wildlife species in order to determine the main source of nutrition.
- Prof. Hennie Snyman (Grassland Science) has been actively involved with research regarding "slangbos" (*Seriphiumplumosum*) for the past six years. This aggressive intruder plant has already infiltrated productive natural pastures, with a subsequent loss in potential grazing capacity. He made certain recommendations and much progress in the control of this intruder plant has been made. Cooperation between institutions has been established by the Prof. Snyman; enquiries as far as the USA have been received in this regard. Chemical or physical eradication has been found to be effective in destroying the bush.

Community Service

All academic members of the Department have been involved in community service in one way or another, whether it be in the form of presentations at farmers' days or short courses and workshops (Animal Breeding). Staff members have also been involved in the judging of national research competitions (Prof. Frikkie Neser, Prof. Johan Greyling and Prof. Hennie Snyman) in collaboration with the livestock industry. Several of the staff also serve on the editorial boards of scientific journals (national and international); being involved in the reviewing of manuscripts. Prof. Johan Greyling also serves as Editor-in-Chief for an American-accredited research journal.

Mr. Francois Deacon and helpers busy with the Giraffe Project.

A flagship in the Department remains the Nguni project (Northern Cape and Free State), led by Prof. H.O. de Waal. Vast inroads have been made in the training and empowerment of black cattle farmers. This project is the combined effort of the Department of Animal, Wildlife and Grassland Sciences, the Industrial Development Corporation (IDC), and the Free State and Northern Cape Departments of Agriculture.

Through the action of community service, much promotion and advertising is performed by the Department for the UFS.

Research Outputs

Department of Animal, Wildlife and Grassland Sciences

Research Articles

Booyens, K., Einkamerer, O.B., Hugo, A., Van der Merwe, H.J., Slippers, S. & Fair, M.D. 2012. Fatty acid composition and oxidative stability of lambs' meat as affected by a bioflavonoid antioxidant and fat sources. *South African Journal of Animal Science* 42(5): 483-487.

Du Toit, J., Van Wyk, J.B. & Maiwashe, A. 2012. Assessment of inbreeding depression for functional herd life in the South African jersey breed on level and rate of inbreeding. *South African Journal of Animal Science* 42(1): 114-122.

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Zietsman, P., Seaman, M.T., Smit, G.N., Avenant, N.L., Buschke, F.T., Adendorff, J., Janse van Rensburg, G., Deacon, F., Du Plessis, J.J. & Zietsman, L.E. 2012. *Integrated report on biomonitoring at Kolomela mine, Kumba Iron Ore*. Report commissioned by the Sishen Iron Ore Company (Kolomela), Postmasburg, South Africa.

Staff

Professors: Profs. Johan Greyling, Frikkie Neser, Nico Smit, Hennie Snyman, and Japie van Wyk.

Professors Extraordinary: Profs. Amie Aucamp, Gert Erasmus, James Hayes, Lucky Nedambale, Michiel Scholtz, and Akke van der Zijpp.

Associate Professor: Prof. H.O. de Waal.

Senior Lecturers: Dr. Alarik Jooste.

Lecturers: Drs. Gerrie Scholtz, Mike Fair, Paul Malan, Ockert Einkamerer, and Mr. Foch de Witt.

Junior Lecturer: Mr. Benedict Raito.

Researcher: Dr. Beanélri Janecke.

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Department of

Plant Sciences

Overview

The Department of Plant Sciences consists of the disciplines of Botany, Plant Breeding and Plant Pathology. These disciplines cover a variety of subjects, including molecular biology, ecology, taxonomy, plant defence responses, plant physiology and biochemistry, gene expression, eco-physiology, conventional plant breeding, marker-assisted breeding, improvement of plant nutritional values, plant pathogens, plant mycology, genetic resistance to diseases, fungal systematics and biodiversity, epidemiology and microbial, biochemical and food biotechnology.

Activities and Achievements

The Department of Plant Sciences is a diverse department as can be evidenced by publications in a wide array of scientific journals, as well as the attendance of conferences and symposia covering many different topics and fields of study. Plant research performed by staff members at both the Main and QwaQwa campuses contributes significantly towards provision, improvement and protection of plants, aiming to be beneficial to society and contributing significantly towards food security. A number of staff members are known worldwide for their involvement in international research, service on international journal editorial boards, and for their stature and scholarship in the scientific community.

Several staff members received awards for their outstanding contribution to Plant Science in 2012:

- During a visit to Addis Ababa in Ethiopia, 28 – 30 January 2012, Prof. Maryke Labuschagne received a prestigious award from the African Union (AU) Commission, namely the African Union Kwame Nkrumah Scientific Award, for her great scientific achievements and contributions towards the socio-economic development in Africa. She also

Prof. Maryke Labuschagne received the African Union Kwame Nkrumah Scientific Award for the advancement of Life Sciences and Earth Sciences from President Jacob Zuma in Addis Ababa, Ethiopia, during the opening of the African Union.

received the Scientist of the Year Award from Grain SA in October 2012.

- Prof. Zakkie Pretorius was invited by Dr. Daisy Selematssela, Executive Director for Knowledge Management and Evaluation, to become a member of a NRF Specialist Committee for rating applications in 2012.
- The International Mycological Association (IMA) honoured Dr. Marieka Gryzenhout as the first recipient of the IMA Young Mycologist Award for Africa – the Ethel Mary Doidge Medal. She was furthermore one of the few scientists who received the South African Young Academy of Science (SAYAS) Award.
- Prof. Liezel Herselman was re-elected as President and Dr. Adré Minnaar-Ontong was elected as Secretary and Treasurer of the South African Plant Breeders' Association (SAPBA).

National and International Collaboration

Several staff members attended international conferences or visited institutes to build links with fellow researchers from over the world:

- Dr. Botma Visser attended the 38th Annual Conference of the South African Association of Botanists (SAAB) in Pretoria, 15 – 18 January 2012, where he delivered three oral presentations and one poster. During 1 – 4 September 2012 he visited Beijing, China, for the 4th Borlaug Global Rust Initiative (BGRI) Technical Workshop to present a poster. He also delivered an oral presentation at the 9th Annual Inkaba ye Africa GEO-FUTURE Workshop: Inkaba ye Africa and Beyond, 25 – 30 November 2012, Potsdam, Germany. Dr. Visser also paid a visit to Dr. Thomas Hüster, CEO of AgraForUmVertriebs GmbH, Dohren, Germany, regarding collaboration.
- Prof. Maryke Labuschagne visited the International Maize and Wheat Improvement Center (CIMMYT) in Zimbabwe to discuss postgraduate student projects, 27 – 29 February 2012. She delivered papers at the 14th ICC Cereal and Bread Congress, 6 – 9 August, and the International Gluten Workshop, 13 – 15 August, Beijing, China. She was also co-author of a poster presented at the Second Scientific Conference of the Global Cassava Partnership for the 21st Century (GCP21),18 – 22 June, Kampala, Uganda and co-authored a paper at the Swedish University of Agricultural

World-renowned plant geneticist, Prof. Bob McIntosh from Australia, visited the UFS wheat rust programme in October 2012. Here he is pictured (centre) with Prof. Zakkie Pretorius and Mrs. Cornel Bender during a visit to field trials in KwaZulu-Natal.

Prof. Zakkie Pretorius assisted Prof. Brian Steffenson (right) from the University of Minnesota, USA, in evaluating barley lines for their response to stem rust race Ug99 at the Pannar research station in KwaZulu-Natal. Prof. Steffenson sends an annual barley nursery to South Africa for disease evaluation.

Sciences (SLU) Africa Food Security Research Symposium in Kampala, Uganda, 4 – 6 December 2012. On a national level she was author or co-author of three oral presentations and four poster presentations at the 9th Southern African Plant Breeding Association (SAPBA) Symposium, Protea Hotel, Kruger Gate, Skukuza, 12 – 14 March 2012.

- Dr. Rouxléne van der Merwe presented a poster during the 18th International Sunflower Conference, 27 February – 1 March 2012, in Mar del Plata & Balcarce, Argentina. During the 9th Southern African Plant Breeding Association (SAPBA) Symposium, 12 – 14 March 2012, she also presented a poster.
- Dr. Marieka Gryzenhout attended the Centraal Bureau voor Schimmelcultures (CBS) Symposium at the University of Utrecht, The Netherlands, during April 2012. The CBS Symposium was entitled: "One Fungus = Which Name?".
- Dr. Adré Minnaar-Ontong attended several symposia and workshops in 2012. From 12 – 14 March 2012 she attended the 9th Southern African Plant Breeding Association (SAPBA) Symposium. She attended the ISM-MycoRed Workshop-training course entitled "Detection techniques for mycotoxins in the food chain", 28 May – 1 June, as well as the Fusarium Laboratory Workshop, 3 – 8 June, in Bari, Italy. Both training sessions delivered valuable knowledge to be implemented in her research.
- Dr. Angeline van Biljon attended the Plant Breeding for Drought Tolerance Summer Field-oriented Short Course, 11 – 20 June 2012, Colorado State University, Fort Collins, Colorado, USA, where she presented a paper.
- Prof. Liezel Herselman presented a paper at the 13th International Cereal Rust and Powdery Mildew Conference (ICRPMC), 28 August – 1 September 2012, and a poster at the 4th Borlaug Global Rust Initiative (BGRI) Technical Workshop, 1 – 4 September 2012, in Beijing, China. She also presented a paper at the 9th Southern African Plant Breeding Association (SAPBA) Symposium in Skukuza, 12 – 14 March 2012.
- Prof. Zakkie Pretorius attended the 4th Borlaug Global Rust Initiative (BGRI) Technical Workshop, 1 – 4 September 2012, in Beijing, China, where he also visited the Institute of Genetics, Chinese Academy of Sciences, Beijing, to build collaborative links.
- Prof. Zakkie Pretorius also made several other conference contributions, namely two contributions

Prof. Johan Venter and Dr. Andor Venter (Research Associates), Linde de Jager (third-year Botany student), Prof. Tatyana Livshultz (Academy of Natural Sciences of Drexel University, Philadelphia, USA) and Lize Joubert on a field trip to Blyde River Canyon, Mpumalanga, to study the pollination biology of six species of the Apocynaceae, as part of a multidisciplinary research project on the evolution of this complex plant family.

during the 38th Annual Conference of the South African Association of Botanists, 15 – 18 January 2012 in Pretoria, three contributions during the 9th Southern African Plant Breeding Association (SAPBA) Symposium, Kruger Gate, Skukuza, 12 – 14 March 2012, and six contributions during the the 4th Borlaug Global Rust Initiative (BGRI) Technical Workshop, 1 – 4 September 2012, in Beijing, China.

- Prof. Louis Scott attended the Southern African Society for Quaternary Research (SASQUA) Conference, 13 – 16 September 2012, in Gobabeb, Namibia, where he delivered one oral presentation and presented two posters.
- Prof. Neal McLaren attended the International Mediterranean Phytopathological Union (MPU) Workshop: Plant Protection for the Quality and Safety of the Mediterranean Diet, 24 – 26 October 2012, in Bari, Italy. One of Prof. Neal McLaren's students, Dr. Belinda Janse van Rensburg, received the South African Society of Crop Production (SASCP) Board Award for the best paper published by a member of the SASCP in *The South African Journal of Plant and Soil* during the Combined Crops, Soils, Horticulture and Weeds Congress in Durban.
- Dr. Lintle Mohase gave a presentation during the Inkaba ye Africa and Beyond 9th Annual Workshop, Potsdam, Germany, 26 – 30 November 2012.

Staff Matters

The year also saw a number of staff changes. The Department was fortunate to appoint two new staff members in Botany. Ms. Marguerite Westcott was appointed as junior lecturer at the Bloemfontein campus, while Dr. Liza Buwa was appointed as senior lecturer in Botany at the QwaQwa Campus.

Research Outputs

Department of Plant Sciences

Research Articles

Agenbag, G.M., Pretorius, Z.A., Boyd, L., Bender, C.M. & Prins, R. 2012. Identification of adult plant resistance to stripe rust in the wheat cultivar Cappelle-desprez. Theoretical and Applied Genetics 125: 109-120.

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Chazan, M., Avery, D., Bamford, M., Berna, F., Brink, J.S., Fernandez-Jalvo, Y., Goldberg, P., Holt, S., Matmon, A., Porat, N., Ron, H., Rossouw, L., Scott, L. & Horwitz, L. 2012. The Oldowan horizon in Wonderwerk Cave (South Africa): Archaeological, geological, paleontological and paleoclimatic evidence. Journal of Human Evolution 63: 859-866.

Crous, P.W., Shivas, R.G., Wingfield, M.J., Summerell, B.A., Rossman, A.Y., Alves, J.L., Adams, G.C., Barreto, R.W., Bell, A., Coutinho, M.L., Flory, S.L., Gates, G., Grice, K.R., Hardy, G.E. St.J., Kleczewski, N.M., Lombard, L., Longa, C.M.O., Louis-Seize, G., Macedo, F., Mahoney, D.P., Maresi, G., Martin-Sanchez, P.M., Marvanova, L., Minnis, A.M., Morgado, L.N., Nordeloos, M.E., Phillips, A.J.L., Quaedvlieg, W., Ryan, P.G., Saiz-Jimenez, C., Seifert, K.A., Swart, W.J., Tan, Y.P., Tanney, J.B., Thu, P.Q., Videira, S.I.R., Walker, D.M. & Groenewald, J.Z. 2012. Fungal Planet description sheets: 128-153. Persoonia 29: 146-153.

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Kulembeka, H., Ferguson, M., Herselman, L., Kanju, E., Mkamilo, G., Masumba, E., Fregene, M. & Labuschagne, M.T. 2012. Diallel analysis of field resistance to brown streak disease in cassava (Manihot esculenta Crantz) landraces from Tanzania. Euphytica 187: 277-288.

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Pretorius, Z.A., Szabo, L., Boshoff, W., Herselman, L. & Visser, B. 2012. First report of a new TTKSF race of wheat stem rust Puccinia graminis f. sp. tritici in South Africa and Zimbabwe. Plant Disease 96: 590.

Ramburan, S., Zhou, M. & Labuschagne, M.T. 2012. Integrating empirical and analytical approaches to investigate genotype x environment interactions in sugarcane. Crop Science 52: 2153-2165.

Ramburan, S., Zhou, M. & Labuschagne, M.T. 2012. Investigating test site similarity trait relations and causes of genotype x environment interactions of sugarcane in the midlands region of South Africa. Field Crops Research 129: 71-80.

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Chapters in Books

Labuschagne, M.T., Wegary, D. & Vivek, B. 2012. The influence of water stress on yield and related characteristics in inbred quality protein maize lines and their hybrid progeny. In: Water Stress, edited by Ismail Md. Mofizur Rahman and Hiroshi Hasegawapp. New York: InTech. pp. 199-218.

Venter, H.J.T. 2012. Periplocoideae (genera 32-45). In: Flora of Tropical East Africa: Apocynaceae Pt 2, edited by H. Beentje. United Kingdom, Richmond, Surrey: Kew Publishing. pp. 118-167.

Third-year students conducting a vegetation survey in a wetland near Hogsback in the Eastern Cape.

Staff

Main Campus:

Professors: Profs. Maryke Labuschagne, Neal McLaren, Zakkie Pretorius, 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: Dr. 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 Ms. Marguerite Westcott.

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

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

QwaQwa Campus:

Lecturers: Drs. Tom Ashafa, Lisa Buwa, Erwin Sieben, and Mr. Robert Lentsoane.

Junior Lecturer: Mr. Raymond Pitso.

Contract Staff: Prof. Rodney Moffett.

Technical and Support Staff: Messrs. Pheello Mojau, and Ngaka Mzizi.

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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 three 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 a gradual growth not only in the number of undergraduate students but also in the number of postgraduate students. In 2012 an average of 40 postgraduate students were enrolled. Approximately 40% of these students came from Botswana, Eritrea, Ethiopia, Germany, Kenya, Lesotho, Malawi, Mauritius, Swaziland, the United States of America, Zambia, and Zimbabwe.

Research in the Department is aimed at various aspects of the soil-crop-atmosphere system. Approximately R5 million was spent on research in 2012, of which only 10% came from the Central Research Fund of the UFS. The rest of the funding came from institutions such as the National Research Foundation (NRF), the Water Research Commission (WRC), the German Research Foundation (GRF), the Protein Research Trust (PRT), the Winter Grain Trust (WGT), Bayer, Montsanto, Syngenta, Omnia Fertilizer Ltd., and Agraforum. Research findings were published in scientific journals as outlined in the research outputs later on, and presented at a wide range of national and international conferences.

Agrometeorology staff: Prof. Sue Walker, Ms. Linda de Wet and Mr. Stephan Steyn, with a group of extension officers from Mpumalanga during one of the FAO training workshops.

Activities and Achievements

In terms of the Department's activities and achievements during 2012, one must note the restructuring of all undergraduate learning programmes to align them with specifications introduced by the Department of Higher Education. These changes will be phased in during the next four years and is expected to have a dramatic impact on both the quality of education and student numbers. Major alterations include an introductory module on Soil Science, Agronomy and Agrometeorology, which will be compulsory for all first-year students in the Agriculture Programme, and the dropping of the double-major system to facilitate in-depth learning of the respective disciplines.

Agrometeorology

Mostly through the efforts of Prof. Sue Walker, who attended a series of meetings in Italy, Kenya and South Africa, this section has managed to become involved in the Agricultural Model Intercomparison and Improvement Project in Sub-Saharan Africa and South Asia (AgMIP). AgMIP is approved and sponsored by the United Kingdom's Department of International Development (UK-DFID), and the United States Department of Agriculture – Agricultural Research Service (USDA-ARS); and is executed by the trustees of Columbia University (CU) in New York. The funds provided by CU for the project's activities will be made available through the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT). Research projects funded under AgMIP will address the modelling of crop-livestock intensification in Southern Africa in the face of climate change. The main goals are to identify pathways for improving food security in Southern Africa's mixed crop livestock systems, develop adaptive management strategies to reduce climate-induced risks, and to increase systems resilience.

Agrometeorology hosted several visiting international scientists. Prof. Kees Stigter, founder of the International Society for Agrometeorology (INSAM), presented an undergraduate class on micrometeorological manipulation and provided valuable input to postgraduate students' research projects. Dr. Pascal Yaka from the Civil Aviation and Meteorology Office in Burkina Faso, and Dr. Višnjica Vučetić from the Croatian Meteorological and Hydrological Service, formed part of an expert team (along with the division's own doctoral students), that facilitated a farmers' workshop as part of a START (System for Analysis, Research and Training) collaboration project with the University of Cape Town. They also presented a Faculty seminar on "Opportunities and constraints for seasonal rainfall forecast applications to agricultural decisions in Burkina Faso and Agrometeorology, phenology and forest fire protection in Croatia".

After graduating in autumn, Dr. Weldemichael Tesfuhuney was appointed as a postdoctoral fellow.

Prof. Sue Walker (front left) at the AgMIP launch in Centurion.

The Agrometeorology exhibit at the Astronomy Fair.

His research on optimising runoff to basin area ratios for maize production with in-field rainwater harvesting constitutes original research into the energy balance above and within the maize canopy in order to describe the fluxes of water vapour and the energy driving the system. Dr. Tesfuhuney was also closely involved in the previously mentioned AgMIP project and farmers' workshop.

The FAO contracted Agrometeorology to train agricultural extension officers at two sites (Coromandel, near Lydenburg, and Kulabakhutsele, near Malelane) 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. Mr. Stephan Steyn, Ms. Linda de Wet and Mr. Pieter van Heerden (an irrigation specialist) lectured the extension officers during two training block weeks at venues near the sites. Prof. Walker and Mr. Van Heerden, accompanied by Aron Magonono (intern) and Letlotlo Mokhomo (Honours' student) made site visits in order to assess the training needs, to assist extension officers and farmers with real problems, and to judge the eventual impact of the training.

The Climate Club community project with St. Michael's Secondary School in Bloemfontein expanded during 2012. Now referred to as the Geoclub, schools throughout the Mangaung district are invited to put forward topics with which they have difficulties to be addressed at the next quarterly meeting. The aims of this interaction are to further the education of Grade 10 - 12 learners in Geography, and to help their teachers to explain key concepts and additional learning material. Since involving more schools, the number of attendees at these quarterly meetings grew to about 100. Other marketing endeavours included a school visit to De Aar and involvement at the newly-established Astronomy Fair on the campus of the University of the Free State.

Dr. László Lakatos, previously from the University of Debrecen in Hungary, joined the Agrometeorology section and hopes to make valuable contributions to some of the undergraduate modules as well as a postgraduate supervisor. Dr. Lakatos is a specialist in microclimate and micrometeorological manipulation in fruit orchards.

The year ended on a sad note as the Department had to say farewell to Prof. Walker. Prof. Walker decided to go on early retirement after 15 years at the Department but she will join the project Crops for the Future Research Centre (CFFRC) in Kuala Lumpur, Malaysia, as the programme director in Crop Physiology, Agroclimatology and Agro-Ecological Potential. During her time as Section Head of Agrometeorology, she delivered outstanding service to the University with 15 Masters' and 12 doctoral students successfully graduating under her guidance.

Agronomy

During the year, six research projects were completed in this section, resulting in the awarding of two Masters' and four doctoral degrees.

Studies on the influence of temperature on the yield and quality of carrots and the response of onions to sowing dates and plant populations were successfully completed. A project investigating the response of the essential crop rose geranium to changes in the nutrient composition of the hydroponic solution and shading was also completed, showing that this crop can be cultivated successfully in central South Africa using this method of production. Nutrient solution composition for both vegetative yield and soil quality purposes were determined, as well as optimal shading levels for the production of this crop. Research on the optimum plant population and water use of an ultra-fast maize hybrid under irrigation established that the phenological development of the crop, as well as its water use efficiency could be altered when increasing inputs beyond established thresholds in order to increase yields.

Research into the allelopathy of *A. cruentus* led to involvement in the South African Nu-grain initiative, which looks into the development of amaranth as a grain rather than a vegetable crop. Herbicide work, concentrating on the chloroacetamide herbicides

Tracey Johnson, a Masters' student, encounters some elephants at Mahalalapanga in the Kruger National Park.

(an important group of grass herbicides) continues and closer ties have been established with major agrochemical companies such as Bayer, Montsanto and Syngenta. Research projects on the effect of soil temperature on sunflower germination, as well as temperature and drought stress effects on the germination of amaranth seeds and early seedling growth are still underway.

A number of contract research projects were conducted during the course of the year and was completed successfully . A project investigating the yield and quality response of barley also continues, together with the amaranth allelopathy project. Research collaboration has been established with Potatoes SA and the Western Free State Seed Potato Producers regarding the control of volunteer potatoes and the establishment of statistically valid potato fertilisation trials in various areas.

The research team led by Prof. Seef Pretorius either completed or showed good progress in three research projects. A study on the physiological and yield response of maize to foliar application of monopotassium phosphate (MKP) indicated that maize yield could be increased by the foliar application of a 4% MKP solution at the V8 growth stage. Physiologically, the positive reaction of photosynthesis to this treatment, as well as the resulting increase in sugar content was shown to be part of the mechanism of action. Studying the growth and yield response of three vegetable and two row crops to foliar application of a plant growth regulator (PGR) proved that the yield of cabbage, carrots and onions, as well as maize and wheat was significantly increased after foliar application of ComCat®, a natural plant growth regulator; a tendency that was replicated over two seasons. A brassinosteroïd, 2.4-epibrassonolide, was identified as one of the components responsible for this crop reaction. Two *in vivo* field trials, using a prototype natural fungicide developed in the Department, provided sufficient control of blackspot in citrus and early blight in potatoes to justify further investigation, as well as possible registration and commercialization of this product in the future. Patents have already been registered.

Soil Science

The pedology team, supervised by Dr. Pieter le Roux, improved their understanding of soil systems. Results indicate that the functions of soils in agricultural and natural ecosystems, namely nutrition and water supply, occur naturally in soil horizons, soil profiles and soilscapes. Surprisingly, some soilscapes do not contribute to peak flow in rivers while others mainly contribute to it. By implication, water reached the stream months after the rain. The application of this knowledge is supported by digital mapping of soils. Digital soil mapping was tested on large and detail scales and the results indicated that soil surveys are due for radical technological development while the costs may drop accordingly.

Various projects were started to improve soil indicators for wetland identification delineation. These soil indicators are currently vague and not based on research data. The pressure on wetlands is increasing due to mining and developments and

Harvesting and storage of a barley irrigation scheduling experiment at Douglas.

Irrigated plantation trees along the road near Al Lain, Abu Dhabi.

is further exacerbated by the shortage of water in South Africa. One project is based in the northern Maputoland coastal aquifer, one in Florisbad, and one in the Kruger National Park. Results from these studies will be taken up in the newly proposed improved wetland delineation manual.

The research group of Prof. Leon van Rensburg was strengthened by the awarding of postdoctoral fellowships from the Strategic Academic Cluster: Water Management in Water-scarce Areas (UFS) to Drs. Sabelo Mavimbela and Mussie Zerizghy. Dr. Sabelo will lead the research on the soil water balance of selected ecotopes at the Kolomela iron mine near Postmasburg. The research should illustrate how soil water balance processes interact with dewatering activities of the open-cast mine. Farmers complain that the dewatering of the mine impacts negatively on groundwater supply and hence on their farming activities. Dr. Zerizghy will focus on the water use efficiency of 140 000 hectares of irrigated tree plantations along the streets of the Abu Dhabi Emirate in the United Emirates. Groundwater is the main water source and the annual plantation yield is less than expected, given this level of irrigation. The groundwater has the same salinity as sea water at some places. Water in semi-arid South Africa is also scarce and demands optimal use. Thus, research on the water footprint of beer, a project sponsored by the Winter Cereal Trust and SAB Miller is still in progress, focusing on the irrigation scheduling of barley.

A special edition of "Irrigation and Drainage" with Prof. van Rensburg as guest editor was published; containing 14 diverse articles with local research findings on rainwater harvesting and conservation techniques for improving household food security. Team members also contributed substantially to two reports published by the Water Research Commission (WRC); namely "Managing salinity associated with irrigation at Orange-Riet and Vaalharts Irrigation Schemes" (Report 147/1/12) and "Modelling nitrogen and phosphorus dynamics in cropping systems at the field scale" (Report 1516/1/12).

The first phase of the research project, namely "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 outcome concerning funding of the second phase is not yet available.

Prof. Du Preez and Dr. Alfredo Nhantumbo from Eduardo Mondlana University in Maputo successfully completed the project entitled "Sustainable management of fertility in agriculture soils". This project was funded by the NRF under the South Africa-Mozambique agreement.

The Agronomy Society of America invited Prof. Du Preez to make a presentation at their Annual Meeting in Cincinnati. The title of his presentation was "A view of soil management and climate change challenges in southern Africa".

Research Outputs

Department of Soil, Crop and Climate Sciences

Research Articles

Bello, Z.A., Walker, S. & Tfwala, C.M. 2012. Influence of water supply and harvesting frequency on production of leafy amaranth in a semi-arid region of South Africa. *African Crop Science Conference Proceedings* 10: 381-385.

Botha, J.J., Van Rensburg, L.D., Anderson, J.J., Hensley, M. & Baiphethi, M.N. 2012. Alleviating household food insecurity through in-field rainwater harvesting. *Irrigation and Drainage* 61: 82-94.

Botha, J.J., Van Rensburg, L.D., Anderson, J.J., Van Staden, P.P. & Hensley, M. 2012. Improving maize production of in-field rainwater harvesting technique at Glen in South Africa by the addition of mulching practices. *Irrigation and Drainage* 61: 50-58.

Bothma, C.B., Van Rensburg, L.D. & Le Roux, P.A.L. 2012. Rainfall intensity and soil physical properties influence on infiltration and runoff under in-field rainwater harvesting conditions. *Irrigation and Drainage* 61: 41-49.

Le Roux, P.A.L. & Hensley, M. 2012. Pedologcal aspects of land evaluation for in-field rainwater harvesting in South Africa. *Irrigation and Drainage* 61: 129-137.

Loke, P.F., Kotze, E. & Du Preez, C.C. 2012. Changes in soil organic matter indices following 32 years of different wheat production management practices in semi-arid South Africa. *Nutrient Cycling in Agroecosystems* 94: 97-109.

Mardamootoo, T., Ng Kee Kwong, K. & Du Preez, C.C. 2012. Evolution of the agronomic and environmental phosphorus status of soils in Mauritius after a seven year sugarcane crop cycle. *Sugar Technology* 14: 266-274.

Mavimbela, S.S.W. & Van Rensburg, L.D. 2012. In-situ evaluation of evaporation in layered soils (Tukulu, Sepane and Swartland). *Journal of Agricultural Science and Technology* A2: 577-590.

Mavimbela, S.S.W. & Van Rensburg, L.D. 2012. Integrating micro-flood irrigation with in-field rainwater harvesting: maize yield and water use efficiency. *Irrigation and Drainage* 61: 70-81.

Moeletsi, M.E. & Walker, S. 2012. A simple agroclimatic index to delineate suitable growing areas for rainfed maize production in the Free State Province of South Africa. *Agricultural and Forest Meteorology* 162: 63-70.

Moeletsi, M.E. & Walker, S. 2012. Assessment of agricultural drought using a simple water balance model in the Free State Province of South Africa. *Theoretical and Applied Climatology* 108: 425-450.

Moeletsi, M.E. & Walker, S. 2012. Evaluation of NASA satellite and modeled temperature data for simulating maize water requirement satisfaction index in the Free State Province of South Africa. *Physics and Chemistry of the Earth* 51: 157-164.

Moeletsi, M.E. & Walker, S. 2012. Rainy season characteristics of the Free State Province of South Africa with reference to rain-fed maize production. *Water SA* 38: 775-782.

Sedibe, M. & Allemann, J. 2012. Yield and quality response of rose geranium (*Pelargonium graveolens* L.) to sulphur and phosphorus application. *South African Journal of Plant and Soil* 29: 151-156.

Tesfuhuney, W.A., Walker, S. & Van Rensburg, L.D. 2012. Comparison of energy available for evapotranspiration under in-field rainwater harvesting with wide and narrow runoff strips. *Irrigation and Drainage* 61: 59-69.

Tshikolomo, K.A., Nesamvuni, A.E., Stroebel, A. & Walker, S. 2012. Water supply and requirements of households in the Luvuvhu-Letaba Water Management Area of South Africa. *International Journal of Business and Social Science* 3: 37-49.

Tshikolomo, K.A., Nesamvuni, A.E., Walker, S. & Stroebel, A. 2012. Water manager perceptions of stakeholder participation and influence on water management decisions in Limpopo and Luvuvhu-Letaba Water Management Areas of South Africa. *American International Journal of Contemporary Research* 2: 26-37.

Tshikolomo, K.A., Walker, S. & Nesamvuni, A.E. 2012. Perceptions of municipal water managers of Limpopo and Luvuvhu-Letaba Water Management Areas on water resources, uses and restrictions. *International Journal of Business and Social Science* 3: 8-20.

Tshikolomo, K.A., Walker, S. & Nesamvuni, A.E. 2012. Rainfall influence on water gain and loss from Middle Letaba Dam in Luvuvhu-Letaba Water Management Area, South Africa. *International Journal of Applied Science and Technology* 2: 24-33.

Van Huyssteen, C.W. 2012. Hydrological classification of orthic A horizons in Weatherley, South Africa. *South African Journal of Plant and Soil* 29: 101-107.

Van Rensburg, L.D., Botha, J.J., Anderson, J.J. & Hensley, M. 2012. The nature and function of the in-field rainwater harvesting system to improve agronomic sustainability. *Irrigation and Drainage* 61: 34-40.

Van Rensburg, L.D., Bothma, C.B., Fraenkel, C.H., Le Roux, P.A.L. & Hensley, M. 2012. In-field rainwater harvesting: mechanical tillage implements and scope for upscaling. *Irrigation and Drainage* 61: 138-147.

Van Tol, J.J., Le Roux, P.A.L. & Hensley, M. 2012. Pedotransfer functions to determine water conducting macroporosity in South African soils. *Water Science and Technology* 65: 550-557.

Van Tol, J.J., Le Roux, P.A.L. & Hensley, M. 2012. Soil indicators of hillslope hydrology in Bedford catchment. *South African Journal of Plant and Soil* 27: 242-251.

Worku, A.W., Le Roux, P.A.L. & Hensley, M. 2012. Quantifying rainfall-runoff relationships on the Mieso Hypo Calcic Vertisol ecotope in Ethiopia. *Water SA* 38: 225-232.

Yada, G.L., Ceronio, G.M. & Van Rensburg, L.D. 2012. Effect of row spacing and plant density on yield and yield components of maize (*Zea mays* L.) under irrigation. *Journal of Agricultural Science and Technology* B2: 263-271.

Zerizghy, M.G., Van Rensburg, L.D. & Stigter, C.J. 2012. Characterization of rainfall in the central South African Highveld for application in water harvesting. *Irrigation and Drainage* 61: 24-33.

Staff

Professors: Profs. Chris du Preez, Seef Pretorius, Leon van Rensburg, and Sue Walker.

Affiliated Professor: Prof. C.J. Stigter.

Associate-Professor: Prof. Cornie van Huyssteen.

Affiliated Associate-Professors: Profs. Malcolm Hensley, and Rianto van Antwerpen.

Senior Lecturers: Drs. James Allemann, Gert Ceronio, Gesine Coetzer, Laszlo Lakatos, and Pieter le Roux.

Lecturers: Mr. Johan Barnard, Ms. Linda de Wet, Ms. Elmarie Kotzé, and Mr. Abraham Steyn.

Research Associate: Dr. J.H. van der Waals.

Professional Officers: Ms. Yvonne Dessels, Mr. Wilhelm Hoffman, and Dr. Elmarie van der Watt.

Senior Assistants: Mss. Ronelle Etzebeth, Lize Henning, and Rida van Heerden.

Technical Assistants: Messrs. Samuel Boer, Daniël Mavuya, Edwin Moeti, Gabriël Mokoena, and Edward Nthoba.

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Department of

Architecture

Overview

The year 2012 was a busy and successful year for the Department. Not only were the annual August Architecture Activities with the 24th Sophia Gray Memorial Lecture and Exhibition a great success, but the department also received continued unconditional validation in October of all its academic programmes.

The Sophia Gray Memorial Lecture entitled "For the love of architecture", was presented by Mr. Stan Field of California. Mr. Field inspired with highlights from his career comprising of projects completed in South Africa, Israel and the United States. The mini-conference hosted architects Mr. Anthony Orlewitz and Mr. Michael Louw from South Africa, as well as Prof. Mies van der Rohe of Architecture at IIT, Chicago, and Mr. Werner Sobek, who presented their work and gave insights into their design process and implementation.

In October, the visiting Board of the Commonwealth Association of Architecture (CAA) and the South African Council of the Architectural Profession (SACAP) unconditionally validated the B.Arch. Stud., B.Arch.Stud. (Hons.) and M.Arch. (Prof.) degree programmes. The Department was lauded for its unique qualities and its ongoing attempts at improving the already high standards.

Activities and Achievements

The renovation of the Architecture building by lecturer Henry Pretorius won the Sustainable Development Commendation at the 2012 Southern African Institute of Steel Construction (SAISC) Steel Awards. "We congratulate the winners but emphasise the exceptional quality of all the entries", said Dr. Hennie de Clercq, Executive Director of SAISC. The judges were full of praise for the entire project. "The building

Photo: Mr. Wynand Viljoen

Mr. Stan Field and his wife at the opening of the Sophia Gray Exhibition at Oliewenhuis.

is finished off with a new roof that dramatically transforms the existing shed-like exterior while elevating the existing interior ceiling heights, creating dramatic double volumes that enhance ventilation while providing excellent natural light for the interior spaces. All this was done to create an inspiring environment for architects and, importantly, was achieved within the very limited budget."

The annual tours undertaken by students in the various year groups were once again successful and informative. The first-year students toured to Tweespruit and Clarens, the second-years to Durban, and the third-years to Cape Town during the AZA (South African Institute for Architects) 2012 Congress, winning the Amazing Race event and the "Geesbeker". Senior lecturer, Philippa Tumubweinee, played a prominent role at AZA, as well as serving as the Master of Ceremonies, and as part of the jury panel for the annual Corobrik-SAIA (South African Institute of Architects) Merit and Excellence Awards.

The Honours' class also travelled to Cape Town. The Cape Town tour focused on conservation. Students visited the Castle and the Athol Fugard Theatre, as well as the St. Cyprian's girls' high school, where architect Jo Noero recently designed additions, in order to gain a greater understanding of what a successful conservation project entails.

The annual Winter School took place on 11 and 12 July during the Vryfees in Bloemfontein in order to provide prospective students with a more intimate perspective on the study of architecture as a career option. Thirty prospective learners attended. Lectures by former head of the Department, Prof. Jan Smit, and by architect Karlien Thomashoff were included in the experience. Ms. Thomashoff's presence was sponsored by the FSIA (Free State Institute of Architects) and she presented a lecture during the Vryfees as part of the Architecture events.

Student Achievements

The third-year design students participated in the P.G. Bison and Des Baker competitions. The Honours' students participated in the SHiFT (South African Housing Institute Foundation) competition at the end of the first semester.

Mr. Jurie Swart, who completed the M.Arch. (Professional) degree in 2011, competed in the online 2012 Graduate Architecture Student Design competition (graudatearchitecture.com). Over 350 entries from around the world were entered into this "best thesis" competition and Jurie Swart not only received an honourable mention but was also ranked under the top five. His project was also nominated as one of the 25 best for Archiprix (a website that chooses the best annual theses worldwide).

Students Marcel Swanepoel, Nico van Huyssteen, Markus Jordaan, Rohann Wessels and Inneke Zulch participated in the AfrikaBurn-Tankwa Karoo Art Festival with their installation entitled "Death from above". The event is an opportunity for artists to form part of the expression of the temporary city of art, sculpture and performance.

Mr. Marcel Swanepoel is also the regional winner of the Corobrik Architecture Student of the Year competition with his thesis entitled "An Arkitecture/ The Duality of Surviving Architecture: Genetic Strongbox in Antarctica".

Mr. Brent Clark and Mr. Wynand Viljoen both participated in the CNCI (Cement and Concrete

The installation "Death from above" at Afrikaburn 2012.

Institute) African City Student Design competition and received honourable mentions.

Mr. Viljoen was also the winner of the Carl and Emily Fuchs Foundation award for South African honours' students in Architecture. Students are judged on a portfolio of work from all previous years and a final presentation is made to a panel of judges. A final design done over a period of 24 hours also forms part of the portfolio.

Five M. Arch. (Prof.) candidates received distinctions for both the design and construction components of their dissertations.

Weekly Research Seminars

The continuation of the Weekly Research Seminars that began in 2011, has proven to be an insightful and productive activity. Visiting professors presented lectures on various aspects related to higher degree studies in Architecture. These seminars also provided staff members with the opportunity of giving feedback on their studies and conferences they had attended, and provided assistance with aspects of higher degree study.

These seminars have proven to be successful in supporting staff members to complete their studies; Mr. Kobus du Preez graduated cum laude with his M.Arch dissertation on the "Pre-Republican sandstone architecture of the Brandwater basin in the Free State". With that the supervisory capacity of the Department has been enhanced.

Other staff members are improving their academic resumes as well. Mrs. Madelein Stoffberg is pursuing her Ph.D. degree. The research seminars provide a tracking system to ensure that all candidates obtain regular support, supervision and feedback, and should, with close monitoring and a willingness of locums, allow for the provision of study leave to keep achievement levels within the expectations.

Staff Matters

Ms. Philippa Tumubweinee and Ms. Annemarie Wagener, both formerly at the University of Johannesburg, were appointed as senior lecturers.

In October, Ms. Tumubweinee represented the Department by presenting a paper at the Archtheo'12 Architectural Theory Conference in Istanbul, Turkey, at which junior lecturer Mr. Jako Olivier also presented a paper. Ms. Tumubweinee also presented her work on "The E-squared house: The fashion of an energy-efficient home" at a Faculty lecture.

Mr. Rudolf Bitzer and the Departmental Chair, Ms. Martie Bitzer, designed the new building for the Institute of Financial Planning Law on the Bloemfontein campus that was completed in November 2012. The Roodt Partnership supervised the construction of this new addition to the architecture on campus.

Prof. Walter Peters appeared on the TV programme Pasella in October during a focus on Greytown, where he informed viewers about the interesting aspects of the architecture and planning of the town. He also featured on the programme Shoreline in November, on an episode dedicated to Durban's Victorian architecture. Prof. Peters and Mr. Kobus du Preez also presented their research at various local conferences.

Mr. Gerhard Bosman presented a paper focused on the perception of wall-building materials in central South Africa at the XI International Conference on the Study and Conservation of Earthen Heritage (TERRA 2012) Conference in Lima, Peru and he also presented his Ph.D. research at Centro de Estudos Arnaldo Araujo at the Escola Superior Artistica do Porto (ESAP) in Oporto, Portugal.

Designs by Mr. Swanepoel for a genetic strongbox in Antarctica.

Junior lecturer Ms. Madelein Stoffberg presented a paper on the public spaces of provincial legislatures at the Tirana Architecture Week in Tirana, Albania. Research assistant Wanda Verster presented her research on the adaptive reuse of church buildings at the Conference of the Athens Institute for Education and Research (ATINER) in Athens, Greece in June 2012.

Mr. Zack Wessels who has been lecturing on a contract basis was appointed as a full-time junior lecturer from January 2013.

Research Outputs

Architecture

Research Articles

Peters, W. 2012. Durban's King Shaka International Airport as a place of transition. *Architecture SA* Jan/Feb: 27-32.

Peters, W. 2012. The women at Winburg's Voortrekker Monument. *South African Journal of Art History* 27(2): 220-236.

Peters, W. 2012. Voortrekker Monument at Winburg: Threshold for a new generation of commerative architecture. *Journal of the South African Institute of Architects* June/July: 36-45.

Van der Vyver, Y. 2012. The human body in death, exhibited as Art. *South African Journal of Art History* 27(2): 1-20.

Staff

Department Chair: Ms. Martie Bitzer.

Professor: Prof. Walter Peters.

Affiliated Professor: Prof. Ora Joubert.

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. Henry Pretorius, Mr. Jako Olivier, Mr. Rudolf Bitzer, Mr. Jan Nel, Mr. Hein Raubenheimer, and Mr. Zack Wessels.

Contract Lecturers: Mr. Charl-Pierre Cilliers, Ms. Carmen Dickens, Mrs. Madelein Stoffberg, Ms. Katie Salzmann, Mr. Jacobus Smit, Ms. Helena Jordaan-Olivier, and Prof. J.D. Smit.

Computer Lab Assistant: Mr. Lindewe Keswa.

Research Assistant: Ms. Wanda Verster.

Secretary: Ms. Yolanda Pretorius.

Departmental Assistant: Ms. Zelda Bronkhorst.

Messenger: Ms. Joyce Mohatlane.

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Department of

Quantity Surveying and Construction Management

Overview

During 2012, the Department of Quantity Surveying and Construction Management was involved in various activities, events and development projects, and experienced a number of highlights.

The Department is accredited with the following professional institutions:

South Africa:

- South African Council for Project and Construction Management Professions (SACPCMP) – accredited for five years until 2017.
- South African Council for the Quantity Surveying Profession (SACQSP).
- South African Council for Property Valuers' Profession (SACPVP).

International:

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

It remains of cardinal importance to the Department and the University to retain the above-mentioned accreditations to enable graduate students to seek employment in the international labour market.

Some outstanding students of the Department performed with excellence. Ms Elana Malherbe completed the B.Sc. Honours' degree in Quantity Surveying, obtaining an average percentage of 86%. Mr. Jacques van der Merwe, as outstanding student in B.Sc. Hons. Learning area Construction Management, obtained a percentage of 80%.

Dr. Frank Berry and Dr. Willie Smith were awarded the Ph.D. qualification in 2012. Mrs. Benita Zulch and Ms Michelle Burger also completed their Ph.D. studies. Mr. Pierre Oosthuizen and Mrs. Olive du Preez received their M.Sc. (QS) degrees at the end of 2012.

The continuation of the Department's research project with the Construction Industry Development

Board (CIDB) again contributed significantly to the Departments' research outputs, as well as providing a third stream of income. The International Congress of the International Cost Engineering Council (ICEC) was held in Durban whereby the Department played a leading role delivering eight referenced papers. The congress was attended by a group of 28 students. Other congresses, like the RICS COBRA 2012 conference (the conference of the Royal Institution of Chartered Surveyors) in Las Vegas, the CIB (International Council for Research and Innovations in Building and Construction Conference) in the United Kingdom, IPMA (International Project Management Association Conference) in Greece and CMC (Construction Management Conference) in Port Elizabeth assisted the Department in obtaining 16.53 research outputs in accordance with the scale of the Department of Education (DoE).

Referring to educational degree programmes, the Department lectures students by means of residential and distance learning programmes. During 2012, a total of 177 undergraduate students, 102 Honours' students, 39 students on Masters' level and five Ph.D. students were enrolled with the Department.

The Department also presents various registered short programmes and courses as an additional training action. In 2012, 66 students were registered for the QCP (Open Learning: Certificate in Quantity Surveying, Construction Management and Project Management) distance learning programme; 117 students completed the Facilities Management Programme (FMP) supported by the South African Property Owners Association (SAPOA), and 29 students completed the Intensive Project Management Programme (IPMP), also supported by SAPOA.

The initiative to maintain the QCP programme is supported by various professional institutions. In total, ten students successfully completed the programme in 2012 and, for the first time, four students who attended the programme were from Namibia. A ceremony to celebrate this occasion was held on 1 March 2013 and was attended by Mr. Van Zyl, the current Acting Head of the Department.

Mr. Kobus le Roux was elected to represent the Free State on the CIOB Africa board, replacing Prof. Verster, and Mr. van Zyl who stepped down.

Mr. Pierre Oosthuizen is currently the Chairman of the Free State Chapter of the Association of South African Quantity Surveyors.

Prof. Hendrik Marx and Mr. Stephen Ramabodu are Council Members of the Association of Schools of Construction in Southern Africa (ASOCSA). Mr. Ramabodu serves on the South African Board of Quantity Surveyors.

The Department of Quantity Surveying and Construction Management publishes the *Acta Structilia*. The *Acta Structilia* 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 2012, the journal celebrated its 19th 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, 93 research articles, 23 review articles, 12 international articles, 14 commentaries, eight book reviews and eight introductions have been published.

In 2012, the 28th publication of the student journal, *Bouvaria*, was published by the Department. This publication creates a platform for Honours' students to publish articles derived from their theses. With this initiative, the Department wishes to sensitise students for the process of research.

It is with great regret that the Department parted ways with the beloved colleague, Dr. Frank Berry. His passing is a great loss to the Department and the profession.

The Department welcomes Prof. Khailo Kajimo-Shakantu as a colleague. Prof. Kajimo-Shakantu is appointed as an adjunct professor and research coordinator for the Department. Her research focus is land and property development and management, construction management, education, and project management.

Research Outputs

Quantity Surveying and Construction Management

Research Articles

Berry, F.H. 2012. 'n Model vir die meting van die bourekenaar se kommunikasie-volwassenheid. *ACTA Structilia* 19(1): 57-70.

Campbell, M.M. & Hauptfleisch, A.C. 2012. The Impact of the Maputo Development Corridor on Wealth Creation within the Region it Serves. *Journal of Civil Engineering and Architecture* 6(9): 1184-1193.

Staff

Professor: Prof. J.J.P. (Basie) Verster.

Contract Professor: Prof. A.C. Hauptfleisch (Midrand).

Senior Lecturers: Prof. Hendrik Marx, and Mr. Frank Berry.

Lecturers: Mr. Ben Swart, Mr. Hendrik van Vuuren, Mr. Stephan Ramabodu, and Ms. Benita Zulch.

Contract Lecturers: Mr. Carl van Zyl, Mr. Pierre Oosthuizen, Mrs. Esti Jacobs, Mrs. Mart-Mari Els, and Mrs. Olive du Preez.

Contact Details

Prof. J.J.P. (Basie) Verster

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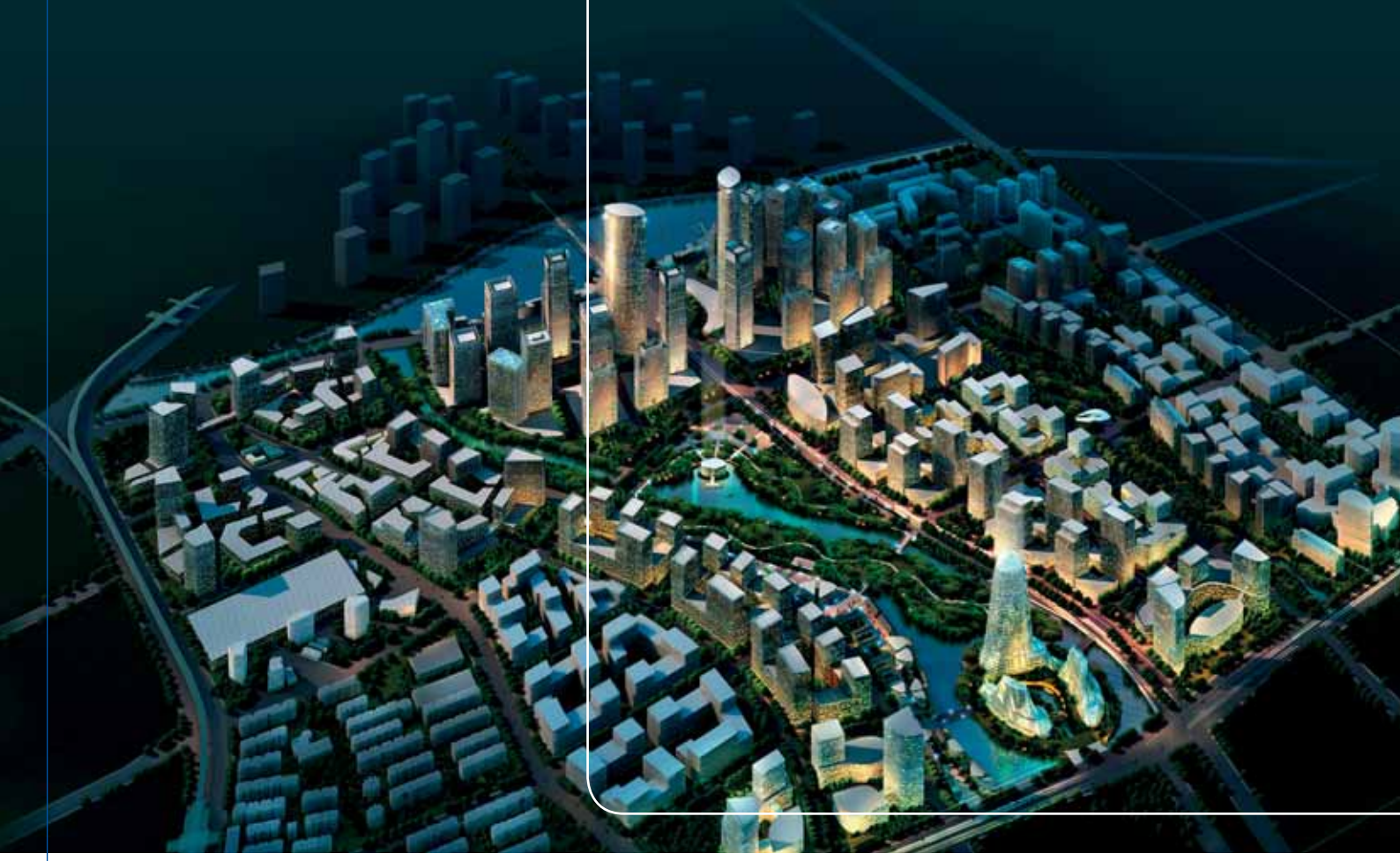

Department of

Urban and Regional Planning

Overview

As with most urban and regional planning departments in the country, this Department is a small department with five academic staff members. The main programmes offered by the Department are an Honours' degree in Spatial Planning, and a Masters' degree in Urban and Regional Planning; both through course work. The Department also offered an Honours' programme in Housing through course work but this programme is being discontinued from 2013.

Although 25 students were selected for the Honours' degree in Spatial Planning, only 17 registered. Ten students will graduate in 2013 with an Honours' degree in Spatial Planning – two with distinction – while a further three students completed the Baccalaureus in Land and Property Development Management (Housing). The number of Masters' graduates is anticipated to exceed the ten of the previous year.

In addition to the course-work programmes, the Department also offers a Research Masters' degree in Urban and Regional Planning (MURP) and a Masters' degree in Housing. There were two registered students for the MURP-degree who were finalising their dissertations for submission in February 2013, and one Masters' student in Housing. Of the five registered Ph.D. candidates, three are staff members in the Department, of which two were finalising their theses for submission in 2013.

Activities

During the July recess, 6 – 15 July, the Department hosted the Applied Centre for Climate and Earth System Science (ACCESS) Habitable Planet Workshop. The purpose of the workshop is to expose senior students to Earth Systems science and the various research options there are in this field. During the

Jan-Frik Ludekke, Mohapi Radiopane, Maléne Campbell (lecturer), Nathi Ngubane and Anneen Maree at the Katse dam wall in Lesotho while doing research on the "Eastern Free State: A contribution to regional planning in the creation of sustainable rural livelihoods".

workshop, students attended lectures on various facets of earth sciences; from astronomy, geology, biology to climatology, and there were guest lectures from scientists at the UFS. There were also field trips to Boyden, the Botanical Gardens in Bloemfontein, the Vredefort impact zone, and the Big Hole in Kimberley.

Dr. Maléne Campbell attended a workshop on National Development Plan Chapter on Transformation of Human Settlements on 30 March 2012 at the Presidency, Pretoria on behalf of the Department and the Committee of Heads of Planning Schools.

During the 2012 South African Planning Institute's (SAPI) Biannual Planning Africa Conference held at the ICC in eThekwini, the Department presented five papers. Of these, two were by Prof. Nel as an invited plenary speaker.

Mr. Mashalaba represented the Department at the Association of African Planning Schools (AAPS) Workshop, 16 – 18 October, Nairobi, Kenya.

Dr. Maléne Campbell was on the review panel of the 8th World Congress on Cost Engineering, Quantity Surveying and Project Management, organised for the International Cost Engineering Council (ICEC) by the Association of South African Quantity Surveyors (ASAQS), 9 – 26 June 2012, Durban, South Africa.

Prof. Nel represented the Department at the Karoo Conference held in Beaufort West in October 2012.

Ms. Toba, a part-time lecturer and past student, presented a paper by her, Dr. Campbell and two others at The International Society of City and Regional Planners (ISOCARP) Conference, 10 – 13 September in Perm, Russia, titled "a critical examination of public transport: A case study of Mangaung Metropolitan Municipality, South Africa".

The Department also hosted the Annual Committee of Heads of Planning Schools (CHoPS) meeting in December 2012 at the UFS. At this meeting common interests including the South African Council for Planners' Competencies and standards process was discussed.

Research

Dr. Maléne Campbell was hosted by Lund University, Sweden, for a one-month staff exchange visit.

Professor Alf Hornborg was the academic host, and the visit was funded by the Erasmus Mundus Scholarship: Eurosa (Europe and South Africa Partnership for Human Development) Consortium. The research topic was "Eastern Free State: A contribution to regional planning in the creation of sustainable rural livelihoods". The aim of this study is to compile a regional plan for the Eastern Free State that addresses the challenges of, and proposes solutions to, the creation of sustainable rural livelihoods. The abovementioned project is an ongoing research project within the research cluster on poverty reduction and sustainable development. Dr. Maléne Campbell is a panel member of the Cluster for Critical Issues in Development.

Other ongoing research in the Department includes the following:

Prof. Nel:

- Developing more appropriate land use management systems for Southern Africa.
- Cities as complex adaptive systems.
- Urban and regional planning in Developmental Local Government.

Mrs. Barclay:

- Tourism realities versus tourism ideals in South Africa.
- The role of the town and regional planning in tourism.
- Campus transportation.
- Innovation spaces.
- Gaming simulation and gaming in town and regional planning.

Mr. Mashalaba:

- Open space planning and development.

Community Service

Mrs. Barclay has been running a combined community service and community service learning project in Greater Dealesville, Tokologo Local Municipality, for the past three years as part of the module Research in Regional Planning Theory. At the end of 2012 the students produced a Development Plan for the region. Once the inputs of the various plans have been combined, this plan will be presented to the community. Students in the Applied Economics Research for Planners module drafted a rural economic development policy for Dealesville as part of the Tokologo project.

Another project in the Research in Regional Planning Theory module consists of students preparing proposals to reinvent the UFS as an innovative space. A Forensic Hub is part of this innovative space proposal. This was done as a collaborative effort between students and staff of the UFS, outside interests and community beneficiaries.

For the BEH752 service learning module, (the Housing module for the Master's degree in Urban and Regional Planning), taught by Dr. Campbell, the Masters' students had to develop a housing chapter of the Integrated Development Plan of a small town. It is a bottom-up process where the students interact with the recipients of government-subsidised houses for low-income families, as well as partners in the Peoples' Housing Process.

The housing chapter details identified housing needs and backlogs, identifying well-located land suitable for development, as well as investigating and verifying alignment of identified land with the Spatial Development Framework. Outcomes for the students were that this service learning module allowed them to gain hands-on experience on how to transform housing needs into spatial needs. The impact on the community is that the "housing voice" of the community was heard.

In the Cultural Consciousness for Planners module, taught by Mrs. Barclay, students drafted policies and proposals for their local authorities and communities that would promote the protection and use of indigenous knowledge systems for local economic development.

In the Transportation Planning module, also taught by Mrs. Barclay, students worked with the children and staff of the Tiny Professors Preschool to design a mini-town for the school to enable early learning about traffic issues and foster social cohesion and environmental awareness from an early age. Other students finalised research on alternative and sustainable transport systems for the UFS campus, with input from UFS staff and students.

Staff Matters

Two staff members, Mrs. Barclay and Mr. Mashalaba, spent much time completing their doctoral theses for submission early in 2013.

Prof. V.J. Nel is currently the chairperson of the Committee of Heads of Planning Schools and in that capacity also served on the Education and Training Committee of the South African Council for Planners. She is the Department's representative on the local South African Planning Institute's (SAPI) Committee.

Mrs. Carin Coetzee joined the Department in March 2012. She is a great asset to the Department and her admirable administration skills are greatly appreciated. Mrs. Coetzee, Ms. Antoinette Nel and Mrs. Riana Hugo ensure the effective administration of the Department.

Research Outputs

Department of Urban and Regional Planning

Research Articles

Jansen Van Rensburg, J. & Campbell, M. 2012. The management of urban sprawl by applying an urban edge strategy. *Urban Forum* 23(1): 61-72.

Nel, V.J. 2012. Thusong Service Centres - Towards a broader planning perspective. *Loyola Journal of Social Sciences* 26(1): 115-128.

Chapters in books

Marais, L., Venter, A., De Gouveia, A., Campbell, M.M. & Myburg, W. 2012. Tourism risks associated with small towns: The case of Clarens. In *Small Geographies in Africa*, edited by R. Donaldson and L. Marais. New York: Nova. pp. 223-231.

Nel, V.J. 2012. A developmental planning approach to the plight of small and dying towns in South Africa. In *Small Geographies in Africa*, edited by R. Donaldson and L. Marais. New York: Nova. pp. 327-337.

Masters' students in Urban and Regional Planning (Dawie Lubbe, Setsoto Sekonyela, Nathe Ngubane and Jan-Frik Ludeke) circulated questionnaires in the Eastern Free State as part of the research project "Eastern Free State: A contribution to regional planning in the creation of sustainable rural livelihoods".

Staff

Professor: Prof. V.J. Nel.

Senior Lecturer: Dr. M.M. Campbell.

Lecturers: Mrs. E. Barclay, Mr. P.J. Potgieter, and Mr. Y.B. Mashalaba.

Administration: Mrs. M.C. Hugo, Miss. A.L. Nel, and Mrs. C. Coetzee

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Department of

Chemistry

Main campus

Overview

The completion of the building and facilities by the end of 2011 enabled the Department of Chemistry to focus on the strategic priorities of the UFS and the Faculty of Natural and Agricultural Sciences. The Department is therefore proud to illustrate with this report the continued quality and excellence in teaching, research and community involvement. The postgraduate core of Chemistry for 2012 consisted of 12 postdoctoral associates, 24 M.Sc. and 29 Ph.D. students in different sub-disciplines; of whom four Ph.D. and eight M.Sc. students graduated during 2012. A significant and sustained research output for 2012 was maintained, as manifested by the more than 100 research articles published in internationally-accredited journals and some 100 presentations made at local and international conferences.

The enthusiasm and commitment of Chemistry's personnel and students are clearly illustrated by activities throughout 2012. 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 supports the extended secondment of Prof. Ben Bezuidenhoudt to the Department, and Eskom 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 R3.5 million for the upgrade of equipment, student support and the development of young capacity in the Department.

Organising committee of the Frank Warren Conference held on the UFS campus during April 2012. From left, front: Mrs. Maryam Amra-Jordaan, Drs. Susan Bonnet and Charlene Marais, Mrs. Cornelia von Eschwege. Back: Mr. Rudi Swart, Profs. Jan vd Westhuizen (Chair of Committee), Ben Bezuidenhoudt and Andrew Marston.

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

The South campus of the UFS saw the continuation and streamlining of the extended programme. Once students successfully completed these, they were promoted to the Main campus to complete their practical work and to continue as main stream students. The Honours' course also experienced the further refinement of advanced topics in a number of courses, exposing the chemistry students to international teachers.

Departmental Activities and Achievements

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

The **Physical Chemistry** division has two research groups, headed by Profs. Jannie Swarts and Jeanet Conradie respectively. Dr. Ernie Langner and Dr. Lizette Erasmus are developing their own autonomous research topics. Dr. Eleanor Fourie, as the laboratory manager in Physical Chemistry, will also develop her own research programme.

Prof. Swarts (C1; ISI H-index=20), Prof. Conradie (C3; ISI H-index=18) and Dr. Erasmus (Y2; ISI H-index=8) are all NRF-rated researchers, while both Drs. Langner and Fourie are still unrated but have ISI H-indexes of 4 and 6 respectively. Profs. Swarts and Conradie are both holders of NRF research grants (Rated Researcher, as well as Competitive Programme for Rated Researchers), while Drs. Erasmus and Langner are holders of a rated Researcher NRF and ThuThuka NRF grants respectively.

The principle research question of the research group of Prof. Swarts concerns synthetic and physical chemistry aspects of multinuclear metallocenes. The focus is on six projects, i.e. porphyrin and phthalocyanine compounds bearing metallocene substituents; titanocene, zirconocene, hafnocene, ferrocene, ruthenocene and osmocene derivatives, especially in association with rhodium, iridium, silver, gold and copper; electrochemical, kinetic and thermal analyses of these complexes; medicinal aspects of these complexes; 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.

The research project Applied Process Chemistry of the SA NRF's THRIP programme, supported by Sasol and PETLabs Pharmaceuticals, is managed by Profs. Jannie Swarts, André Roodt and Ben Bezuidenhoudt (back from left), with front from left Ph.D. students Ms. Maretha Serdyn, Mr. Maqqi Nceba (Sasol employee completing his Ph.D.) and Dr. Alice Brink (UFS Prestige scholar and young scientist supported by Sasol special initiatives).

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. Kolio Troev (Director of the Polymer Division of the Bulgarian Academy of Sciences in Sofia, Bulgaria (Polymer Chemistry). Dr. Conradie visited the Department of Physical Chemistry, University of Tromsø, Norway. During these visits, both staff members presented research lectures. Dr. Langner visited Prof. Hans Niemantsverdriet of the Schuit Institute of Catalyses at the Technical University, Eindhoven, The Netherlands. Dr. Fourie made two research visits to international research groups. Five weeks were spent in the laboratory of Prof. Kolio Troev at the Bulgarian Institute for Polymer research where skills in the synthesis and derivatisation of biodegradable phosphor-containing polymers (namely Polyphosphonates) were developed. Dr. Fourie also spent four weeks in the laboratory of Prof. Ian Manners at the University of Bristol where she obtained experience in the synthesis and derivatisation of polyphosphazenes (also biodegradeable phosphor-containing polymers). Dr. Ernie Langner, while attending NCCC XII (The Netherlands Catalysis Conference), had valuable discussions with Prof. J. Gascon and his student, Mr. Maarten Goesten.

Highlights from the Physical Chemistry Division include:

- **Dr. Lizette Erasmus** who obtained her Y-rating as NRF researcher and gave lectures at ICCOS2012, Moscow, Russia, and 4ICNN-2012, Bloemfontein, South Africa.
- **Dr. Eleanor Fourie** visited two international research groups and spent five weeks in the laboratory of Prof. Kolio Troev at the Bulgarian Institute for Polymer research and four weeks in the laboratory of Prof. Ian Manners at the University of Bristol.
- **Prof. Swarts** gave a plenary lecture at NSP-17, Ribaritsa, Bulgaria, and an invited talk at ICPP-7, Jeju, Korea. Prof. Swarts was also co-author of a multidisciplinary article spanning the horizons of Physics, Microbiology and Chemistry which was published in *FEMS Yeast Res*., (12: pp. 867-869). The article was rated the "most influential article of the year" by this journal. It received numerous accolades, including being awarded the cover page motive in *FEMS* for the entire 2013.
- **Prof. Conradie** gave a keynote lecture at the Centre for High Performance Computing (CHPC) National Meeting, Durban International Convention Centre, Durban, 3 – 7 December 2012). She also published an article (Reactivity of [Rh(β-diketonato)(cod)] complexes: A DFT approach in the *Journal of Organometallic Chemistry* 719: 8 – 13) which was chosen by the Scientific Computing & Modelling NV (SCM), developers of the scientific modeling program: Amsterdam Density Functional Theory (ADF), as an example under the heading "Recent research highlights structure and reactivity with ADF" on their webpage, (http://www.scm.com/Products/\Capabilities/StructureAndReactivity.html). Prof. Conradie also co-authored a publi-

Busy preparing solutions of transition metal complexes in the synthetic laboratory are M.Sc. students Ms. Thato Taoane and Mr. Pennie Mokolokolo.

cation in *Accounts of chemical research* (45(8): 1203-1214), which has an impact factor of 21.6. Prof Conradie also chaired sessions at the 12th Student Symposium on Natural Science, North-West University, Potchefstroom, 25 – 26 October 2012, and at the National Meeting of the Centre for High Performance Computing (CHPC), Durban International Convention Centre, Durban, 3 – 7 December.

- **Rickus Peens**, M.Sc. student of Dr. Langner, received the 4th prize at the Afrikaans Student Symposium, NWU (Potchefstroom campus), Potchefstroom, 25 – 26 October 2012, with his lecture "*Sintese van Amino-MIL-53(Al) met Adsorpsie van Ferroseen en Ferroseen-karboksielsuur*".

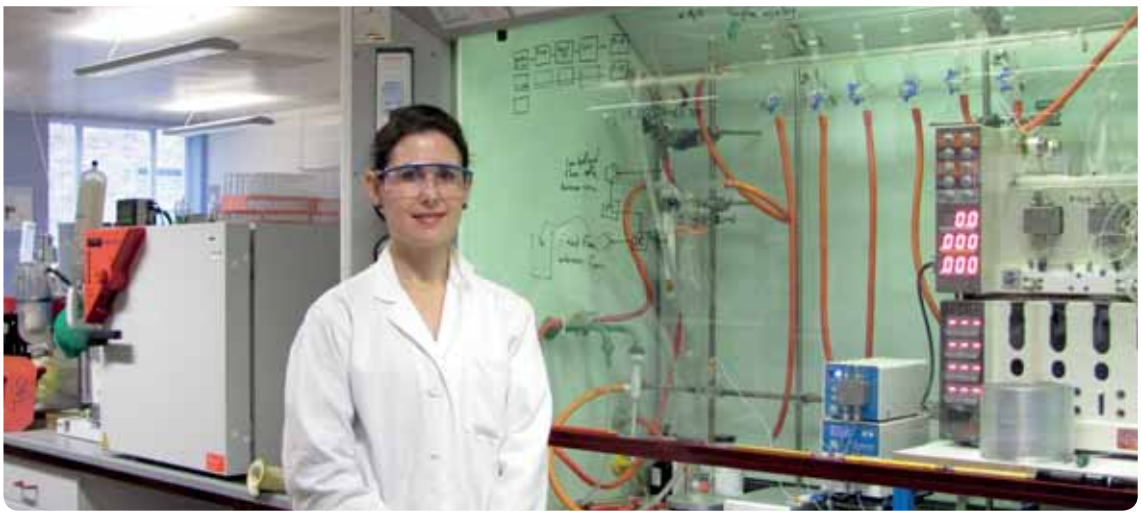
The **Analytical Chemistry** division consists of Prof. Walter Purcell (NRF C3-rated researcher (ISI H-index=17), Dr. Karel von Eschwege (ISI H-index=4), and Dr. Rebotsamang Shago (ISI H-index=2). The division is supported by one Ph.D. student and six M.Sc. students.

The Analytical Chemistry group was involved in a number of analytical and inorganic projects. The analytical projects 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 also 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. Numerous element analyses for private companies such as SA Truck Bodies were also performed.

The group is also involved in different inorganic chemistry projects and are currently concentrating on kinetic and structural studies of organometallic complexes of Ir(I) and Rh(I) oxidative addition reactions, Re(V) and Os(VI) cyanido complexes, as well as some Co and Cr aqueous chemistry. Another study involves the investigation of photochromic reactions in different transition metal complexes, with potential applications in high density optical molecular switching mechanisms. Instrumental techniques such as Pulsed Laser, UV/visible, Infrared, Nuclear Magnetic Resonance spectroscopy (NMR), Cyclic-Voltammetry, Quantum Computational Chemistry (ADF & Gaussian) and X-ray Crystallography are employed in these studies. The



Ms. Anke Wilhelm-Mouton at sophisticated flow chemistry set-up in the Whiffen Lab system at the University of Cambridge in England during a six-month research visit.

elemental analyses laboratory is the responsibility of the Analytical section. It provides services for other sections in the Chemistry Department, as well Geology, Physics and Microbiology.

Cooperation with NECSA was continued. They are still funding four students to do research on the establishment of digestion methods and element quantification in plasma dissociated and natural zircon, as well as tantalite minerals. Collaboration was also extended to Mintek as an external laboratory on method validation procedures.

Dr. Rebotsamang Shago received NRF (ThuThuka) funding on the Economical use of Glycerol as part of renewable energy focus area.

Prof. Walter Purcell attended the workshop: Thorium and Rare Earth Conference hosted by the South African Institute of Mining and Metallurgy, Cape Town, 21 – 22 February 2012, as well as Symposium 2012 on Tantalum and Niobium, Tantalum-Niobium International Study Center, Cape Town, 7 – 10 October 2012. Prof. Purcell and Mr. T. Chiweshe attended the 9th Annual Inkaba ye Africa Workshop in November 2012, held in Potsdam, Germany.

Dr. Shago attended the ASSAf 3rd Annual South African Young Scientists' Conference, Our Energy Future, Pretoria, 16 – 18 October 2012, and undertook two research visits during October to Green-Diesel and Biodiesel centre companies, both in Cape Town. During these visits crude glycerol from Biodiesel production was collected for purification in the Economical use of Glycerol Research Thrust.

The **Inorganic Chemistry** group 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=26), supported by Profs. Deon Visser (ISI H-index=9), Gideon Steyl (NRF Y2 rated; ISI H-index=9), Dr. Johan Venter (ISI H-index=6), Ms. Alice Brink (ISI H-index=5), and Ms. Marietjie Schutte-Smith (ISI H-index=5), 17 M.Sc. and Ph.D. students, and four post-doctoral associates. Prof Steyl also ran a separate research thrust related to the Institute for Ground Water Studies at the UFS, as indicated further on.

The medical research focus in the research group of Prof. Roodt, in collaboration with the Universities of Lund, Sweden (Prof. Ola Wendt), Missouri, USA (Dr. Hendrik Engelbrecht) and Zürich, Switzerland (Prof. Roger Alberto), as well as with NECSA under the Nuclear Technologies in Medicine and the Biosciences programme (NTeMBi) and PETLabs Pharmaceuticals (Dr. Gerdus Kemp) showed good progress. The project "Development of Novel Nuclear Pharmaceuticals" from Profs. Roodt and Visser with Prof. Roger Alberto (Zurich) sourced another R1 million from PETLabs Pharmaceuticals and the NRF.

The homogeneous catalysis research in the Inorganic group is 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. The focus is on the conversion of simple feedstock molecules into value-added products and includes studies such as carbonylation, hydro-

Receiving the prize for the best poster at the CATSA 2012 Conference from Mr. Soovi Hurgobin from Clariant (previously Süd-Chemie) is Mr. Johannes van Tonder (left).

At the inauguration ceremony in Bergen, Norway, as new president of the European Crystallographic Association (2012-2015) are Prof. André Roodt (left), with outgoing president Prof. Santiago Garcia-Granda (University of Oviedo, Spain).

formylation, olefin metathesis and oligomerisation. Collaboration with Sasol forms part of this thrust, and significant funding was sourced under the "Applied Process Chemistry" theme. An industrially-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 some R600 000 for bursaries and project expenses for four Ph.D. students.

Prof. Gideon Steyl was project leader for the Water Research Commission's (WRC) "State-of-the-Art Knowledge on Hydraulic Fracturing" which addressed the current state of knowledge on this subject as it pertains to South Africa. He collaborated with the Institute for Groundwater Studies and the Council of Geosciences of South Africa on this project. An additional research contract was awarded to him by Eskom and WRC to investigate the effect of surface water and groundwater interaction as it relates to chemical, isotopic and data gathering aspects to assist South Africa in starting a standard setup in collecting vital information to manage climate change.

Profs. Deon Visser, André Roodt and Dr. Johan Venter and eight students attended the 40th International Conference on Coordination Chemistry (ICCC40) in Valencia, Spain, during September 2011. Profs. Roodt and Visser and Dr. Stefan Warsink (postdoctoral fellow in the Inorganic Group) presented lectures at ICCC40, while Dr. Venter gave a lecture at the 25th International Conference on Organometallic Chemistry (ICOMC), Lisbon, Portugal, 2 – 7 September 2012, and visited several research groups in the Netherlands. Prof. Roodt presented lectures in Lund, Sweden (February), and was part of the UFS Cluster visit to the Okinawa Institute of Technology (OIST), Okinawa, Japan (October).

Prof. Deon Visser was elected as the South African representative of the Special Interest Group on Chemical Crystallography (SIG13) of the European Crystallographic Association (ECA).

Mr. Renier Koen (Ph.D. student in the Inorganic Group) was the South African representative of the General Interest Group for Young Crystallographers of the ECA.

Dr. Stefan Warsink (postdoctoral fellow in the Inorganic Group) presented a lecture at CATSA2012 in Langebaan, Western Cape (November), and another postdoctoral fellow in the Inorganic Group, Dr. Nagarajan Logathan, visited the University of Lund, Sweden, twice under a Swedish Links collaboration with Prof. Ola Wendt.

Highlights from the Inorganic Division include more than 30 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 Spain, Portugal, Norway, Turkey, Russia, Hungary, Sweden, Japan, Hawaii, Botswana, and South Africa.

Dr. Marietjie Schutte-Smith presented an invited lecture at the 9th International Conference on Methods and Applications of Radioanalytical Chemistry, MARC IX, in Kailua-Kona, Hawaii, March 2012; while Miss Kina van der Merwe (Ph.D. student) gave a lecture at the 16th Annual Green Chemistry and Engineering Conference, Washington DC, USA, June 2012, following a short research visit to the group of Prof. Tom Cundari at the University of North Texas, Denton, USA.

At the 27th European Crystallographic Meeting in Bergen, Norway. From left: Prof. André Roodt (President of the ECA), Prof. Deon Visser (Chair of special session at ECM27 on Coordination Chemistry), Mr. Tinus Viljoen, Dr. Alice Brink and Mr. Theuns Muller (poster presenters). Front from left: Dr. Nicoline Cloete (invited lecture at ECM27 and UFS Chemistry Alumni; currently as Sasol) and Mr. Renier Koen (poster presenter).

Prof. Deon Visser was the co-convening chair at a session on Coordination Chemistry of the 27th European Crystallographic Meeting (ECM27) of the European Crystallographic Association (ECA) in Bergen, Norway.

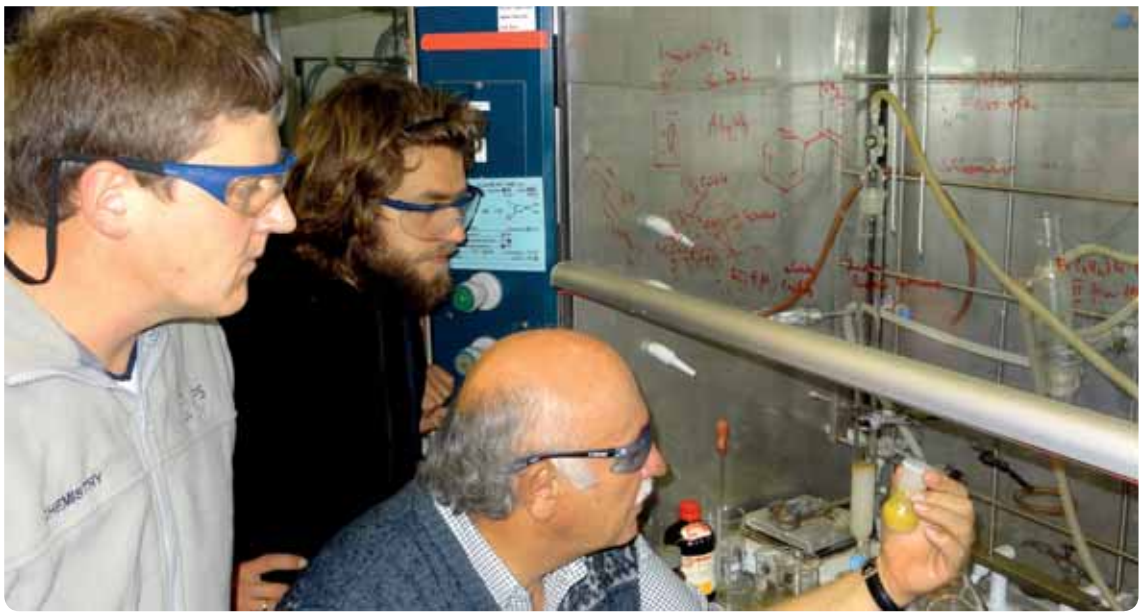
Dr. Alice Brink was the recipient of a prestigious postdoctoral scholarship from the MNS cluster and visited Zürich for a three-month research trip to the group of Prof. Roger Alberto; gaining valuable experience in radiopharmaceutical preparation and advanced X-ray crystallography.

Prof. André Roodt presented invited lectures to the Hungarian Academy of Sciences in Budapest in February 2012, at the 2nd Frontiers in Organometallic Chemistry Conference in St. Petersburg, Russian Federation, September 2012, as well as at the international Indaba7 in Skukuza, Kruger National Park, 2 – 5 September 2013. Prof. Roodt also gave a keynote lecture at TUCr3, the 3rd Turkish Crystallographic Meeting, Izmir, Turkey, 7 – 9 June 2012, and was elected president of the European Crystallographic Association (the first person outside Europe; 40 countries across the European and African region) for the period 2012 – 2015. He was also elected as Chair of the Indaba series of conferences for 2012 – 2015, and served on the international editorial board of the Journal of Coordination Chemistry.

The **Organic and Process Chemistry** division is headed by Profs. Ben Bezuidenhoudt (ISI H-index=16), Andrew Marston (NRF B-rated; ISI H-index=27), and Jan van der Westhuizen (NRF L-rated; ISI H-index=4), with Dr. Susan Bonnet (ISI H-index=5), as senior lecturer and Ms. Anke Wilhelm-Mouton as lecturer. Mr. Rudi Swart was appointed as technical officer during 2012. Nineteen M.Sc. and Ph.D. students were studying towards higher degrees during 2012, while three postdoctoral fellows were actively working in the division.

Prof. Marston contributed widely to the activities of the division and continued his collaboration with colleagues from the European Union Seventh Framework Programme for Building Sustainable Research Capacity on Plants for Better Public Health in Africa, the Norwegian Research Council bioprospecting, and the South African Rooibos Council. He also acted as reviewer for research proposals for the NRF's Revised ThuThuka Programme, the South Africa/Japan Society for the Promotion of Science Research Partnership Programme, and the European Research Council, and became a member of the editorial boards of several international scientific journals, namely *Scientia Pharmaceutica*, *Planta Medica*, *Journal of Biochemistry and Biotechnology*, and *Isan Journal of Pharmaceutical Science* (Thailand). Prof. Marston also gave presentations at workshops organised within the framework of the EU Muthi Project in Bamako (Mali) and in Kampala (Uganda).

Prof. Jan van der Westhuizen and Dr. Susan Bonnet continued their collaboration with Parexel, as well as their efforts towards finding industrial applications for the workhorse research area of the division, i.e. flavonoid research, which led to the filing of another patent on the synthesis of flavonoids. Prof. Van der Westhuizen also collaborated on projects funded by



In the Physical Chemistry section, evaluating a new compound are from left: Drs. Uwe Siegert and Jan Lewtak (post-doctoral fellows), and Prof. Jannie Swarts.

the Medical Research Council, the Agricultural Research Council and the Bioprospecting Programme of the CSIR on the synthesise a bioactive natural products.

Ms. A. Wilhem-Mouton had the opportunity of spending six months in the research laboratories of Prof. Steve Ley at Cambridge University in order to advance her Ph.D. studies.

The Process Chemistry group continued to strengthen ties with the catalysis research group of Prof. Manie Vosloo at NWU and received the Potch group for a two-day interaction during October. In a "Chemistry Intervarsity", M.Sc. and Ph.D. students from both universities were given the opportunity to present the results from their research to their peers. The group also visited Sasol Technology in Sasolburg, Shimadzu Instruments in Randburg, and the chemical production plant of Chemical Process Technologies in Pretoria during the group's annual excursion to chemical production facilities.

The division's research image was further expanded by the participation and attendance of staff and students in several international and national conferences. In this regard the division participated in conferences like the CATSA 2012 Conference, International Conference on Catalysis in Organic Synthesis (Moscow), Symposium on Frontiers of Organometallic Chemistry (St. Petersburg), 4th European Association for Chemical and Molecular Sciences (EuCheMS) Chemistry Congress (Prague), 26th Journées Franco-Belges de Pharmacochimie (Orléans, France), and 13th Belgian Organic Synthesis Symposium (Leuven).

Students from the Process Chemistry group gave excellent performances at the conferences. In this regard, Mr. Johannes van Tonder was awarded the prize for the best student lecture at CATSA 2012 and was also nominated as the runner-up in the best student lecture competition at the Frank Warren Conference, while Ms. Tanya Pieterse was the runner-up for best lecture at the annual "SA Akademie vir Wetenskap en Kuns Student Symposium" in Potchefstroom.

The highlight of the division's activities, however, was the organising of the SA Chemical Institute's biannual Organic Chemistry conference, the Frank Warren Conference, which took place on the Main campus of the UFS. Approximately 120 delegates attended the conference. The organising committee managed to bring one of the leading organic chemists in the world, Prof. Steve Ley from Cambridge University, to the Conference as the main plenary speaker. Other leaders in the field of Organic Chemistry, i.e. Prof. Daneel Ferreira (University of Mississippi), Prof. Leon Ghosez (University of Louvain), Prof. Kurt Hostettmann (University of Geneva), and Prof. Berhanu Abegaz (African Academy of Science), also attended the conference. The prestigious Warren Lecture and medal (for a substantial local contribution to Organic Chemistry) was awarded to Prof. Fanie van Heerden, a former doctorate of the UFS Chemistry Department and currently chairperson of Chemistry at the Pietermaritzburg campus of the University of KwaZulu-Natal. Two students from the division were selected for oral presentations at the

At the sophisticated Maldi-Tof instrument are from left: Prof. Ben Bezuidenhoudt (Head Organic Chemistry) with Materials and Nanosciences Strategic Academic Cluster Prestige Ph.D. students Tanya Pieterse and Maretha Serdyn.

conference, and 11 others participated by presenting posters at the event.

The outputs from the division were further complemented by the publishing of research results in 15 papers and the graduation of two M.Sc. and two Ph.D. students.

Additional Research-related Outputs

Different researchers of the Department of Chemistry participated in the Material and Nanosciences Cluster (MNS). Profs. Riaan Luyt, Jannie Swarts and André Roodt are three of the four focus-area leaders, with Prof. Roodt as the cluster director. Ten students supported under the MNS Cluster during 2012 published more than15 research papers. Dr. Alice Brink (prestigious postdoctoral), Dr. Ellen Kuo and Dr. Carla Pretorius (prestigious Ph.D. scholarships) received special support under the MNS Cluster initiative.

A significant number of colleagues acted as external reviewers for different international chemistry journals and for the NRF, served on the faculty and UFS committees, 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, as a member of the Executive Committee and vice-president of the European Crystallographic Association (ECA), attended the Executive Meetings in Budapest, Hungary (February), and Bergen, Norway (August), also as a member of the International Scientific Committee of the 28th European Crystallographic Meeting in Warwick, UK. He also chaired the committees of the prestigious Max Perutz and Bertaut Prizes of the ECA, the presentation sessions at the gala event during ECM27, as well as the Jan Boeyens prize committee at Indaba7, Skukuza, Kruger National Park.

Staff Matters

Prof. Jeanet Conradie was promoted to a full professor and Dr. Karel von Eschwege to senior lecturer. Drs. Alice Brink (X-ray crystallography) and Marietjie Schutte-Smith (Radiopharmaceuticals) were appointed as lecturers in Inorganic Chemistry. Mrs. Callie Laubscher joined the Department as financial officer, while Dr. Marianne Conradie-Bekker and Ms. Truidie Venter (part-time chief officers: professional services) and Mr. Rudi Swart (officer: professional services) were appointed. Dr. Johan Venter was appointed as Programme Director: Main campus, while Dr. Charlene Marais succeeded Dr. Versteeg as lecturer for the extended programme at the South campus, and Ms. Rina Meintjes as Programme director: South campus.

Prof. Gideon Steyl (August 2012) and Dr. Marietjie Versteeg (April 2012) resigned from their positions in Chemistry and emigrated to Australia and New Zealand respectively.

Networking

More than 20 prominent international scientists visited the Department during 2012. They presented lectures and held research discussions with researchers and postgraduate students in the departmental research seminar programme, which were coordinated by Prof. Jeanet Conradie and continued very successfully with approximately thirty research presentations given during 2012.

The Swarts and Conradie research groups in Physical Chemistry have 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); 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, USA, on electrochemistry), Prof. Henry Lang (Chemnitz Technical University, Chemnitz, Germany, on metal carboxylates and electrochemistry) and Prof. Hans Niemantsverdriet of the Schuit Institute of Catalysis at the Technical University, Eindhoven, The Netherlands. Dr. Erasmus is in collaboration with Prof. B. Gates of the University of California at Davis.

The industrial research collaboration of the Swarts research group led to visits by Dr. Thys Botha and Dr. Philip Gibson, both from Sasol, on various industrial research issues with respect to heterogeneous catalysis. Prof. Hans Niemantsverdriet from of the Schuit Institute of Catalysis at the Technical University, Eindhoven, and Dr. Sergey Ushakov from UC Davis, USA, visited Prof. Swarts and Dr. Langner for a month to work on the gas DSC and ASAP gas absorption instruments and to interface a mass spectrometer with this equipment. Prof. Kolio Troev, Director of the Bulgarian Academy of Sciences, Polymer Division, also visited the Swarts group for one month to do research on polyphosphonates.

Prof. Ola Wendt from Lund, Sweden, Dr. Petra Bombicz, Hungarian Academy of Sciences, Budapest, and Prof. Roger Alberto, Dr. Henrik Brabant and Mr. Daniel Can, University of Zurich; Switzerland, spent short periods on research in the Inorganic Group. Similarly, Dr. Johann Nel and Ms. Wilna du Plessis (Advanced Metals Initiative from the DST/ NRF), and Drs. Neil Jarvis and Jan Rijn Zeevaart (DST/NRF NTeMBi project on development of radiopharmaceuticals) from NECSA, visited the Inorganic Group, while Prof. Fanie Otto (affiliated professor at UFS Chemistry from Sasol), spent time with Profs. Roodt and Visser and had fruitful discussions with students.

The Roodt Group extended the funding period (2012 – 2013) under the Swiss-South Africa bilateral initiative in biomedicine to co-host the 2nd Symposium on the Manganese triad of elements (Manganese, Technetium and Rhenium) RheManTecII in Switzerland. It was initiated from research collaborations between groups in South Africa at NMMU, PetLabs Pharmaceuticals, NECSA and the Inorganic Section at the UFS, and the Alberto Group at the Institute of Inorganic Chemistry, University of Zurich, Switzerland.

Community Service

Dr. Johan Venter, Dr. Ernie Langner and Prof. Deon Visser 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 from a chemist's perspective under the theme "How green is green?" and Drs. Langner and Blenner Buitendach took responsibility for the Chemistry Magic Show for approximately 2 000 students.

Prof. Roodt acted as Dean for the prestigious South African Young Scientist Summer School Programme (SA-YSSP) for the three-month period of 1 December 2012 – 28 February 2013. 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 the first time that this school was held outside Austria. It included 28 supervisors from 17 countries and hosted 19 international students (selected from more than forty applications) from 12 countries. Prof. Roodt also visited four universities around Tokyo, Japan, as part of a UFS delegation to expand collaboration under the UFS Cluster initiative.

Prof. Deon Visser was again coordinator and principle negotiator for new apparatus purchases for research for the Faculty of Agricultural and Natural Sciences.

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. Drs. Karel von Eschwege and Rebotsamang Shago assisted different learners with Escom Science Expo projects. Prof. Purcell and Dr. Venter contributed to the Universitas Primary School Leadership programme in January 2012.

Mrs. Ina du Plessis organised the chemistry session at Minquiz, one of the Faculty's five community service flagships. All staff members and students from Physical Chemistry assisted in this effort to make it a big success. Prof. Conradie helped four scholars with their Expo projects and also continued to organise and handle the ILEARN programme at the UFS for Physical Chemistry which provided question and answer quizzes for computer-guided first-year Physical Chemistry revision. Dr. Erasmus assisted three learners with their Expo projects; one who won gold at the provincial and bronze at the national Expo. Dr. Langner was secretary for the UFS HPC group during 2012, as well as a judge at the Expo for Young Scientists and assisted a learner from Eunice High School with a project for the National Expo, and

At the new polymer tensile tester are Mr. Thabang Mokhothu (left) and Prof. Riaan Luyt (head of Polymer Science at QwaQwa campus).

organised an equipment demonstration by Wirsam to demonstrate the Nanosurf Atomic Force Microscope (AFM) to the Faculty.

QwaQwa Campus

Overview

The Department of Chemistry at the QwaQwa campus has performed well again in terms of research and other activities during 2012. Several projects were completed and a number of research collaborations, both nationally and internationally, were continued during the year.

Departmental Activities and Achievements

The Polymer Science research area is headed by Prof. Riaan Luyt (ISI H-index=18) at the QwaQwa campus. He is C1-rated by the NRF, and his group focuses on physical properties of polymer/wax mixtures, polymer/natural fibre composites and polymer nano-composites. Two M.Sc. and two Ph.D. students graduated during 2012, while QwaQwa colleagues authored/co-authored 23 papers and made seven conference presentations.

The collaborations of the group at QwaQwa are with the Vinća Institute of Nuclear Physics, Belgrade, Serbia (Dr. Vladimir Djoković), and 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 reinforced plastics". This is an official, NRF-funded collaboration. A student of Prof. Messori, Ms. Katia Paderni, spent 30 days in the QwaQwa laboratories during November/December 2012, while Mr. Thabang Mokhothu and Mr. Tsietsi Tsotetsi spent 30 days and ten days respectively in Modena during June 2012. Additional collaboration also exists 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 also an official, NRF-funded collaboration. Prof. Luyt spent ten days in Dresden during June 2012, and his Ph.D. student, Mr. Shale Sefadi, visited there for one month during June/July 2012. Dr. Pionteck and his student, Mr. Marco Liebscher, visited QwaQwa for 20 days during November 2012. There is also collaboration with Prof. Albert van Reenen from the University of Stellenbosch on a project entitled "The influence of β-nucleation on the morphology and properties of a high-impact PP copolymer".

The highlight of the year was when Prof. Luyt was invited as guest of honour to the 60th birthday celebrations of the Shenyang University of Chemical Technology in China, and presented a plenary lecture at the accompanying conference.

Mrs. Amra-Jordaan completed the research for her Ph.D. thesis and is starting the organic research group at the QwaQwa campus. She has secured funding for equipment and chemicals from the UFS (with the bench-top NMR having been purchased and a mass spectrometer being donated by Prof. van der Westhuizen). The research project "Low Temperature Preparative Photochemistry of Anti-AIDS drugs" already has one Masters' student registered for 2013.

Additional Research-related Outputs

Prof. Luyt is one of the focus area leaders within the UFS Research Cluster on Materials and Nanosciences and received funding for three students under this initiative.

Staff Matters

Ms. Maryam Amra-Jordaan had leave for a part of 2012 and her lectures were presented by Mr. Tsietsi Tsotetsi. Ms. Moipone Malimba had sabbatical leave for 2012 to advance her Ph.D. studies and Messrs. Thabu Mokhothu, Jeramia Sefadi, Mphiso Mngomezulu and Prof. Riaan Luyt were recruited on part-time basis to take care of her lecturing responsibilities. Messrs. Twafo Motaung and Mfiso Mgumezulu from the QwaQwa campus terminated their services as officers: professional services (December 2012).

Networking

A number of prominent national and international scientists visited the Department at the QwaQwa campus. They presented lectures and held research discussions with students and also discussed collaborative research.

There was collaboration between the QwaQwa campus and the Polymer Institute at the University of Stellenbosch in terms of Honours' and Masters' student training. Two staff members from this institute (Profs. Mallon and Van Reenen) visited the QwaQwa campus to lecture to Honours' students. Prof. Luyt also spent two days at the University of Stellenbosch lecturing to their Honours' students, while Profs van Reenen and Luyt co-supervised a Masters' degree student who was registered with the UFS.

Mrs. Amra-Jordaan attended a basic and advanced AVANCE NMR course in Germany, Rheinstetten, 20 February – 3 March 2012, and she also completed a course in Mass Spectrometry (MS) at the Central Analytical Facility (CAF) at Stellenbosch University in July 2012.

Research Outputs

Department of Chemistry

Research Articles

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Chemistry personnel and students at the 2012 year-end function.

Staff

Main Campus

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).

QwaQwa Campus:

Professor: Prof. Riaan Luyt.

Lecturers: Mr. Tsietsi Tsotetsi, Mss. Moipone Malimba, Maryam Amra-Jordaan, and Mpondi Molefe.

Junior Lecturer: Mr. Rantooa Moji.

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Department of

Computer Science and Informatics

Overview

The Department of Computer Science and Informatics presented two major undergraduate learning programmes, namely B.Sc.(IT), and B.Com.(IT). The latter is however being phased out as there were no new first-year students in 2012. These programmes deliver highly-trained information technologists with skills in programming, Internet programming, database and system analysis and design, as well as software engineering, network management and human-computer interaction; supported by a background of natural sciences' subjects.

The Honours' degree consists of various modules, of which one is a research module, and a project that includes the development of a system. The Masters' degree consists of a research dissertation only, or can be structured with a smaller dissertation. The Department also offers a doctoral degree. Special devices are acquired as necessary to assist the postgraduate students in their studies.

The Department is responsible for the Computer Literacy module for all new students on the Main campus and the QwaQwa campus, as well as students in the extended programme and the University Preparation Programme on the South Campus.

Research focuses are Human-Computer Interaction (Prof. Pieter Blignaut and Dr. Lizette de Wet), Data Warehousing (Prof. Theo McDonald and Dr. Eduan Kotzé) and E-learning (Dr. Liezel Nel).

External funds are generated by using the Department's modern eye-tracking equipment and the Centre of Excellence (COE). The projects undertaken by the COE are funded by an industrial partner. These projects are research-related and can be implemented to provide assistance to, as well as aiding the development of, postgraduate students. Emphasis is currently on the development of the Department's own eye-tracker.

Two second-year students from the Department of Computer Science and Informatics, Eugene Botma (right) and Ian van der Linde (left), each won a Nokia Lumia 710 cell phone in a national Windows Phone 7 development challenge hosted by Microsoft South Africa.

Activities and Achievements

Prof. Pieter Blignaut received the 2012 Department of Trade and Industry (DTI) Technology Award: Runner-up in the THRIP advanced Hi-Tech Category for the research performed in the UFS Telkom Centre of Excellence.

The Department organised the congress of the South African Computer Lecturers' Association (SACLA) at the Black Mountain Resort near Thaba 'Nchu, 1 – 3 July 2012. Lecturers from all academic institutions in and across southern Africa were invited. The theme for SACLA 2012 was "Educating in a changing environment". SACLA 2012 also enjoyed in-cooperation status with the Association for Computing Machinery (ACM).

Dr. Tanya Beelders was promoted to senior lecturer during 2012, while Dr. Patient Rambe started in the Department as a postdoctoral student and is doing research under the guidance of Dr. Liezel Nel.

The Department's "Friday IT Talks" consist of reports on research by staff and students, new technologies, and other topics of interest.

The Department also hosted an informative Digital Forensics Workshop, presented by Ms. Riana Smalberger, head of the Digital Forensic Lab in South Africa, 18 – 19 June 2012, in one of the departmental laboratories.

Mr. Brian Campbell was selected as one of only 13 Microsoft Student Partners in South Africa. The training that he received enabled the Department to be the first IT-department in the country that could offer software development training for Microsoft's latest operating system.

On 20 April 2012, representatives from the Apple Core Group presented a workshop on the UFS campus and participants had the opportunity to work on and become familiar with using iPads.

Mr. Victor Grobler, a third-year IT-student, received the award as the best tutor in the Faculty of Natural and Agricultural Sciences.

The Department's extension on the QwaQwa Campus received the award for the best contribution to Teaching and Learning and the following staff members received individual awards for Teaching and Learning: Messrs. M.B. Mase, T. Lesesa, V.F.S. Mudavanhu, B. Sebastian and Mrs. R.D. Wario.

Capacity-building in the community: students on QwaQwa Campus assisted people from the community to learn how to use a computer.

During the workshop that was presented by representatives of Apple Core in 2012. Various staff members attended this workshop.

Two staff members obtained their Masters' degrees: Mrs. R.D. Wario (M.Sc.) and Mr. V.F.S. Mudavanhu (MA Higher Education Studies).

The capacity of the main computer laboratory on the QwaQwa Campus was extended from 70 to 120 computers.

Ms. Temi Adebayo-ojo (a second-year IT student) was selected as a Google Ambassador for Kovsie Campus. She organised some exciting events for the students. She was also selected as a member of the Golden Key International Honour Society.

Two second-year students from the Department, Eugene Botma and Ian van der Linde, each won a Nokia Lumia 710 cell phone in a national Windows Phone 7 development challenge hosted by Microsoft South Africa. Microsoft gave away Windows Phone 7 cell phones to the first 40 South African students to develop a Windows Phone 7 application and successfully publish them on the Windows Phone 7 Marketplace.

Mr. Romeo Mabasa from IBM, Johannesburg visited the Department on several occasions and an agreement was signed with respect to the IBM Academic Initiative.

Dr. Charles Barker from the Department Geography of the UFS was invited by the Information Technology Student Association (ITSA) to present a lecture on GIS (Geographic Information Systems) to students and personnel of the Department Computer Science and Informatics.

Community Service

The Department of Mineral Resources invited Dr. Anelize van Biljon to talk to a group of school children in Kimberley about the uses of mathematics in everyday life.

Dr. Anelize van Biljon received the Faculty Award in 2012 for community involvement and accompanied two groups of school children to the Maths Olympiads in Hong Kong and Taiwan. She also attended the Euromaths 2012 Conference in Bulgaria.

Staff of the Monyetla Project used the computer lab at the South Campus to teach Computer Applications Technology (CAT) to school children on Saturdays. Monyetla is a Sesotho word for "opportunity" and the project aims at better preparing learners from previous disadvantaged communities when it comes to qualifying for bursaries, thereby creating an opportunity to attend an institution of higher education.

The Python project, a programming training course for learners between Grade 7-9, commenced in 2010 and continued during 2012 under the guidance of Mr. Victor Grobler and Mr. Louwrens Potgieter.

Community service is regarded a high priority in the Department as it also showcases the Department to prospective students and the public. The Community Service module (RIS242) of the Department again equipped a number of people in the community with basic computer skills. The RIS242 students trained a group of unemployed persons from previously disadvantaged population groups in basic computer skills. Classes were presented at South campus during the second semester. At the end of the programme, a ceremony was held where the successful individuals received certificates.

Facilities

The Department has well-equipped computer laboratories on all three UFS campuses. In the

Mathematical Sciences Building on the Main campus there are two laboratories for undergraduate students of the RIS module and the Hans Messerschmidt Laboratory for postgraduate students. The Sasol Laboratory is used for BRS practical sessions and tests. The QwaQwa campus also has laboratories where the students have BRS and RIS practical sessions. On South campus the laboratories are used for BRS lectures and practical sessions, as well as for RIS242 training during the second semester.

Staff Matters

Prof. Theo McDonald and Mss. Maletsatsi Bless and Palesa Rampeta left the Department at the end of 2012.

Research Outputs

Department of Computer Science and Informatics

Research Articles

De Wet, L., Greeff, F. & Nel, W. 2012. Comparing questionnaire and physiological usability testing results for a social network. *International journal of Information Technology and Computer Science*, May/June: 1-8.

Dednam, M.J. & Dednam, E.H. 2012. Some remarks on the success rate data of an extended LL.B. programme for the period 2005 - 2009. *South African Journal of Higher Education* 26(5): 941-959.

Kotze, J.E. & Mcdonald, T. 2012. A longitudinal patient record for patients receiving antiretroviral treatment. *Journal for New Generation Sciences* 10(1): 49-62.

Messerschmidt, J.J.E. & Messerschmidt, H.J. 2012. Voorwaardelike konstruksie met indien soos gebruik in wetenskaplike tydskrifte (Deel 2: Gemerkte Konstruksies). *Tydskrif Vir Geesteswetenskappe* 52(2): 271-289.

Books

Beelders, T.R., Nel W. & Campbell, R.B. 2012. *Databases: The programmer's guide.* Bloemfontein: Xerox.

Blignaut, P.J. 2012. *Be Sharp with C#.* Bloemfontein: PL3 Databases.

Research Reports

Blignaut, P.J., Beelders, T.R. & Wium, D.J. 2012. *Noordfed maize meal packageing: An eye-tracking study.* Report no 1/2012, commissioned by NWK (Noordfed), South Africa.

Beelders, T.R. & De Kock, H.S. 2012. *Voermol: A consumer preference study.* Report no 2/2012, commisioned by Voermol Feeds, South Africa.

Staff

Main Campus:

Professors: Profs. Pieter Blignaut, and Theo McDonald.

Affiliated Professor: Prof. Hans Messerschmidt.

Senior Lecturers: Drs. Anelize van Biljon, Lizette de Wet, Liezel Nel, Eduan Kotze, and Tanya Beelders.

Lecturers: Ms. Engela Dednam, Mr. Andries Burger, and Mr. Wynand Nel.

Junior Lecturers: Ms. Marina Botha, Mr. Rouxan Fouché, and Mr. Jaco Marais.

Administrative Officers: Ms. Erna Dippenaar, and Ms. Suezette Opperman.

Technical Officers: Mr. Brian Campbell, and Mr. Victor Grobler.

Assistant, Special Equipment: Mr. Daniël Wium.

QwaQwa Campus:

Lecturer: Mr. Robert Alfonsi, and Ms. Ruth Wario.

Junior Lecturers: Mr. Ben Mase, Mr. Frederick Mudavanhu, Mr. Fani Radebe, Mr. Benedict Sebastian, Mr. Gavin Dollman, and Mr. Teboho Lesesa.

Administrative Officers: Ms. Beauty Leshoro, and Ms. Matsego Mahakoe.

Technical Officer: Mr. Peter Mosikili.

South Campus:

Lecturer: Mr. Ronnie Brown.

Administrative Officer: Ms. Suretha de Klerk.

Technical Officer: Mr. K. Masisi.

Contact Details

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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 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.

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 2012, 24 students in the B.Consumer Science (Foods) and eight in B.Sc Home Economics (Foods). Sixteen students were registered for the B.Sc. Honours' Degree in Home Economics, two in M.Sc. Home Economics and three for Ph.D. degrees.

Activities and Achievements

The paper, "The influence of anolyte as an environmentally-friendly disinfectant on the strength properties of cotton, polyester cotton and polyester", delivered by J.F. Vermaas (presenter) and H.J.H. Steyn at the XXII World Congress of the IFHE in Melbourne, Australia, 16 – 21 July, was awarded as one of the five best presentations at the congress.

Prof. H.J.H. Steyn and Mrs. J.S. van Zyl are members of the programme committee Household Technology and Sustainability of the International Federation for Home Economics (IFHE). Both attended the annual meeting of the committee on 16 July in Melbourne, Australia.

The tour group of the Department of Consumer Science.

Mrs. P.Z. Swart in Melbourne in July 2012 at the 22nd IFHE Word Conference with her poster presentation.

Dr. J.F. Vermaas is a member of the programme committee for Textiles and also for the committee for Education of the International Federation for Home Economics (IFHE). She attended the annual meetings of the committees on 16 and 17July in Melbourne, Australia.

During the April 2012 holiday, a tour group of the Department of Consumer Science visited the KwaZulu-Natal Midlands. The tour kicked off with a visit to Shuttleworth weaving, where students saw first-hand how a mohair carpet was manufactured for a client in New York.

Next on the itinerary was a visit to the Marakesh Cheese Farm. Students learned more about cheese and the production thereof. A fun afternoon was spent at Chocolate Heaven, where the quality of different chocolate was tested. The owner of Terbodore Coffee Roasters taught the students more about roasting coffee beans and processing the coffee beans on the trees to the coffee one purchases in stores.

The artist, Caroline Zilenka, invited us into her studio where she makes incredible artwork from textile materials that she dyes herself. The tour group left the Midlands and moved on to Durban, where the Beacon factory and the Levi factory were visited. In between all the educational outings, there was also time for fun at a local Indian restaurant and U-Shaka Marine World. This tour was indeed a great success.

Research

Research done in the Department of Consumer Science in 2012 mainly included projects that:

Investigated the possibility of using electrochemically-activated water (anolyte and catholyte) as an alternative detergent and the effect of the treatment on the properties of the textile fibres, and

Investigated natural textile fibres and fabrics available in Southern Africa. Projects on *Gonometa Postica* silk and *Alpaca Huycaya*fibres are currently in progress.

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. In the first semester, final-year students under the supervision of Mrs. Petro Swart worked with a group of unemployed members from the community. They identified the needs of the group and with the group planned a skills development plan for 2012. The students and the community group identified income-generating skills as one of their major needs. They planned a series of lectures, demonstrations and workshops to assist the community group members to develop skills in making ragdolls, sewing dresses with crochet work detail, doing upholstery, and decorating photo frames with mosaic work.

In the second semester, Mrs. Doretha Jacobs continued with the Mamello group to improve their sewing skills. Most of them improved their sewing skills to enable them to sew chef jackets and they made some that were sold to students to wear in the Foods laboratory.

Collaboration

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

Mrs. J.S. van Zyl participated in the efforts of the programme committee Household Technology and Sustainability of the International Federation for Home Economics (IFHE) to compile "best practices" for household activities. She and Dr. C. Bothma were responsible for best practices in home food preservation that was published on the website of the IFHE.

Prof. H.J.H. Steyn worked with Prof. R. Stamminger and Dr. C. Pakula from Germany and Prof. G. Hustveld and Ms. Mira Ahn from Mexiko to write "From ice boxes to smart grids: Technology in the homes of the future", a chapter in the book "Creating home economics futures: The next 100 years" (edited by Donna Pendergast, Sue Mcgregor and Kaija Turkki).

Rachel with a crochet dress she completed in the community development programme.

Research Outputs

Department of Consumer Science

Research Articles

Mmopelwa, M. & Steyn, H.J.H. 2012. An evaluation of food labels and students' interpretation and use of food labels. Proceedings of the 5th IFHE –Africa Regional Conference: 1-7.

Van Heerden, N., Steyn, H.J.H. & Schall, R. 2012. Soil removal efficacy of catholyte on polyamide 6.6 fabric. *Chinese Business Review* 11(7): 682-689.

Vermaas, J.F. & Steyn, H.J.H. 2012. Evaluation of the physical properties of locally produced *Gonometa postica* silk and wool fabrics. *Journal of Family Ecology and Consumer Sciences* 40: 74-82.

Chapter in Book

Hustvedt, G., Pakula, C., Steyn, H.J.H. Ahn, M. & Stamminger, R. 2012. From ice boxes to smart grids: Technology in the homes of the future. In *Creating home economics futures: The next 100 years*, edited by D. Pendergast, S. Mcgregor and K. Turkki. Australia: Australian Academic Press. Chapter 11.

Staff

Associate professor: Prof. H.J.H.Steyn.
Lecturers: Dr. J. Vermaas, and Mrs. I. van der Merwe.
Junior lecturers: Mrs. J.S. van Zyl, and Mrs. P.Z. Swart.
Administrative staff: Mrss. D. Jacobs, W. van der Walt, M.A. Heyman, M. Makhapela, and Ms. S. Senokoane.

Contact Details

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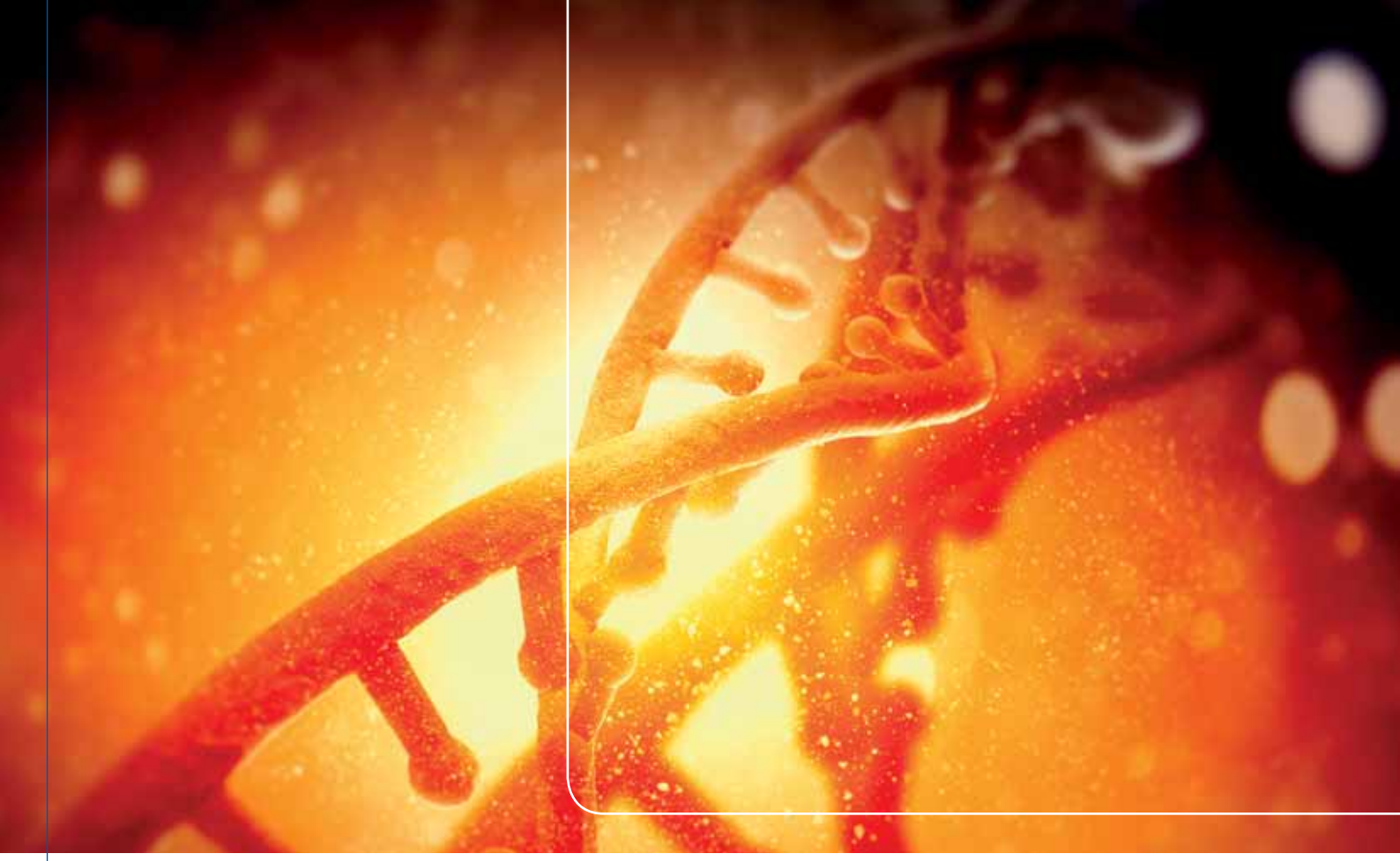

Department of

Genetics

Professional activities

The Plant Genetics Group consists of Prof. Johan Spies, Ms. Paula Spies and Mr. Frank Maleka. Ms. Paula Spies received a cluster bursary and progress has been made on her research on the plant genera *Lachenalia*, *Clivia* and *Gethyllis*. DNA barcodes of about 130 species in *Lachenalia* and all the *Clivia* species have been established as part of the International Barcode of Life (IBOL) initiative. Various new chromosome counts have been determined in *Lachenalia*. The difficult technique of genomic *in situ* hybridization has been incorporated as part of the cytogenetic analyses of *Lachenalia* and progress has been made on improving this technique.

Mr. Frank Maleka's research interest is on the genetics of flower pigmentation in Clivias. He previously used a high-throughput sequencing technology to sequence the *Clivia miniata* flower transcriptome. Over 37 000 transcript sequences were identified. Mr. Maleka's research is specifically focused on genes regulating the biosynthesis of flavonoid pigments in flower tissues. So far, a total of eight regions homologous to previously-characterised genes involved in the regulation of flavonoid pigmentation have been identified. These genes will be analysed using bioinformatics approaches and later with molecular biology techniques to determine changes in expression during flower development in *C. miniata*. Additionally, studies on the molecular evolution of some of the key genes will also be performed to unravel polymorphisms that may be responsible for trait variation. The study approach is feasible as demonstrated recently by Ms. M.E. Botha, a student supervised by Mr. Maleka.

The research group on Human and Behavioural Genetics (HBG) is led by Prof. J.J. Spies, Ms. Zurika Odendaal and Ms. Sue-Rica Schneider. Three projects

Prof. Paul Grobler with staff and students at the ILRI-BeCA hub in Nairobi, Kenya. Left to right: Dr. Rob Skilton, Ms. Bongo Ndyogolo, Mr. James Barassa, Dr. Romulus Abila, Prof. Grobler and Dr. Moses Njahira.

are currently ongoing. These projects cover (i) the effects of serotonergic neurotransmitter genes on aggressive behaviour; (ii) the allelic diversity of selected neurochemical cluster genes within South African population groups; and (iii) the effects of neurochemical cluster genes on Anxiety and Depression.

For the Forensic Genetics Group under Dr. Karen Ehlers and Mrs. Letecia Wessels, the main focus for 2012 fell on the development and implementation of a part time B.Sc. in Forensic Genetics. This programme was developed in conjunction with members of the South African Police Service (SAPS) to specifically accommodate employees of the Forensic Science Laboratories who want to further their studies. At the launch of the Plattekloof Forensic Laboratory in Cape Town, Minister Nathi Mthethwa specifically highlighted the need for programmes like these in tertiary institutions for the education of the members of the SAPS. Dr. Ehlers and Mrs. Wessels were the only members of a tertiary institution who were invited to attend the opening. They also attended a seminar series at the end of 2012 hosted by Life Technologies, focusing on the Human Identification Trends in Forensic DNA Technology, where the most recent technologies and research were presented by renowned forensic science experts from around the world.

In the Conservation Genetics (CG) research group (under Prof. Paul Grobler, Ms. Antoinette Kotze, Dr. Desire Dalton and Ms. Hesmari van der Westhuizen), projects aimed at the conservation of a number of animal species are ongoing. In the current environment, with increased poaching of white rhino, a number of projects aimed at assisting conservation management and forensic studies involving the species are underway. Karen Ehlers completed her Ph.D. that yielded new genetic markers that can be used for parentage determination and individual identification in rhino. In a follow-up programme, Ph.D. student Christiaan Labuschagne developed novel Single Nucleotide Polymorphism (SNP) markers that are extremely powerful in estimates of relatedness. The team (with the Tshwane University of Technology – TUT) is also involved with the determination of the genetic diversity and population structure of different populations of ground pangolin in Southern Africa. This is the first molecular study that has been conducted on this species in South Africa.

Ms. Hesmari van der Westhuizen joined the Conservation Genetics group during 2012. Her Ph.D. project focuses on the close relationship between the Mopane moth (*Imbrasiabelina*) and the Mopane tree (*Colophospermummopane*). Aspects of spatial and temporal genetic connectivity, co-evolution and adaptation will be investigated.

Several projects on Southern African antelope species are ongoing. M.Sc. student Ms. Elzet van Aswegen completed a project where interpopulation variation in growth rate in springbok was studied using the BMP4 gene. A long-term project, aimed at finding molecular markers to identify hybrids between blue and black wildebeest, also continues. In a final project on mammals, collaboration with UCLA continued, whereby wild vervet monkey populations were used as a model to study epidemiology of the SIV virus, a close analogue of HIV. Initial results in 2012 generated the first data on the prevalence of this virus in wild populations.

Moving to birds, the CG team, in collaboration with the University of Cape Town (UCT), developed novel markers in order to develop a genetic management plan for the African Penguin. The CG team, in collaboration with TUT, also developed novel markers that can be used to determine relatedness, genetic structure and to determine level of genetic diversity in the Southern Ground Hornbill. The team also developed new markers as part of an effort to understand

Four members of the new Executive Council of the South African Genetics Society (SAGS) at the biennial conference in Stellenbosch. Left to right: Ms. Zurika Odendaal (UFS), Dr. Albie van der Merwe (Tukkies, old Kovsie), Prof. Rouvay Roodt-Wilding (University of Stellenbosch, President of SAGS and old Kovsie) and Mrs. Paula Spies (UFS, Vice-President of SAGS)

the population structure of Red-billed Oxpeckers throughout the distribution range in South Africa.

In the aquatic environment, M.Sc. student, Bongo Ndyogolo, assisted by Honours' student Daniella Strauss, started a project to determine the genetic structure of African Catfish in South Africa. This is part of a bigger collaboration between the CG group and researchers from two Kenyan Universities, aimed at elucidating the genetic structure of catfish in the two countries. As part of this collaboration, Prof. Grobler and Ms. Ndyogolo visited two research institutes in Kenya in May 2012.

Staff matters

- A chapter by Riana Kleynhans (Ph.D. student), Paula Spies (Ph.D. Student) and Johan Spies in a special edition of *Floriculture and Ornamental Biotechnology* (Global Science Books) was contributed on invitation from the editors.
- Staff of the Department of Genetics attended two congresses during the year and this resulted in three conference contributions.
- Ms. Paula Spies was elected as vice-president of the South African Genetics Society (SAGS) during the SAGS conference.
- Ms. Paula Spies attended a course at the University of Stellenbosch on species distribution modelling using the statistical software R.
- Ms. Sue-Rica Schneider obtained her M.Med.Sc. degree *cum laude* during 2012.
- Ms. Zurika Odendaal, another staff member attached to the HBG research group, was elected to the Executive Committee of the South African Genetics Society (SAGS).
- Ms. Nadia Laubscher obtained her M.Sc. *cum laude* during 2012 and was also invited as a Young Investigator to attend the XXth World Meeting of the International Society for Research on Aggression (ISRA) 2012, at the University of Luxembourg, Walferdange, Luxembourg.

Research Outputs

Department of Genetics

Research Articles

Danzy, J., Grobler, J.P., Freimer, N. & Turner, T.R. 2012. Sunbathing: A behavioral-response to seasonal climatic change among South African Vervet Monkeys (*Chlorocebusaethiops*). *African Primates* 7: 230-237.

Kleynhans, R., Spies, P. & Spies, J.J. 2012. Cytogenetic and phylogenetic review of the genus *Lachenalia*. *Floriculture and Ornamental Biotechnology* 6 (Special Issue 1): 98-115.

Kotze, A. & Morgan, D. 2012. Research in African zoos: Stepping up to the plate? *International Zoo Yearbook* 46: 232-238.

Labuschagne, C., Kotzé, A. & Dalton, D.L. 2012. Isolation and characterization of SNP markers for African Penguin (*Spheniscusdemersus*). *Conservation Genetic Resources* 4: 1067-1069.

Labuschagne, C., Kotzé, A., Grobler, J.P. & Dalton, D.L. 2012. A targeted gene approach to SNP discovery in the White Rhino (*Ceratotheriumsimum*). *Conservation Genetic Resources* 5: 265-266.

Labuschagne, C., Kotzé, A., Van Wyk, A.M. & Dalton, D.L. 2012. Isolation and characterization of species-specific microsatellite loci in African Penguin (*Spheniscusdemersus*). *Conservation Genetic Resources* 5: 169-171.

Monadjem, A., Kane, A., Botha, A., Dalton, D. &Kotze, A. 2012. Survival and population dynamics of the Marabou Stork in an isolated population, Swaziland. *Plos One* 7: e46434.

Naidoo, V., Wolter, K., Espie, I. &Kotzé, A. 2012. Lead toxicity: consequences and interventions in an intensively managed vulture (*Gyps coprotheres*) colony. *Journal of Zoo and Wildlife Medicine* 43: 573-578.

Osmers, B., Petersen, B.X., Hartl, G.B., Grobler, J.P., Kotzé, A., Van Aswegen, E.&Zachos, F.E. 2012. Genetic analysis of southern African gemsbok (*Oryx gazelle*) reveals high variability, distinct lineages and strong divergence from the East African *Oryx beisa*. *Mammalian Biology* 77: 60-66.

Schwab, P., Debes, P.V., Witt, T., Hartl, G.B., Hmwe, S.S., Zachos, F.E. &Grobler, J.P. 2012. Genetic structure of the common impala (*Aepycerosmelampusmelampus*) in South Africa: Phylogeography and implications for conservation. *Journal of Zoological Systematics and Evolutionary Research* 50: 76-84.

Soma, P., Kotzé, A., Grobler, J.P. & Van Wyk, J.P. 2012. South African sheep

breeds: Population genetic structure and conservation implications. *Small Ruminant Research* 103: 112-119.

Spies, R., Dalton, D.L., Labuschagne, C. &Kotzé, A. 2012. Isolation and characterization of species-specific microsatellite loci in red-billed oxpecker. *Conservation Genetic Resources* 4: 869-871.

Van der Merwe, N.C., Hamel, N., Schneider, S-R., Apffelstaedt, J.P., Wijnen, J.T.&Foulkes, W.D. 2012. A founder *BRCA2* mutation in non-Afrikaner breast cancer patients of the Western Cape of South Africa. *Clinical Genetics* 81: 179-184.

Staff

Professors: Profs. Johan Spies, and Paul Grobler.

Affiliated Professor: Prof. Trudy Turner.

Affiliated Associate-Professor: Prof. Antoinette Kotzé.

Affiliated Senior Lecturer: Dr. Desiré Dalton.

Lecturers: Dr. Karen Ehlers, Mrs. Paula Spies, Ms. Sue-Rica Schneider, and Mr. Frank Maleka.

Affiliated Lecturer: Lt. Col. Anton Lucassen.

Junior Lecturers: Ms. Zurika Odendaal, Ms. Hesmari van der Westhuizen, and Mrs. Letecia Wessels.

Senior Professional Officer: Ms. Susan Reinecke.

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Department of

Geography

Overview

The Department of Geography prides itself on being one of, if not the oldest, geography departments at a South African tertiary institution. A Department of Earth Sciences was established at the then University of the Orange Free State in 1918. Professor W. von Bonde was appointed Lecturer of Geography in 1919.

Geography, on both the Bloemfontein and the Eastern Free State (QwaQwa) campuses continues to attract students in both the natural sciences and the humanities because of its vocational possibilities. There is also growing environmental awareness amongst students, and a significant increase in the interest in Geographical Information Systems (GIS), which is perceived as a real value-added component of Geography.

Bloemfontein Campus

Collaborative research with foreign and local institutions and the involvement of postgraduate students continues to flourish.

Visitors to the Department included Prof. Jarkko Saarinen (Oulu University, Finland), Prof. Clive Barnett (Open University, UK), and Dr. Alec Thornton (University of New South Wales, Sydney, Australia).

To cater for the growing number of undergraduate students taking GIS modules, plans have been approved and the necessary funding has become available to expand the Department's GIS laboratory. This involves internal alterations to physical teaching space, as well as extensive recabling and the purchase of 30 new GIS-dedicated computers. It is expected that this project will be completed during the second semester of 2013.

The combination of natural and human phenomena in the Blue Ridge Mountain Range near Boone, North Carolina, USA, provides an interesting landscape from a geographical point of view.

Staff Matters

Prof. Holmes served on the NRF Sarchi Chairs panel for the finalising of Chairs in the broad category of water quality and management, and land use management.

Prof. Peter Holmes stepped down as Departmental Chair at the end of 2011 after a term of eight years, and was replaced by Dr. Charles Barker.

Dr. Shirley Brookes left the Department at the end of the first semester to take up a post at the University of the Western Cape.

Ms. Sheila Vrahimis retired at the end of 2012.

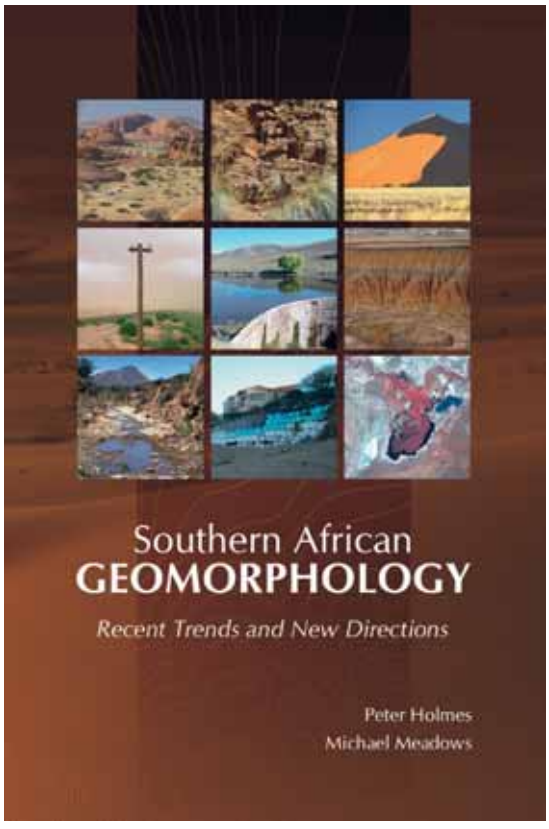
Dr. Charles Barker visited the Department of Geography and Planning at the Appalachian State University (ASU) in Boone, North Carolina, as part of a UFS delegation to foster research cooperation between the ASU and the UFS.

Special Achievements

The year 2012 saw the publication of a brand new text book entitled "Southern African Geomorphology", edited by Prof. Peter Holmes and Prof. Mike Meadows from the University of Cape Town. The book, published by SUN Press, is the first major contribution devoted exclusively to Southern African geomorphology to appear since 1988. Its 15 chapters, written by local and international experts, reflect the current state of academic geomorphology in southern Africa.

Postgraduate Outputs

The following postgraduate degrees were awarded in 2012: Mark Ingle obtained a Ph.D. under the leadership of Prof.Visser of the Centre for Development Studies; Mulalo Rabumbulu and Mnqobi Ngubane obtained their M. degrees under the leadership of Prof. Holmes and Dr. Brooks respectively. Ashley Marchand and



Southern African Geomorphology, edited by Prof. Peter Holmes and UCT colleague, Prof. Mike Meadows, is the first new book on the geomorphology of Southern Africa's landforms and landscapes to appear since 1988.

Appalachian State University (ASU) founded in 1899 is home to about 17 000 students.

Juanita Moolman both obtained M.Sc. degrees under leadership of Ms. Kruger and Dr. Barker respectively.

QwaQwa Campus

Dr. Hennie Claassen, Dr. Geofrey Mukwada and Ms. Merle Naidoo compiled and submitted the final draft of the new programme in Environmental Geography in September 2012. The recommended date of introduction of this programme is January 2014.

Dr. Mukwada is involved in the setting up of the Montane Research Initiative. The aim of this initiative is to spearhead research in various fields of the life sciences in the eastern parts of the Free State Province. By way of community service, Dr. Mukwada was involved in the training of municipal personnel in LED (Local Economic Development).

Ms. Naidoo chaired the Campus Going Green Committee. Ms. Naidoo attended a postgraduate course on Earth Observation and Integrated Water Resources Management in Kenya during the first semester of 2012.

Postgraduate Outputs

Ms. P.J. Lekhotla obtained an M. degree with the dissertation "Limitations on the growth of economic multipliers in the small business sector in the Eastern Free State" under the supervision of Dr. Tom Ruhiiga (external supervisor/assessor) from NWU. The internal co-supervisor and assessor was Dr. Hennie Claassen.

Research Outputs

Department of Geography

Research Articles

Hammett, D.P. 2012. Envisaging the nation: The philatelic iconography of transforming South African national narratives. *Geopolitics* 17: 526-552.

Hammett, D.P. 2012. Negotiating the academic periphery: Critical reflections on early career mobility. *Singapore Journal of Tropical Geography* 33: 286-290.

Hammett, D.P. 2012. Requiring respect: Searching for non-racialism in post-apartheid South Africa. *Politikon* 39: 71-88.

Hammett, D.P. 2012. Reworking and resisting globalising influences: Cape Town hip-hop. *Geojournal* 77: 417-428.

Hammett, D.P. 2012. Tales from the road: Reflections on power and disciplining within the academy. *Environment and Planning A* 44: 445-457.

Hammett, D.P. 2012. W(h)ither South African human geography? *Geoforum* 43: 937-947.

Hammett, D.P. & Hoogendoorn, G. 2012. Reflections on the politics and practices of knowledge production beyond the Anglo-American core: An introductory note. *Singapore Journal of Tropical Geography* 33: 283-286.

Hammett, D.P. & Sporton, D. 2012. Paying for interviews? Negotiating ethics, power and expectation. *Area* 44: 496-502.

Holmes, P.J., Thomas, D., Bateman, M., Wiggs, G. & Rabumbulu, M. 2012. Evidence for land degradation from aeolian sediment in the west-central Free State province, South Africa. *Land Degradation and Development* 23: 601- 610.

Hoogendoorn, G. & Visser, G.E. 2012. Stumbling over researcher positionality and political-temporal contingency in South African second homes tourism research. *Critical Arts* 26: 253-271.

Houghton, J.L. & Bass, O. 2012. Routes through the academy: Critical reflections on the experiences of young geographers in South Africa. *Singapore Journal of Tropical Geography* 33: 308-313.

Manatsa, D. & Mukwada, G. 2012. Rainfall mechanisms for the dominant rainfall mode over Zimbabwe relative to ENSO and/or IODZM. *The Scientific World Journal* 2012: 1-15.

Manatsa, D., Reason, C. & Mukwada, G. 2012. On the decoupling of the IODZM from Southern Africa Summer rainfall variability. *International Journal of Climatology* 32: 727-746.

Mukwada, G. 2012. Scales of vulnerability: Resettlement and exposure to multiple stressors and shocks in Zimbabwe. *Journal of Human Ecology* 40: 101-113.

Mukwada, G. & Dhlamini, S. 2012. Challenges of event tourism in local economic development: The case of Bethlehem, South Africa. *Journal of Human Ecology* 39: 27-38.

Cover sand deposits near Knysna. These deep deposits of wind-blown sand are beyond the range of optically-stimulated luminescence (OSL) dating. Prof. Peter Holmes and colleagues, Prof. Mark Bateman (Sheffield) and Andy Carr (Leicester), hope to apply cosmogenic nuclide dating in order to determine the onset of large-scale aeolian deposition within the Knysna area.

Mukwada, G. & Manatsa, D. 2012. Assessment of community-based natural resource management in the Savannas using the capacity continuum - multiple drivers model. *Journal of Human Ecology* 40: 69-84.

Rabumbulu, M. & Holmes, P.J. 2012. Depositional environments of the Florisbad Spring site and surrounds: A revised synthesis. *South African Geographical Journal* 94: 191-207.

Visser, G.E. & Hoogendoorn, G. 2012. Uneven tourism development in South Africa: Another on-going struggle. *Africa Insight* 42: 66-76.

Book

Holmes, P.J. & Meadows, M.E. (editors). 2012. *Southern African Geomorphology: Recent trends and new directions*. Bloemfontein: Sun Press.

Chapters in Books

Boardman, J., Hoffman, M.T., Holmes, P.J. & Wiggs, G.F.S. 2012. Soil erosion and land degradation. In: *Southern African Geomorphology: Recent trends and new directions*, edited by P.J. Holmes and M.E. Meadows. Bloemfontein: Sun Press. pp. 305-328.

Eckardt, F., Barker, C.H. & Meadows, M.E. 2012. Landscape inventories and remote sensing. In: *Southern African Geomorphology: Recent trends and new directions*, edited by P.J. Holmes and M.E. Meadows. Bloemfontein: Sun Press. pp. 371-399.

Garland, G.G. & Holmes, P.J. 2012. Applied geomorphology. In: *Southern African Geomorphology: Recent trends and new directions*, edited by P.J. Holmes and M.E. Meadows. Bloemfontein: Sun Press. pp. 351-370.

Holmes, P.J. 2012. Lithological and structural controls on landforms. In: *Southern African Geomorphology: Recent trends and new directions*, edited by P.J. Holmes and M.E. Meadows. Bloemfontein: Sun Press. pp. 23-39.

Staff

Bloemfontein Campus:

Professors: Profs. Peter Holmes, and Gustav Visser.

Senior Lecturers: Drs. Charles Barker, and Shirley Brooks.

Lecturers: Mss. Eldalize Kruger, Tobeka Mehlomakhulu, and Sheila Vrahimis.

Junior Lecturers: Mss. Mulalo Rabumbulu, and Aretha Steenekamp.

QwaQwa Campus:

Senior Lecturer: Dr. Hennie Claassen.

Lecturers: Mr. Alex Adjei, Dr. Geoffrey Mukwada, and Ms. Merle Naidoo.

Junior Lecturer: Mr. Pululu Mahasa.

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Department of

Geology

Overview

The Department of Geology constitutes a varied menu of disciplines that includes specialities such as Geology, Geochemistry, Environmental Geology and Geochemistry as well as Mineral Resource Throughput Management. The Department of Geology is proud to serve the South African and African Mining Communities.

The year 2012 was once again an active year for the Department of Geology. An important strategy was to reduce student numbers to align the intake with the teaching and research capacity of the Department. Student numbers of the first-year intake dropped as a result of the selection process while the number of second-year students also decreased. The third-year number remains high and an increase in honours' students resulted from the high third-year numbers of the 2011 class. The honours' intake increased to more than thirty, despite efforts to keep the intake at twenty-five.

Three senior staff members (Prof. W.A. van der Westhuizen, Dr. H. Praekelt and Prof. M. Tredoux) are nearing the end of their careers and a new appointee, Dr. Johann Claassen, joined the Department on the 1st of January 2012. Dr. Claassen will concentrate on Mineral Resource Throughput Management (MRTM) and will also add value to a number of existing courses, especially in the field of geo-metallurgy.

Activities

The well-known MINQUIZ competition for schools (Free State Province) was hosted by the Department of Geology. The Department took the task over from the Department of Chemistry that hosted the competition in the past.

Students at Namaqua Sands where heavy mineral deposit where ilmenite and other heavy minerals are mined.

Staff Members Visiting Abroad

Mrs. H.C.F. Pretorius conducted mineralogical research at the Massachusetts Institute of Technology (MIT) in Boston for three months during the latter half of 2012. She also visited the Laurentian University in Sudbury in Canada where she investigated a technique to concentrate unique minerals from samples (Bon Accord) from Barberton. This research forms part of a project under the auspices of Prof. Marianne Tredoux. Preliminary research indicates a possibility for the discovery of one or more unknown minerals. She also attended the 34th International Geological Congress in Brisbane, Australia, where she presented a paper entitled "Behaviour of Natural Radionuclides in Groundwater hosted in the Uranium-rich Granitic Basement of Vaalputs, Namaqualand, South Africa".

Dr. J. Claassen visited Brisbane during February 2012 to discuss the MRTM course with role players in Australia. Meetings were also scheduled with a number of mining companies where the aims and principles of the course were explained.

Dr. Lutz Hecht and Prof. W.-U. Reimold invited Prof. C. Gauert to visit the Natural History Museum in Berlin, Germany, where Prof. Gauert presented a public talk on "The Bushveld and Uitkomst Complexes – similarities and differences". Prof. Gauert also attended the 9th Annual Inkaba ye Africa workshop at GFZ, the German Research Centre for Geosciences, Potsdam, where he presented two research papers on topics related to the eastern Bushveld Complex. Students, Miss E. Kotze, Miss J.J. Beukes and Mr. H.Giebel were co-authors.

Prof. Gauert attended the First European Mineralogical Conference in Frankfurt, Germany, where he was a co-author on three research papers. Prof. Gauert also attended the International LASI V Conference – Karoo 2012, in Port Elizabeth in October where he was a co-author on two papers. At the beginning of October he participated in the GeoHannover Conference in Germany where he and Mr. C. Guenther presented a paper on the mapping of deuteric alteration and mineralisation critical for the geo-metallurgy of the Uitkomst Complex in the Mpumalanga Province.

Dr. F. Roelofse attended the 9th Annual Inkaba ye Africa workshop at GFZ, the German Research Centre for Geosciences, Potsdam, where he presented a paper on his Bushveld Igneous Complex research. Dr. Roelofse was also co-author on a paper with an Honours' student, Mr. A. Bentile, and Prof. M. Tredoux.

Prof. M. Tredoux conducted a few short overseas visits. The visits included the Bonn University, Germany, 12 – 15 November, where she had discussions with Prof. Chris Ballhaus about collaborative work which forms part of the Ph.D. work of Ms. Megan Purchase, who accompanied her on the visit. This was followed by a visit to Leoben University in Austria, 16 – 24 November, where she used the electron microprobe and Raman spectrometer with collaborators, Dr. Federica Zaccarini and Dr. Ronald Bakker. Prof. Tredoux also attended

Honours' students visit Namdeb on the Orange River where diamonds are mined.

the 9th Annual Inkaba ye Africa workshop at GFZ, the German Research Centre for Geosciences, Potsdam, Germany, from 25 – 30 November 2012. She was a co-author of five presentations with her students: Mr. A. Bentile (Hons.), Miss R. Makhadi (Hons.), Miss J. Markram (Hons), Mr. K. Milanzi (M.Sc.), and Miss M. Purchase (M.Sc.). Prof. Tredoux also presented a talk entitled "International programmes as vehicles for capacity building: An overview of Inkaba Phase 2".

Student Matters

Miss R. Makhadi won the second prize for Best Presentation at the 9th Annual Inkaba ye Africa workshop at GFZ, the German Research Centre for Geosciences, Potsdam, Germany.

Miss J. Markram, a Magister student, visited Potsdam in Germany during November 2012 to attend the 9th Annual Inkaba ye Africa workshop where she presented a talk entitled "Mineralogical and geochemical interpretations on the pegmatoidal and non-pegmatoidal Merensky Reef, Western Bushveld Complex". Her co-authors were Prof. M. Tredoux and Dr. F. Roelofse.

Other Magister students attending the 9th Annual Inkaba ye Africa workshop included Mr. H. Giebel, Miss M. Kotze, and Miss J.J.Beukes. All these students presented scientific talks and posters at the conference. Profs. M. Tredoux and C. Gauert put in much time and effort to manage the Inkaba ye Africa project at the UFS.

Mr. J. Clark (M.Sc.) attended the 9th International Symposium on Environmental Geochemistry (ISEG) at Aveiro, Portugal, 15 – 22 July. He presented a paper co-authored by Profs. M. Tredoux and C. Van Huysteen. The title of the paper was "The environmental geochemistry of mercury in Bloemfontein, South Africa".

Miss B. Kennedy, another M.Sc. student supervised by Prof. Tredoux, attended a congress on "Ophiolites" (2012) in Trabzon, Turkey, 16 – 22 May 2012, where she was presented with the prize for the best presentation. Her presentation was entitled "A novel mechanism to explain the highly enriched PGE ores in cumulus phases of ophiolite complexes". (Co-authors were Tredoux, M. and Steyl, G.).

The postgraduate Mineral Resource Management programme is still popular with 19 students registered for 2012 (15 students enrolled for 2011). Workshops were conducted at the University of Pretoria and at the Council for Geoscience in Pretoria. The following Geology degrees were conferred in 2012: 49 B.Sc., 16 B.Sc. (Honours), five M.Sc. and seven MRM degrees, two MRM diplomas and one Ph.D. Graduates from this institution continue to be preferred by employers in the mining industry.

It is expected that student numbers will continue to decrease for the next two years after which the numbers should remain constant. First-year student numbers declined from 194 students (GLG114) in 2011 to 118 in 2012. Second-year student numbers were 85 for GLG214 (98 in 2011) while third-year numbers for GLG324 were 79 (64 in 2011). Honours' students totalled 30 (29 in 2011).

Learners enjoy a volcano experiment during SciFest Africa held in Grahamstown.

Schools in the Gold category during the oral competition of the annual Minquiz Provincial Competition.

Visitors to the Department

Prof. Lew Ashwal from the University of the Witwatersrand paid a visit to Dr. F. Roelofse in February to discuss research matters.

Mr. Dennis Hoffman from Lonmin visited the Department on 19 April 2012 and had discussions with the lecturing staff. He acted in his capacity as a member of the Minerals Education Trust Fund, an organisation representing the South African Mining Industry on the tertiary education front.

The President of the Geological Society of South Africa, Mrs. Marcia van Aswegen, visited the Department on 20 April 2012. After discussions with staff members she gave a presentation on Sable Software, a package that is applicable to the mining environment.

Mr. R. da Silva from GW Base Metals visited the Department in August 2012. GW Base metals provided a bursary to a student for an honours' project. The bursary was awarded to Mr. K.C. Mahlahlane.

The prestigious biannual Alex du Toit Lecture was hosted by the Geology Department in August 2012 where the world-renowned komatiite expert, Prof. Nick Arndt, presented a lecture covering aspects of komatiite volcanology and geochemistry.

Dr. D. Harney (Anglo-American Base Metals) also visited the Department in December 2012 to discuss matters relating to the Minerals Education Trust Fund, as well as to present a donation from Anglo-Gold Ashanti for the erection of a core store.

Mr. Deon Nel from Anglo American (Kumba Iron Ore), who conducted geological exploration around the Kolomela Mine north of Postmasburg, visited the Department of Geology in September 2012. He presented a lecture on geological exploration for iron ore and also had a contact session with the students studying geology.

Mineral Resource Throughput Management (MRTM)

The Department of Geology hosted its first winter school for students in the MRTM programme from 30 July to 1 August 2012. Thirty-five students and delegates from the industry attended the school, which included practical workshops and a mini-symposium. Case studies on mining optimisation and the application of throughput accounting and change management in the mining environment were some of the topics covered during the symposium. Students were also advised regarding aspects of the compilation of reports and mini-dissertations. It is envisaged that this winter school will become an annual event.

Geological Excursions

Mrs. H. Pretorius and Dr. J. Claassen accompanied the sixteen Mineralogy honours students to Johannesburg in March 2012. The group visited Gold One's gold plant in Springs, Mintek's research facilities and attended two seminars on analytical techniques and geometallurgy at Mintek and the University of Johannesburg (UJ), respectively.

Prof. M. Tredoux and Dr. F. Roelofse conducted their annual geochemistry/metamorphic geology excursion to the Vredefort Impact Structure during September 2012. Sixty students were introduced to phenomena relating to the impact of a large meteorite, as well as the geochemistry and metamorphic petrology of the area.

During July 2012, Prof. Gauert accompanied twenty-two honours' students on their annual economic geology visit to mines and ore deposits to investigate their nature, genesis and age relationships. This excursion lasted eight days and nines mines were visited; including Kuruman, Sishen (iron ore), Kolomela (iron ore), Aggeneys (lead and zinc), Namaqua Sands (heavy minerals) and Copperton (copper, not in production) in the Northern Cape as

Honours students collecting samples at Rosh Pinah, southern Namibia. Sphalerite is a zinc sulphide that occurs at the Rosh Pinah mine.

well as Namdeb (diamonds) and Rosh Pinah (Namibia, zinc) and Scorpion (Namibia, zinc) on the lower Orange River.

Prof. Gauert also conducted economic geology excursions to the Free State Gold Fields that constituted three groups of honours' students visiting the Tsepong, Masimong and Phakisa shafts of Harmony Gold Mines during September 2012.

Prof. Gauert also accompanied 75 third-year students for one-day visits to the New Generations group of companies' dolerite quarry (aggregates supplier to Ready Mix Concrete) in Bloemfontein-East and to the dolerite quarry on the Kimberley road for open-pit mapping.

Prof. W.P. Colliston undertook an excursion to the Free State Goldfields during March 2012 where the students were enlightened regarding the complexities of underground mapping in a deep gold mine. The Masimong Shaft of Harmony Gold Mines was used for the mapping exercise that lasted for five days. Afterwards, the students had to submit the plans that resulted from their mapping exercise.

Dr. H. Praekelt and Prof. W. Colliston took the second-year students on a number of excursions to the Austin's Post area south of Bloemfontein where they were taught the skills of geological field work, mapping and the draughting of geological sections.

Mr. A. Odendaal entertained the first-year students on a number of excursions around the Bloemfontein area to introduce them to the local geology and for them to appreciate the wonders of the Karoo Supergroup with all its geological splendour. Included in their wanderings were plant and reptile fossils, intrusive geological relationships, as well as a variety of sedimentary rocks and structures.

Dr. H. Praekelt and Mr. A. Odendaal conducted the second-year students' excursion to Barkly East and the students were exposed to the upper part of the Karoo succession consisting of mudstone, sandstone and lava. Interesting volcanological and sedimentological characteristics were studied and discussed. An ancient volcanic neck occurs in the area and this usually gives rise to intense discussions and speculation.

Degrees Conferred

Ph.D. graduate during 2012:

- **Nel, L.** The geology of the Springbok Flats. (Supervisor: Prof. W.A. van der Westhuizen).

The following M.Sc. students graduated during 2012:

- **Globig, J.** Phase relationships of lherzolites from the Rovic mine, South Africa: a pilot study of extensive and intensive parameters using mineralogical; phase equilibria.

- **Joubert, A.** Structural-stratigraphic controls on carbon in the Witwatersrand Basin.
- **Ngaruye, J.** A petrographic and geochemical investigation of Sn-W-Nb-Ta-rich pegmatites and mineralised quartz veins in southeastern Rwanda.
- **Pretorius, H.C.F.** The content and behaviour of natural radionuclides in basement-hosted groundwater from Vaalputs, Namaqualand, South Africa.
- **Wildau, A.** An investigation of microscopic phases in the Bon Accord oxide body, Barberton region, South Africa.

Magister in Mineral Resource Management (MRM):

- Claassen, J.O.
- Henderson, D.
- Mmebe, S.G.T.
- Moller, W.R.
- Van den Heever, M.
- Van den Heever, M.B.
- Van Heerden, C.N.

Postgraduate diploma in Mineral Resource Management:

- Mogwera, K.G.
- Sheppard, D.A.

Community Service

Although Inkaba no longer supports the EarthWISE outreach project, Inkaba students acted as facilitators for the EarthWISE participation in SciFest 2012, TecnoX 2012 and the 2012 MinQuiz competition, and helped with an enrichment weekend for science teachers and learners in the Northern Cape. EarthWISE activities for 2012 included the following:

Geology boxes

Ten Geology boxes were made for the Department of Education. Only different rocks were requested. Three different sedimentary rocks, two igneous rocks and four metamorphic rocks were included in the boxes.

Science Unlimited, Bethlehem (8 & 9 March)

EarthWISE participated in the Science Unlimited Meeting in Bethlehem. The coordinator had a presentation entitled: "Whoa! My continent is moving!" The sessions were sold out and were presented eight times each of the two days with the classroom filled to the brim. The presentations entertained grade 8 – 10 learners from different schools.

SciFest Africa, Grahamstown (14 – 20 March)

EarthWISE assisted the science exhibition of the Faculty of Natural and Agricultural Sciences, UFS, at the annual SciFest in Grahamstown. The theme of the festival was "Science Rocks" and the Faculty's theme was "Journey to the centre of the Earth".

Second Science & Technology Train and Space Geodesy Observatory Workshop, Matjiesfontein (15 April – 21 April)

EarthWISE attended the above-mentioned workshop and delivered a presentation entitled: "Vehicle Science Centre from the S&T train".

Kovsie Open Day, University of the Free State, Bloemfontein (1 May)

EarthWISE organised an interactive exhibition for the Department of Geology to encourage learners to study geology.

Minquiz Provincial Competition, UFS, Bloemfontein (10 May)

The EarthWISE coordinator was responsible for organizing the annual Minquiz Provincial Competition in conjunction with Mintek and the Department of Geology. Thirty-nine Free State schools participated in the competition where the top three schools in the Platinum and Gold category walked away with prize money. The two highest scoring learners in the written test were invited to take part in the National Minquiz Competition in Randburg.

Astronomy Fair, UFS, Bloemfontein (19 July – 21 July)

The University of the Free State presented an Astronomy Fair and invited EarthWISE to attend. The first two days of the fair was for UFS101 students only, but it was open to the public on the last day. An exhibition was set up with meteorites, rock samples from the Vredefort Dome and posters explaining the different types of meteorites, and the difference between the different space objects and craters.

National Science Week, Boyden Observatory, Bloemfontein

The National Science Week was held from 30 July to 3 August 2012 and Boyden Observatory invited EarthWISE to form part of the activities at their site. Interactive presentations and experiment sessions were held for eight schools throughout the week. It was entitled "Meteorites, Impacts & Mass Extinction" and learners were shown rock samples of impact sites and real meteorites. Learners conducted their own experiments where they made moon craters.

Science Day, De Aar (24 & 25 October)

EarthWISE again presented the Science Day at De Aar High School. Six science presenters and a marketing manager participate in this day and they presented lectures to around 300 learners.

Interaction with Industry

Samancor Chrome, Eastern Chrome Mine, African Rainbow Minerals / Nkomati Mine, Norilsk Nickel, Dt. Rohstoff AG, Harmony Gold Mines, Two Rivers Platinum (ARM-Impala), Exxaro, and AngloGold Ashanti.

Research Outputs

Department of Geology

Research Articles

Colliston, W.P., Schoch, A.E. & Praekelt, H.E. 2012. Stratigraphy of the Mesoproterozoic Aggeneys Terrane, Western Namaqua Mobile Belt, South Africa. *South African Journal of Geology* 115(4): 449-464.

Roelofse, F. & Ashwal, L.D. 2012. The lower Main Zone in the Northern Limb of the Bushveld Complex - A >1.3 km thick sequence of intruded and variably contaminated crystal mushes. *Journal of Petrology* 53(7): 1449-1476.

Zintwana, M.P., Cawthorn, R.G., Ashwal, L.D., Roelofse, F. & Cronwright, H. 2012. Mercury in the Bushveld Complex, South Africa and the Skaergaard intrusion, Greenland. *Chemical Geology* 320-321: 147-155.

Chapter in Book

Tredoux, M. 2012. The mixed blessing of large mineral resources. In: *Terra*, edited by A. Lamprecht and I. Powel. Cape Town: SoSo Press. pp. 96-109.

Book

Roelofse, F. 2012. *Mineralogical, geochemical and isotopic constraints on the evolution of the lower Main Zone and Platreef on the Northern Limb of the Bushveld Complex: Bulletin 141.* Pretoria: Council for Geoscience.

Staff

Professor: Prof. W. Van der Westhuizen.

Associate-professors: Profs. W. Colliston, C. Gauert, and M. Tredoux.

Senior Lecturers: Drs. H. Praekelt, F. Roelofse and J. Claassen.

Junior Lecturers: Ms. H. Pretorius and Mr. A. Odendaal.

Part-Time Lecturers: Drs. J. Loock and L. Nel.

EarthWise-officer: Ms. M. du Plessis.

Affiliated Lecturers: Messrs. A. Dunne, J. Grobler, I. Hunt, P.G. Laurens, R. Vrijens, Dr. P. Viljoen, and Dr. H.B. Prinsloo.

Senior Officer: Ms. R. Immelman.

Secretary: Ms. P. Swart.

Technician: Mr. A. Felix.

Officer: Professional Services: Mr. P. Roodt.

Assistant Officer: Mr. J. Choane.

Technical Officer: Mr. D. Radikgomo.

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Department of

Mathematical Statistics and Actuarial Science

Overview

The Department of Mathematical Statistics and Actuarial Science has about 2 000 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 2012 with a new record in publication outputs. Publication units increased by more than 50%; from 11.2 units in 2011 (the previous record) to 16.9 units in 2012.

At the June 2012 graduation ceremony, three Ph.D. students and one Masters' student of Prof. Abrie van der Merwe graduated. To graduate three Ph.D. students at a single graduation ceremony probably constitutes a South African record in the field of Mathematical Statistics (although no statistician keeps statistics of this nature); it certainly is a South African record for a retired academic, probably not only for the field of Mathematical Statistics. For this achievement, Prof. Abrie van der Merwe received the 2012 Faculty Award for Mentorship (senior staff member) from the Faculty of Natural and Agricultural Sciences, UFS.

Justin Harvey, Ph.D. (Promotor: Prof. Abrie van der Merwe) and Ruaan van Zyl, M.Sc. (Supervisor: Prof. Robert Schall) were among the winners of the 2013 International Competition for Young African Statisticians, sponsored by Statistics South Africa. The competition identified a number of young African statisticians to attend the World Statistics Congress in Hong Kong (August 2012) to showcase their work. The selection was based on the submission of an as yet unpublished paper by each

Graduate students of Professors Abrie van der Merwe and Robert Schall. Back, from left to right: Justin Harvey, Ph.D. and winner of 2013 International Competition for Young African Statisticians; Prof. van der Merwe; Johan Hugo, Ph.D. Front: Elzanne du Plessis, M.Sc.; Ruaan van Zyl, M.Sc. and winner of 2013 International Competition for Young African Statisticians; Lizanne Raubenheimer, Ph.D.; and Prof. Schall.

entrant. Of the five South African prize winners, two came from the Department.

Mr. Michael von Maltitz, lecturer in the Department, received the 2012 Faculty Award for Teaching (young staff member) from the Faculty of Natural and Agricultural Sciences, UFS.

Prof. Daan de Waal was elected Honorary Member of the South African Statistical Association (SASA) in November 2012.

In April 2012, Dr. Morné Sjölander, lecturer in the Department, obtained his Ph.D. in Mathematical Statistics from the Nelson Mandela Metropolitan University with a thesis entitled "Time series models for paired comparisons".

A first-year student in Actuarial Science, Thinyane Mosala, won a bursary sponsored by the Hannover Reinsurance Group, which comprehensively covers the costs of his studies through to Honours' level.

Visitors to the Department

The Department received several national and international visitors, among them Prof. Jan Dhaene (CU Louvain), Mr. Lusani Muluadzi and Dr. Senzo Myeni (ESKOM), Mr. Dawie Roodt (Efficient Group) and Ms. Hesna Rheeder (Price-Waterhouse-Coopers), all of whom presented lectures at the annual Workshop on Applications of Statistics and Probability in Energy, Finance and Actuarial Science; hosted by the Department in March 2012. The workshop was organised by Mr. Frans Koning, leader of the Department's Actuarial Programme.

International Collaborative Research Projects

Prof. Max Finkelstein, an international authority in the area of mathematical reliability, has three ongoing international research projects. The first project is with Prof. J.H. Cha (Ewha Women's University, South 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"; the collaboration includes annual visits of six weeks each to the Max Planck Institute. Prof. Finkelstein also collaborates with the Dr. Rozenhaus of the Reliability Unit of the 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 a year.

Prof. Finkelstein gave a keynote address on "Reliability approaches to human mortality modeling" at the 5th Asia-Pacific International Symposium on Advanced Reliability and Maintenance Modeling (APARM 2012) in Nanjing, China.

Prof. Finkelstein is the Editor, and Prof. Schall an Associate Editor, of the *South African Statistical Journal*.

Actuarial and Statistics Students Council (ASSC) picnic.

Prof. Robert Schall is a statistical consultant to Quintiles, an international clinical contract research organisation, and to TB Alliance, an international non-governmental organisation dedicated to the development of new treatments for tuberculosis. The joint project with TB Alliance (with Dr. Carl Mendel) involves the "Statistical characterization of the early bactericidal activity of anti-tuberculosis drugs".

Research Outputs

Department of Mathematical Statistics and Actuarial Science

Research Articles

Cha, J.H. & Finkelstein, M. 2012. A note on curable shock processes. *Journal of Statistical Planning and Inference* 142: 3146-3151.

Cha, J.H. & Finkelstein, M. 2012. Burn-in and the performance quality measures in continuous heterogeneous populations. *Journal of Risk and Reliability* 226: 417-425.

Cha, J.H. & Finkelstein, M. 2012. Burn-in via shocks for avoiding large risks. *Journal of Risk and Reliability* 226: 318-325.

Cha, J.H. & Finkelstein, M. 2012. Information-based thinning of point processes and its application to shock models. *Journal of Statistical Planning and Inference* 142: 2345-2351.

Cha, J.H. & Finkelstein, M. 2012. On a terminating renewal process with independent wear increments. *Structure and Infrastructure Engineering* 8: 403-408.

Cha, J.H. & Finkelstein, M. 2012. Shocks as burn-in in heterogeneous populations. *Communications in Statistics-Theory and Methods* 41: 325-340.

Cha, J.H. & Finkelstein, M. 2012. Stochastic analysis of preventive maintenance in heterogeneous populations. *Operations Research Letters* 40: 416-421.

Cha, J.H. & Finkelstein, M. 2012. Stochastic survival models with events triggered by external shocks. *Probability in the Engineering and Information Sciences* 26: 183-195.

Chikobvu, D. & Chifurira, R. 2012. Predicting Zimbabwe's annual rainfall using the Southern Oscillation Index: Weighted regression approach. *The African Statistical Journal* 15: 87-107.

Chikobvu, D. & Chinhamu, K. 2012. Random walk theory: Empirical evidence from the gold Market. *Pioneer Journal of Theoretical and Applied Statistics* 4: 29-45.

Chikobvu, D. & Makarati, F. 2011. The challenges of solid waste disposal in rapidly urbanizing cities: A case of Highfield suburb in Harare, Zimbabwe. *Journal of Sustainable Development in Africa* 13: 184-199.

Chikobvu, D. & Sigauke, C. 2012. A frequentist and Bayesian regression analysis to daily peak electricity load forecasting in South Africa. *African Journal of Business Management* 6: 10524-10533.

Chikobvu, D. & Sigauke, C. 2012. Regression-SARIMA modelling of daily peak electricity demand in South Africa. *Journal of Energy in Southern Africa* 23: 23-30.

Chikobvu, D., Sigauke, C. & Verster, A. 2012. Modelling daily increases in peak electricity demand using a generalized Pareto distribution. *South African Statistical Journal*: Peer-reviewed proceedings of the 54th Annual Conference of the South African Statistical Association, Special Issue 1: 58-66.

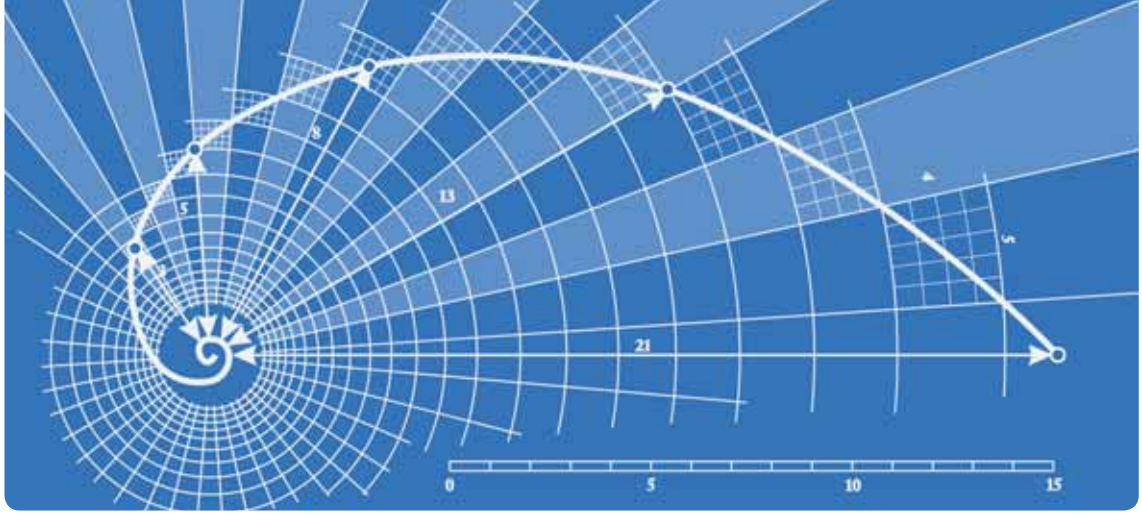
Chikobvu, D., Sigauke, C. & Verster, A. 2012. Winter peak electricity load forecasting in South Africa using extreme value theory. *South African Statistical Journal* 46: 377-393.

De Waal, D.J. & Verster, A. 2012. Modelling high river flows and Southern Oscillation Index Jointly. *Structure of Infrastructure Engineering* 8: 367-372.

Finkelstein, M. 2012. Discussing the Strehler-Mildvan model of mortality. *Demographic Research* 26: 191-206.

Finkelstein, M. 2012. On ordered subpopulations and population mortality at advanced ages. *Theoretical Population Biology* 81: 292-299.

Finkelstein, M. 2012. The Gompertz law of mortality and longitudinal data. Comment on



"The quadratic hazard model for analyzing longitudinal data on aging, health and life span" by Yashin, Arbeev, Akushevich, Kulminski, Ukraintseva, Stallard & Land. *Physics of Life Reviews* 9: 189-190.

Harvey, J. & Van der Merwe, A.J. 2012. Bayesian confidence intervals for means and variances of lognormal and bivariate lognormal distributions. *Journal of Statistical Planning and Inference* 142: 1294-1309.

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Staff

Senior Professor: Prof. Max Finkelstein.

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

Senior Lecturers: Dr. Andréhette Verster, Dr. Delson Chikobvu, Dr. Martin van Zyl; Ms. Linda van der Merwe, and Mr. Frans Koning.

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

Part-time Lecturers: Dr. Ariane Neethling; Mr. Stefan Britz, and Mr. Rodrique Gnitchogna.

Secretary: Mrs. Elize Mathee.

Assistant Officer: Mrs. Ella Hayes.

Messenger: Mr. William Baranye.

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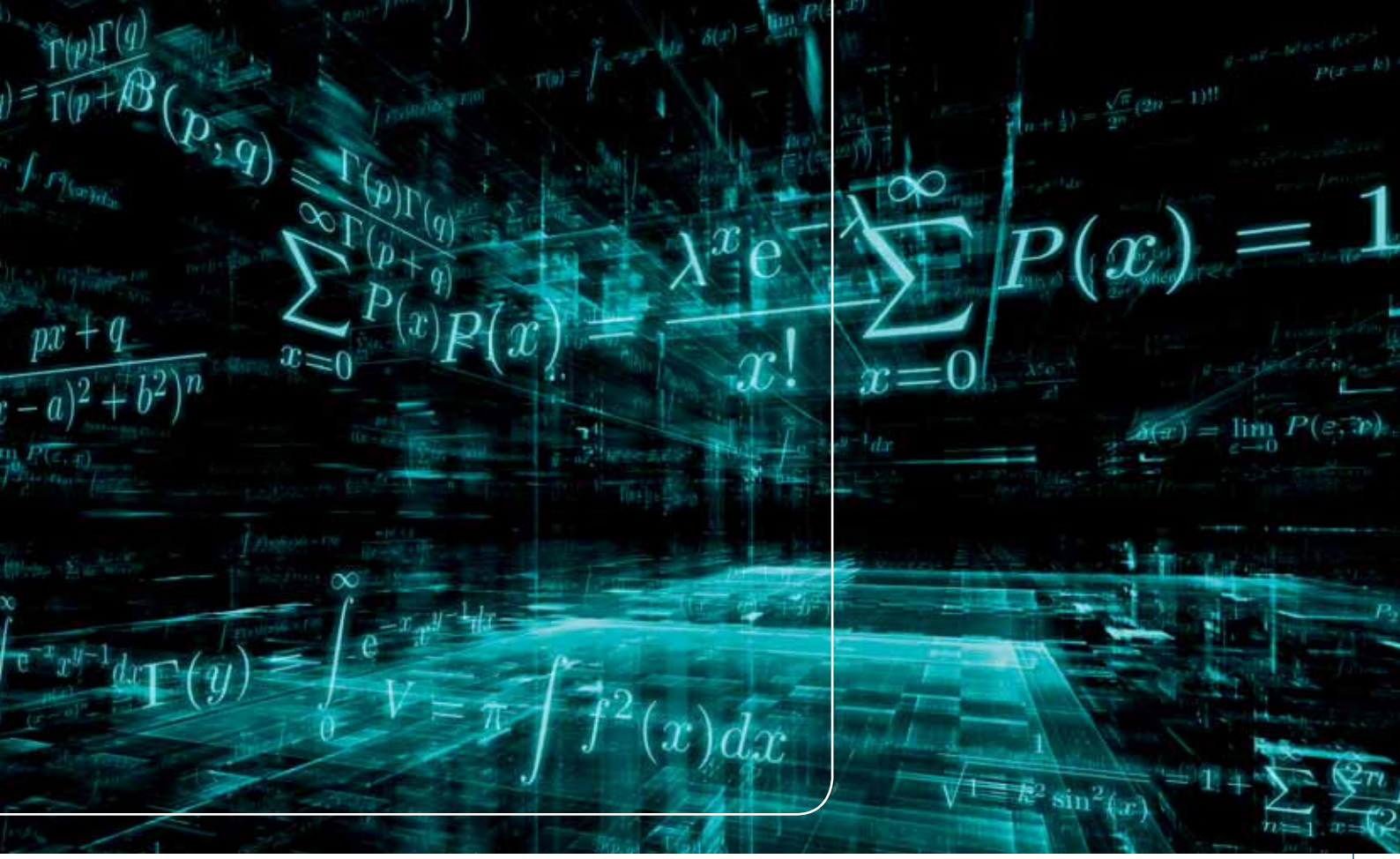


Department of

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 the Department typically obtain the degrees B.Sc., B.Com and sometimes even BA. We also offer service modules to many students that study in other scientific directions, such as Biology.

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 that are interested in Mathematics Olympiads.

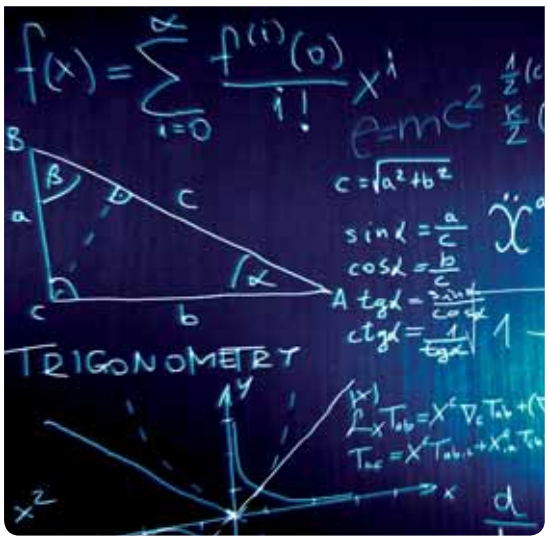
Activities and Achievements

Prof. Johan Meyer continued his research by visiting a colleague in Miskolc, Hungary, as well as a colleague from the National Cheng Kung University in Taiwan. During the latter visit, he presented an invited talk at the National Taitung University, Taitung, Taiwan. He also received a visit from a former Ph.D. student to continue further research that resulted from the student's dissertation. Two research papers (one of which is already accepted for publication) were written due to these visits. Furthermore, Prof. Meyer was closely involved (as in the past 20 years) with the training and setting of papers with respect to Mathematics Olympiads, nationally and internationally. He also reviewed several papers for *Zentralblatt Math* (published by Springer), and has been appointed as reviewer for *Math Reviews* as well. He was also appointed as the convener for the problems selection committee of the upcoming International Mathematical Olympiad to be held in South Africa in July 2014.

Dr. S. Dorfling collaborated with Dr. M.J. Dorfling in the area of graph theory and a paper entitled "Graph colourings with forbidden k-coloured subgraphs" was accepted for publication.

Prof. T.M. Acho reviewed two papers for the *American Mathematical Society Math Review* database.

Prof. J. Schröder paid a research visit to "Arbeitsgruppe (AG) Diskrete und Algorithmische Mathematik", Technical University, Berlin, June to December 2012. During this time, on 31 August 2012, he gave a talk entitled "Eigen sequences; Kirchhoff and Graphs" at the research seminar in the context of the AG Diskrete Mathematik. A paper entitled "Finite Euler Transformation" was also submitted for publication. Dr. Schröder also reviewed an article for Quastiones Mathematicae.



Research Outputs

Department of Mathematics and Applied Mathematics

Research Articles

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Meyer, J.H., Szigeti, J. & Van Wyk, L. 2012. A Cayley-Hamilton trace identity for 2 x 2 matrices over Lie-solvable rings. Linear Algebra and its Applications 436: 2578-2582.

Dorfling, M.J. & Meyer, J.H. 2012. On polynomials and divisibility. American Mathematical Monthly 119: 502-506.

Ke, W-F. & Meyer, J.H. 2012. Matrix near-rings and 0-primitivity. Monatshefte für Mathematik 165: 353-363.

Staff

Main Campus:

Professors: Profs. Johan Meyer, Alain Cloot, and Schalk Schoombie.

Associate-professor: Prof. Thomas Acho.

Senior lecturers: Dr. Hubertus Bargenda and Ms. Julia van Niekerk.

Lecturers: Dr. Samantha Dorfling, Ms. Ansa Kleynhans, and Mr. Christiaan Venter.

Temporary lecturers: Prof. Dana Murray, Mss. Larisse Bolton, Elizabeth Viljoen, Magrietha Theron, Anita Swart, Annelie Litthauer, Marina Botha, and Hermina Oosthuizen, and Mr. Jon Smit and Mr. Ben-Eben de Klerk.

Postdoctoral fellow: Dr. Simon Childs.

Qwaqwa Campus:

Associate-professor: Prof. Jo Schröder.

Lecturer: Mr. Patrick Mbambo.

Junior lecturer: Ms. Christa Faber.

Temporary lecturer: Mr. Nallapan Sebastian.

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Department of

Microbial, Biochemical and Food Biotechnology

Overview

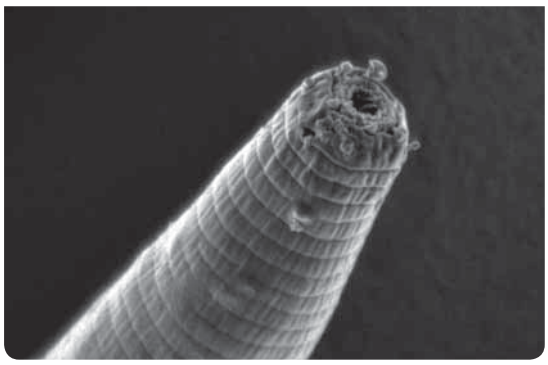
One of the highlights of 2012 was that the new undergraduate laboratories, built at a cost of R15.9 million, were taken into use at the beginning of the academic year. These large laboratories are especially useful to host practical sessions for the first-year Biology students, whose numbers usually exceed 600. Both lecturers and students were of the opinion that these new facilities greatly enhanced the practical teaching and learning experience. Towards the end of the year the Department received the wonderful news that the Department of Higher Education had allocated a further R22 million for the 2013 fiscal year that was to be used for the urgently-needed upgrading of the current Biotechnology building and to provide much needed additional laboratory and office space.

Academics from the Department maintained a high international profile during 2012. Some of the research done in the Department was based on excursions ranging from the dark depths of gold mines to the lofty foothills of the Himalayas. Some of the published work made international and national headlines, as indicated below.

Activities and Achievements

The discovery of a minuscule nematode of about 0.5 mm in length in the Beatrix gold mine near Welkom at a depth of 1.3 km by an international research team, with Prof. Esta van Heerden as the leader of the UFS scientists, still make headlines in 2012. *Halicephalobusmephisto* (devil's worm) made it into the list of Top Ten New Species of the World. The list is published by the International Institute for Species Exploration (IISE) at Arizona State University, USA, and a committee of scientists from around the world. An article on this new worm species appeared

Prof. Esta van Heerden on the cover of Engineering News.



Halicephalobusmephisto (devil's worm) discovered in a gold mine at a depth of 1.3 km.

in the authoritative journal, *Nature*, in June 2011 (474: 79-82). As far as is known, this nematode is the deepest-living terrestrial multicellular organism in the subsurface. The work of Prof. van Heerden's group on extremophiles in South African deep mines also featured in the April/May 2012 issue of *Engineering News*, with Prof. van Heerden becoming the Department's first "cover girl".

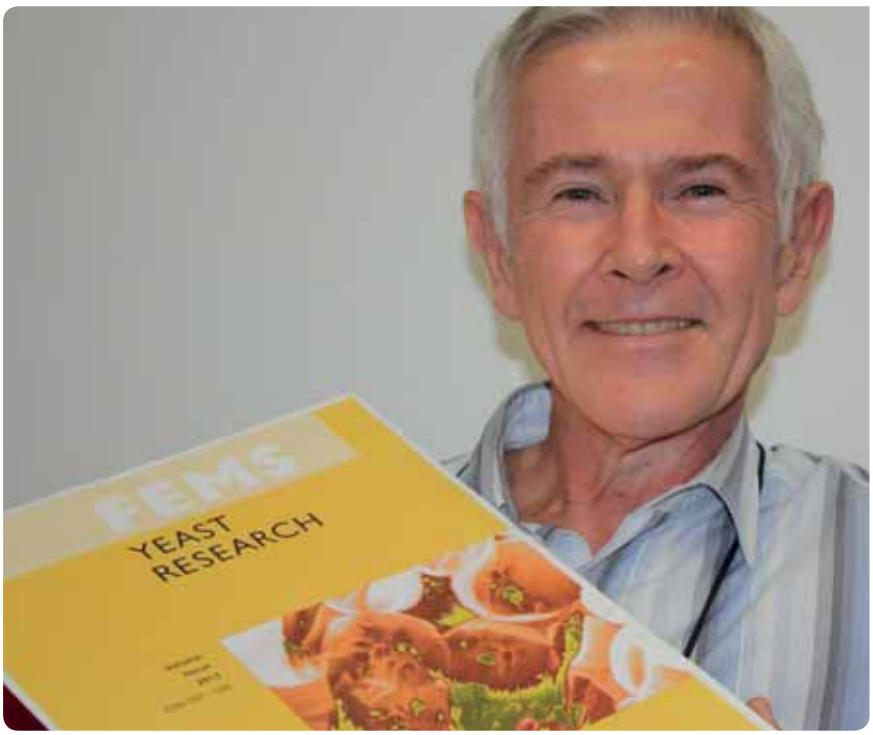
Prof. Lodewyk Kock experienced a phenomenal year. His research also made it to the cover of a journal: an article authored by C.W. Swart, K. Dithebe, C.H. Pohl, H.C. Swart, E. Coetsee, P.W.J. van Wyk, J.C. Swarts, E.J. Lodolo and J.L.F. Kock and published in *FEMS Yeast Research* 12 (2012): 867-869, was selected for promotion by the Wiley-VCH Verlag house-journal *Biotec Visions* as one of a few "very interesting articles". This discovery was also selected from 20 000 articles by *Global Medical Discovery* for worldwide promotion.

A colour enhanced nano-micrograph from this article was selected for the cover of the 2013 issue of *FEMS Yeast Research*. The micrograph was obtained by nano-scanning Auger microscopy linked to argon etching in scanning electron microscopy mode; showing for the first time gas bubbles inside the cytoplasm of a fermenting yeast cell. The group also found that the anti-malarial drug, chloroquine, is in fact a fertility drug with implications to the present treatment of this disease. A yeast genus (*Kockiozyma gen. nov.)* was named in his honour for his contributions to yeast systematics, especially the lipomycetaceous yeasts.

In August, Prof. Kock presented the opening and plenary lecture at an international symposium organised by the famous Mayo School of Continuous Professional Development in Minneapolis, USA. His lecture was on the application of a new nanotechnology to medicine, developed by the Kock team in collaboration with Prof. Pieter van Wyk (Centre for Microscopy) and Prof. Hendrik Swart and Dr. Liza Coetsee of the UFS Department of Physics. This was followed by an invited lecture on this nanotechnology at the Boys' Town National Research Hospital in Omaha, Nebraska, US. Prof. Kock was invited to present the opening and plenary lecture at the 4th International Conference on Nanoscience and Nanotechnology held at the UFS. In addition, he gave the keynote lecture on nanotechnology in medicine at the BITs 3rd Annual International Conference of Medichem (ICM-2012) in Beijing, China. Here he was the Renowned Speaker and Session Chair. Also at this conference, Dr. Chantel Swart-Pistor gave a lecture on invitation. Following this, Prof. Kock and Dr. Chantel Swart-Pistor presented lectures at the Chinese Academy of Sciences in Beijing. Prof. Kock was also invited to give one of the two opening keynote lectures at the First International Conference on Infectious Diseases and Nanomedicine (ICIDN), held in December in Kathmandu, Nepal. Prof. Kock literally ended the year on a high note, as after the latter conference he undertook an excursion to collect samples for yeast isolations along the Mount Everest "highway" that winds through the villages of the Sherpa tribe. This took three days of up to six hours of walking per day in icy cold conditions.

Also at the above conference in Nepal, Prof. Rob Bragg gave two excellent lectures entitled "Bacteriophages as potential treatment option of antibiotic-resistant bacteria" and "Bacterial resistance to quaternary ammonium compounds".

In April, Prof. James du Preez presented an invited paper on the biotechnological potential of the yeast *Kluyveromycesmarxianus* at the BITs 5th Annual World Congress of Industrial Biotechnology (ibio-2012) in Xi'an, China. In June 2012 Prof. Du Preez attended



Prof. Lodewyk Kock and the FEMS Yeast Research cover page (Adapted by F. Belliard, FEMS Central Office).

the Annual General Meeting of the American Society for Microbiology (ASM) in San Francisco, where, in his capacity as ASM ambassador to South Africa, he attended several ASM ambassador meetings. In August, a group comprising Profs Lodewyk Kock, James du Preez, Koos Albertyn and postgraduate student, Ruan Ells, participated in the 13th International Congress on Yeasts held in Madison, Wisconsin, USA. Prof. Albertyn organised and chaired a session entitled "New genetic, transformation and expression systems" at this congress. Profs. Du Preez and Kock attended the meeting of the International Commission on Yeasts as commissioners representing South Africa.

Prof. Du Preez was appointed joint Editor-in-Chief of *Biotechnology for Biofuels*, a high-impact open-access online journal, and was invited to serve as a member of the Applied Life Sciences and Non-Medical Biotechnology Panel of the European Research Council to evaluate grant applications submitted to this institution. This appointment required attendance of two meetings of the panel in Brussels for the 2013 round of applications.

On national level, the *Mail & Guardian* included Dr. Olihile Sebolai in the list of 200 young South Africans (35 years and younger) who are the most influential achievers in various fields, such as business, science, education, health, law and arts. Dr. Sebolai, listed in the health category, had made headlines for a groundbreaking discovery concerning future nanotechnology, earning him a M.Sc. in microbiology and six awards.

Achievements of Students

Also making the news was an article originating from the research of Dr. Carina Bothma, post-graduate student Cobus Feirreira and supervisor Prof. Arno Hugo on the health benefits of supplementation of pig feed with conjugated linoleic acid that was published in the March 23 issue of *Farmer's Weekly*.

Mr. Cobus Feirreira and supervisor, Prof. Arno Hugo, wrote on the health benefits of the supplementation of pig feed with conjugated linoleic acid, which was published in the March 23 issue of *Farmer's Weekly*.

During the 4th International Conference on Nano-science and Nanotechnology held in April at the UFS, student Khumisho Dithebe received an award for the best M.Sc. poster presentation in biology. The supervisors were Prof. Lodewyk Kock and Dr. Chantel Swart-Pistor.

Ms. Esti-Andrine Smith, a Ph.D. student in Food Science (supervisor Dr. Koos Myburgh), received the Brian Koeppen Award from SAAFoST (SA Association for Food Science and Technology) as this Association's most prestigious student of 2012.

In October, a group comprising 62 third-year Microbiology students, with Profs. Du Preez and Stephanus Kilian, undertook what has now become an annual excursion to the SAB Training Institute, the Alrode Brewery and the SAB World of Beer in Johannesburg. Prof. Bettie Lodolo, brewing consultant at SAB and affiliate associate-professor in the Department, presented a lecture on the theoretical and practical aspects of the beer-brewing process. The students

found this exposure to industry highly stimulating and thoroughly enjoyed the excursion (and the free beer). SAB partially sponsored the tour.

Research

The Department comprises two divisions, namely Microbiology and Biochemistry, and Food Science. Within these two divisions there are various research groups.

Research led by Prof. Garry Osthoff of the Food Science Division on milk of non-dairy animals has provided new insight in the control of the chain length of synthesised fatty acids. In the mammary gland, the fatty acid synthesis process is terminated by a thioesterase after the addition of 8 to 16 carbon atoms. In the milk of the domesticated species, e.g. cow and goat, the termination is mainly focused at 16 carbon atoms in length, while for one ruminant family, *Alcelaphinae* (blesbok and hartebeest), it is at 14 carbon atoms. In the African elephant and the rhinoceros it is at 12 carbon atoms or shorter, which shows that this property is determined genetically. The synthesis does not change much in most species; however, it was observed that in the African elephant and the rhinoceros the synthesis of short chain fatty acids is favoured as lactation progresses. The difference being that in rhinoceros milk the amount of 12:0 fatty acids increases together with the short chain fatty acids, whereas in the elephant milk it increases together with the longer chain fatty acids. Application of milk with a specific fatty acid composition would find application in products for people who suffer from a genetic disorder in their fat metabolism, specifically a defective enzyme, acylCoA synthase. Another application would be butterfat with different melting properties, resulting in improved spreadability. The research on elephant milk led to an invited contribution of a chapter in the book "Elephants: Ecology, Behaviour and Conservation".

Dr. Koos Myburgh's research group is involved with the improvement of dairy processes. During 2012, a final patent, number 2012/01139, was filed on the improvement of the yoghurt process. Dr. Myburgh was appointed to the South African National Committee of the International Dairy Federation (IDF) and also to a specialised international IDF workgroup on the adulteration of milk with whey powder.

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 and peel), seeds and cladodes of 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. The cladodes are being investigated as a source of nutraceutical compounds. These include mucilage, a major compound in cactus pear fruit and cladodes, which is responsible for the slimy appearance. It is investigated for its role as fat replacer, water binder and gelling agent in food products such as carrot cake and marshmallows. Cactus cladode flour is rich in dietary fibre and was investigated for use in traditional fermented beverages such as mageu and beer, as well as baked products such as health bread.

Prof. Lodewyk Kock at the Everest viewpoint with Mount Everest in the background.

The research of Prof. Celia Hugo on the microbial quality of food is ongoing, especially on the chryseobacteria and their significance in food. Upon invitation, a chapter on the food-related members of the Flavobacteriaceae (of which *Chryseobacterium* is one of the genera) was published in the "Handbook of Culture Media for Food and Water Microbiology" (third edition).

Prof. Arno Hugo and his postgraduate students continued with investigations into the manipulation of the lipid component of the diets of farm animals with the aim of improving the technological and/or health properties of fat tissue from such animals. Several of the completed projects were successful in improving the health properties of products from monogastric animals such as pigs and chickens (and eggs). The researchers also succeeded in improving the fatty acid profiles of ruminants with the inclusion of *Acacia karroo* leaves in goat diets. This research programme produced a large number of congress contributions and several peer reviewed articles.

Dr. Olihile Sebolai (left) with Mr. Trevor Manual, Minister in the Presidency, at the 2012 Mail and Guardian's Top 200 Young South Africans Awards that was held on the 21st of June in Sandton.

The Extreme Biochemistry group, where the TIA/UFS Metagenomics Platform is hosted, had a busy deep subsurface sampling year that included an influx of international researchers to the UFS. The sampling also included a new aspect of ^{81}Kr dating of groundwater that is funded by the National Geographic Society and led by Dr. Roland Purtschert from the University of Bern. The project has a lot of momentum with continued funding by the Deep Carbon Observatory (DCO), sponsored by the Alfred P. Sloan Foundation. The research specifically addresses microbial carbon transformations in environments influenced by high hydrogen fluxes and abiogenic production of organic molecules, allowing SANERI (South African National Energy Research Institute) and SACCCS (South African Centre for Carbon Capture and Storage) to sponsor a Ph.D. student to investigate carbon sequestration for terrestrial storage in South Africa.

During the year, Prof. Esta van Heerden attended the Pathway Tools Workshop in the USA and the bioremedial collaboration for platform development was extended with a research visit to Geosyntec Consultants, USA, to investigate several developments in bioremediation for implementation in South African environmental remediation strategies. The group participated in an invited public lecture series at the Boyden Observatory on astrobiology and is also involved with the ACCESS (Applied Centre for Climate and Earth System Science) Habitable Planets Workshop to extend the multidisciplinary interaction of geology and microbiology.

The group has several projects that deal with mining and industrial contamination. Three upscaled projects linked to industrial partners for the use of biological engineered systems are currently available as demonstration of this technology in South Africa. Using the knowledge gained from the deep subsurface work, the research group has created a service component to make microbial diversity assessments available to industry as a selection tool for soil and water health. This can also identify environmental biomarkers as an early detection for contamination.

The Food Biotechnology research group, led by Prof. Bennie Viljoen, continued research to focus on indigenous fermented foods and beverages with emphasis on food security in rural areas. A specific project was aimed at improving the livelihoods and incomes of rural communities and small-scale processors through improved technologies for processing and the development of unique fermented products native to Zambia, namely Mabisi (milk-based), Munkoyo and Chibwantu (maize/grits or millet and roots – *Rynchosiainsignis* and *Rynchosiaheterophylla*). These are important beverages utilised as weaning and/or complementary foods for children, as supplements for immune-compromised individuals, and as dietary staples for adults. The project contributes to local entrepreneurship and food security by obtaining fundamental knowledge of the growth kinetics, biochemical activities and technological properties of the micro-organisms native to these fermented beverages. Research activities focused on the micro-

Profs. James du Preez, Lodewyk Kock, Koos Albertyn and postgraduate student Ruan Ells at the 13th International Congress on Yeasts held in Madison, Wisconsin, USA.

bial loads (yeasts, lactic acid bacteria and pathogens) associated with these products, which might be applied as starter cultures, probiotics, and antagonists or as agents of biological control. The influence of a range of environmental variables on their growth, their interactions with other micro-organisms and their contributions to food quality, safety and shelf-life were explored. The most significant finding was the unique application of indigenous roots as enzyme inducers during the fermentations, which will be further investigated to evaluate its commercial value. Two Ph.D. students focused on the enzymes associated with the rapid utilization/breakdown of the maize in the fermented product. Preliminary results indicated an enhanced amylase activity.

The Lipid Biotechnology research group (including its community service unit, SAFOI – South African Fryer Oil Initiative) under the leadership of Prof. Lodewyk Kock, Dr. Carlien Pohl-Albertyn and Dr. Chantel Swart-Pistor, was very productive in 2012 (see Overview above and www.ufs.ac.za/myoilguide). Dr. Chantel Swart and two M.Sc. students (sponsored by SAFOI) successfully presented their work at the 4th International Conference on Nanoscience and Nanotechnology held at the UFS, as well as at the BITs 3rd Annual International Conference of Medichem in Beijing, China. In line with their mission, this group concentrated on the development of novel medicines such as antifungal and anticancer drugs. Here, yeasts linked to nanotechnology, specifically Nano Scanning Auger Microscopy (NanoSAM), are used to uncover novel medicines. 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 the 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 laboratories from the Mayo Clinic Medical School and Boys' Town National Research Hospital, all based in the USA.

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 a rare fatty acid can be incorporated into host lipids and may reduce the production of this virulence factor during infection by pathogenic yeasts and so reduce the associated inflammation. In addition, long-chain polyunsaturated fatty acids, which elicit their antifungal activity by inducing apoptosis of the yeast cells, can be used in combination with commercial antifungals to synergistically increase their antifungal activity. These findings indicate the importance of fatty acids during infection by pathogenic yeasts. The work on oxylipins in pathogenic yeasts was presented at the 13th International Congress on Yeasts in Madison, USA.

The Molecular Virology Research Group of Dr. Trudi O'Neill focuses on gastroenteritis-causing viruses, specifically rotavirus. Current research involves the development of a rotavirus reverse-genetics system and is conducted in collaboration with Prof. Albie van Dijk at the North West University in Potchefstroom. This work was funded by a senior fellowship awarded to Dr. O'Neill by the European Foundation Initiative for Neglected Tropical Diseases (EFINTD) and Dr. O'Neill attended a grantees meeting in Maputo, Mozambique

Prof. Bettie Lodolo at the SAB Training Institute during a lecture to third-year Microbiology students.

(30 January – 1 February 2012). Attendance of the 11th International Symposium on dsRNA viruses in San Juan, Puerto Rico (27 November – 1 December 2012), was also partly funded by the fellowship. In addition to the reverse-genetics project, the production of virus-like particles in yeast is another research focus in collaboration with Prof. Koos Albertyn.

The research of the Clinical Biochemistry group, led by Dr. Frans O'Neill, is currently focused on human cellular detoxification. The current work uses next-generation sequencing to detect single nucleotide polymorphisms (SNPs) within the GLYAT gene of a South African cohort of African descent. 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. As part of the preparation for the analysis of the data, Dr. O'Neill attended a workshop on Population Genetics and Genomics in Cape Town, 4 – 8 June. Dr. O'Neill also headed a committee consisting of members from the Faculties of Natural and Agricultural Sciences and Health Sciences that was successful in obtaining funding from the Department of Higher Education and Training (DHET) to purchase a next-generation sequencer for the UFS. This will allow researchers to do their high-throughput sequencing on-site and make valuable contributions to the progress of several projects across the two faculties.

The Yeast Molecular Biology Research Group, led by Prof. Koos Albertyn, further investigated the application of a novel yeast expression system, patented in 2011, that was developed for the heterologous expression of various proteins. These include a collaborative project with Dr. Trudi O'Neill to express viral particles in a number of selected yeast species. In collaboration with Dr. Carlien Pohl-Albertyn, a project funded by SANBI (South African National Biodiversity Institute) led to the description of two newly-discovered yeast species in 2012. These were named *Cryptococcus cyanovorans*, referring to the ability of this strain to assimilate cyanide, and *Trichosporon vanderwaltii*, named in honour of Prof. Johannes van der Walt, an eminent yeast taxonomist and former Extraordinary Professor affiliated with the Department, who passed away in 2011. Another collaborative project with Dr. Pohl-Albertyn attempts to identify and investigate enzymes involved in prostaglandin synthesis in the pathogenic yeast *Cryptococcus neoformans* for possible drug targeting.

The results of an expanded study to evaluate the role of each of the five alcohol dehydrogenase isozymes in *S. cerevisiae* were published in 2012. This study, in collaboration with Prof. du Preez and conducted by Dr. Olga de Smidt, was done by analysing the growth parameters, physiological and transcriptional behaviour of quadruple deletion mutants, each harbouring only one functional ADH gene. One important observation was that a strain expressing only ADH1 was able to utilise ethanol, a function previously attributed to ADH2.

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. Research, in collaboration with Prof. Koos Albertyn, on the physiological role of five ADH genes encoding alcohol dehydrogenase (Adh) isozymes associated with ethanol metabolism in

Saccharomyces cerevisiae continued (see above). The metabolic effects of multiple ADH gene deletions were investigated using a high-throughput analytical approach. The metabolic profiles of these deletion mutants were determined using an OmniLog® Phenotype MicroArray™ system, which facilitates the rapid and precise quantitation of phenotypes, thereby providing a deeper understanding of the functional substitution of the five ADH isozymes.

The investigation of ethanol production from a novel lignocellulosic biomass source, the cladodes of the prickly pear cactus (*Opuntia ficus-indica*), using *Kluyveromyces marxianus* was concluded in 2011. The advantage of using this feedstock is that *O. ficus-indica* is well-adapted for cultivation in semi-arid regions. The year saw the conclusion of the second phase of this research, namely the protein enrichment of an enzymatic hydrolysate of the cladodes through the cultivation of the yeasts *K. marxianus* and *Candida utilis*. The total protein content of the hydrolysate was increased up to 2.8-fold and the amino acid profile of the yeast biomass compared favourably with the FAO reference. *K. marxianus* proved its potential as an alternative to *C. utilis* for single-cell protein production from lignocellulosic biomass at an elevated temperature.

To further the metabolic engineering of *K. marxianus* for ethanolic fermentation, the ploidy of the yeast was determined using flow cytometry. Cassettes for the disruption of the *K. marxianus* KU70 genes were constructed from a *Candida albicans* SAT1-flipper plasmid; disruption of the KU70 gene would make the yeast more amenable to genetic transformation with foreign genes. The bioinformatics and systems biology aspects of *K. marxianus* (investigated by Mr. Schabort) resulted in the complete sequencing, assembly and annotation of this yeast, revealing approximately 5 000 genes. A genome scale metabolic pathway model was constructed from the annotated genome, which could soon be used for predictive simulations for metabolic engineering. Software was developed for a convenient assembly and annotation workflow, which can be used for similar projects in the future. Also, various other computer programs were developed for high-throughput genome-scale systems biology to handle data from high-throughput sequencing and GC-MS and LC-MS analyses. An experimental protocol for intracellular metabolomics using LC-MS was also set up and protocol for GC-MS is in progress.

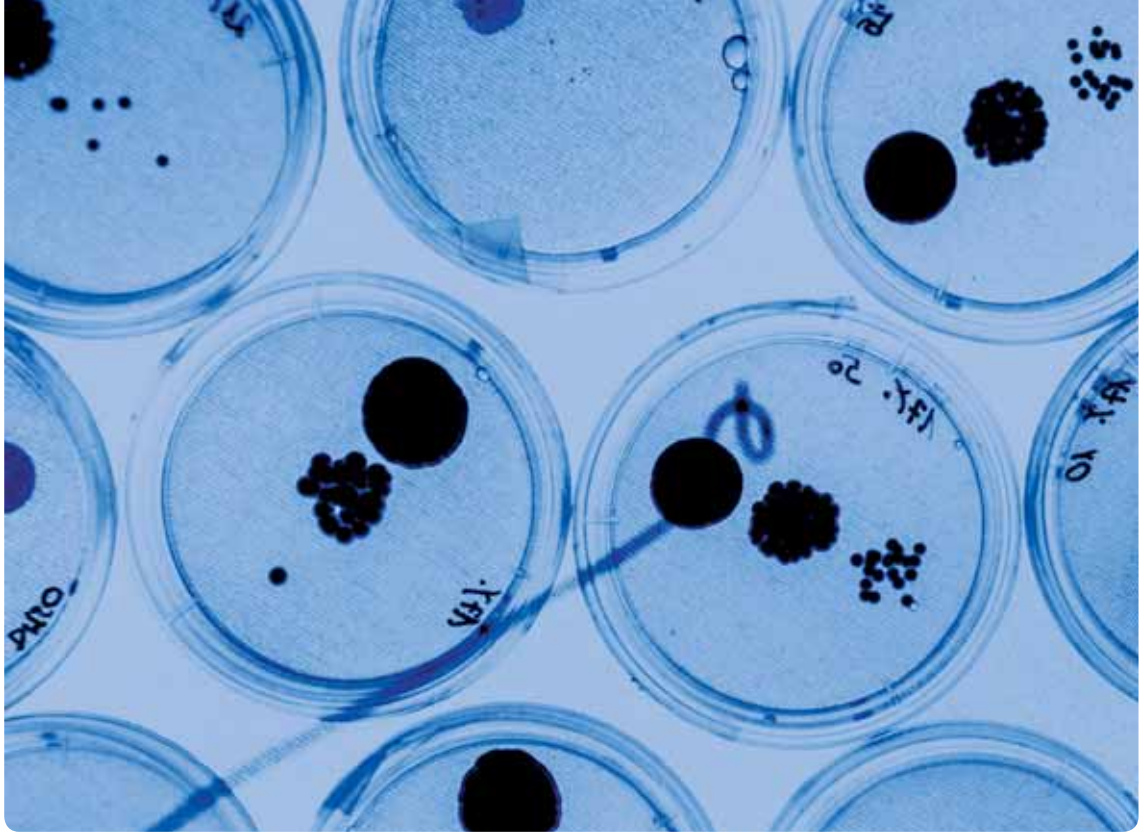
Prebiotics beneficially modify the intestinal microbial population when ingested, resulting in an improvement of the individual's health. Prof. Kilian's research remained focused on prebiotic oligosaccharides produced by yeasts. A total of 32 g l^{-1} of oligosaccharide was produced from sucrose using shake flask cultures of *Leucosporidium scottii*. The two trisaccharides and one tetrasaccharide in the product mixture were separated and fractions collected by HPLC for use in further characterisation of the oligosaccharides.

The aim of the Biocatalysis research group of Prof. Martie Smit and Dr. Dirk Opperman is to develop excellent whole-cell biocatalysts for hydroxylation reactions. The group focuses on the hydroxylation of linear and cyclic alkanes and alkenes by cytochrome P450 mono-oxygenases, 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. During July 2012, Dr. Opperman spent two weeks in the laboratory of Prof. Frank Hollmann to present a course on computational methods in protein modelling. Prof. Smit and Dr. Opperman were invited speakers at the Structural Biology in the Bio-Economy Conference, 2 – 4 December 2012, held at the University of Cape Town as part of the Germany-South Africa Year of Science. The structural biology effort at the UFS was boosted by the installation of a Rigaku X-ray diffractometer for protein/macromolecular crystallography. Dr. Opperman received the Faculty Prize in Academic Entrepreneurship for negotiating the donation of this diffractometer by the University of the Western Cape.

The main highlights of the Veterinary Biotechnology Research Group of Prof. Rob Bragg and Ms. Charlotte Boucher included the establishment of a molecular diagnostic laboratory serving mainly the poultry and parrot industries. Dr. Arina Jansen, who recently obtained her Ph.D. after studying in the group, was appointed as a postdoctoral student to run the diagnostic laboratory. The group was invited to host a beak and feather disease virus information day for parrot-breeding clubs in the North West province. This very successful day was attended by about 200 parrot breeders, many of whom submitted samples to the diagnostic laboratory. Prof. Bragg was invited to participate in a panel discussion at the launch of the Tshwane Animal Health Innovation Cluster Initiative (TAHICI), which was held in Pretoria in October. Dr. Arina Jansen and Prof. Bragg were invited to attend a *Mycoplasma* seminar, which was arranged by the South African Poultry Association (SAPA) in Johannesburg. This led to a visit by representatives from SAPA to investigate possible cooperation and funding in 2013. This was as a result of the excellent Masters' project on the diversity of *Mycoplasma* in Southern African poultry by Serena Moretti. Prof. Bragg was also invited as a keynote speaker to a workshop with a group of poultry veterinarians from all of the major poultry producers, and to a workshop held in Portland, USA, by IDEXX, the major supplier of diagnostic reagents in the poultry industry around the world. Ms. Charlotte Boucher received a certificate in bio-entrepreneurship from the University of Pretoria.

Staff Matters

Drs. Frans and Trudi O'Neill were appointed as senior lecturers in Biochemistry as from January 2012.



Research Outputs

Microbial, Biochemical and Food Biotechnology

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Patents

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Staff

Division of Microbiology and Biochemistry:

Distinguished Professor: Prof. Lodewyk Kock.

Professors: Profs. James du Preez, Koos Albertyn, Rob Bragg, Stephanus Kilian, Hugh Patterton (part-time; research cluster director), Martie Smit, Esta van Heerden, and Bennie Viljoen.

Senior Lecturers: Drs. Frans O'Neill, Trudi O'Neill, Dirk Opperman, Carlien Pohl-Albertyn, and André van Tonder.

Lecturer: Dr. Olihile Sebolai.

Junior Lecturers: Ms. Charlotte Boucher, and Mr. Du Toit Schabort.

Researcher: Ms. Laurinda Steyn.

Affiliate Associate Professor: Prof. Bettie Lodolo.

Research Associate: Prof. Derek Litthauer.

Secretary: Ms. Millie Cohen.

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Officers, professional services: Mss. Suzanne Brandt, Yvette Makaum, Christelle Möller, Dalene van den Berg, and Andri van Wyk.

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Division of Food Science:

Professor: Prof. Garry Osthoff.

Associate Professor: Profs. Arno Hugo, and Celia Hugo.

Senior lecturers: Drs. Maryna de Wit, Koos Myburgh, and Mr. Neels Bezuidenhout (part-time).

Lecturer: Dr. Carina Bothma.

Secretary: Ms. Ilze Auld.

Officer, professional services: Dr. G. Charimba, and Ms. Eileen Roodt.

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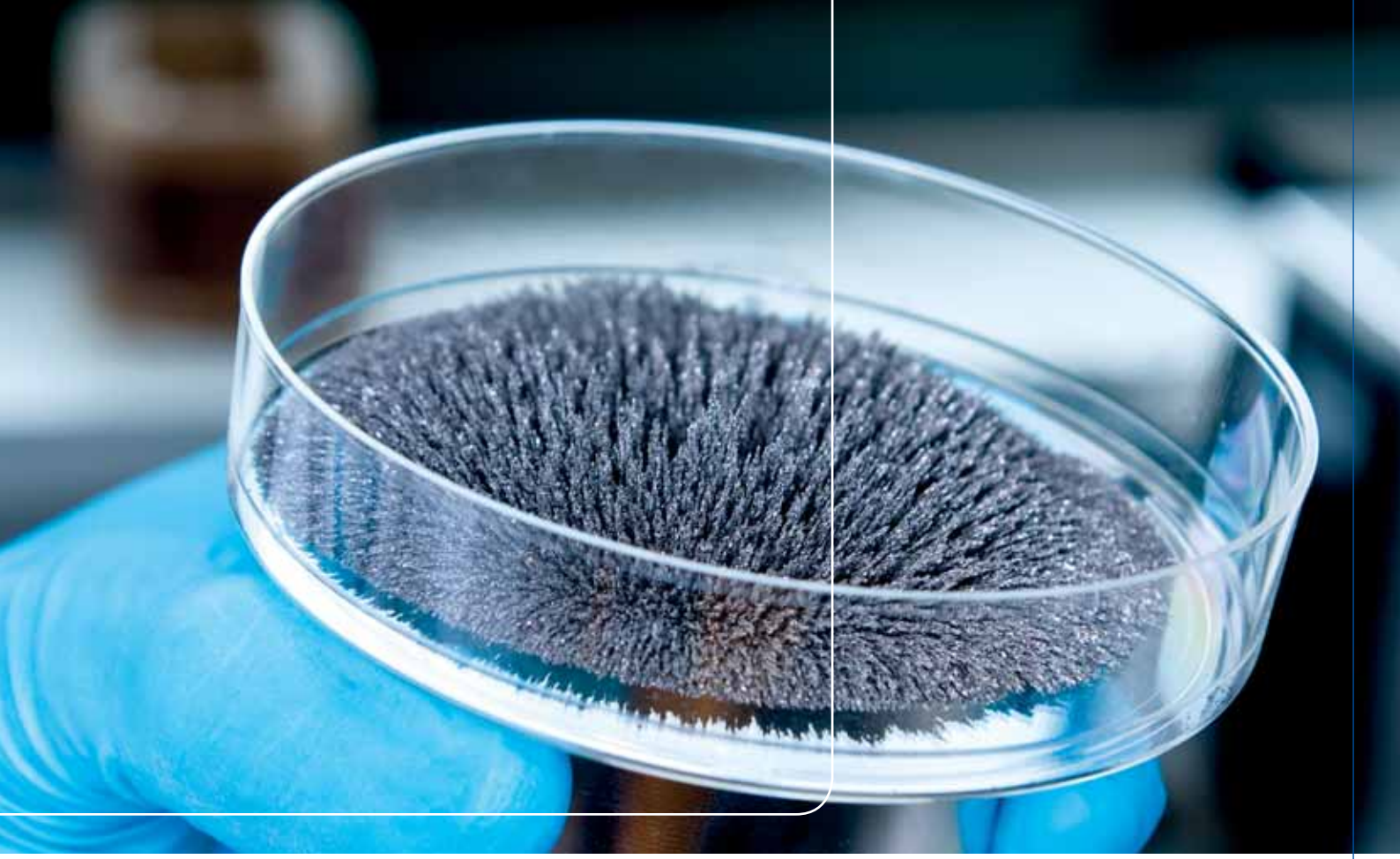

Department of

Physics

Overview

Physics had an exceptional year once again and it is fast becoming one of the leading Physics departments in South Africa based on research, education and community services. It is well-recognised internationally for its research and community services. The community services are mainly coordinated through the Boyden Science Centre, of which a summary of the annual report is attached.

Research Highlights

A new Time-of-Flight Secondary Ion Mass Spectrometer (TOF-SIMS) was installed and commissioned as a new characterisation technique in the New Nano-Surface Characterisation Facilities (NNSCF) in the Department. The Department hosts three of the main surface characterisation techniques making it one of only a few research laboratories in the world with such state-of-the-art equipment.

Activities and Achievements

During 2012, the Department received its first Physics students from the new National Nanoscience Masters' Degree Programme. This programme is operated in collaboration with the University of the Western Cape, Nelson Mandela Metropolitan University, and the University of Johannesburg. Students were hosted for a month; during which they attended lectures on the theory of Nanophysics (Dr. R.E. Kroon), as well as obtaining experience in using the sophisticated practical equipment of the Department (Prof. H.C. Swart, Prof. J.J. Terblans and Prof. W.D. Roos).

The Department, under the leadership of Prof. Ntweaeborwa and supported by Prof. H.C. Swart, Prof. J.J. Terblans, Dr. R.E. Kroon, Ms. Y. Loots and Ms. K. Cronje, hosted the 4th International Conference on Nanoscience and Nanotechnology (NanoAfrica2012, 1 – 4 April) at the UFS.

Ms. Duvenhage, Prof. Terblans, Prof. Swart, Mr. Barnard, Mr. Cronje and Dr. Coetsee-Hugo at the new Time-of-Flight Secondary Ion Mass Spectrometer.

Prof. H.C. Swart was awarded the prestigious research chair in Solid State Luminescent and Advanced Materials from the South African Research Chairs Initiative (SARChI) at the end of 2012.

It was an excellent year for the Department's post-graduate students at the 57th Annual Conference of the South African Institute of Physics (SAIP), where they won several prizes in the fields of Condensed Matter Physics and Materials Sciences and Astrophysics. The winners were:

- Best M.Sc. presentation in Applied Physics: Sipho Dlamini (Profs. Swart and Ntwaeaborwa).
- Best M.Sc. poster – Solid State: Puseletso Mokoena (Profs. Ntwaeaborwa and Swart).
- Best M.Sc. publication – Semi-conductors: Luyanda Noto (Profs. Swart and Terblans).
- Best M.Sc. publication – Solid State: Mantwa Lephoto (Profs. Ntwaeaborwa and Swart).
- Best Ph.D. publication – Solid State: Yousif Mohammed (Profs. Swart and Ntwaeaborwa).
- Best Ph.D. poster – Solid State: Samy Shaat (Profs. Ntwaeaborwa and Swart).
- Best M.Sc. presentation – Astrophysics: Jacques Maritz (Prof. Meintjes).
- Best Ph.D. presentation – Astrophysics: Alida Odendaal (Prof. Meintjes).

During the Square Kilometre Conference in Stellenbosch, Alida Odendaal won the prize for the best poster presentation at Ph.D. level.

Prof. P.J. Meintjes, part of the Astrophysics Research Group, gave an invited talk at Vulcano 2012: Frontier Objects in Astrophysics and Particle Physics Conference in Vulcano, Italy, in June.

At the Faculty's annual reward ceremony, three of the Physics staff members received awards, namely:

- Prof. Swart received the Dean's Excellence medal for his contributions to the Faculty.
- Prof. Meintjes received the prize for research given to researchers over 36 years of age.
- Prof. Hoffman received the Kovsie Ambassador Award during an Alumni function.

Dr. Vinay Kumar from the School of Physics, Shri Mata Vaishno Devi University (SMVDU), India, a former postdoctoral student of the UFS, visited us for a month to do some collaborated research.

Two other postdoctoral students, Dr. Indrajit Nagpure and Dr. Shreyas Pitale, completed their postdoctoral studies during the year; both of them spent about two years in the Department. Several papers followed from their research.

Prof. Swart went to Linköping, Sweden, for collaboration talks. A workshop was held to promote collaboration between South Africa and Sweden during his visit.

Dr. Kroon was granted beam-time at the DESY synchrotron in Hamburg, Germany, together with an NRF travel grant.

A team consisting of Profs. Swart and Ntwaeaborwa and the postgraduate student, Luyanda Noto, measured the luminescent properties of various phosphor materials using VUV (vacuum-ultraviolet) light not currently available in South Africa.

The Department participated in the review of Undergraduate Physics Education organised by the South African Institute of Physics (SAIP) in conjunction

with the Council for Higher Education (CHE). Dr. Kroon acted as the departmental representative. Dr. Kroon was also invited to be on the Panel for the Standard Setting of the National Benchmark Tests (NBT), which are used in conjunction with matriculation results to assess the capabilities of prospective students.

Prof. Meintjes visited the Appalachian State University in the USA and finalised academic exchange, as well as establishing formal research collaboration. A very exciting aspect forthcoming from these discussions is the building of a medium-resolution spectrograph for the UFS-Boyden 1.5 m telescope by the Appalachian State University. This will be a very valuable asset for student training and research programmes. It is believed that the spectrograph will arrive at Boyden in 2013.

The UFS Astrophysics research group focuses on multi-wavelength studies of high energy astrophysical sources. In 2012, the UFS Astrophysics Research Group was formally incorporated into the very prestigious international HESS (High Energy Stereoscopic System) Collaboration, with the telescopes in Namibia. On the South African side, only the UFS, NWU and Wits are members of this collaboration.

Pat van Heerden, Edward Hlazo, Shaun Cronje and Pieter Barnard helps to install the new Time-of-Flight Secondary Ion Mass Spectrometer.

Postgraduate Students

The following M.Sc. students obtained their degrees: P.E. Barnard, K.E. Foka, M.A. Lephoto, M.J. Madito, L.L. Noto, A. Odendaal, M.A. Tshabalala, and A. Wako.

The following Ph.D. students obtained their degrees: B.D. Dem, B. Oruru, H.A.A. Seed Ahmed, and B. van Soelen.

Boyden Observatory Science Centre and the Two Observatories Project

Boyden Observatory has become a unique attraction in central South Africa. It is a versatile site that engages many people for various reasons, including its historical significance, the spectacular views, and the authentic indigenous veld experience. At the core of these attractions are numerous education programmes and presentations. As a public facility, Boyden Observatory offers ordinary people personal contact with visiting and local scientists, and the opportunity to view celestial objects trough telescopes.

The science communication and educational activities at Boyden Observatory are well-established and include open evenings where public lectures are presented, as well as various programmes for school and community groups that visit the observatory on a regular basis. Special projects, such as the annual Astronomy Quiz and National Science Week, also form part of the Boyden calendar.

Site upgrades at the observatory during 2012 included improvements to the Boyden entrance, paving, landscaping, and storm water management. Visitors are now welcomed by a beautiful stone-walled entrance and attractive water channels.

The single most significant project development in 2012 was the expansion of the Boyden Observatory Project to include the Lamont-Hussey Observatory through the Planetarium project. This followed a request from the Provincial Government. The Lamont-Hussey Observatory is Bloemfontein's second optical observatory. In the late 1920s, Boyden Observatory was established by Harvard University on a site north-east of Bloemfontein, while the Lamont-Hussey Observatory was founded by the University of Michigan on Naval Hill almost in the center of the city. The Lamont-Hussey Observatory (which is situated on land belonging to the Mangaung Metropolitan Municipality) has fallen into disuse in the past 35 years, and the beautiful old building has suffered some neglect.

Thus, in this period, the Boyden Observatory and Science Centre Project evolved to become the Two Observatories Project. The two observatories are:

- The Boyden Observatory and Science Centre, which will continue to focus on research and specialized education programmes; and
- The Lamont-Hussey Observatory, focusing on more popular public and edutainment programmes, will have a digital planetarium within a game reserve in the middle of Bloemfontein.

A fundraising campaign for the planetarium was launched after a number of interactions with local

Dr. Du Toit presents the Kovsie Ambassador Award to Prof. Hoffman.

and provincial government officials in late 2011. A breakthrough was made with a commitment of R6 million from DETEA Free State (Department of Economic Development, Tourism and Environmental Affairs) to the UFS for the planetarium. A further very positive and essential Planetarium Project breakthrough took place in April 2012 when the national Department of Science and Technology approved a grant of R6 million to the UFS to purchase the digital technology needed for the planetarium. Thus, in the period, a total amount of R12 million was secured for the project.

Development and Infrastructure Projects at Boyden Observatory

The Boyden Environment Projects: Contributions from the Charl van der Merwe Foundation, the Hermann Ohlthaver Trust, as well as the University of the Free State, funded some improvements that included the completion of a beautiful stone wall at the entrance, the installation of an electric sliding gate, additional paving, and, significantly, the building of several stone pond areas at the side of the koppie to make provision for storm water control and to establish permanent watering spots to attract wildlife to the koppie.

Boyden Heritage and Museum Projects: The project received additional momentum this year with the visit of the Science History Professor, Keith Snedegar, from the Utah Valley University, USA. During his visit, he gave public lectures at the University and at the Boyden Observatory, as well as academic lectures to the Community Service Learning class (NEC302).

The Boyden Museum Project also involved the restoration of some of the old telescopes and other instruments. Mr. Frans Human, one of the volunteers from the Astronomy Society in Bloemfontein, made a substantial contribution to this renovation project. The renovation of the Roberts telescope (circa 1838 – the oldest telescope at Boyden) is almost completed and will be on exhibition soon. The exhibit will include Roberts' library and scientific papers which were donated to Boyden in the 1950s.

Ongoing programmes: During the period under review a large variety of programmes were presented – 101 at Boyden Observatory, and 28 outreach programmes at other venues in the Free State and the Northern Cape.

Educational and outreach programmes included the following high impact events:

- Programmes and workshops to Grade 10 – 12 learners;
- Two-hundred and forty top achievers in Physical Science, Mathematics and Biology attended an Energy Focus Week in June. This two-day event for learners from schools in inland provinces, was held in collaboration with the Department of Energy and PetroSA;
- The NEC 302 Community Service Module of the UFS made an important contribution to two township schools;
- Approximately 340 Grade 7 learners from approximately 84 schools all over the Free State participated in the SAASTA's Astronomy Quiz competition. The Free State leg of the competition is co-coordinated by the Boyden Science Centre, in collaboration with the Free State Department of Education;
- During the DST (Department of Science and Technology) National Science Week, a number of activities and programmes were presented and coordinated by the Boyden Science Centre team;

Third-year tours at the Hartebeesthoek Radio Astronomy Observatory (HartRAO).

- Boyden Observatory presented the module "Are we alone?" as part of the UFS 101 course for first-year students;
- The Boyden and UFS101 Astronomy Fair took place on 22 July 2012.

Public events and science communication: In addition to the numerous education programmes mentioned above, the following activities also took place:

- Many public and school groups visited Boyden Observatory on appointment;
- Prof. Hoffman is a regular guest on the popular SABC programme *Sterre en Planete*;
- Prof. Hoffman also helped to keep Boyden Observatory and Science Centre in the news with regular radio interviews on SABC (e.g. *Monitor*), as well as on a monthly basis on a community radio station. The national radio broadcasts reached hundreds of thousands of people;
- On 8 September 2012, a special episode of the SABC programme, *Sterre en Planete*, was recorded at Boyden Observatory;
- Seven astro-tourism programmes were presented at various venues in the Free State in collaboration with the Free State Department of Economic Development, Tourism and Environmental Affairs (DETEA), the Afrikaanse Handels Instituut (AHI) and the SABC programme, *Sterre en Planete*.

Research at Boyden Observatory

The Astrophysical Research team has grown substantially during the last few years, with a steady increase in the number of M.Sc. and Ph.D. students. Most of these students are involved with the Boyden educational activities and they regularly make popular presentations about their research. In this way they make a valuable contribution as role models for future scientists who visit Boyden.

The Watcher Robotic telescope of the University College Dublin in Ireland, which is located at Boyden, had another productive year and another upgrade of this instrument has commenced in September 2012.

Regarding observing proposals, the UFS Astrophysics research group submitted three proposals to the Southern African Large Telescope in 2012. Results from these observations have been accepted for publication.

Research Outputs

Physics

Research Articles

Abdallah, H.M.I., Moyo, T. & Msomi, J.Z. 2012. The Effect of Annealing Temperature on the Magnetic Properties of Mn*x*Co1–*x*Fe2O4 Ferrites Nanoparticles. *The Journal of Superconductivity and Novel Magnetism* 25: 2625-2630.

Abdallah, H.M.I., Msomi, J.Z., Moyo, T. & Lan˘cok, A. 2012. Mössbauer and Magnetic Studies of Co0.5Mn0.5Fe2O4 and Mn0.1Mg0.2Co0.7 Fe2O4 Nanoferrites. *The Journal of Superconductivity and Novel Magnetism* 25: 2619-2623.

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Staff

Main Campus:

Professors: Profs. Hendrik Swart, Koos Terblans, Pieter Meintjies, and Martin Ntwaeaborwa.

Associate Professors: Profs. Wiets Roos, and Matie Hoffman.

Senior Lecturer: Dr. Ted Kroon.

Lecturer: Dr. Brian Van Soelen.

Researcher: Dr. Liza Coetsee-Hugo.

QwaQwa Campus:

Associate Professor: Prof. Francis Dejene.

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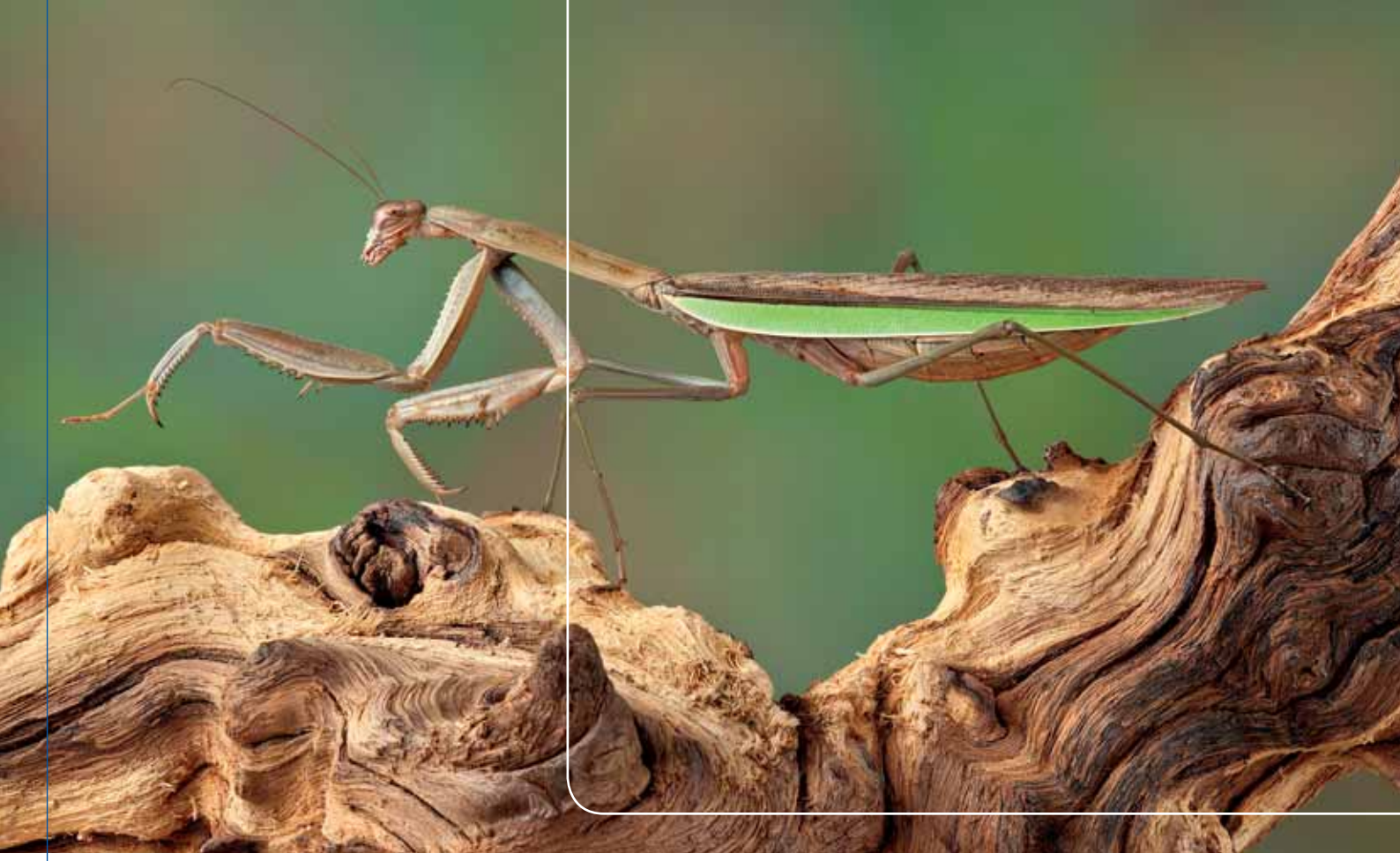


Department of

Zoology and Entomology

Overview

The Department is organized into eight research groups, each with its own objectives and specific study areas. 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. Prof. Jo van As, Departmental Chairperson, is also involved in activities of the Cluster for Water Management in Water-Scarce Areas at the UFS, whilst Prof. Schalk Louw participates in the Cluster concerning Technologies for Sustainable Crop Industries in Semi-arid Regions.

Aquatic Ecology

During October 2012, Aquatic Ecology hosted the 41st annual Conference of the Parasitological Society of Southern Africa (PARSA) on the campus of the UFS. All the invited speakers were former postgraduate students of the Department of Zoology and Entomology, even Prof. Ivan Horak, who received a D.Sc. under the supervision of Prof. Jo van As in 2008. Papers and a poster were presented by the Department's research group, as well as by other colleagues from the Department. At the gala evening of the conference, Josef Moller received the Junior Neitz medal for the best M.Sc. in Parasitology.

During August 2012, Aquatic Ecology went on field trips to the ephemeral rivers of the Okavango System to do follow-up surveys in the Boteti River (the first one was done in 2009 and the second in 2011) to collect plankton and fish parasites. Another survey was done in Lake Xua that was flooded for the second time since 2011. Lake Ngami was surveyed for the seventh time, after it received water for the first time in 2006 after a drought of more than 40 years.

Collecting plankton at Lake Xau.

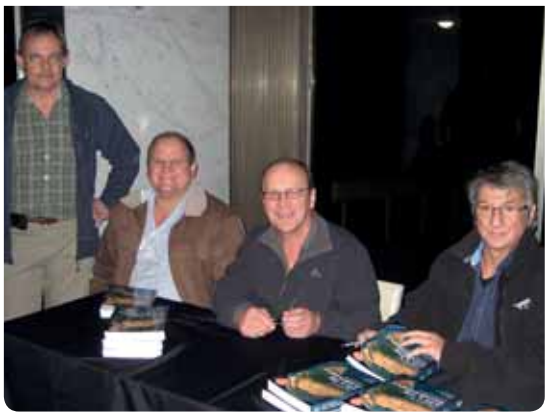
Aquatic Ecology also joined a former student, Leon Barkhuizen (currently employed by the Department of Economic Development, Tourism and Environmental Affairs), during various field surveys to dams in the Free State. This is a collaborative project where Leon surveyed the fish populations of the province's dams and fish parasites were simultaneously collected. Trips were made to 13 dams, from December 2012 to March 2013, including a visit to the Xariep Dam, and the China-South African Agricultural Demonstration Centre.

Arachnology

The Arachnology group consists of Dr. Charles Haddad (lecturer and researcher) and Mr. Jan-Andries Neethling (Honours' student).

Early in February 2012, Charles submitted his Ph.D. thesis for examination and subsequently received his degree at the winter graduation ceremony in June 2012. His work included an overview of the Afrotropical Castianeirinae spiders; including a key to the genera, revisions of five genera, the taxonomic treatment of selected species of three other genera, and the description of two new genera; totalling 37 new species and redescriptions of 20 species. Several chapters have already been published and most of the other chapters have been submitted for publication.

Dr. Haddad also continued collaborative research on South African jumping spiders with Prof. Wanda Wesolowska (Wrocław University, Poland); submitting a paper with the description of 19 new species from the Eastern Cape, KwaZulu-Natal, Limpopo and Free State Provinces. A team consisting of Prof. Ansie Dippenaar-Schoeman and Ms. Robin Lyle (ARC – Plant Protection Research Institute, Pretoria), Prof. Stefan Foord (University of Venda, Thohoyandou) and Mr. Leon Lotz (National Museum, Bloemfontein), submitted for publication a review paper on the spider diversity of the Grassland Biome in South Africa. This paper provides a detailed checklist of the 792 species recorded from the biome so far; including data on their distribution, conservation importance and patterns of family abundance and species richness.



Launch of the book "The story of life and the environment: An African perspective" in Bloemfontein on 30 July 2012.

Mr. Jan-Andries Neethling spent a considerable portion of the first year of his M.Sc. degree conducting field work in South Africa to generate material for his study, namely a revision of the South African Geogarypidae pseudoscorpions. Museum collections generally have poor representation of this family but his field work has generated a large number of specimens; indicating that the group has been poorly sampled historically. His travels took him to all South Africa's provinces

Josef Moller received the Junior Neitz medal for the best M.Sc. in Parasitology from Prof. Barnie Penzhorn.

except the Northern Cape and North West, which he will sample during 2013. To date, only ten species of Geogarypidae have been described from South Africa, five each in the genera *Afrogarypus* and *Geogarypus*. So far Mr. Neethling has collected more than ten morphospecies in each genus, which will result in the description of a considerable number of new species. He has taken detailed habitus photographs of each species, and the material he sampled will be included in a molecular phylogeny of the family as a basis for a discussion on the biogeography and speciation of the family in the country.

Bio-pesticide Management

Appointed as junior lecturer at the start of 2012, Mr. De Villiers Fourie established the Bio-Pesticide Management Research Group. The aim of the group is to investigate a wide field of biological control methods in agriculture, with emphasis on the use of botanical extracts as insecticides, and the use of other biological control agents towards an integrated, holistic insect management programme.

Research focused 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 stable flies *Stomoxys calcitrans* (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.

Mr. Fourie was invited as a guest speaker to a farmers' workshop funded and organized by Ecosoil, a compost tea producer situated in the Western Cape Province. The aim of the workshop was the promotion of sustainable farming through integrated management practices, including cultural and biological methods. The workshop was attended by farmers and farming groups, mostly involved in the organic fruit production industry. Mr. Fourie presented a talk on the implementation of farmscaping tactics towards the promotion of beneficial insects and the sustainability of beneficial insect populations.

Mr. Fourie presented a guest lecture at the Central University of Technology (CUT), Bloemfontein, on research methodology and techniques in the biological sciences. The lecture was attended by B.Tech. students in agriculture and was organized by Prof. P. Fourie, Departmental Head of Agriculture at CUT.

Mr. Fourie was also invited to attend the XXIV International Congress of Entomology (ICE): New Era in Entomology which took place 19 – 25 August in Daegu, South Korea. The ICE is the largest and most comprehensive congress in the field of entomology and is hosted every four years; each time in a different country. The 2012 conference was hosted at the beautiful and modern EXCO Conference Centre and was attended by approximately 2 700 delegates from countries all over the world. After the congress, Mr. Fourie travelled to Beijing, China. Presenting talks together with Mr. Vaughn Swart, the primary purpose there was to encourage collaborative research, to meet with researchers at the China Agricultural University, and to promote the Department of Zoology and Entomology and Strategic Cluster 4: Technologies for Sustainable Crop Industries in semi-arid Regions.

Environmental Entomology

The group consists of Mr. Vaughn Swart (junior lecturer); M.Sc. students Jaco Saaiman and André van Rooyen; and B.Sc. honours' students Ms. Alta Lotriet and Mr. Schalk Kotze.

Research during 2012 involved investigations into the interactions between stinkbugs (Hemiptera: Pentatomidae) and fungi in pecan (*Caryaillinoensis*) orchards in South Africa; the possible migration of economically-important Lepidoptera borer species from citrus (*Citrus sinensis*) to pecan nuts (*Caryaillinoensis*), and vice versa, at Vaalharts, Northern Cape; the effects of different environmental conditions, such as temperature, rainfall and humidity, as well as the different lunar phases on the flight behaviour of maize stem borers; a comparison between the length of the maize stem borer tunnels with the RIA (Reciprocal Index of Attack) and an attempt to isolate total RNA from maize stem borer (*Busseolafusca*) larvae.

The following two projects were in partial fulfilment of Mr. Jaco Saaiman and Mr. Andre van Rooyen's M.Sc. degrees. Mr. Jaco Saaiman's study involved research on the interactions between stinkbugs (Hemiptera: Pentatomidae) and fungi in pecan

Field lab at Rustfontein Dam.

(*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. These included *Aplosporella* spp., *Alternaria* spp., *Cladosporiumcladosporioides*, *Mucor* spp. and *Epicoccumsorghi*. Overall, similar patterns of incidence were observed between the stinkbug, air and soil. These were not consistent with the patterns of incidence observed in the nuts and leaves. During December 2012, Mr. Saaiman extracted the DNA of the various fungal isolates so that the process may be completed in early 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 to citrus fruit; displacing the false codling moth as the dominant citrus borer pest. Carob moths were found to congregate in citrus orchards. Stinkbug pests on pecan nuts were investigated to ascertain the effect that plant growth inside and immediately outside orchards has on the stinkbug population in the pecan trees. Cultivars that indicate high susceptibility to stinkbug attacks, such as Wichita and Barton were found to have high populations of stinkbugs during active searching.

Two B.Sc. entomology Honours' students, Ms. Alta Lotriet and Mr. Schalk Kotze, focused on year-projects with support from Monsanto pertaining to BT-maize and the maize stem borer (*Busseolafusca*). Ms. Alta Lotriet investigated the effect of different environmental conditions on the flight behaviour of maize stem borers. BT-maize is genetically-manipulated maize and was engineered to resist to the maize stem borer. Populations of the maize stem borer are affected by human activity, climatic factors, natural enemies, and the availability of wild and cultivated host plants; thus causing varied yield loss amongst regions. It was confirmed that rainfall is needed to terminate diapauses although humidity was observed to have a greater effect on the termination of diapauses. It was also confirmed that the maize stem borer is vulnerable to high temperatures and low humidity.

Mr. Schalk Kotze investigated the length of the maize stem borer tunnels and how it compared with the RIA (Reciprocal Index of Attack). The RIA is a rating system where each internode of the maize plant is given a RIA value depending on the damage to the maize plant between one and five; where one indicates no damage and five indicates the highest level of damage. During this investigation, both conventional and BT-plants were examined. It was clear that both varieties showed a strong correlation between the RIA value and the total length of the tunnels. It was observed that BT-maize exhibited less

Field lab at Sterkfontein Dam.

damage than the conventional maize but showed a higher frequency of spiral feeding within the plant itself. Diapausal larvae were found in both the conventional and BT-plants, illustrating that maize stem borers already indicate resistance against BT-endotoxins.

An attempt was made to isolate total RNA from maize stem borers to identify resistance genotypically. Larvae of the maize stem borer larvae were obtained from various locations in South Africa and DNA was extracted. Since the maize stem borer cadherin gene is not yet cloned, three pairs of degenerate primers were designed using the encoded polypeptides from various insects. PCR amplification using extracted genomic DNA yielded complex amplification profiles, of which several fragments were cloned and sequenced. Up to date, none of the cloned fragments showed significant homology to the maize stem borer cadherin gene. Several attempts to isolate total RNA from larvae was unsuccessful, proving to be a stumbling block since using DNA could improve the chances of cloning the gene.

Mr. Vaughn Swart was invited to the XXIV International Congress of Entomology (ICE) New Era in Entomology, which took place 19 – 25 August in Daegu, South Korea. After the congress in Daegu, Korea, Mr. Swart travelled to Beijing, China. His main purpose there was to encourage collaborative research, to meet with researchers at the China Agricultural University, and to promote the Department of Zoology and Entomology, as well as Strategic Academic Cluster 4 (Technologies for Sustainable Crop Industries in Semi-arid Regions).

Mr. Swart has been associated with SAPPA (South African Pecan Producers Association) since 1998. SAPPA has donated annually for research purposes since 2009. Recent developments have led to the establishment of a statuary levy for research on pecan nuts. In addition, funding has been provided by Insect Science and BayAgro for a two-year project on pecan nuts, which has already commenced.

Eco-ethology

Two members of the academic staff, Mr. Hennie Butler and Ms. Lindi Heyns, work within the Eco-ethology Research Group, actively combining teaching and research. They formed a study group with eight postgraduate students that encourages interdisciplinary research through a combination of laboratory and field science.

The Eco-ethology Group pursues basic research in the field of behavioural biology and ecology but diverse areas such as the anatomy, physiology, natural and evolutionary history, taxonomy, conservation, management and economics of animals are also included. Projects under way by group members mainly focused on applied questions in wildlife management of various antelope species during 2012 but studies were also carried out on small mammals.

Mr. Hennie Butler (Ph.D.), Ms. Marianca Barnard (Hons.), Ms. Thea Odendaal (Hons.) and Ms. Anneke Vermeulen (Hons.) focused on the soil-eating behaviour (enzootic geophagy) of antelopes in semi-arid regions, while Ms. Elsabé Coetzee researched enzootic geophagy occurrences amongst domestic animals. Ms. Nadine Jacobs (M.Sc.) investigated behavioural differences between geographical races of the southern sable antelope, and Mr. Phillip Olivier (M.Sc.) continued with his study on dominance behaviour associated with different colour variations

in springbok populations and an article on this matter was published in the July issue of *Farmer's Weekly*.

Mr. Roe Wiid (M.Sc.) researched the extent of problem hyrax populations in urban areas in the southern Free State, as well as possible mitigation methods.

Research carried out by Mr. Savvas Vrahimis (Ph.D.) entailed a combination of behavioural biology and conservation genetics. Mr. Vrahimis, associated with the Free State Department of Tourism, Environmental and Economic Affairs (DETEA), continued to research aspects of the ecology, behaviour and genetic status of black wildebeest.

Mr. Butler, Marianca Barnard, Thea Odendaal and Anneke Vermeulen attended the 10th Annual Meeting of the Primate Ecology and Genetics Group, held at the Black Mountain Hotel, Thaba 'Nchu, 30 June – 1 July 2012.

Hennie Butler, Elsabé Coetzee, Philip Olivier and Roe Wiid also presented talks on animal communication to the Botanical Association at the Free State National Botanical Gardens, Bloemfontein. As an invited speaker, Hennie Butler delivered an oral presentation entitled "Life in the Oven (Deserts)" at Wageningen, The Netherlands, during the annual Production Ecology and Resource Conservation Day.

Medical, Veterinary and Forensic Entomology

This group consists of Dr. Sonja Brink and the following M.Sc. students: Mr. Julian Liebenberg and Ms. Carmen Luwes, specialising in veterinary entomology, and Mr. Shaun Hoffman and Ms. Elaine Allemann, specialising in forensic entomology. All M.Sc. students are students of Prof. Theuns van der Linde who retired from the Department at the end of 2010.

Dr. Brink joined the Department at the beginning of 2012. Her role was administrative in the case of Mr. Liebenberg, who has completed all aspects of his thesis by mid-2012, and supportive in the cases of Mr. Hoffman and Ms. Allemann, who are in the process of preparing their manuscripts for submission.

Mr. Liebenberg completed his M.Sc. thesis ("The species composition and bio-ecology of Culicoides spp. frequenting livestock in the central Free State") and the degree was conferred upon him during the December 2012 graduation.

Work on the manuscripts of Mr. Hoffman ("The influence of multiple trauma-related injuries on carcass decomposition and insect activity: a seasonal study") and Ms. Allemann ("Influence of feeding media and varying temperatures on the development of some forensically important blowflies in central Free State, South Africa") is progressing and will be submitted for evaluation by the second half of 2013.

Insects on New Crops Programme (INCroP) and Soil Ecology

The research group: Insects on New Crops Programme (INCroP) and Soil Ecology, under the leadership of Prof. S. vd. M. Louw, consists of Mr. V. Swart (junior lecturer; part-time Ph.D. student in Environmental Management); Mr. De. V. Fourie (junior lecturer; part-time Ph.D. student in Entomology); Mr. B. Muller (M.Sc. student); Mr. R. du Preez (M.Sc. student); Ms. J. Smith (Hons. student); Ms. H. Badenhorst (Hons. student); and Mr. H. van As (Hons. student).

Throughout the year there was continued participation in the activities of UFS Academic Cluster 4: Technologies for Sustainable Crop Industries in Semi-arid Regions. Specific expertise was provided under the auspices of the Cluster regarding pest management on new crops and arthropod soil ecology.

In terms of Soil Ecology Research, 12 sites containing a range of cultivated composts and cotton, maize, wheat, lucerne, sunflower and amaranth field crops were sampled in the Free State, North West and Northern Cape provinces and analyses of mesofaunal species assemblages under different agricultural practices were conducted. Progress regarding this work was presented as an annual report at a seminar of the Cluster in November 2012.

In collaboration with the North West Province Department of Agriculture and Rural Development, the fieldwork of the project of M.Sc. student, R. du Preez, was completed. It involves an investigation into the effect of nitrogen additives to the soils of amaranth cultivations on soil mesofauna assemblages and their underlying interactions.

Prof. Louw participated in the NuGrainSA Consortium initiative as a soil health–arthropod ecology expert and in this regard consortium meetings were attended at NWU, Potchefstroom, in April and at the UFS main campus in November 2012. Prof. Louw served as Ad Hoc Committee member of the Arid Zone Ecology Forum (AZEF). Prof. Louw contributed to the revision of Annecke and Moran's "Insects and Mites of Cultivated Plants in South Africa". Three chapters covering amaranth, kenaf and pistachio were completed and submitted to the editors.

Postgraduate students of the research group are:

- **Charles R. Haddad**, Ph.D. in Arachnology: "Advances in the systematics and ecology of African Corinnidae spiders (Arachnida: Araneae), with emphasis on the Castianeirinae" (Supervisor: Prof. Louw).
- **Ms. Jehané Smith**, Honours' in Entomology: "Influences of GM crops on soil mesofauna in cultivated maize fields in the central Free State, South Africa."
- **Ms. Hannelene Badenhorst**, Honours' in Entomology: "Influence of different agricultural practices

on soil mesofauna in agro-ecosystems in the Free State, South Africa".

- **Mr. Heinrich van As**, Honours' in Entomology: "Towards the differentiation between arthropod and fungal chitin in soils."

Nematology

The research group Nematology consists of Dr. Candice Jansen van Rensburg (lecturer and researcher) and Miss Ayesha Mobara (M.Sc.).

Research in this group is currently focused on plant parasitic and free-living nematodes occurring in the Free State province. The study group is currently working on nematodes from wetlands, with work being carried out at the Seekoeivlei Nature Reserve, near Memel in the Free State. Information regarding nematodes from wetlands in South Africa has been negligently studied for a number of years and the group hopes to increase this knowledge.

Two field trips were undertaken to the Seekoeivlei Nature Reserve during the year; one in February 2012 and another in May 2012. One of the main purposes of the fieldtrips was to collect data for Ms. Mobara's M.Sc. dissertation.

Dr. Jansen van Rensburg and Ms. Mobara attended the 41st annual Conference of the Parasitological Society of Southern Africa (PARSA) in October 2012. Both presented papers at the conference.

Pesticide Resistance Testing and Research Facility

The Pesticide Resistance Testing and Research Facility consists of Mss. Ellie van Dalen (lecturer and researcher), Christa du Rand (professional officer), Sharon Terry, Octavia Motlogeloa and Mr. Adri Jordaan (part-time M.Sc. students).

Tick resistance development against chemical control is still the main focus and samples received from different problem areas in South Africa were tested and evaluated for developing resistance. A study on alternative tick control by using extractions from plant material, incorporated into pills and released into drinking water of cattle, investigates the repellency effect this remedy may have on tick load reduction of cattle. Collaboration with pharmaceutical companies providing chemical control remedies to address the problem of resistance development was also re-established to be able to continue the challenge of implementing adequate tick control management strategies and monitoring thereof.

Collaboration with Dr. Christine Maritz of the Genetics Department of the University of Pretoria, with regards to molecular determination of resistance development and the correlation to field resistance profiles, was discussed. The displacement of *Rhipicephalusdecoloratus* by *Rhipicephalusmicroplus* further complicated resistance profiles and projects to shed some light were also discussed.

Sharon Terry and Octavia Motlogeloa, both part time M.Sc. students, are still working on their dissertations on the comparative taxonomy of four morphological very similar ticks from the *Rhipicephalus* genus and the management strategies and development of resistance to chemical control by the blue tick *Rhipicephalusdecoloratus* in the Grahamstown area. Both plan to hand in during mid-2013.

M.Sc. Zoology students of this research group include:

- **S. Terry**: "A taxonomic description of all stages of four *Ixodes* (Acari: Ixodidae) tick species". Supervisor: Prof. I.G. Horak, Co-supervisor: Mrs. E.M.S.P. van Dalen.
- **A.J. Jordaan**: "Species composition and geographical distribution of ixodid ticks (Acari: Ixodidae) in the Free State Province, South Africa". Supervisor: Prof. I.G. Horak, Co-supervisor: Mrs. E.M.S.P. van Dalen.
- **B.O.O.O. Motlogeloa**: "Management strategies and development of resistance to chemical control by the blue tick *Rhipicephalusdecoloratus* in the Grahamstown Area (South Africa)". Supervisor: Mrs. E.M.S.P. van Dalen.

QwaQwa Campus

Mammalian Cognition Research

Dr. Aliza le Roux is a behavioural ecologist who specialises in cognitive ecology. She currently focuses on primate and carnivore research in wild as well as captive populations. In 2012, Le Roux continued producing papers on her gelada monkey research in Ethiopia, while starting negotiations with the National Zoological Gardens, Bloemfontein, and Johannesburg Zoo to conduct comparative research on cognitive skills in canids (dog-like carnivores). She has also applied for several grants that will fund fieldwork focused on bat-eared fox hormones and behaviour in the Karoo. This long-term field project will create numerous opportunities for postgraduate students, ranging from questions in foraging ecology and endocrinology to field experiments in carnivore learning.

Parasitology Research

The principal investigators are Dr. Oriel Thekisoe and Dr. Mosioua Leeto. The main research focus of the programme is on the development of molecular diagnostic tools for rapid detection of parasitic pathogens, including haemoparasites, helminths, water-borne parasites and food-borne parasites. Furthermore, the programme conducts research in prevalence and epidemiological studies of parasitic diseases and the development of remedies for the control of parasitic diseases such as the use of medicinal plants extracts. The programme

Ruan Schlebusch and Deidre West collecting water samples.

collaborates with the Phytomedicine Research Group of the Department of Plant Sciences of the UFS – QwaQwa campus, Onderstepoort Veterinary Institute – Pretoria, National Zoological Gardens – Pretoria, University of Pretoria, John Hopkins Medical University – USA, Obihiro University of Agriculture and Veterinary Medicine – Japan, and Hokkaido University – Japan.

Postgraduate students of the Parasitology Research Programme include:

- **K. Mtshali** – M.Sc.: "Molecular Detection of Zoonotic Tick-borne Pathogens in Livestock in Different Provinces of South Africa".
- **Z. Khumalo** – M.Sc.: "Development of species-specific polymerase chain reaction (PCR), real-time PCR and loop mediated isothermal amplification (LAMP) assays for detection of *Anaplasmamarginale* strains in South Africa".
- **L. Mabe – M.Sc.**: "Development of molecular diagnostic methods (LAMP and PCR) for detection of *Haemonchuscontortus*, *Fasciola* spp. and *Trichostrongylus* spp. infections in livestock".
- **M. Ramokopu** – B.Sc.: "Detection of *Babesia, Ehrlichia, Theileria* infections in ticks collected from cattle, sheep and dogs in different South African provinces".
- **F. Marais** – B.Sc. Honours': "Development of a multiplex real-time PCR for the detection of *Theileriaequi* and *Babesiacaballi* infections in horses".
- **N. Mabogoane** – B.Sc. Honours': "Evaluation and validation of Taqman real-time PCR assay for the detection of *Babesiagibsoni* in dogs".

Entomology Research

Mr. Emile Bredenhand is the leader of the Entomology research group that was established in 2011. His research interest is mainly on landscape ecology and biomonitoring, as well as insect ecology.

Postgraduate students of the Entomology research group include:

- **S.A. Modise** – B.Sc. Honours': "Investigation of the effect of seasonal temperature changes on ground-dwelling insect assemblages in grassland biome of the eastern Free State, South Africa".
- **S.N. Motitsoe** – B.Sc. Honours': "Survey of aquatic micro-invertebrate assemblages found in high altitude wetlands in the eastern Free State, South Africa".

Reptile Haemoparasite Research

Dr. Johann Van As conducted research on high altitude lizard blood parasites and described a number of new apicomplexan and nematode species. He also elucidated and described two new life cycles associated with these high altitude lizards and found the final host species acting as vectors for these new infections. He is currently investigating the phylogeny of saurian plasmodiid parasites in Cordylid lizards in the Free State and North West provinces.

Dr. Van As received his Ph.D. during the June 2012 graduation ceremonies in Bloemfontein.

The Reptile Haemoparasite research group received the following awards during 2012:

- Best veteran oral presentation, Dr. Johann van As (lecturer): The 41st Annual Conference of the Parasitological Society of Southern Africa (PARSA), 1 – 3 October 2012, Bloemfontein, South Africa.
- Best first-time oral presentation: Khethiwe Mtshali (M.Sc. Student): The 41st Annual Conference of the Parasitological Society of Southern Africa (PARSA), 1 – 3 October 2012, Bloemfontein, South Africa.
- Golden Key Academic Merit Award 2012 – Ms. Nthatisi Molefe (M.Sc. student).
- Dux Academic Merit award 2012 – Ms. Samantha Renda-Dollman (third-year student).

Research Outputs

Zoology and Entomology

Research Articles

Durand, F., Swart, A., Marais, M., Jansen van Rensburg, C., Habig, J., Dippenaar-Schoeman, A., Ueckermann, E., Jacobs, R., De Wet, L., Tiedt, L. & Venter, E. 2012. Die karst-ekologie van die Bakwenagrot (Gauteng). *Suid-Afrikaanse Tydskrif vir Natuurwetenskap en Tegnologie* 31(1): 1 of 17.

Gutison, M.L., Le Roux, A. & Bergman, T.J. 2012. Derived vocalizations of geladas (Theropithecus gelada) and the evolution of vocal complexity in primates. *Philosophical Transactions of the Royal Society* 367: 1847-1859.

Haddad, C.R. 2012. A revision of the Afro-tropical ant-like sac spider genus *Cambalida* Simon, 1909 (Araneae: Corinnidae). *ZooKeys* 234: 67-119.

Haddad, C.R. 2012. A revision of the spider genus *Echinax* Deeleman-Reinhold, 2001 (Araneae: Corinnidae) in the Afrotropical Region. *Zootaxa* 3450: 33-61.

Haddad, C.R. & Louw, S.v.d.M. 2012. A redescription of *Merenius alberti* Lessert, 1923 (Araneae: Corinnidae), with remarks on colour polymorphism and its relationship to ant models. *African Invertebrates* 53: 571-591.

Kirunda, H., Thekisoe, O.M.M., Kasaija, P.D., Kerfua, S.D., Nasinyama, G.W., Opuda-Asibo, J. & Inoue, N. 2012. Use of reverse transcriptase loop-mediated isothermal amplification assay for field detection of Newcastle disease virus using less invasive samples. *Veterinary World* 5(4): 206-212.

Molefe, N.I., Tsotetsi, A.M., Ashafa, A.O.T. & Thekisoe, O.M.M. 2012. In vitro anthelmintic effects of *Artemisia afra* and *Mentha longifolia* against parasitic gastro-intestinal nematodes of livestock. *Bangladesh Journal of Pharmacology* 7: 157-163.

Mtshali, K., Mtshali, M.S., Nkhebenyane, J.S. & Thekisoe, O.M.M. 2012. Detection of *Salmonella*, *Clostridium perfringens* and *Escherichia coli* from faecal samples of captive animals at the National Zoological Gardens of South Africa. *African Journal of Microbiology Research* 6(15): 3662-3666.

Pretorius, R.J., Louw, S.vdM., Venter, P. & Van Der Westhuizen, C. 2012. The impact of varying aphid populations in different shadehouse structures on some physical charateristics of head lettuce, cultivated in the central Free State (South Africa). *Journal of New Generation Sciences* 10(1): 116-129.

Štáhlavaskỳ, F., Král, J., Harvey, M.S. & Haddad, C.R. 2012. The first cytogenetic characterisation of atemnids: Pseudoscorpions with the highest chromosome numbers (Arachnida: Pseudoscorpiones). *Cytogenetic and Genome Research* 137: 22-30.

Books

Van As, J.G., Du Preez, P.J., Brown, L. & Smit, N. 2012. *The story of life and the environment: An African perspective.* Cape Town: Struik Nature.

Reports

Swart, V.R. & Saaiman, J. 2012. *Pecan insect damage: Current problems in Hartswater*, Hartswater, South Africa.

Staff

Main Campus:

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, Mr. Hennie Butler and Mrs. Ellie van Dalen.

Junior Lecturers: Ms. Lindie Heyns, Mr. De Villiers Fourie and Mr. Vaughn Swart,

Affiliated Researchers: Profs. Jacob den Heyer, O.B. Kok, and Dr. Jennifer Botha-Brink.

Professional Officers: Mss. Christa du Rand, and Isabel Human.

QwaQwa Campus:

Subject Head and Senior Lecturer: Dr. Oriel Thekisoe.

Senior Lecturer: Dr. Aliza le Roux.

Lecturers: Dr. Mosioua Leeto, Dr. Johann van As, and Mr. Emile Bredenhand.

Junior Lecturers: Mrs. Hafeleni Matete, and Mrs. Michelle van As.

Professional Officers: Mrs. Maria Sithole, and Mr. Jacob Mabena.

Affiliated Researchers: Dr. Ana Tstotetsi, and Mr. Moses Mtshali.

Contact Details

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Disaster Management Training and Education Centre for Africa

(UFS-DiMTEC)

Overview

Since the official establishment of the the Disaster Management Training and Education Centre for Africa (UFS-DiMTEC) as an independent Centre within the Faculty of Natural and Agricultural Sciences, we continuously strive to develop and strengthen close ties with various local, national and international organisations with interests in risk reduction and disaster management-related activities. Such linkages were established through the participation of students and personnel at national and international conferences and workshops, short courses, research projects and personal visits.

UFS-DiMTEC is well-connected to most of the faculties and departments of the University of the Free State due to the multidisciplinary nature of Disaster Management that depends on contributions and participation of experts in various disciplines. The parties involved include professors and lecturers from departments such as Chemistry, Microbiology, Physics, Geography, Agricultural Economics, Social Sciences, Psychology, Medical Sciences, Engineering, Communication, and others, as well as lecturers in the UFS-DiMTEC programme. Experts from the private sector, NGOs and government are also contracted as affiliated professors or lecturers to lecture in the programme.

Academic Programme

UFS-DiMTEC receives more than 250 applications annually from students from all over Africa. The success and excellent performance of the graduates in national and international institutions serve as the best testimonial of the quality of education provided by the Centre. The graduates occupy senior and middle management positions at several

Students at the 2012 graduation ceremony.

United Nations Institutions, NGOs, private sector and governments in several African countries.

UFS-DiMTEC is currently the largest postgraduate education and training programme in Disaster Management on the African continent and a world leader in its own right. UFS-DiMTEC has established working relationships not only with a number of African universities but also with leading universities in Europe, Asia, the United States and Southern America.

The Centre has not only explored challenges and helped create solutions through affiliation with government departments, it has produced a large number of Masters' students with an equivalent of research outputs on various topics such as food security, climate change, floods, drought, community resilience, vulnerability, social support programmes, governance, conflict management, and crime - to mention a few. These research topics were conducted in several African countries. Apart from projects in South Africa, personnel at UFS-DiMTEC actively participated in and led developmental and/or risk reduction projects in Sudan, Congo-Brazzaville, Zimbabwe and other African countries.

Education and training, supported by research, are the main activities of UFS-DiMTEC. Students enroll for the Advanced University Diploma as a first-year requirement for the Masters' degree. The Diploma consists of eight modules distributed over two semesters; four modules per semester. An average of more than 60% qualifies students to continue with the Masters' degree; which consists of two electives worth 60 credits in total, and a research dissertation worth 120 credits.

Annually, students from six to eight African countries are enrolled in the programme. During the past seven years, DiMTEC enrolled students from 18 different countries (apart from South Africa). These are: Lesotho, Swaziland, Zimbabwe, Mozambique, Namibia, Zambia, Angola, DRC, Congo-Brazzaville, Kenia, Uganda, Tanzania, Ethiopia, Sudan, Nigeria, Cameroon, Israel, and Palestine.

The demand for a Ph.D. in Disaster Management was recognized and the Ph.D. qualification in Disaster Management was registered during 2012. The first Ph.D. students will register during 2013.

Short Courses and Training

UFS-DiMTEC provides Disaster Risk Reduction and response training to professionals, officials, politicians and volunteers through a number of short courses in South Africa and in some of the SADC countries. The following courses were presented during 2012:

- Ph.D. block course on Disaster Risk, Vulnerability and Resilience in Cape Town.
- Introduction to Disaster Management to the following groups:
  - Correctional Service.
  - Personnel from district and local municipalities.
  - Department of Social Welfare
- Introduction to GIS.

Since 2005, more than 2 000 individuals from government, municipalities, private sector and NGOs benefited from these courses. The value and impact of these courses are recognized through its high demand from different institutions and employers.

Staff

UFS-DiMTEC has a highly motivated and professional team that ensures the highest quality education and support to its students.

Research

UFS-DiMTEC is involved in various Masters' research projects in different African countries. Amongst the 2012 research themes are the following:

- Flood risk reduction.
- Drought adaptation and coping.
- Vulnerability to hazards such as flood, fires, drought and health-related hazards.
- Climate change adaptation.
- Food security.
- Wildfire management.

The full-time DiMTEC team.

- Disaster risk and vulnerability assessments.
- Trauma impacts and preparedness of emergency personnel.
- Conflict management and disaster risk reduction.

The most recent large-scale research project focused on the development of a methodology for drought risk assessment and by applying the methodology to complete the drought risk assessment for the Northern Cape province. This led to the development of a disaster risk atlas for the Northern Cape through an interactive website; found at http://dimtecrisk.ufs.ac.za/nc.

As a result of the Northern Cape research, the Water Research Commission (WRC) awarded a four-year research contract worth R2.95 million to UFS-DiMTEC to perform a drought risk assessment for the Eastern Cape. Adaptation and coping capacity of different groups of farmers will be assessed. Four Masters' students and one Ph.D. student will be able to qualify through this project and the outcomes of the project will inform the development of a national drought plan for South Africa.

UFS-DiMTEC benefited from the National Disaster Management Center (NDMC) bursary and learnership programme for capacity building in Disaster Management at postgraduate level. The total value of the bursary for 2012 was R2.5 million and 56 students benefited from the NDMC bursary during the 2012 academic year. Seven 2011 bursary students graduated with their Masters' degrees during 2012.

International Involvement

- Dr. Jordaan was an invited keynote speaker to the International Conference for Environmental Innovators at Keio University, Yokohama, Japan. The title of his presentation was: "Building resilience in Africa trough Transformation and a Green Economy: Challenges and Opportunities".
- Dr. Jordaan, representing UFS-DiMTEC, was invited by the International Society for Integrated Disaster Risk Management (IDRiM) as a founding member of the Consortium of 13 World-class Universities with inter-disciplinary education and research programmes in disaster risk reduction to Beijing, China.
- Dr. Jordaan, together with Prof. Maitland Seaman and Dr. Danie Vermeulen visited three Universities in Germany with the purpose to collaborate on research and education programmes. Universities visited include the United Nations University, Bonn University, Freie University of Berlin and the Technical University of Dresden.
- Prof. Sakulski has lectured at the University of Novi Sad, Faculty of Technical Sciences, Serbia. At the undergraduate level he has lectured various disaster risk management topics, such as natural and human induced hazard, vulnerability assessment, mathematical and statistical methods of risk assessment. At postgraduate level (Bologna accredited Master level) he has lectured selected topics of disaster risk assessment.

Prof. Sakulski has delivered his annual lectures as a part of the UNESCO IHE Master Course, in Delft, Netherlands.

Projects

- Dr. Jordaan was co-opted by the National Drought Task Team as specialist for the development of drought indices in preparation for a national drought management plan.
- Dr. Jordaan was appointed as project leader: Drought Management Plan for the Northern Cape province; Department of Agriculture, Northern Cape, Kimberley, South Africa.
- Dr. Jordaan was appointed as project leader: Veldfire management plan for the Northern Cape province, Kimberley, South Africa.
- Dr. Jordaan was appointed as project leader: Flood management plan for the Northern Cape province, Kimberley, South Africa.

Research Outputs

Disaster Management Training And Education Centre For Africa (UFS-DIMTEC)

Chapter in book

Jordaan, A.J. & Groenewald, J. 2012. Unlocking credit markets. In *Unlocking markets to smallholders: Lessons from South Africa,* edited by H. Van Schalkwyk; J. Groenewald; G. Fraser; A. Obi and A. Van Tilburg. Netherlands, Wageningen: Wageningen Academic Publishers. pp. 175-190.

The full-time DiMTEC team.

Staff

Director: Dr. Andries Jordaan.
Secretary: Ms. Annelene Schröder.
Short Course Coordinator and lecturer: Ms. Alice Ncube.
Research Assistant: Ms. Kihinde Balogun.
Financial Administrator: Ms. Gerdanarue van Coppenhagen.
Master Course Coordinator and lecturer: Ms. Olivia Kunguma.
Bursary Manager and lecturer: Mr. Johannes Belle.

Contact Details

Ms. Annelene Schröder.

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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 an envied niche for itself in South Africa. The niche is based on three intertwined components, namely the Masters' and Doctoral programmes, various short courses, and a research and contract component.

The Centre is an established centre of expertise in aquatic ecology that carries out a number of mainly applied projects and provides appropriate services to communities in the central part of South Africa.

The Masters' programme developed gradually and strongly around Sustainable Development, Project Management, Environmental Assessment, Environmental Management Systems, and Integrated Environmental Management. The Masters' programme enrolled 40 students from 110 applicants in 2012. The intake increases in diversity every year. In 2012, about 30% of the students were from the Southern African Development Community (SADC) and a few were from the rest of Africa, making this a truly continental programme. The programme stretches over 43 full days of contact time at the Main campus of the UFS in Bloemfontein, consisting of one session per semester.

There is a perceived need to produce graduates with a healthy overview of the South African environment. Graduates are in demand by large companies, government and nature conservation bodies. There is a growing importance of research in water. Conservation is no longer only the domain of environmentalists. Environmental assessment has become more sophisticated, and environmental management systems are required in even the smallest of businesses. Sustainability science has become established as its

Monitoring macro-invertebrates using the South African Scoring System version 5 (SASS5) at Sannaspos on the Modder River.

own discipline and Africa needs to move beyond irrational exploitation towards cultural maturity as far as the environment is concerned.

Approximately 50 lecturers are involved in the programme, half of whom are contracted from government and the private sector for their specific competencies.

During the 2012 Winter Graduation of the UFS, Dr. Linda Rossouw received her Ph.D. degree, Charl de Witt received the Roodt Architects Award for the Best Masters' Student in Environmental Management for 2011, and Riana Janse van Rensburg received the ERM (South Africa Award for the Best Mini-Dissertation in Environmental Management) for 2011.

CEM is in a cooperation agreement with the Catholic University of Louvain in Belgium to conduct research on temporary water ecology. As a result of this cooperation agreement, a Ph.D. student, Bram Vanschoenwinkel from Louvain, and a number of graduate students have spent time working at CEM on studies initiated by the Centre in 2009.

Research Projects:

WRC project K5/1798: Testing a methodology for Environmental Water Requirements in non-perennial rivers. The Mokolo River Case Study

This project follows on from a one-year project (WRC K5/1414) and a three-year project (WRC K5/1587), both of which were recently completed. Both projects focused on the Environmental Water Requirements (EWRs) for non-perennial rivers. A multidisciplinary project team consisting of 28 members was appointed for the study. Most of the specialists were from the UFS (CEM, Department of Geography, Department of Soil, Crop and Climate Sciences, and Department of Sociology) and most had worked on non-perennial rivers as part of the previous project. Specialists from Rhodes University and consultancy firms such as Southern Waters and Water Matters were also involved in the study. As the project progressed, it was found that soil scientists were an invaluable addition to the project team, especially when the hydrological modelling was done. Specialists in hydrological modelling (MIKE SHE modelling) were also included in the project.

A prototype DRIFT-Arid method (adapted from the original Downstream Response to Imposed Flow Transformation (DRIFT) method developed by Southern Waters) for non-perennial rivers was developed (in project K5/1587) using the Seekoei River as case study. The main objective of the current study is to test the prototype DRIFT-Arid 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 DRIFT-Arid 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 projects associated with the development of the method for which project proposals will be sent to the WRC in June 2013.

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 – 2011, various exploration applications for shale gas mining and coalbed methane mining were lodged with the Petroleum Agency of South Africa (PASA). These applications currently cover almost 31% of the total surface area of South Africa and are located in the Karoo geological basin and sub-basins. As a result of public resistance, a moratorium was placed on the further acceptance and processing of unconventional oil and gas mining applications at PASA during 2011. During the moratorium, a Parliamentary Task Team investigated the possible impacts of unconventional gas mining in South Africa and a report detailing the findings was released shortly after the moratorium was lifted on 7 September 2012.

In light of the applications made by various companies for exploration permits with the PASA, researchers at CEM proposed a study with the WRC in 2011. The aims of this study are to write a background review report; to develop an interactive vulnerability map of selected aspects; and to propose provisional screening level monitoring protocols for selected aspects. The aim is make recommendations to help decision makers decide where this activity may be allowed and give to advice on how unconventional gas mining and hydraulic fracturing activities could be monitored.

Biodiversity monitoring at Kolomela Mine (Kumba Iron Ore), Postmasburg

Kumba Iron Ore approached CEM in 2010 with the request to compile a Biodiversity Monitoring Protocol for Kolomela Mine close to Postmasburg in the Northern Cape. The protocol was accepted and the CEM, in collaboration with the National Museum (NMB), started with biomonitoring in 2012. Aspects that are being monitored include Rangeland Management and Bush Encroachment, conducted by Prof. Nico Smit (Pasture Science, UFS), Vegetations Diversity and Rehabilitation, conducted by Dr. Ziets Zietsman (NMB), Soil Water Balance, conducted by Profs. Leon van Rensburg and Pieter le Roux (Soil Studies, UFS), Aquatic and Terrestrial Invertebrates, conducted by Joan Adendorff (CEM), Small Mammals, conducted by Dr. Nico Avenant (NMB), and Reptile and Amphibians, conducted by Mr. Hennie Butler (Zoology). The initial two-year period of the biomonitoring programme ends in December 2013. Thereafter a decision will be made about the continuation of this programme.

Cape Clawless Otters – to measure if they are useful indicators for determining environmental water requirements in non-perennial rivers

The project aims to conclude if otters (*Aonyxcapensis*) may be used as indicators to determine the environmental water requirements (EWR) of non-perennial rivers systems. EWR's main goal is to protect the ecological integrity of streams and rivers through sensitive indicators. These indicators may include changes in flow or water level and any physical, biological and social aspects of a river system. A method for non-perennial river systems has been established but the terrestrial components have not yet been tested. Otters are predators, thus top links in the food web of river ecosystems. Prey utilisation of these species includes most of the river ecosystem species; therefore they may possibly be used as an indicator of the EWRs. Stakeholders in this project are CEM, the National Museum in Bloemfontein, and the Water Cluster.

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 province. The aim of the project is to identify, characterise and quantify hazardous agricultural chemical waste (pesticides, herbicides, fertilizers, lubricants, fuels and oils), as well as 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.

Biomonitoring of the ecological status of Free State rivers

CEM has continued the biomonitoring of the Caledon, Modder and Riet Rivers, which was originally a project funded by Bloemwater. The CEM now funds the project and data and reports written are housed at the CEM. The CEM chose 11 sites; one on the Caledon, two on the Riet and eight on the Modder River from the sites sampled as part of the Bloemwater contract. These sites are now monitored three times a year (March, July and November) for water quality, algae and macro-invertebrates.

Long-term data collection on the Seekoei River, Northern Cape, South Africa

Very few studies have been completed on non-perennial rivers in South Africa and even less where long-term data has been collected. Long-term data collection on the Seekoei River is therefore invaluable to the understanding of an ephemeral (non-perennial) river in South Africa. A team from CEM, namely Marinda Avenant (fish); Marie Watson (macro-invertebrates); and Tascha Vos together with Dr. Linda Rossouw (independent consultant) (water quality and algae), have sampled the Seekoei River

Monitoring macro-invertebrates using the South African Scoring System version 5 (SASS5) at Sannaspos on the Modder River.

since 2005. Surina Esterhuyse has also been involved in interpreting groundwater data collected by Tascha Vos in 2012. Several student assistants (Joan Adendorff, Ina Ferreira, Hennie Louw, Arjen Nell, and Esté Prinsloo) have gained experience in sampling and data collection in the project.

DAAD project – Alliance for Wetlands – Research and Restoration (AllWet RES)

CEM is one of the core partners of a German-South African project on wetlands funded by DAAD (the German Academic Exchange Service). The importance of ecosystem services provided by wetlands and especially peatlands for human society is generally acknowledged but in many cases not well understood and inefficiently applied.

In 2012, the Chair of Restoration Ecology, Centre of Life and Food Sciences Weihenstephan, Technische Universität München (TUM), applied for the financing of an international project AllWet (Alliance for African Wetlands – Increasing capacity and learning networks for ecologically and socio-economically sustainable wetland management) within the scope of the second call of the EU Programme, ACP Science and Technology. Consequently, a trilateral academic cooperation between the TUM, the University of KwaZulu-Natal (UKZN), and the University of the Free State (UFS) was established. Besides the planned research results and outcomes, the project package aims at the further development and strengthening of the academic cooperation between the TUM, the UFS and the UKZN, as well as on supporting the bilateral mobility of students and researchers.

The cooperative research should improve knowledge about the possibilities and limitations of the restoration of degraded wetlands and peatlands, and contribute to the better understanding of their functionality and role to the society in South Africa. M.Sc. studies, Ph.D. research and student training will focus mainly on particular questions in the vegetation population biology and socio-economy in wetland restoration and the wise use of wetlands. The summer schools and the excursion should sensitise the students to actual and urgent particular African issues in the field of environmental protection, resource management and sustainability; they will also help the students in formulating their research hypotheses and topics.

Piet-Louis Grundling, Research Associate of the CEM, is central to the study, while soil scientist, Lulu Pretorius, has been appointed to assist in the fieldwork, under the guidance of Professor Corni van Huyssteen of the Department of Soil at the UFS.

Cooperation and Special Student Exchanges

Following contact made in Mozambique between Dr. Dirk Jungmann (TUD) and Dr. Andries Jordaan (DiMTEC, UFS), Dr. Jordaan, Dr. Danie Vermeulen (Institute for Groundwater Studies, UFS) and Prof. Maitland Seaman (CEM) visited the TUD in April 2012. Though no formal Memorandum of Understanding (MOU) has yet been signed, there has been significant follow-up cooperation, the first of which was a visit by two interns, Nora Hütter and Gerog Enke, for a period of two months from July to September 2012. During this time they participated in the CEM's overall long-term programme on biomonitoring and the development of methodologies for the assessment of environmental water requirements in non-perennial rivers, which itself forms part of the Strategic Academic Cluster: "Water management in water-scarce areas". They looked specifically at the roles of sediments, contaminants and macro-invertebrates.

Besides the main project, the students also assisted with literature research that focused on identifying countries in which moratoria were imposed on the use of hydraulic fracturing to mine unconventional gas, as well as reasons for these moratoria.

During November, the Centre was joined for a week by Dr. Jungmann and Ms. Maren Hess for the exchange of ideas on future cooperation between the TUD, CEM and DiMTEC.

Japanese Scientific Exchange

Dr. Michiko Kojima of the Meiji University in Tokyo visited CEM in 2012, during which he pursued his interest in sediment transfer by rivers.

Community-Service Research on Environmental Water Quality: Loch Logan, Bloemfontein's Tourist Waterfront.

Monitoring the condition of the urban impoundment, Loch Logan, which is the centrepiece of Bloemfontein's Waterfront, and advising on its management is a community service task undertaken by CEM. ABSA's contribution has allowed CEM to continue this service. The monitoring and advice is primarily to reassure stakeholders regarding the condition of this public water body, ensuring that it is aesthetically and functionally acceptable for public use. This impoundment is a focal point for a large proportion of the local urban population, so public health and recreational use issues are important.

Blue and Green Drop Committee

The Centre for Environmental Management is represented on the Free State Provincial Blue and Green Drop Water Quality Management Committee. CEM is able to give inputs regarding water quality issues, which have a direct bearing on the well-being of communities. The intention is that CEM would be able to assist in redressing the skill gaps which have been identified by the annual Blue and Green Drop assessments, by offering targeted training courses to water managers in local municipalities and District and Provincial management level staff.

Orange River Basin Symposium

The Centre for Environmental Management supported the Third Orange River Basin Symposium, which was held in Bloemfontein, 6 – 7 June 2012, at the UFS, under the auspices of the UFS' Strategic Academic Cluster "Water Management in Water-scarce Areas", with the theme "The role of water in food security".

Awards

Prof. Seaman won the prize for "Service to the Faculty 2012" at the year-end function of the Faculty of Natural and Agricultural Sciences. He took over as Director for the Centre for Environmental Management in 1997 and both the Centre and the Masters' Programme grew into the successful entities they are today. His leadership and management got the Centre involved in various contract and research work. He played an integral role in the establishment of the first Biomonitoring Programme of the Free State. He also played an important role in the development and expansion of Environmental Management as a new field in South Africa. He was central to the process of developing a national, professional and regulating body for Environmental Practitioners in South Africa. In 2005 he was part of a team that developed the Strategic Clusters of the University, where he currently is the Director of the Water Cluster. Prof. Maitland Seaman celebrates more than 30 years at the University of the Free State.

Hennie Louw, Masters' Student and research assistant at the CEM, will be graduating in 2013; receiving his Masters' Degree in Environmental Management. He received an elite contract with the Department of Environmental Affairs for the 70th relief expedition to Marion Island. As researcher, he will be part of the Arctic Seal monitoring group, focusing mainly on population monitoring of these peculiar creatures.

Conferences Attended

Mrs. Marie Watson and three students, Ina Ferreira, Hennie Louw and Esté Prinsloo, attended the conference of the Southern African Society of Aquatic Scientists (SASAqS) in July 2012. SASAqS is a learned society concerned with the research, management and conservation of inland waters throughout Southern Africa. The 2012 conference was held at the Cape St. Francis Resort, which was an ideal venue for a conference with a conservation and connectivity theme focusing mainly on estuaries.

The three oral presentations, namely "The development of an environmental water requirement (EWR) method for non-perennial rivers" (Marie Watson), "The influence of different hydrological phases in the non-perennial Seekoei River on the macro-invertebrate species composition" (Ina Ferreira), and "An investigation into the fish community structure of three pools in the Seekoei River, Northern Cape Province, South Africa" (Hennie Louw), all focused on the Seekoei River and are part of the WRC 1798 project. Dr. Jackie King (WRC 1798 project advisor) also launched her book entitled "Sustainable Use of South Africa's inland waters: A situation assessment of resource directed measures" during the conference.

Prof. Maitland Seaman, Mrs. Marinda Avenant and Mrs. Marie Watson attended the International Water Association (IWA) World Congress on Water, Climate and Energy, which was held in May 2012 in Dublin, Ireland. The IWA is a global network of 10 000 water professionals spanning the continuum between research and practice and covering all facets of the water cycle. The theme of the congress was "Building a Sustainable Global Future". The Eastern Cape Development Corporation and the Water

Monitoring macro-invertebrates using the South African Scoring System version 5 (SASS5) at Sannaspos on the Modder River.

Research Commission sponsored two of the students' conference fees.

Prof. Seaman presented a poster on "The challenges of developing a strategic academic cluster on Water Management in Water-scarce Areas" at a South African University. Mrs. Marinda Avenant introduced the congress participants to the challenges and constraints of setting environmental reserves for non-perennial rivers and Mrs. Marie Watson explained the prototype method to determine the Environmental Water Requirements of non-perennial rivers (developed by the team involved in two phases of a Water Research Commission Project WRC 1587 and WRC 1798).

Various students and staff at the Centre attended the following other conferences and symposia during 2012:

- Orange River Basin Symposium (6 – 7 June 2012).
- 9th Kimberley Biodiversity Research Symposium (4 September 2012).
- 17th Annual Conference of the International Associates for Impact Assessment South African Affiliates (IAIAsa).
- Second GFZ- AEON shale gas workshop, 15 – 17 February 2012.
- South African Society of Aquatic Sciences (SASAqS) (1 – 5 July 2012).
- Karoo Development Conference, (14 – 17 October 2012).
- IWA-WCE Dublin Congress, Dublin, Ireland (May 2012).

Community Service

The Centre for Environmental Management serves the environmental community and the general public with numerous workshops each year. All the students are employed in environmental management positions, so there is a very direct contact with the community and its needs.

Research Outputs

Centre for Environmental Management

Research Articles

Berna, F., Goldberg, P., Horwitz, L.K., Brink, J., Holt, S., Bamford, M. & Chazan, M. 2012. Microstratigraphic evidence of in situ fire in Arheulean strata of wonderhoek cave, Northern Cape Province, South Africa. *Proceedings of the National Academy of Sciences of the United States of America* 109(20): 1215-1220.

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Green, G.C., Day, J.A., Mitchell, S.A., Palmer, C., Laker, M.C. & Buckley, C.A. 2012. Editorial: WRC 40-year celebration Conference – Synthesis of themed sessions. Session 2 Sustainability of water ecosystem and energy nexus. *Water SA* 37(5): 609-618.

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Pelser, A. & Letsela, L. 2012. Mainstreaming sustainability into biodiversity conservation in Lesotho. *Environment Development Sustainability* 14: 45-65.

Toerien, D.F. & Seaman, M.T. 2012. Proportionality in enterprise development of South African towns. *South African Journal of Science* 108(5/6): 1-10.

Toerien, D.F. & Seaman, M.T. 2012. Regional order in the enterprise structures of selected Eastern Cape Karoo towns. *South African Geographical Journal* 94(2): 137-151.

Research Reports

Ashton, P.J., Roux, D.J., Breen, C.M., Day, J.A., Mitchell, S.A., Seaman, M.T. & Silberbauer, M.J. 2012. *The Freshwater Science Landscape in South Africa, 1900-2010. Overview of research topics, key individuals, institutional change and operating culture.* Report No. TT 530/12 to the Water Research Commission (WRC), Pretoria, South Africa.

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Staff

Director: Prof. Maitland Seaman.

Acting Director: Mrs. Marinda Avenant.

Associated Research Associates: Drs. Ziets Zietsman, James Brink, Nico Avenant, Daan Toerien, Nacelle Collins, Steve Mitchell, and Mr. Piet-Louis Grundling.

Affiliated Professor: Prof. Anthony Turton.

Course Coordinator: Ms. Marthie Kemp.

Senior Professional Officer: Ms. Marie Watson (Macro-Invertebrates).

Professional Officers: Ms. Surina Esterhuyse (Hydrology), Ms. Joan Adendorff (Entomology), Ms. Tascha Vos (Water Quality and Algae), Ms. Ina Ferreira (Invertebrate), Ms. Betty Phillips (Finance), Ms. Sanet Neethling (Marketing), Ms. Donné Kolesky (Administration), Ms. Marthie Kemp (Riparian Vegetation), and Messrs. Frank Sokolic (GIS), Arjen Nell (Research Ecology), and Hennie Louw (Invertebrate).

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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.

Human resource development is being realised in all sectors of the economy but a particular need exists within the agricultural sector because black farmers were excluded from participating in mainstream agriculture for many decades. Prospective black farmers were engaged in subsistence farming on communal land and 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 and 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 businesses. 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 Local Municipality, Free State Provincial Department of Agriculture, and National African Farmers' Union embraced the programme as partners in agricultural transformation. A Memorandum of Understanding (MOU) was signed by the Mangaung Local Municipality, National African Farmers' Union, and the University of the Free State in December 2004. They agreed to compile a Cooperative Agreement for local and provincial governance and

Stock farmers granted certificates for their participation in the stock farming internship.

funding of the initiative. The Council of the Mangaung Local 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 Local Municipality, the cooperative agreement between the parties was cancelled in 2011. However, 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 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.

Activities

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 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 via short courses at the Centre, a mobile training capacity to serve municipalities in the Free State, 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 every Friday 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.

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.

The Lengau Agricultural Development Centre as part of the University of the Free State was not allowed initially to operate as an accredited training centre at educational levels lower than Grade 12. The Centre entered into a cooperative agreement with Umnga Farmers Training Group during 2011 and is now regarded as an accredited training centre for any training at levels lower than Grade 12. The Centre, in collaboration with Umnga Farmers Training Group,

Agricultural students recording mass data of sheep at one of the internship sessions.

applied at AgriSETA for two learnerships and 240 skills development short learning programmes. Funding for the two learnerships in crop and animal production at NQF Level 4 and 20 skills development programmes were granted. The training will be offered until 2013.

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 in 2012. Mr. Johan Stassen was contracted by the University to develop the programme.

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 on breeding and bull selection for the improvement of livestock. More than 1000 head of cattle were handled and an average of 11 farmers attended the sessions.

Six hydroponic units were erected since 2007 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.

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 percent and a slaughter mass of more than 2 kg per bird on 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 in 2012. These farmers are mentored on a regular basis in collaboration with the Free State Department of Agriculture.

Two entrepreneurs are utilising the eucalyptus (Bloekom) trees at the Lengau Development Centre as an opportunity for firewood in the local community. The first samples of fire bricks were produced from waste paper and the marketing of the products is currently investigated by the Students in Free Enterprise (SIFE) of the Faculty of Economic and Management Sciences.

An audit of the sustainability of the projects at the Centre was performed 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 that retraining and weekly reports of each project will 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 four times 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 from 28 reproductive sows.

Thirty-eight pest control operators wrote their qualifying examination papers of the South African

Some beneficiaries of Lengau Agri-Centre at a stock farming training session.

Crop Life and Animal Health Association during eight sessions at the Centre.

Ms. 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.

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 towards farmers. Accommodation facilities being erected during 2011 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.

Staff

Senior Lecturer: Dr. Léan van der Westhuizen.
Farm Assistant: Mr. Albert Khumalo.
Farm Guards: Mr. Alfred Mxhaka, and Mr. Esau Selepe.

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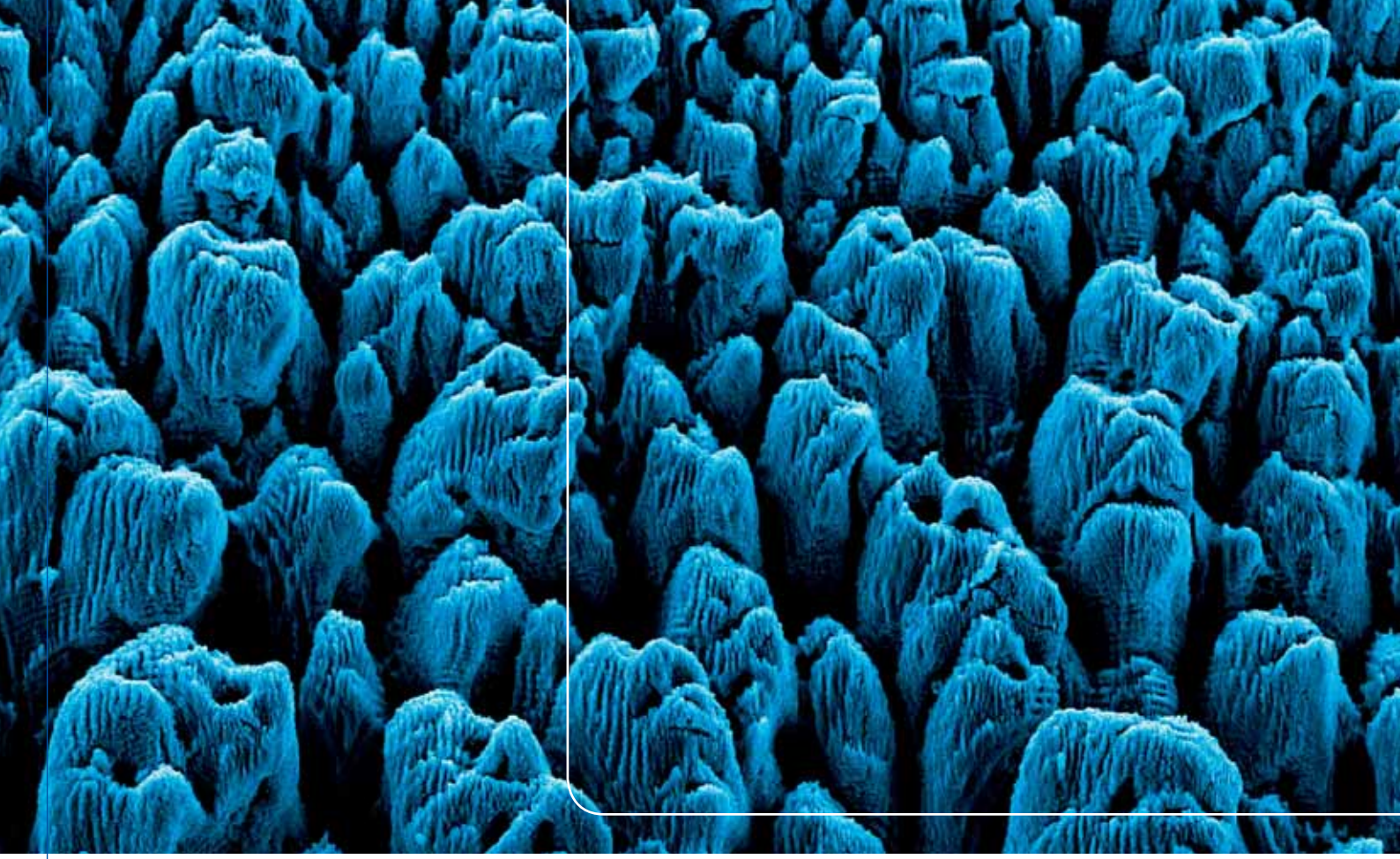


Centre for

Microscopy

Overview

The outputs of researchers and students as publications and conference attendances form an integral part of the outputs of the Centre. Postgraduate students, where Microscopy formed part of their studies, are thus involved in all outputs. The support engagement of the Centre with users, which fully commenced in 2012, proved to be very successful. Skilful staff members support users with the microscopes to obtain results as quickly as possible. Departments save research funding by the support given as time is not wasted by long training sessions and inexperienced usage. All users now utilise the "pay-as-you-go" management aspect of the Centre. The opportunity still exists for students to be fully trained to operate any apparatus and microscopes according to the specific needs of each department.

The time of usage of the apparatus and laboratories by researchers still remains a significant indicator of research support to departments in the Faculty of Natural and Agricultural Sciences and external institutions. In 2012, the running time of the Scanning Electron Microscope (SEM) was 614 hours, the Transmission Electron Microscope (TEM) 88 hours and the Confocal Laser Scanning Microscope (CLSM) 112 hours. The average usage of each microscope per year for the last four years (2009 – 2012) was 508 hours for the SEM, 69 hours for the TEM and 72 for the CLSM. The usage of the apparatus compares favourable over an average period of four years. The improved user support service made it possible to successfully complete all research projects for 2012. The Centre was visited by 64

Dr. Yolanda Fernandez-Jalvo, a visitor from the Museo Nacional de Ciencias Naturales (Madrid, Spain) and Prof. Pieter van Wyk at one of the scanning electron microscopes of the Centre for Microscopy during an examination of fossil samples.

researchers in 2012 compared to 39 researchers in 2011 and 37 in 2010.

Research Aspects and Training Activities

Demonstrations in material preparation and handling of equipment were presented to the honours' students of the departments Zoology and Entomology (DRK/ENT614); Microbial, Biochemical and Food Biotechnology (MKB/BOC614); and Plant Sciences (PWS614).

The second-year students of the Department of Zoology and Entomology and Department of Plant Sciences attended a demonstration about microscopy research.

The Centre is frequently visited by external researchers to commence or complete research projects. In 2012, two international researchers, Dr. Yolanda Fernandez-Jalvo (Museo Nacional de Ciencias Naturales, Madrid, Spain) and Dr. Vinay Kumar (School of Physics, Shri Mata Vaishno Devi University, India), performed microscopy examinations at the Centre.

Local researchers from the Central University of Technology, Dr. Ntsoaki J. Malebo (Postdoctoral Fellow, Unit of Applied Food Science and Biotechnology) and a Masters' degree student, Zenzile P. Khetsha (School of Agriculture and Environmental Health), both from the Faculty of Health and Environmental Sciences, did research with the Scanning Electron Microscope.

Internal researchers and students at the Faculty still form the fundamental part of users. **Table 1** portrays an averaged usage of the microscopes by students and staff (64) of different departments.

Table 1

Department	Usage hours		
	CLSM	SEM	TEM
Cardiothoracic Surgery	-	10	1
Centre (image processing, support, training)	40	169	44
Chemistry	30	12	16
Consumer Sciences	-	10	-
Genetics	-	21	-
Microbial, Biochemical and Food Biotechnology	16	28	20
Physics	-	250	9
Plant Sciences	18	67	1
Zoology and Entomology	4	35	4
External researchers/projects: Free State			
Central University of Technology (SUT/CUT)	-	11	-

Maintenance Aspects

The X-ray analyser of the Shimadzu SEM broke in June 2012 and cannot be repaired. The microscope is also very unstable and there is no company in South Africa that supports repairs for this brand of electron microscope. The purchase of new SEM is thus a priority for 2013. Internal maintenance for 2012 on the microscopes was done by Prof. Van Wyk, which accumulated 28 hours with an estimated saving cost of approximately R12 000 (calculated at external rates of companies performing similar maintenance on microscopes).

Acquisitions

Additional image analysis software programs were purchased for the laser confocal microscope. The software can create three-dimensional models from fluorescent samples imaged by the confocal microscope. These images can also be animated to make innovative interpretations of the anatomy of microscopic organisms. Prof. Van Wyk donated, via his NRF incentive allocation of R40 000 for 2012, to the Centre for this purchase.

Research Outputs

Centre for Microscopy

Research Articles

Ahmad, E.E.M. & Luyt, A.S. 2012. Morphology, thermal, and dynamic mechanical properties of poly(lactic acid)/sisal whisker nanocomposites. *Polymer Composites* 33(6): 1025-1032.

Negussie, T.G., Bender, C.M., Van Wyk, P.W.J. & Pretorius, Z.A. 2012. Hypersensitivity of rust resistance in lentil. *South African Journal of Plant and Soil* 29(1): 25-29.

Swart, C.W., Dithebe, K., Pohl, C.H., Swart, H.C., Coetsee, E., Van Wyk, P.W., Swarts, J.C., Lodolo, E.J. & Kock, J.L.F. 2012. Gas bubble formation in the cytoplasm of a fermenting yeast. *FEMS Yeast Research* 12(7): 867-869.

Swart, C., Olivier, A., Dithebe, K., Pohl, C., Van Wyk, P., Swart, H., Coetsee, E. & Kock, L. 2012. Yeast sensors for novel drugs: Chloroquine and others revealed. *Sensors (Switzerland)* 12(10): 13058-13074.

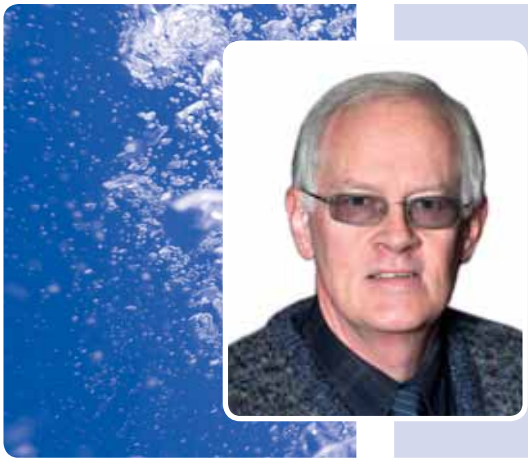
Thibane, V.S., Ells, R., Hugo, A., Albertyn, J., Van Rensburg, W.J.J., Van Wyk, P.W.J., Kock, J.L.F. & Pohl, C.H. 2012. Polyunsaturated fatty acids cause apoptosis in *C. albicans* and *C. dubliniensis* biofilms. *Biochimica et Biophysica Acta - General Subjects* 1820(10): 1463-1468.

Thibane, V.S., Kock, J.L.F., Van Wyk, P.W.J., Ells, R. & Pohl, C.H. 2012. Stearidonic acid acts in synergism with amphotericin B in inhibiting *Candida albicans* and *Candida dubliniensis* biofilms in vitro. *International Journal of Antimicrobial Agents* 40(3): 284-285.

Staff

Director: Prof. P.W.J. van Wyk.

Laboratory manager: Ms. Hanlie 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 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 and Mr. Kevin Whitfield, the Centre's senior lecturer and research associate, 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 senior 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 entering 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. Most of the students are in the full-time employment of the Department of Agriculture and the Agricultural Research Council (ARC). Some are commercial, part-time or small-scale farmers, while others are employed by banks, agribusinesses and consultancies. International students account for about 35% 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.

Six of the MSA students were awarded their Masters' degrees with distinction. From left to right are: J. Arries, J. van Berkel, Dr. J. van Niekerk, M. Wessels, Prof. I. Groenewald, P. Venter, D. Nel, and R. Meyer.

Mr. Kevin Withfield, Prof. Luc D'Haese from Belgium, and Dr. Johan van Niekerk.

Activities and Achievements

In 2012, 40 students enrolled for the first year of the Masters' programme. In the same academic year, an all-time record of 50 students graduated with a Masters' degree in Sustainable Agriculture (MSA), six with distinction. Four Ph.D.'s were also awarded: to Johan van Niekerk (CENSARD), Sammy Carsan (Kenya), Sabelo Mavimbela (Swaziland) and Kathu Tshikolomo (Department of Agriculture, Limpopo). This is the highest academic achievement of this Centre to date as well as for any department or centre in the Faculty. An audit team comprising of Drs. D. Nkosi (ARC), E. Zwane (SASAE) and S. Brokensha (Department of English, UFS) 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 325 since the Centre's inception in 1994. CENSARDE has a proud track record of its graduates who leave the programme well-equipped to address the challenges of the workplace. This is an important contribution since modern-day agriculture is practised 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 their third semester of 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 a further qualification. 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.

The Department of Agriculture in the Limpopo province contracted CENSARDE to offer additional training to their employees in project management. A special short learning programme, namely Project Management for Sustainable Development in Agriculture, was compiled. This was offered in four sessions of one week each to 30 attendees per session. This interaction resulted in numerous advantages for the Centre, Faculty and university through the acquisition of Ph.D. and Masters' students and external study leaders for research projects. A Ph.D. workshop was held in Polokwane with five Ph.D. students.

International guest speakers, Prof. Akke van der Zijp from Wageningen University, The Netherlands, and Prof. Luc D'Haese from Gent University, Belgium, were invited to address the MSA students during the winter and summer schools on campus. Enriching experiences were shared regarding agricultural practices and extension in Central Africa and Europe. Prof. Fanie Terblanche, well-known extensionist from Pretoria University, also addressed the students on the extension profession.

Personnel from the Centre were also involved in various conferences around the country. Prof. Groenewald and Dr. Johan van Niekerk attended the South African Society for Animal Science (SASAE) Conference in Durban. Dr. Johan van Niekerk was elected as a board member of SASAE and initiated the process that the University of the Free State will host the conference in 2013. Prof. Izak Groenewald was appointed to a National Reference Group to develop and formalise a New Extension Policy for South Africa. Regional policy development

Advanced Diploma class at Dohne Research Station, lectured by Dr. S. Brokensha.

A short course, Project Management for Sustainable Agriculture, was presented at Polokwane for extension officers.

workshops were held where staff from the Centre made contributions. A close associate and director of Global Forum for Rural Advisory Services (GFRAS) in Switzerland, Dr. Kirsten Davis, delivered the keynote address.

Regionally, the Centre and the Free State branch of SASAE organised a workshop at the Centre's office in Bloemfontein where the national president of SASAE, Dr. Elliot Zwane, and the Free State Branch chairperson, Ms. Mantombi Mbongo, were present.

Furthermore, CENSARDE's staff attended a Rural Development, Land Reform and Rural Local Governance Summit in Durban. Numerous regional workshops were facilitated between the Centre's students and external study leaders to enhance tuition and research.

Whilst Prof. Groenewald remains on the editorial board of the international-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 coordinating a student exchange programme between the UFS, Virginia Polytechnic and State University in Virginia, USA. This exchange started in 1998 and is the longest 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.

- Prof. Groenewald and Dr. Johan van Niekerk attended a World Sustainable Agriculture Congress in Singapore during July 2012. Approximately 200 delegates from all parts of the world attended the congress. Contacts made here initiated reciprocal visits in the future.

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.

Dr. Kirsten Davis, associate of the Centre, addressing the SASAE congress in Durban.

Research Outputs

Centre for Sustainable Agriculture, Rural Development and Extension

Research Articles

Ahmad, E.E.M. & Luyt, A.S. 2012. Morphology, thermal, and dynamic mechanical properties of poly(lactic acid)/sisal whisker nanocomposites. *Polymer Composites* 33(6): 1025-1032.

Negussie, T.G., Bender, C.M., Van Wyk, P.W.J. & Pretorius, Z.A. 2012. Hypersensitivity of rust resistance in lentil. *South African Journal of Plant and Soil* 29(1): 25-29.

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Swart, C., Olivier, A., Dithebe, K., Pohl, C., Van Wyk, P., Swart, H., Coetsee, E. & Kock, L. 2012. Yeast sensors for novel drugs: Chloroquine and others revealed. *Sensors (Switzerland)* 12(10): 13058-13074.

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Thibane, V.S., Kock, J.L.F., Van Wyk, P.W.J., Ells, R. & Pohl, C.H. 2012. Stearidonic acid acts in synergism with amphotericin B in inhibiting *Candida albicans* and *Candida dubliniensis* biofilms in vitro. *International Journal of Antimicrobial Agents* 40(3): 284-285.

Staff

Professor: Prof. Izak Groenewald.

Professors Extraordinary: Profs. Edward Nesamuvuni, Alice Pell, Monty Jones, and Frans Swanepoel.

Associate Professor: Prof. Aldo Stroebel.

Senior Lecturer: Dr. Johan van Niekerk.

Research Associate: Mr. Kevin Whitfield.

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Paradys Experimental Farm

Overview

During the past year, Paradys experimental farm, located 14 km from the Main campus of the University of the Free State, demonstrated excellent growth in each of the five branches. The experimental farm establishes itself annually as an excellent agricultural business where students can gain practical experience for their studies and learn new techniques. The demographic changes in student origins attract many students to the farm, since it is the only place where practical skills can be learned from the first year. The environment in which the farm is situated causes agricultural communities to graduate as a business with good discipline.

Each year is kicked off by welcoming all the prospective Agriculture students and their parents to the experimental farm and providing tours in each branch. By doing this, the Agriculture students cooperate with 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 there were 150 parents and students that participated in the event. The day testified to the Faculty's serious approach to agricultural training and during the work sessions, the parents were given the opportunity to meet the lecturers of the Faculty and ask them important questions.

In 2012, Paradys experimental farm included three students in an internship programme which forms part of the farm management branches, thus applying theories that are taught in the various disciplines. Students come in direct contact with the practice and the challenges that exist in the agricultural sector and on a farming level. The internship system is designed to give continuity to the management system and senior students are continuously assigned to mentor junior students in the various business branches. In

2012, postgraduate students from Nigeria formed part of a poultry study.

Paradys established sustainable farming practices on the experimental farm, especially during 2012. The purpose is firstly to simulate the agricultural business in this way and to bring the students in the various disciplines in contact with all the trends that occur in the agricultural sector. Structural changes were made in all the branches in order to succeed in this goal. Development of some of the non-sustainable branches currently enjoys a lot of attention since economies of scale is addressed, which is relevant to Paradys. The developments attempt to clearly influence the contributions to the surrounding communities, as well as to increase opportunities for student training. Therefore, the vision is to establish a modernised experimental farm that is managed commercially, is equipped with the best technology in the world and adheres to all sustainability guidelines. The processes are already in a very advanced stage and should be completed over the next two years. Provision is also made for further growth after reasonable targets are reached by the farm and its management team.

In 2012, 400 of Paradys' Agriculture students had the opportunity to experience practical sessions that were presented on the farm. Paradys offers students, especially those who do not come from a farm, the opportunity to better understand the operations of an agricultural business and thus undertake a more relevant approach to their studies. Many students that come to Paradys for training are pleased to come in contact with the animals as well as the soil during cultivation excursions. The methods established especially stimulate their interest as well as insight in the industry.

Learners and staff from Lesotho also visited the farm, where programmes were presented to stimulate their interest in agriculture.

The Israeli Embassy sent staff from Israel to inform farmers of their farming practices. We also visited Israel on invitation to gain more knowledge.

Paradys' contributions to the agricultural industry and communities also progressed significantly during the past year. Various products were introduced to the market and demonstrated by means of work sessions and congresses.

John Deere presented a successful farmers' day by means of practical demonstrations to introduce a new range of tractors that entered the South African market. Emergent farmers expanded the information they obtained and interaction was stimulated to bring the emergent farmers in contact with commercial farmers so that the latter's experience can be transferred to them.

Grain SA also presented a training day where farmers competed against one another in various activities.

The Agronomy branch of the experimental farm was also privileged to receive a donation in the form of a centre pivot from Franklin/Senter, who donated it to the University. Pioneer also experimented with new cultivars this year.

Decisive contributions were also made in the field of animal science, where AMFA introduced the latest control measures. Artificial insemination (AI)

and pregnancy courses are presented annually to students and farmers and are well supported.

Free State Agriculture also presented a business focus day.

In 2012, the University supported the Department of Agriculture in the Free State to present a very successful training day that was intended for emergent farmers only. More than 50 emergent farmers visited Paradys where they attended lectures by guest speakers. After that they also participated in practical demonstrations in the various branches of the experimental farm.

Paradys experimental farm was approached in 2012 to be the host of the very prestigious Voermol Sheep and Cattle Farmer of the Year competition. The winners shared their methods with approximately 350 guests who attended the event. Facilities were available to accommodate the winners' animals so that farmers could see first-hand what the animals looked like as well as discuss them. Speakers supplied the audience with hints that would be of crucial importance to the agricultural sector in the future. Students also benefited greatly from the prestigious event. During the event many farmers and agricultural businesses thanked the University for the special way in which it contributes to agriculture by providing a world-class facility, namely Paradys experimental farm, that creates an atmosphere of development and learning.

The management of Paradys experimental farm is in agreement that staff development forms a very important part of any business or institution and therefore the training of unskilled workers working on the farm enjoys a lot of attention. Programmes are in place where all staff members are trained until they reach Grade 10 level, after which they can further participate in the programmes in their various disciplines at their workplace. The progress causes positive development on all levels of the farm and management.

Paradys experimental farm will therefore continue to develop as an outstanding farming business that will add value to the agricultural sector and will offer participants in the industry and elsewhere opportunities to learn and experience new methods and techniques.

Farmlands

In 2012, Paradys experimental farm received a new tractor with an output of 135 kW. This was made possible by a collaboration agreement with McCormick, who has been working on an experimental farm for some time now. The technology of the tractor required additional training for drivers and students involved. The training commenced and six of the experimental farm staff and three students participated. Ronin SA donated a complete "drive straight apparatus" to the farm, which, with the new tractor, was a massive jump in technology. It enabled the farm to treat the soil with lime and use more modern cultivation methods. The apparatus also helped many students to better understand the principles of precision farming and to demonstrate the related practices. There were improvements in weed control and soil fertilisation before planting time.

The expectations of a good rainy season did not realise but with the early implementation of good moisture retention practices the farm managed to successfully plant 300 hectares of mealies. They are mainly used as feed on the dairy farm; 130 hectares are used for silage and 170 hectares are harvested as grain. An additional 20 hectares is also planted for experimental purposes and 6 varieties are currently being examined. Oats was planted for grazing

purposes and due to a dry season, nothing was planted after that.

Mr. M. Molomo is in charge of the daily management of Farmlands.

Dairy Farm

The number of herd currently on the experimental farm is 130, of which 110 are Jerseys and 20 are Holsteins. There are 55 cows that are being milked and they produce about 23 litres of milk per cow per day. In the dairy herd, 20% are dry cows and the rest are in different stages of growth as they are being raised to form part of the dairy herd. The dairy is one of the branches of the farm where economies of scale plays an integral part and therefore we are attempting to buy more cows so that the total amount would be 200. In this way the dairy will benefit from the scale advantages that exist in the market. There are no bulls in the herd and we only make use of artificial insemination.

During the past year, the dairy was upgraded and now uses the new Waikato milking machine that is supported by an Afikim computer system. There are 12 milking points, each equipped with an electronic metre and pulsation. The Afikim system collects about 30 data sources on each of the cows twice a day, which includes anything from their mass to the energy consumption of the animal. Daily accurate data from the system is used to make management decisions, as well as update the data bank for future research.

The dairy significantly transformed during the past year in order to adapt to the modern dairy community. The progress of the dairy is of great importance to the experimental farm since student training on the related animals and factors occurs frequently. Although the herd is still small, it is managed very efficiently.

Mr. M. Smit is in charge of the daily management of the Dairy Farm.

Sheep Branch

The merino sheep herd is managed on a basis of three lambing seasons in two years. The herd consists of 60 ewes that are fertilised by means of AI. The pregnancy percentage was 94% and the lambing percentage was 140%; with 45% of the ewes giving birth to twins and triplets. When the lambing season starts, the ewes are placed in cages to ensure that the lambs form a bond with their mothers. It also ensures that the lambs are healthier. The mortality rate was 1%. The pastures for the ewes consist of established pasture and veld grass.

Mr. J. Barnard is in charge of the daily management of the herd.

Beef Cattle Branch

During 2012, the breeders of the scheme decided to expand the Afrikaner herd by means of crossbreeding. The Afrikaner herd on the farm consists of 102 stud cows, of which 45 are not up to standard; it was decided that they will be used in the crossbreeding programme with Simmentaler cattle. The goal of this programme is to sell all the male calves at weaning age and to use all the female calves for the breeding programme. The pregnancy percentage of the herd was 95% out of 102 cows; of which 85% gave birth, 3% aborted and 7% were killed by predators. During the winter months the herd grazes on harvested

The lapa as prepared for a wedding reception.

mealie lands so that the camps can rest. A camp system is used so that the veld can be optimally used.

Mr. J. Barnard is in charge of the daily management of the herd but the chairperson of the scheme, Prof. F. Neser, still participates in making decisions regarding the breeding of the herd.

Lapa Branch

The lapa can accommodate 180 people and is a popular place for workshops, farmers' days, fundraising projects, weddings and general functions. It can accommodate 120 guests for weddings, which take place in the garden next to the lapa. Every year we collaborate with Radio Rosestad and Diamonds Events to host a bridal competition.

A Dutch Reformed church in the city spoiled an old age home in Heidedal with a visit to the lapa and a programme that included light exercise, massages, refreshments and sing-alongs. Various churches also have picnics here for their year-end functions. On Sundays they have country sports and public worship.

Staff

Farm Manager: Mr. Jannie Myburgh.

Administrative Manager: Amanda Smith.

Student Assistants: Manie Smit, Johan Barnard, and Johnny Molomo.

Farm Workers: Anna Sebonyane, Elisa Sebonyane, Thabo Khubeka, Isaac Nkotshane, Daniel Somi, Paulus Somi, Samuel Motswari, Samuel Kheswa, Petrus Ramatekoane, Petrus Moriribela, Stephen Bavuma, Richard Mxhaka, Ernst Maqala, and Johannes Sebonyane.

Security: Azael Khoele, and Zacharia Makopo.

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Institute for

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 and groundwater resources and, lately, on shale gas and hydraulic fracturing (fracking) in the Karoo.

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 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 partakes 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.

Our mission is to produce world-class postgraduate students who can apply their knowledge to ensure sustainable groundwater resources, and to produce high-quality research that is relevant and practically applicable. We also strive to serve the community through students, research and actions that will empower stakeholders to manage groundwater sustainability.

Geohydrology students during their winter school in the Drakensberg Mountains.

Staff Matters

The Institute for Groundwater Studies (IGS) was founded in 1974 and is currently under the leadership of Dr. Danie Vermeulen as the director. He is assisted by Prof. Gerrit van Tonder, Prof. Gideon Steyl, Dr. Francois Fourie and affiliated associate-professors Kai Witthüser and John Nieber. Prof. Gideon Steyl from the Chemistry Department was involved as Ph.D. student and lecturer at IGS from 2007 to August 2012, wherafter he took up a position in Australia. Three affiliated researchers are also on the staff of IGS, namely Prof. Jopie Botha, Mr. Fanie de Lange and Dr. Johan van der Merwe. A new personnel member, Mrs. Wanda Geyer, was appointed to help with the accreditation of the IGS laboratory.

Postgraduate Students

The Institute had 32 enrolments for the B.Sc. Honours in Geohydrology, 37 for the M.Sc. and 11 who registered for the Ph.D.

Two of the Institute's staff members received degrees in 2012, namely Prof. Gideon Steyl, who received his Ph.D. in Geohydrology, and Mr. Eelco Lukas, who received his M.Sc. in Geohydrology.

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 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 therefore industry-related and may include a mine, a power station or a petrochemical site.

Activities and Achievements

Fracking in the Karoo – Both sides of the coin: The debate around shale gas as a future energy resource for South Africa is certainly an emotional and highly contentious issue, and even among the IGS staff there were different views. According to Dr. Danie Vermeulen, who conducted two study tours to Texas and Wyoming in the USA during May 2012 (and also one to Pennsylvania in 2011), there is too little information about the effects of hydraulic fracturing (or "fracking") and that scientific exploration in the Karoo should be allowed. He was accompanied by Prof. Gideon Steyl.

On the other hand, Prof. Gerrit van Tonder became known as the professor who made a U-turn regarding his views on fracking. Until recently he had said that fracking would not contaminate groundwater but he now says their research showed that fracking would undoubtedly cause massive problems with the region's water. "We need more research and until we are certain about what fracking could cause, it should be banned."

On Global Anti-Fracking Day (28 July 2012), there were protests and rallies around the world, and Prof. Van Tonder attended the protest held in the South African Karoo, in the village of Nieu-Bethesda.

These views led to various talks and articles in the media, to name a few:

- Prof. Van Tonder was a guest speaker at a debate on hydraulic fracking in the Karoo, held on 23 September 2012 in the Groote Kerk Dutch Reformed Church in Cape Town. Other speakers were members of Treasure the Karoo.
- The *Cape Times* published an article on Prof. Van Tonder's change of view: "Pro-fracking Prof. does U-turn", 1 June 2012.
- Dr. Vermeulen presented a lecture on hydraulic fracturing to the National Strategic Committee (White Paper on Energy) at Parliament in Cape Town, February 2012.
- Dr. Vermeulen was invited to present a keynote address on "Facts about fracking – Both sides of the coin" at the annual breakfast awards of the South African Council for Natural Scientific Professions (SACNASP) on 13 March 2012, Gallagher Estate, Midrand, as well as at SACNASP's annual networking breakfast at the Meerendal Wine Estate, Durbanville, Cape Town, 15 June 2012. This time his topic was on "Fracking in the Karoo".
- Dr. Vermeulen presented a lecture on the "The shale gas story in the Karoo" at the UFS on Thursday, 17 May 2012. The lecture formed part of a public lecture series of the Faculty of Natural and Agricultural Sciences under the theme "Sustainability".
- Dr. Vermeulen's view on doing away with emotion and focusing on the facts was published in *Rapport*, 8 July 2012.
- Dr. Vermeulen also presented talks on shale gas at the Fossil Fuel Foundation, Agri Northern Cape Annual Congress in Kimberley on 22 August 2012, as well as a series of talks on request from AgriSA to farmers' unions throughout the Karoo, namely Colesberg, Richmond, Victoria West, Carnarvon and the Williston District Farmers' Unions. He was also invited to present a talk at Digby Wells in Johannesburg.
- Dr. Vermeulen presented a keynote address entitled "Shale gas overview" at the Conference of the Geological Society of South Africa (GSSA) with the theme "South African Energy Production: Reviews of the current options", 30 – 31 October 2012, Glenhove, Johannesburg.
- Dr. Vermeulen was also an official reviewer of the PASA (Petroleum Agency of South Africa) report to the government on hydrofracking.
- Articles by researchers followed in *The Water Wheel*, May/June 2012; *Cape Times*, 1 June 2012, 12 October 2012; *Business Report*, 3 June 2012; *Volksblad*, 14 June 2012; *Daily Maverick*, 15 June 2012; *Landbouweekblad*, 22 June 2012 and 3 August 2012; *Rooi Rose*, September 2012; and *Landbouweekblad Aktueel*, 12 October 2012.

Prof. Gerrit van Tonder at the Nieu-Bethesda protest against fracking.

- Even the *Vrij Nederland* had an article on "Gasboringen in de Karoo: De prinses, de oliemaatschappij en het gas", 13 October 2012.

Three video clips on fracking were produced:

- Prof. Van Tonder compiled a video clip to demonstrate their model of fracking fluid migration.
- Mr. Fanie de Lange, Ph.D. student and researcher at IGS, performed an upgrade called "Karoo fracking – A model for fluid migration".
- Dr. Modreck Gomo, postdoctorate researcher, and Mr. Pacome Ahokpossie, Ph.D. student in Geohydrology, developed a physical model to illustrate that fracking can create a man-made artesian aquifer.

These videos are available on the IGS website at www.ufs.ac.za/igs.

Various invitations to talk on radio and to appear in television programmes about the impact of fracking in the Karoo followed, to name a few:

- Dr. Danie Vermeulen: Television interview on *Engineering News*, 13 March 2012.
- Prof. Van Tonder: Radio Pretoria, 13 June 2012.
- Prof. Van Tonder: RSG, 14 July 2012.
- Dr. Vermeulen: Hour-long debate on hydraulic fracturing on SAFM via telephone in the programme *Forum @ eight* on 11 June 2012.
- Dr. Vermeulen: Lifting of moratorium on fracking, *John Robbie's Talk Radio 702*, 12 September 2012.
- Prof. Van Tonder: *50/50 Fracking debate*, Episode 20, 22 October 2012.

Other Activities

Prof. Gideon Steyl attended the 2nd GFZ-AEON Shale Gas Workshop and Think Tank in Port Elizabeth, 15 – 17 February 2012. The workshop started with a one-day field trip, followed by a two-day workshop and discussions. The workshop was organised by Inkaba ye Africa Earth Systems Science at the time when

Dr. Danie Vermeulen (second from left) and Prof. Gideon Steyl (on the right) during the tour to the United States of America (USA).

the second academic research well was drilled. Over the last two years shale gas potential has featured prominently on the conference circuit but these gatherings have predominantly focused on socio-political and environmental issues.

Prof. Steyl was a guest speaker at the "Alternative Scenarios for the Central Basin" Meeting, held on 29 February 2012 at the Aurecon Lynnwood Bridge Conference Centre, Pretoria.

Prof. Steyl attended the 2nd Annual Shale Gas Conference in Johannesburg, 5 – 8 March 2012. This conference was presented by the Institute for International Research (IIR). Prof. Steyl also attended a workshop to "Brainstorm Geohydrological Scenarios for Acid Mine Drainage (AMD)" with the title "AMD fasibility study"; which was held in Pretoria, 9 – 12 April 2012.

Two personnel of the IGS Laboratory – Elna de Necker and Henrihet Human – attended a short course in Statistical Method Validation: "Enhancing your knowledge and competence in statistical method validation"at the Radisson Blu Hotel in Sandton, 5 – 6 March 2012.

They also attended an industry conference on Bottled Water SA: "Ensuring sustainability, unlocking profitability", presented by the South African National Bottled Water Association on 16 and 17 July 2012 in Midrand.

Prof. Gerrit van Tonder attended the Shale Gas Southern Africa Conference, 26 – 27 March 2012 in Cape Town. He also presented a paper at the Symposium on Groundwater and Municipalities organised by the Groundwater Division of GSSA, Potchefstroom, 15 – 16 October 2012. He also attended the Acid Mine Drainage SA Conference in Johannesburg on 27 November 2012.

Dr. Danie Vermeulen is a registered Earth Scientist with the South African Council for Natural Scientific Professions (SACNASP), a fellow of the Water Institute of Southern Africa (WISA) and a member of the Ground Water Division of GSSA. He is also a member of the International Association of Hydrogeologists (IAH), an executive council member of the International Mine Water Association (IMWA), a council member of the Fossil Fuel Foundation (FFF), and serves on the editorial board of Water SA.

Dr. Vermeulen presented the following lectures in 2012: A lecture on "Coalmine waters" delivered to the Water Research Commission (WRC) and the Department of Mineral Resources in Pretoria in January 2012, and "Hydraulic fracturing" to the National Strategic Committee (White Paper on Energy) at Parliament in Cape Town in February 2012.

He also lectures at the University of the Witwatersrand in the Postgraduate Masters Programme for Industrial Personnel where he was elected best lecturer for 2012. The contents of the module include water legislation in South Africa; shale gas; the impact of coal mining on the water resources of South Africa; acid mine drainage; and groundwater and geohydrology.

Dr. Danie Vermeulen, Prof. Gerrit van Tonder and Prof. Gideon Steyl attended a workshop for Sasol on underground coal gasification on 28 March 2012.

Mr. Eelco Lukas (left) and Dr. Danie Vermeulen (right) at the IMWA Conference in Australia.

National and International Collaboration

Mrs. Lore-Marie Deysel, laboratory manager at IGS, attended the 3rd Annual Green Mining Workshop, hosted by the School of Geography and Earth Sciences, Faculty of Science, McMaster University, Hamilton, Ontario, Canada, 20 – 25 May 2012.

Dr. Danie Vermeulen attended the "Society of Freshwater Science" Conference in Louisville, Kentucky, 20 – 24 May 2012, where he presented a paper in the special session on "Exploring the effects of gas extraction from shale plays on freshwater ecosystems". This visit included a study tour to hydrofracking sites in Texas and Wyoming, where he was accompanied by Prof. Gideon Steyl.

Dr. Danie Vermeulen and Mr. Eelco Lukas attended the International Mine Water Association Symposium (IMWA) in Bunbury, Australia, 29 September – 4 October 2012, where three papers from the IGS were delivered.

Mr. Abdon Atangana, Ph.D. student at the Institute for Groundwater Studies, presented a paper at the International Conference on Applied Analysis and Algebra at the Yildiz Technical University in Istanbul, Turkey, 20 – 24 June 2012. The title of his presentation was "Numerical solution of a space-time fractional derivative of groundwater flow equation". He received a prize for the best presentation in the B-section and also for the practical application of a mathematical equation to a groundwater model. The prize consisted of putting on the dress of the king of Ottoman Empire (see photo). Mr. Atangana also presented a paper at the First International Conference on Analysis and Applied Mathematics in Turkey, 18 – 21 October, and one at the International Conference on Theory, Methods and Applications of Nonlinear Equations at the Texas A&M University Kingsville in Texas, 17 – 21 December 2012.

Postgraduate students, Teboho Shakane, Kenneth Milanzi and Suleen Vermaas, were part of the German-South African delegates who attended the 9th Annual Inkaba ye Africa Geo-Future Workshop in Germany, 25 – 30 November 2012. This year's event was hosted by the Helmholtz Centre, (GFZ), Potsdam, the German Research Centre for Geosciences, as part of the German-South African Year of Science 2012/2013.

Community Engagement Projects

The IGS Lab is an academic/commercial laboratory, and as part of community engagement it sometimes tests water for community members at no charge.

During July/August 2012, Mr. Modreck Gomo (who obtained his Ph.D. degree at the winter graduation ceremony and is now in a postdoctorate position at IGS), was involved in a groundwater-awareness exercise for a non-governmental organisation (NGO) called Tholulwazi Uzivikele (www.tuproject.org). The NGO is an OXFAM (Australian) Water, Sanitation and Hygiene Program (WASH) partner. OXFAM is an international confereration with the goal to find solutions to poverty and related injustice around the world. The OXFAM (Australia) NGO works in various South African rural areas. The groundwater awareness exercise was conducted in the KwaNgwanase district of KwaZulu-Natal. The exercise was meant to enhance the technical understanding of the NGO's workers on basic aspects of groundwater occurrence, quality and protection, with special reference to hand-dug wells.

Research Outputs

Institute for Groundwater Studies (IGS)

Researh Articles

Atangana, A. 2012. New class of boundary value problems. *Information Science Letters* 1(2): 67-76.

Atangana, A. & Botha, J.F. 2012. Analytical solution of the groundwater flow equation obtained via homotopy decomposition method. *Journal of Earth Science & Climate Change* 3(2): 1-5.

Barnes, M.R. & Vermeulen, P.D. 2012. Guide to groundwater monitoring for the coal industry. *Water SA* 38(5): 831-836.

Gomo, M., Steyl, G. & Van Tonder, G. 2012. Investigation of groundwater recharge and stable isotopic characteristics of an alluvial channel. *Hydrology Current Research*, Special Issue 12.

Gomo, M., Van Tonder, G.J. & Steyl, G. 2012. Investigation of the hydrogeochemical processes in an alluvial channel aquifer located in a typical Karoo Basin of Southern Africa. *Environmental Earth Sciences*, November: 1-12.

Van Wyk, E., Van Tonder, G.J. & Vermeulen, P.D. 2012. Characteristics of local groundwater cycles in South African semi-arid hard rock terrains: Rainfall–groundwater interaction. *Water SA* 38(5: 747-754.

Group picture of German-SA Delegates, 9th Annual Inkaba ye Africa GEO-FUTURE Workshop, Germany.

Staff

Director: Dr. Danie Vermeulen.

Professor: Prof. Gerrit van Tonder.

Researcher/Geohydrologist: Dr. Francois Fourie.

Affiliated Professors: Profs. Kai Witthüser, and John Nieber.

Affiliate Researchers: Prof. Jopie Botha, Dr. Johan van der Merwe, and Dr. Fanie de Lange.

System Analist: Mr. Eelco Lukas.

Laboratory staff: Mss. Lore-Mari Deysel, Elna de Necker, Henrihet Human, Wanda Geyer, and Ennie NciNci.

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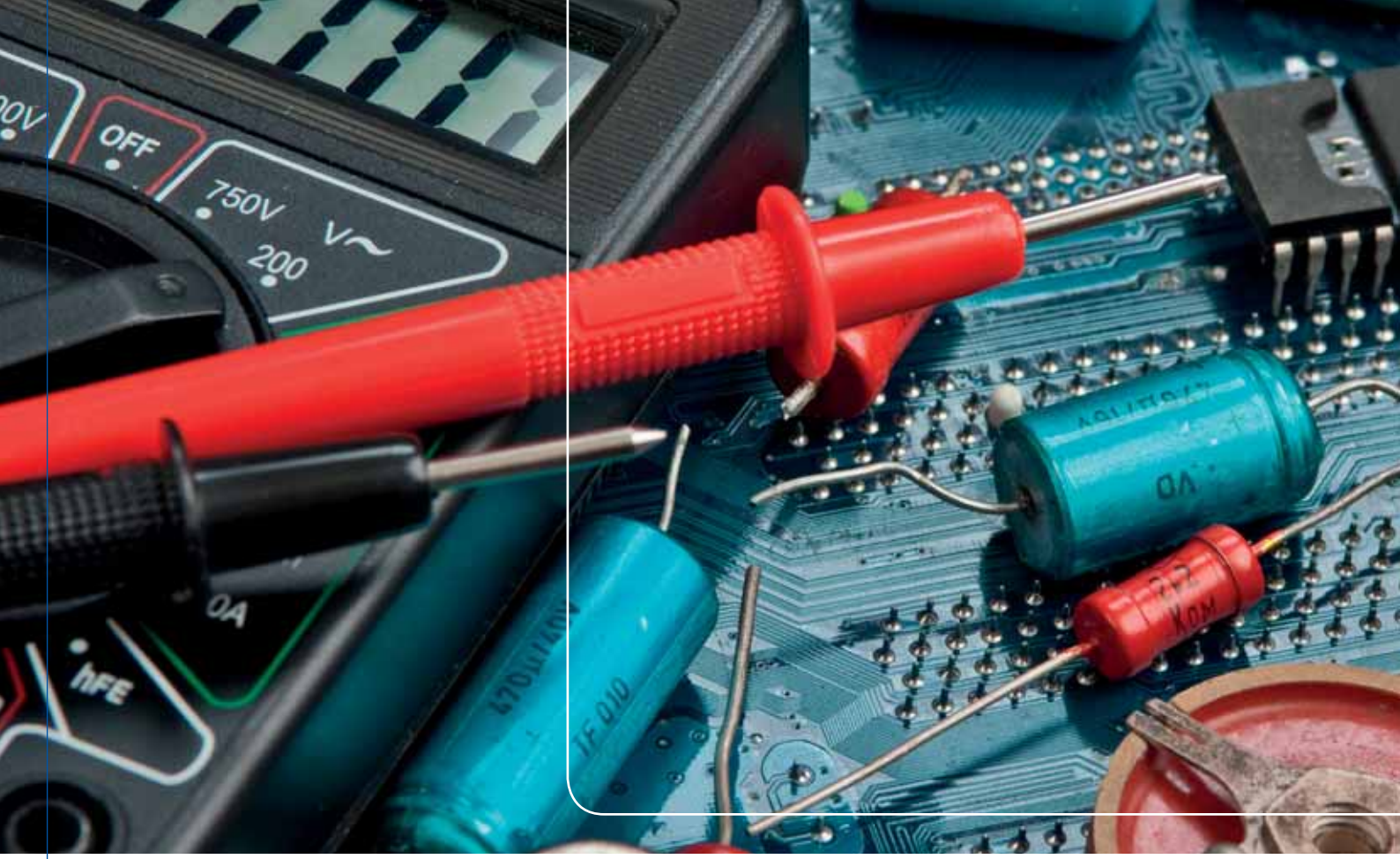


Workshop:

Electronics

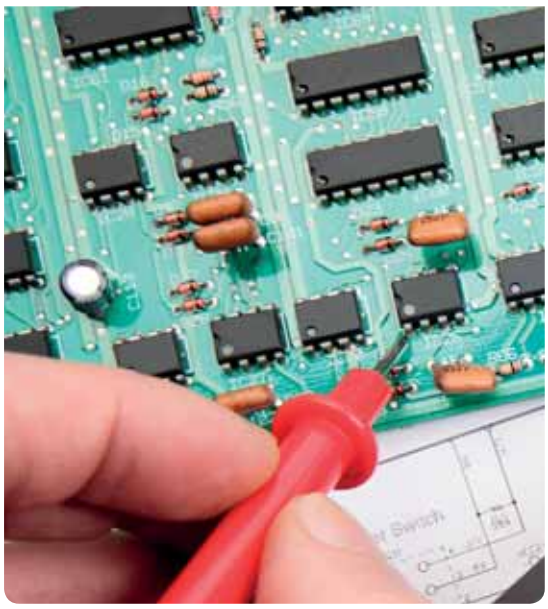
Overview

The Electronics Division experienced a very busy year and has repaired various items of expensive equipment with success. New apparatus was also develop and completed successfully. The Division experienced a substantial increase in the time spent on administration due to new systems implemented by the UFS.

The estimated saving for the Faculty of Natural Sciences for 2012 is R3 528 000.00. This amount is calculated by taking the actual amount of working hours multiplied by R600.00. An amount of R1 730 000.00 was saved by repairing the under-mentioned apparatus. The total savings amount is therefore R5 381 600.00.

The Division repaired the following expensive apparatus:

- ICP x 2
- Fermenter
- Potensiostat x 2
- Bass x 2
- Versaprobe
- Sam 700



Work Activities

A total of 421 work requisitions were received the past year; representing 761 apparatus. Of this, 26 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 Tables 2 and 3.

Of a possible 6 086 working hours, 6 086 were actively used. Percentage-wise the active usage is calculated at 100%. The possible hours were calculated at 7.25 hours per day per person present.

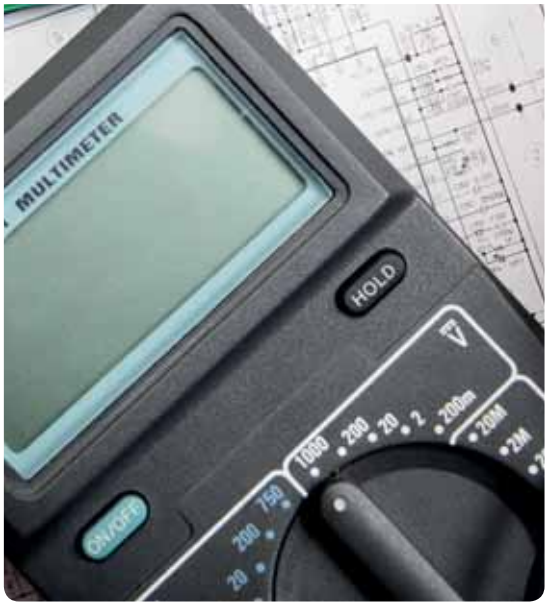


Table 1 lists the 31 departments and divisions that made use of the services of the Electronics Division, with the total time needed for each project, and the percentage of the total time it took to complete the project.

Table 1:

Department	Total time spent	Percentage
Physics	885.00	14.54%
Biotechnology	807.00	13.26%
Soil, Crop and Climate Sciences	758.00	12.45%
Internal Administration	614.00	10.09%
Chemistry	552.00	9.07%
Pharmacology	501.00	8.23%
Plant Science	443.00	7.28%
Medical Microbiology	292.00	4.80%
Electronics	215.00	3.53%
Computer Sciences and Informatics	199.00	3.27%
Geology	196.00	3.22%
Outside Work	134.00	2.20%
Animal, Wildlife and Grassland Sciences	125.00	2.05%
Institute for Groundwater Studies	90.00	1.48%
Physical Recourses	48.00	0.79%
Zoology and Entomology	39.00	0.64%
National Control Laboratory	34.00	0.56%
Urban and Regional Planning	30.00	0.49%
Exercise and Sport Science	20.00	0.33%
Centre for Sustainable Agriculture	19.00	0.31%
Experimental Farms	19.00	0.31%
Genetics	17.00	0.28%
Centre for Environmental Management	15.00	0.25%
Centre for Microscopy	11.00	0.18%
Haematology	10.00	0.16%
Architecture	4.00	0.07%
Library and Information Services	3.00	0.05%
Anatomy	3.00	0.05%
Instrumentation	1.00	0.02%
Economic and Management Sciences	1.00	0.02%
Theology	1.00	0.02%
Total	**6 086.00**	**100.00%**

Table 2 lists completed projects done for different departments.

Table 2:

Department	Apparatus
Biotechnology	3 x Access Control 2 x Incubation Room Temperature Control 1 x Block Temperature Controller 1 x Access Control/Chart
Physics	7 x 480Hz/384Hz Standing Wave Generator 1 x Access Control 1 x Alarm/Access Control Coupling
Institute for Groundwater Studies	4 x Access Control 1 x Alarm System
Geology	4 x Camera System 1 x Access Control
Animal, Wildlife and Grassland Sciences	1 x Access Control 1 x Cordless Immobiliser
Soil, Crop and Climate Sciences	1 x Automatic Pipet Control
Plant Sciences	2 x Glass Houses Temperature Control
Chemistry	3 x Access Control
Genetics	1 x Camera System
Centre for Environmental Management	1 x Camera System
Pharmacology	8 x Fridge/Freezer Temperature Control

Table 3 lists projects that are still in process.

Table 3:

Department	Apparatus
Medical Microbiology	10 x Fridge/Freezer Temperature Control
Chemistry	3 x Fraction Collectors
Computer Sciences and Informatics	1 x Computer/Wheel Chair Interface
Electronic Division	1 x Study of the USB Port

Table 4 shows the time spent on the different faculties:

Table 4:

Faculty	Hours	Percentage of time
Natural and Agricultural Sciences	5 038.00	82.79%
Other	1 048.00	17.21%
Total	**6 086.00**	**100.00%**

Table 5 shows the hours spent on different activities, with the percentage of time indicated:

Table 5:

Activity	Development	Maintenance	Administration
Hours	1 943	3 529	614
Percentage	31.92%	57.99%	10.09%

Messer. Mark Jackson, Adriaan Hugo, Innes Basson, and Henri Roodt.

Staff

Head of Department: Mr. A.B. Hugo.

Control technicians: Mr. I. Basson, Mr. H.J. Roodt, and Mr. M. Jackson.

Contact Details

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Workshop:

Instrumentation Division

Overview

The aim of the Instrumentation workshop is to design and manufacture special research equipment, namely equipment that are not available on the market, for the academic departments and to assist them in their research work. For example: the Workshop manufactures pipette stands,containers for test tubes, bottles, laboratory trolleys, stands for cadavers for Anatomy, and services and repairs pumps.

Furthermore, the Workshop designs and manufactures stainless steel bailers for the Institute of Groundwater Studies, and filaments and heaters for the Department of Physics. The Workshop also services and repairs scales and microscopes for various departments on campus.

The Workshop mainly supports the Faculty of Natural and Agricultural Sciences. **Table 1** shows the time spent on the different faculties:

Table 1:

Faculty	Hours	Percentage of time
Natural and Agricultural Sciences	6 207.00	90.1%
Health Science	573.00	8.3%
Other	112.00	1.6%
Total	**6 892.00**	**100%**

Table 2 shows the working hours spent on each of the departments of the Faculty of Natural and Agricultural Science.

Table 2:

Department	Total time spent
Physics and Astronomy	502
Soil, Crop and Climate Sciences	711
Chemistry	963
Plant Science	1 538
Electronics	231
Geology	29
Microbial, Biochemical and Food Biotechnology	1 126
Animal-, Wildlife and Grassland Sciences	334
Institute for Groundwater Studies	239
Zoology and Entomology	133
Instrumentation(maintenance)	140
Internal Administration	180
National Control Laboratory	36
Biokinetics	45
Total	**6 207**

Table 3 shows the working hours spent on each of the departments of the Faculty of Health Sciences.

Table 3:

Department	Total time spent
Anatomy	201
Basic Medical Science	361
Pharmacology	11
Total	**573**

External work done for various institutions amount to 112 working hours.

Activities

Table 4 lists completed projects done for different departments.

Table 4:

Department	Apparatus
Chemistry	Service vacuum pumps Manufacture fraction collectors
Zoology	Manufacture pipette holders
Physics	Manufacture clean gloveboxes Manufacture soundboards Manufacture trollies
Institute of Groundwater Studies	Manufacture permometers Service and repair vacuum pumps
Microbiology	Repair shake machines Manufacture permometers Manufacture heating blocks
Botany	Manufacture Perspex holders Manufacture 20 trollies
Agriculture	Manufacture pipette holders Repair shake machines Manufacture Effendorf holders
Electronics	Manufacture boxes of different sizes and shapes for the use of electronic parts
Other departments	Repair and service vacuum pumps Manufacture Perspex pipette shelves Service microscopes and balances

Staff

Head of Department: Mr. J.S. Myburgh.

Head Assistant: Mr. J. Erasmus.

Control Technicians: Mr. P.D.S. Botes, Mr. J.P.W Rautenbach, and Mr. N.J Kruger.

Technical Assistants: Mr. G. Tshwene, and Mr. E. Hlazo.

Contact Details

Mr. Japie Myburgh

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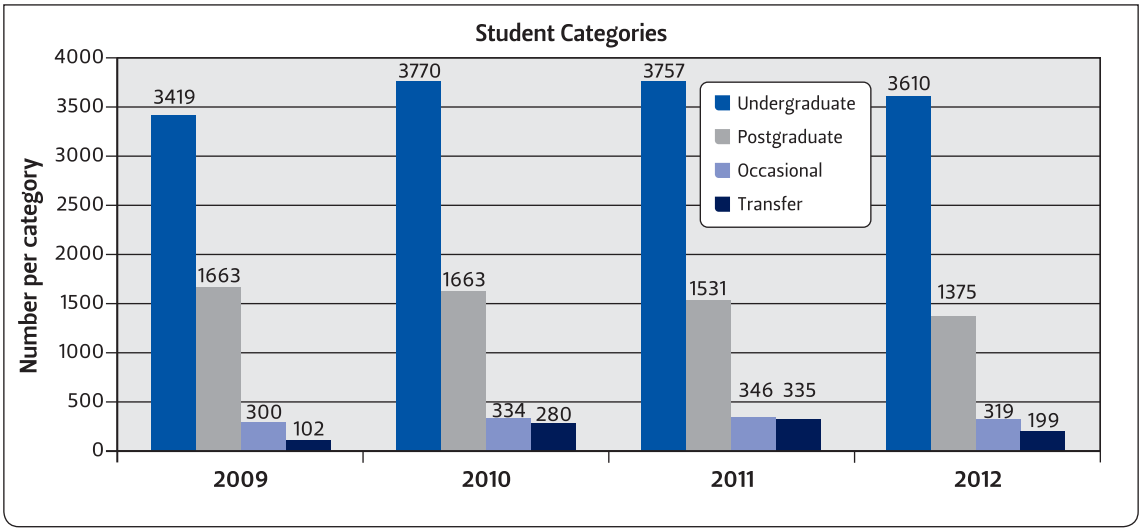
Statistical Data

Students

Enrolement by Category 2009 - 2012



Students

Student Figures: 2010 – 2012

	Female					Male					Total				
	Black	Coloured	Asian	White	Total	Black	Coloured	Asian	White	Total	Black	Coloured	Asian	White	Total
2010															
Undergraduate	1121	31	16	503	**1617**	1048	38	20	828	**1934**	2169	69	36	1331	**3605**
Postgraduate	365	14	15	288	**682**	533	25	19	483	**1060**	898	39	34	771	**1742**
Occassional	128	5	1	15	**149**	128	2	1	26	**157**	256	7	2	41	**306**
Total	1614	50	32	806	**2502**	1709	65	40	1337	**3151**	3323	115	72	2143	**5653**
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**

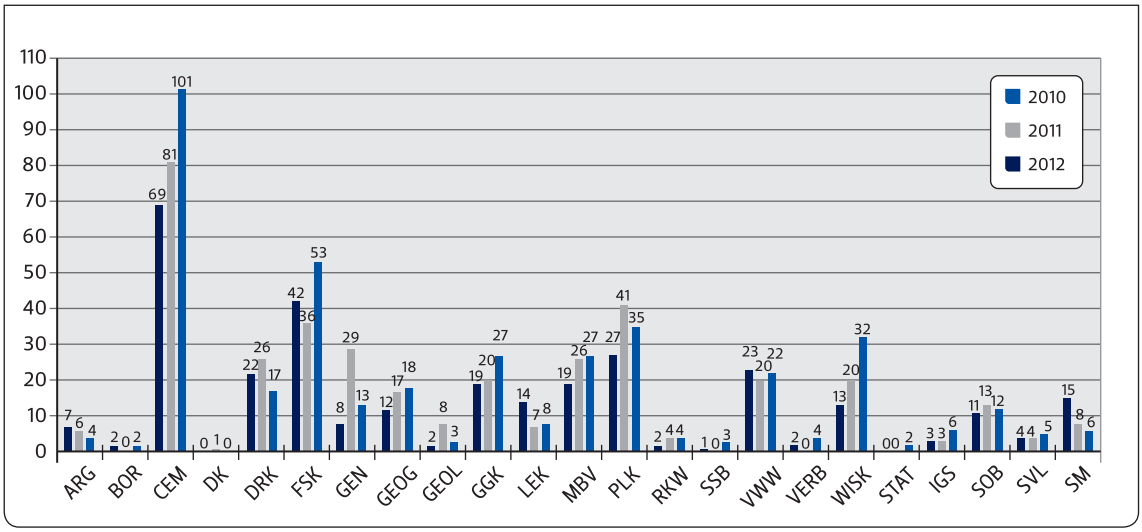
International Students

Country	2010	2011	2012
Asian countries	22	0	0
Bangladesh	0	1	1
Belgium	0	1	0
Benin	0	0	1
Botswana	28	24	12
Cameroon	0	12	13
China	0	12	9
Congo	0	4	1
Democratic Republic of Congo	2	0	1
Egypt	0	1	0
Eritrea	0	4	3
Ethiopia	0	4	6
European countries	9	5	0
Gabon	0	1	1
Gambia	0	0	1
Germany	0	0	1
Ghana	0	3	0
India	0	1	1
Kenya	0	15	14
Lesotho	198	188	176
Malawi	3	4	4

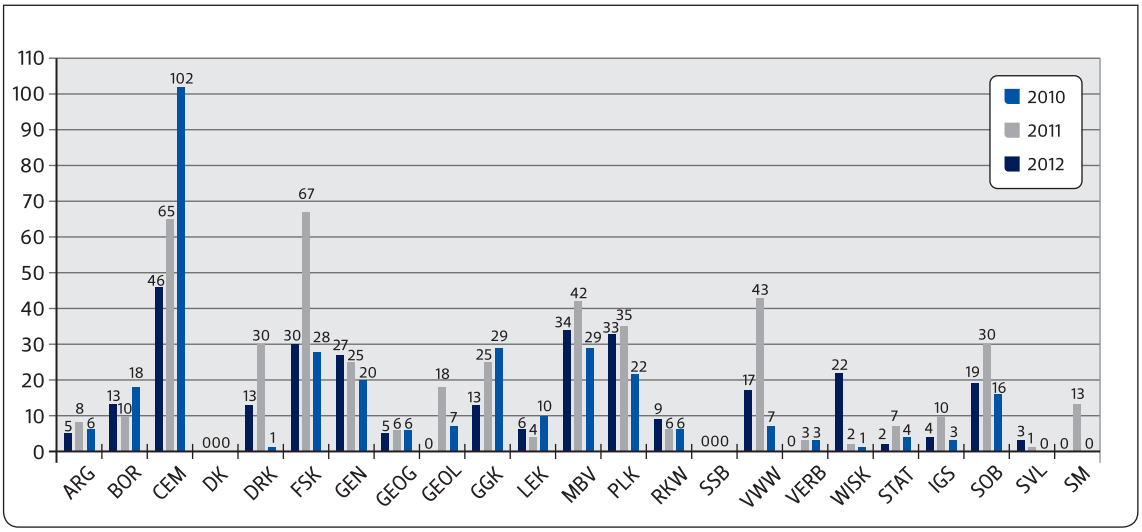
Country	2010	2011	2012
Mauritius	4	4	4
Mozambique	2	2	1
Namibia	88	99	101
Netherlands	0	0	1
Nigeria	0	18	17
North American countries	2	0	0
Other African countries	83	0	0
Pakistan	0	2	1
Palestinian Territory, Occupied	0	0	3
Republic of Korea	0	1	1
Rwanda	0	1	0
Sri lanka	0	1	0
Sudan	0	4	3
Swaziland	6	10	8
Taiwan	0	1	1
Uganda	0	4	3
United Republic of Tanzania	0	2	3
United Kingdom	0	0	1
United States of America	0	5	1
Zambia	13	7	10
Zimbabwe	83	69	66
TOTAL	**543**	**510**	**470**

Research

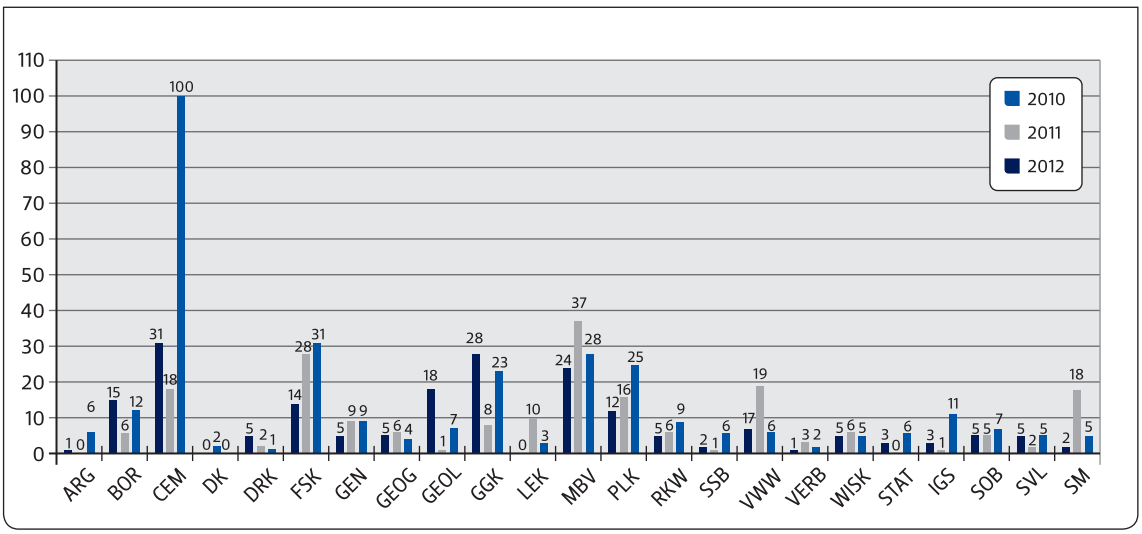
Accredited articles (2010-2012)



Local conferences (2010-2012)

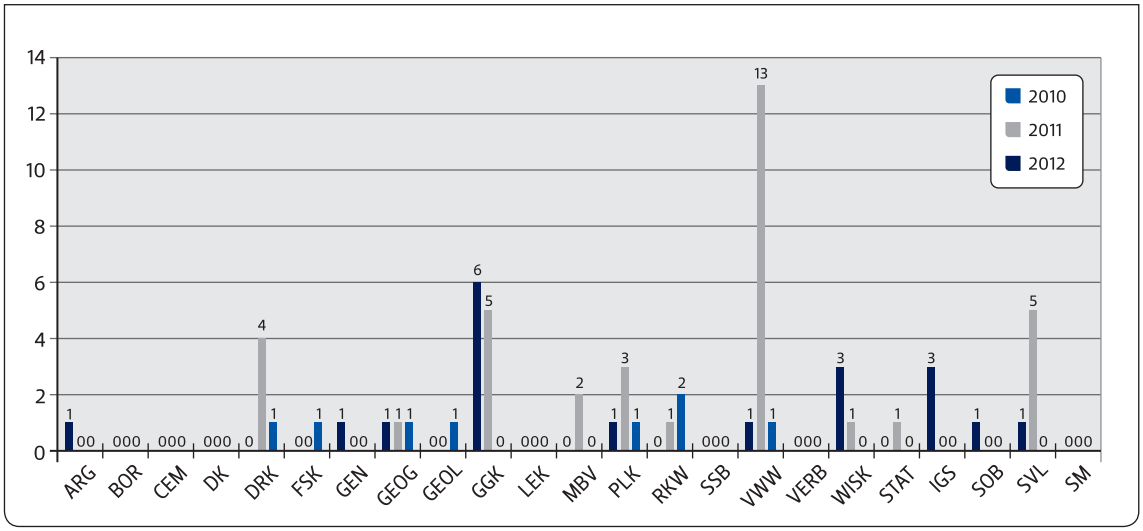


International conferences (2010-2012)

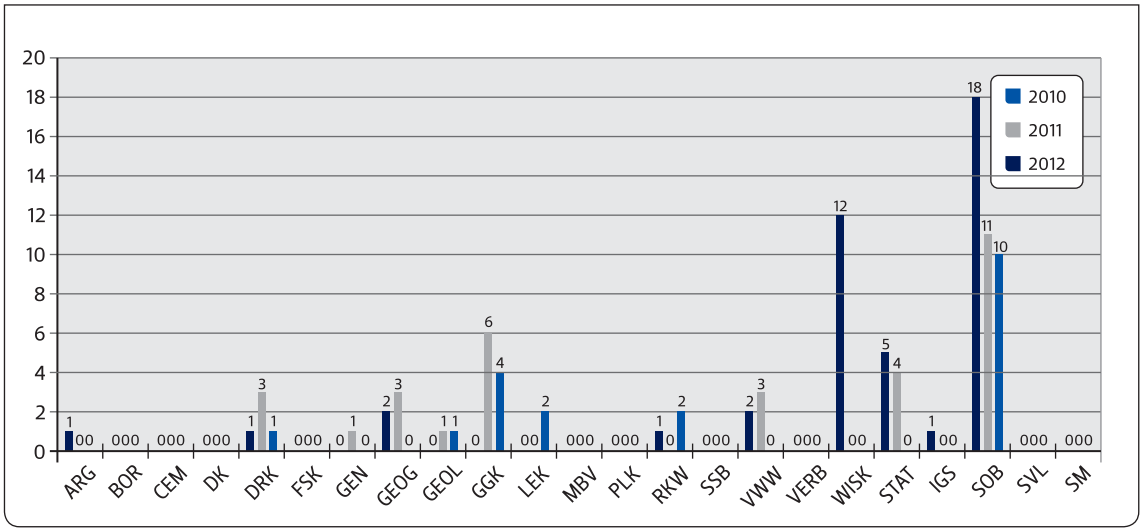


Research

Books (2010-2012)



Reports (2010-2012)



Glossary

A

ACCESS	Applied Centre for Climate and Earth System Science
ADF	Amsterdam Density Functional Theory
Adh	Alcohol dehydrogenase
ADSARD	Advanced Diploma in Sustainable Agriculture and Rural Development
AFM	Atomic Force Microscope
AgMIP	Agricultural Model Intercomparison and Improvement Project
AHI	Afrikaanse HandelsInstituut
AI	Artificial Insemination
AllWet	Alliance for African Wetlands
AMD	Acid Mine Drainage
AMI	Advanced Metals Initiative
APARM	Advanced Reliability and Maintenance Modeling
APEC	Avian Pathogenic Escherichia Coli
APR	Adult Plant Resistance
ARC	Agricultural Research Council
ARC	Agricultural Research Council
ASM	American Society for Microbiology
ASOCSA	Association of Schools of Construction in Southern Africa
ASSC	Actuarial and Statistics Students Council
ASU	Appalachian State University
AU	African Union
AZA	South African Institute for Architects

B

BGRI	Borlaug Global Rust Initiative

C

CAA	Commonwealth Association of Architecture
CAF	Central Analytical Facility
CAT	Computer Applications Technology
CBS	Centraal Bureau voor Schimmelcultures
CEM	Centre for Environmental Management
CENSARDE	Centre for Sustainable Agriculture, Rural Development and Extension
CFFRC	Crops for the Future Research Centre
CHE	Council for Higher Education
CHoPS	Committee of Heads of Planning Schools
CHPC	Centre for High Performance Computing
CIDB	Construction Industry Development Board
CIMMYT	International Maize and Wheat Improvement Center
CIOB	Chartered Institute of Building
CLSM	Confocal Laser Scanning Microscope
CMC	Construction Management Conference
CNCI	Cement and Concrete Institute
COE	Centre of Excellence
CRRP	Cereal Rust Research Programme
CU	Columbia University

D

DAAD	The German Academic Exchange Service (Deutcher Akademischer Austausch Dienst)
DCO	Deep Carbon Observatory
DETEA	Department of Economic Development, Tourism and Environmental Affairs
DHET	Department of Higher Education and Training
DoE	Department of Education
DRIFT	Downstream Response to Imposed Flow Transformation
DSC	Differential Scanning Calorimetry
DSM	Digital Soil Mapping
DST	Department of Science and Technology
DTI	Department of Trade and Industry

E

EAAP	European Association of Animal Production
EBV	Estimated Breeding Value
ECA	European Crystallographic Association
EFINTD	European Foundation Initiative for Neglected Tropical Diseases
ESAP	Escola Superior Artistica do Porto
ET	Embryo Transfer
EuCheMS	European Association for Chemical and Molecular Sciences
EWR	Environmental Water Requirements

F

FFF	Fossil Fuel Foundation
FSIA	Free State Institute of Architects

G

G x E	Genotype x Environment
GCP21	Global Cassava Partnership for the 21st Century
GFAAS	Grapite Furnace Atomic Absorption Spectroscopy
GFRAS	Global Forum for Rural Advisory Services
GIS	Geographical Information Systems
GLYAT	Glycine-N-acyltransferase
GRF	German Research Foundation
GSSA	Geological Society of South Africa

H

HESS	High Energy Stereoscopic System

I

IAH	International Association of Hydrogeologists
IAIAsa	International Associates for Impact Assessment South African Affiliates
ICCC40	40th International Conference on Coordination Chemistry
ICEC	International Congress of the International Cost Engineering Council

ICEC	International Cost Engineering Council
ICIDN	International Conference on Infectious Diseases and Nanomedicine
ICM	International Conference of Medichem
ICOMC	International Conference on Organometallic Chemistry
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
ICRPMC	International Cereal Rust and Powdery Mildew Conference
IDC	Industrial Development Corporation
IDF	International Dairy Federation
IFHE	International Federation for Home Economics
IGA	International Goat Association
IGS	Institute for Groundwater Studies
IIASA	International Institute for Applied Systems Analysis
IIR	Institute for International Research
IISE	International Institute for Species Exploration
IMA	International Mycological Association
IMWA	International Mine Water Association
INSAM	International Society for Agrometeorology
IPF	Institute of Polymer Research
IPMA	International Project Management Association Conference
IPMP	Intensive Project Management Programme
ISOCARP	International Society of City and Regional Planners
ITSA	Information Technology Student Association

L

LED	Local Economic Development
LRAD	Land Redistribution for Agricultural Development programme

M

MIT	Massachusetts Institute of Technology
MKP	Monopotassium Phosphate
MNS	Material and Nanosciences Cluster
MNS	Materials and Nanosciences
MOF	Metal Organic Framework
MOU	Memorandum of Understanding
MRM	Mineral Resource Management
MRTM	Mineral Resource Throughput Management
MS	Mass Spectroscopy
MUCCP	Mucociliary Clearance Phantom
MURP	Masters' degree in Urban and Regional Planning

N

NanoSAM	Nano Scanning Auger Microscopy
NBT	National Benchmark Tests
NCCC XII	The Netherlands Catalysis Conference
NECSA	Nuclear Energy Corporation of South Africa
NGO	Non-Governmental Organisation
NMB	National Museum, Bloemfontein
NMR	Nuclear Magnetic Resonance spectroscopy
NNSCF	New Nano-Surface Characterization Facilities
NRF	National Research Foundation
NTeMBi	Nuclear Technologies in Medicine and the Biosciences programme

O

OES	Optical Electronic Spectroscopy
OIST	Okinawa Institute of Technology
OSL	Optically-Stimulated Luminescence

P

PASA	Petroleum Agency of South Africa
PGR	Plant Growth Regulator
PRT	Protein Research Trust

R

RICS	Royal Institution of Chartered Surveyors (UK)

S

SAAB	South African Association of Botanists
SAAFoST	SA Association for Food Science and Technology
SAASTA	South African Agency for Science and Technology Advancement
SAB	South African Breweries
SACAP	South African Council of the Architectural Profession
SACCCS	South African Centre for Carbon Capture and Storage
SACNASP	South African Council for Natural Scientific Professions
SACPCMP	South African Council for Project and Construction Management Professions
SACPVP	South African Council for Property Valuers' Profession
SACQSP	South African Council for the Quantity Surveying Profession
SADC	Southern African Development Community
SAIP	South African Institute of Physics
SAISC	Southern African Institute of Steel Construction
SANBI	South African National Biodiversity Institute
SANERI	South African National Energy Research Institute
SAPA	South African Poultry Association
SAPBA	South African Plant Breeders' Association
SAPI	South African Planning Institute
SAPOA	South African Property Owners Association
SARChI	South African Research Chairs Initiative
SASA	South African Statistical Association
SASAE	South African Society for Animal Science
SASAqS	Southern African Society of Aquatic Scientists
SASCP	South African Society of Crop Production
SAYAS	South African Young Academy of Science
SA-YSSP	South African Young Scientist Summer School Programme
SE-HPLC	Size Exclusion High Performance Liquid Chromatography
SEM	Scanning Electron Microscope
SHiFT	South African Housing Institute Foundation
SIFE	Students in Free Enterprise
SLU	Swedish University of Agricultural Sciences
SMVDU	Shri Mata Vaishno Devi University
SNP	Single Nucleotide Polymorphisms
SSR	Simple Sequence Repeat
START	System for Analysis, Research and Training

T

TAHICI	Tshwane Animal Health Innovation Cluster Initiative
TGA	Thermal Gravimetric Analysis
THRIP	Technology and Human Resources for Industry Programme
TOF-SIMS	Time-of-Flight Secondary Ion Mass Spectrometer
TUM	Technische Universität München

U

UAAAN	Antonio Narro Agrarian Autonomous University
UJ	University of Johannesburg
UK-DFID	United Kingdom's Department of International Development
UKZN	University of KwaZulu-Natal
USDA-ARS	United States Department of Agriculture – Agricultural Research Service

V

VUV	Vacuum-Ultraviolet

W

WGT	Winter Grain Trust
WRC	Water Research Commission

X

XRD	X-Ray Diffraction
XRF	X-Ray Fluorescence